iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** XII **Month of publication:** December 2023

DOI: https://doi.org/10.22214/ijraset.2023.57730

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue XII Dec 2023- Available at www.ijraset.com

To Study the Concrete by Partial Replacement of Cement with Tobacco Waste and Bamboo Leaf Ash with Addition of Sugarcane Fibre

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Abstract: The demand for concrete is growing with the growing demand for infrastructure, energy and resources. One of these harms comes from the large emission of carbon dioxide gases during the manufacturing procedure of cement. The leaves, when dried and burnt, produce ashes that have been found to be pozzolanic. The carbohydrate content in bamboo plays an important role in its strength and in improving its health. The partial replacement of aggregates is need for the future generation of concrete structures for the environment supportable. The depletion of the natural resources gets exhausted. We have think over the alternate replacement of the materials. In present work the partial replacement of the TWA and BLA with the Cement and addition of sugarcane fibers. The optimum percentage that was noticed, was at 12&12% of cement was replaced Tobacco waste ash and Bamboo leaf ash and for reinforcement 0.6% of addition Sugar cane fibers was used. The workability of mixture increases and after that there is decrease in the workability of the concrete when we increase the percentage of TWA and BLA. A series of experiment were carried out to measure the compressive strength, split tensile strength and flexural strength of the concrete. The results showed that the compressive strength, split tensile strength and flexural strength increases with the adding TWA and BLA with the Cement with addition of sugarcane fibers.
Keywords: TWA (Tobacco waste ash), BLA (Bamboo leaf ash), SCF (Sugarcane fibers) workability, compressive strength, Split Tensile strength, Flexural strength.

I. INTRODUCTION

Cement finds its application in most of the civil engineering applications. The use of cement while very important leads to various ecological harms. One of these harms comes from the large emission of carbon dioxide gases during the manufacturing procedure of cement. The consequences of these huge emissions of carbon dioxide are already evident and thus there is a need to prevent any further damage. This has led to research in various materials for the replacement of cement and the best way forward is to replace cement with industrial wastes. However these researches so far have only been successful in partial replacement of cement. The use of mineral admixtures not only reduces the cement consumption but also improve some of the properties of concrete. The first property is the generation of extra calcium silicate hydrate gel because of the reaction between calcium hydroxide and mineral admixture. The mineral admixtures are also very fine and thus act as fillers. The use of mineral admixture reduces the use of cement and thus decreases the cost of the materials.

A. Bamboo Leaf ASH

Bamboo is a major crop in many tropical countries. The stem of the tree is round, smooth and hollow. The tree has no branches in the lower parts which means that one-third of the tree has many spines between the nodules and has light shiny, small, strong, smooth and dark green leaves. During the dry season, most of the leaves are removed and the soil becomes compacted, making the soil or surrounding soil unsuitable for planting. The leaves, when dried and burnt, produce ashes that have been found to be pozzolanic. The carbohydrate content in bamboo plays an important role in its strength and in improving its health. The durability of the bamboo against the attack of mold, mildew and borer is closely related to the chemical composition.

B. Tobacco Waste ASH

One of the residues from a cigarette factory is the Tobacco stem, and it is easy to collect as its production is concentrated in cigarette factories. This has led to a serious waste of resources and environmental problems as more than 95 % of the tobacco stems end up in landfills or incineration.

Thus there is a need to dispose this residue in a way which is environmental friendly. Tobacco waste ash is produced by burning these unwanted tobacco stems. Tobacco waste ash displays properties such as fineness, amorphous form and high silica content and thus needs to be investigated with its potential to show high pozzolanic activity. The ashes are not pozzolanic material, they have pozzolanic activity, but this activity is less than that in pozzolanic material. The ashes exhibit the “filler effect”, which is composed of two phenomena, the nucleation and packing effects that primarily depend on the fineness of the materials. The nucleation effect occurs when the small particles are spread in blended cement paste, leading to an enhanced hydration reaction, while the packing effect occurs when the voids in pastes are filled with fine particles. Tobacco waste ash is not a pozzolanic material but it has been known to display some pozzolanic activities.

C. Sugarcane Fiber

Sugar cane is a natural Plant Fibre, which is collected from Sugarcane Plant. Mainly Sugarcane Fibre is called “Bagasse”. Bagasse is a fibrous material that’s remains after sugarcane is crushed toexact their juice from sugarcane. It is dry pulp residue left after the extraction of juice from sugarcane. About 30 to 32% of bagasse is produced from 1 ton of sugarcane. Since bagasse is a by-product of the cane sugar industry, the quantity of production is in line with the quantity of sugar cane produced. Bagasse is the fibrous residue of the cane stalk left after crushing and extraction of juice.

II. LITERATURE REVIEW

Naveen Kumar A, Vivekananthan, Chithra 2019 Tobacco waste ash and waste glass powder were used in place of some cement in a paper titled "Study the Effects of Tobacco Waste Ash and Waste Glass Powder as a Partial Replacement of Cement on Strength Characteristics of Concrete." Tobacco waste ash was substituted in percentages of 5, 7.5, 10, and 12.5, and waste glass powder was substituted in percentages of 5, 10, 15, and 20. Compressive strength, flexural strength, and split tensile tests were performed on the At 12.5% waste glass powder and 12.5% waste tobacco waste ash, the flexural strength test values increase. In the end, the author came to the conclusion that the silica from the powdered glass waste enhanced the strength of the concrete and added to its durability and hardness. Water usage was decreased since the concrete was easier to work with thanks to the addition of ash from tobacco waste.

S.celikten, M. Canbaz 2017 The consequences of partially substituting tobacco waste ash for cement in concrete technology were examined in a paper titled "A Study on the Usage of Tobacco Waste Ash as a Mineral Admixture in Concrete Technology." Two sources of tobacco waste ash were used for the tests, and each specimen of the two sources underwent testing. Ten, fifteen, and twenty percent of the weight was replaced in part. The samples of mortar were then put to the test. The tests that were conducted included flexural and compressive strength testing. The mortar specimen's dynamic modulus of elastic values, unit weight, and ultrasonic pulse velocity were computed based on the test findings. The values of these results were observed to have decreased.

Divyadevi Sundaravadivel and Dr. R. Mohana 2018, In this article, An overview of Sugarcane Bagasse Ash (SCBA) and its main characteristics are provided in this article. This essay explores the several SCBA processes. An explanation of the background and application of SCBA as a mineral additive is presented in this work. This paper examines the mechanical and durability characteristics of SCBA in mortar and concrete.

S Chandrasekar and Dr. P. Asha 2018, Researchers from all around the world are currently concentrating mostly on finding methods to use agricultural or industrial wastes as a supply of raw materials for the building sector. The efficient use of garbage could potentially contribute to the development of environmentally sustainable and eco-friendly environments. One such fibrous byproduct of sugar cane is sugar cane bagasse ash (SCBA), which also contains silica, aluminum, and ethanol vapours. In order to improve the hardness and suitability of the concrete for structural use, the fibers will be crucial. High silica content, such as that found in SCBA, can make it a valuable pozzolanic material that helps cementitious systems gain strength. The usage of agricultural waste is covered in this review study. Sugar cane bagasse and the state of research at the moment. the addition of varying percentages of scrap steel fibers by volume fraction to different proportions of regular Portland cement and sugar cane ash for a variety of typical concrete mixtures.

Umoh A.A et. al. 2013 In this paper entitled as “The study "Comparative assessment of concrete properties with different ratios of periwinkle shell and bamboo leaf ashes replacing cement" assessed the efficacy of adding periwinkle shell ash (PSA) and bamboo leaf ash (BLA) to cement. A ratio of 1: 2: 4 with a w/c ratio of 0.65 was utilized as a reference. Up to 40% of the cement content of the ten combinations was substituted with a combination of different percentages (by weight) of PSA and BLA. The qualities that were examined were density, porosity, water absorption, and compressive strength and strength.

The outcome shown that after 28 and 56 days, the water flow, cement-based cement with compacted PSA concentrations, and BLA of 20% converted cement increased in compressive strength, absorption capacity, and porosity compared to citation. Thus, it was determined that a sizable portion of the ternary cement mix included the 20% cement replacement.

Olugbenga O. et. al. 2010 In this paper entitled as “An investigation into the characteristics of fortifying bamboo leaves in lartitic soil during highway building was conducted as part of the "Characters of Bamboo Leaf Ash Stabilization on Lateritic Soil in Highway Construction" project. According to the findings, adding BLA strengthened the sample. In examples A, B, and C, the ideal humidity dropped for BLA additives 8, 4, and 6%. Samples A and B likewise showed increases in their respective non-immersed CBR values. Also, samples A and B's shear strengths grew.

III. MATERIALS

A. Cement

Cement is a binding material in concrete that develops strong bonding properties when mixed with water and provides strength to the concrete. The chemical composition of cement mainly contains lime. There are many types of cement available in the market according to the need and strength desired. The cement we will use in this research work is 43 Grade Ordinary Portland cement conforming to IS: 8112 with brand name Ambuja Cement.

B. Coarse Aggregates

Crushed aggregates, angular in shape have been used in experimental work. Grading of coarse aggregate was done according to IS: 383-1970 and nominal size was determined. Two different coarse aggregates of a nominal size of 20 mm single size and 12.5 mm graded were combined in gradation ratio of 1.2:1 to obtain graded aggregates. Grading of coarse aggregate was done according to IS:383-1970. Aggregates of Nominal size 20mm & 10mm to form a graded aggregate. The concerned lab provided the properties of coarse aggregate.

C. Fine Aggregates

Natural river sand was used as fine aggregates. The zone of the sand was decided by doing sieve analysis as per IS: 383-1970. Physical properties of sand like specific gravity, water absorption and fineness modulus were determined. In general, river sand is used as a fine aggregate having a particle size of 0.07mm. The extraction is done from rivers, lakes or seabeds. Fine aggregate that was present at the site. Sieve analysis would be done to find out the zone conforming IS: 383-1970. The physical properties of sand were provided by the concerned lab.

D. Tobacoo Waste ASH

The Tobacco wash ash that was used in the experiments was made by purchasing tobacco stems and then burning them and the ash that was obtained was sieved through a 425 µm sieve to remove any undesirable particles. The ashes were further rounded in the Los Angeles machine to reduce the size of particles to 60 µm. The amount of silica in the tobacco waste ash depends on the burning temperature and the amount of time for which the burning is done. Thus from different sources of tobacco stems, we get different composition. The total amount of silicon dioxide, aluminum oxide and ferric oxide is less than 70 percent, which is the minimum value required for a material to be considered as pozzlanic.

Table no. 1 Properties of TWA

Particular	Percentage
Silicon Dioxide (SiO_2)	25.67
Aluminum Oxide (Al_2O_3)	0.16
Ferric Oxide (Fe_2O_3)	0.31
Sodium Oxide (Na_2O)	0.49
Calcium Oxide (CaO)	25.54
Magnesium Oxide (MgO)	4.6
Sulphur Trioxide (SO_3)	7.04
Potassium Oxide (K_2O)	17.84

E. Bamboo Leaf ASH

Bamboo is probably the fastest growing and most productive natural resource and building material found in humanity. However, the use of bamboo creates other residues that cant be used as fibers, such as bamboo leaves. In some countries, large amounts of bamboo are processed, producing a large amount of solid waste. These debris are often burned in open landfills, having a detrimental effect on the environment. In the literature, studies on the pozzolanic properties of bamboo waste are rare. The ash found after burning bamboo leaves has an amorphous nature and has pozzolanic properties. The bamboo leaves are dried in the sun, burnt in the open for 2 hours to form a pile of bamboo leaf ash. The ash represented gray and black colour.

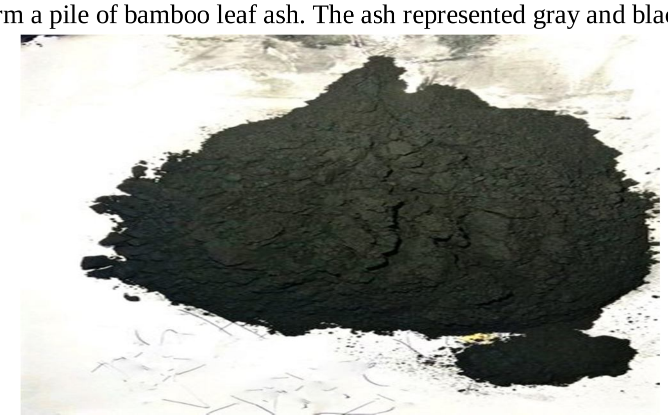

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Table no. 2 Properties of BLA

S.no	Elemental Oxide	BLA (% by mass)
1.	Calcium Oxide (CaO)	4.23
2.	Silicon Dioxide ($SiO_{2)}$	72.25
3.	Aluminum Oxide (Al_2O_3)	4.08
4.	Magnesium Oxide (MgO)	1.01
5.	Ferric Oxide (Fe_2O_3)	1.97
6.	Potassium Oxide (K_2O)	3.15
7.	Manganese dioxide (MnO_2)	0.22
8.	Phosphorus pentoxide (P_2O_5)	0.74
9.	Sulphur Trioxide (SO_3)	0.15
10.	Titanium Dioxide (TiO_2)	0.35

F. *Sugarcane Fiber*

Sugar cane is a natural Plant Fibre, which is collected from Sugarcane Plant. Mainly Sugarcane Fibre is called “Bagasse”. Bagasse is a fibrous material that’s remains after sugarcane is crushed to exact their juice from sugarcane. It is dry pulp residue left after the extraction of juice from sugarcane.

Table no. 3 Properties of SCF

S.No.	Parameters	Carrier(SugarcaneBagasse)
1	Water Content(W)(%)	7.77 ±0.35
2	Water content of hydrated carrier	84.27±1.38
3	Water retention (H)(g/g)	4.80 ±0.44
4	Lignin content	24.40±1.52
5	Water absorption index(WAI)(g/g)	8.58 ±0.21

IV. METHODOLOGY

A. *Mixing Concrete*

All the ingredients of concrete are mixed together however this mix should be homogenous and uniform in color and consistency. The mixing can either be done by hand or with the use of mixer.

B. *Mixing Concrete*

Thorough mixing of the materials is essential to produce uniform concrete. The mixing should make sure that the mass become homogeneous, uniform in consistency and colour. There are two methods adopting for mixing concrete one is hand mixing and other is machine mixing.

C. Curing

Before removing the mould, it is dried for 24 hours, and then specimens are placed in a water tank made to cure specimens. The specimens must be marked for identification so that there must not be any error. The specimens are removed from the tank and dried before putting in the testing machine. The specimens are kept in the tank for 7,14,28 days.

D. Workability Test

It can be used in site as well as in lab. This test is not applicable for very low and very high workability concrete. It consists of a mould that is in the form of frustum having top diameter of 10cm, bottom diameter of 20cm and height of 30cm. The concrete to be tested if fitted in the mould in four layers. The each is compacted 25 times with the help of tamping rod. After the mould is completely filled it is lifted immediately in the vertically upward direction which causes the concrete to subside.

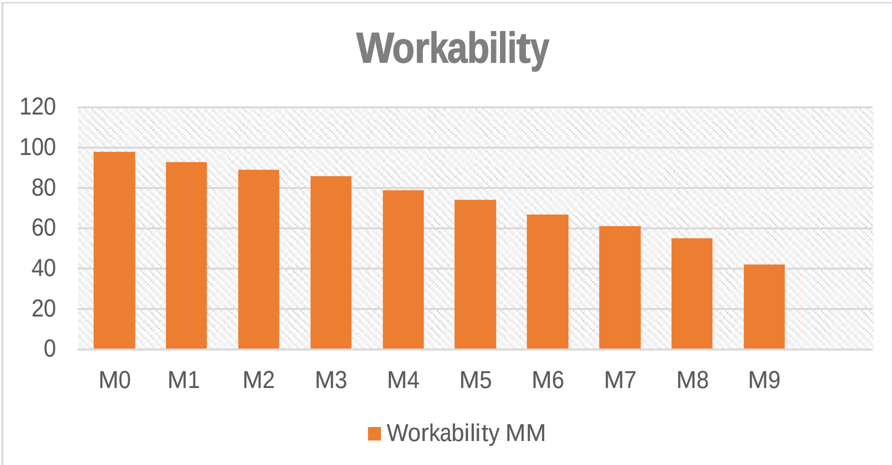

Fig -1: Slump Cone Test

E. Compressive Strength Test

Then fresh concrete is filled in mould in 4 layers and after filling each layer tamping should be done 35 times in case of cube and 25 times in case of cylinder by using standard tamping rod. Once the mould is filled then leveled top surface of concrete with trowel. After the day the mould will removed and specimen are dropped in the curing tank under standard temperature of 27±2° c. After 7,14 days and 28 days in this research.

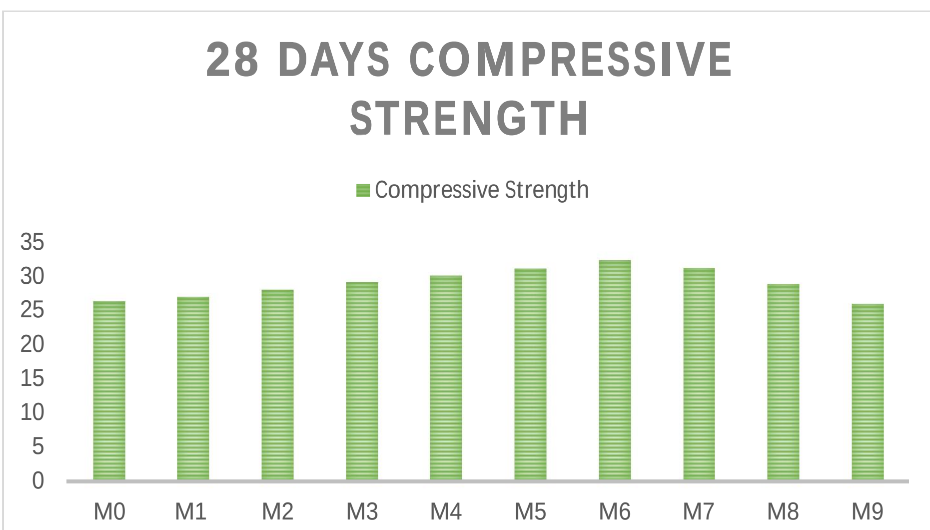

Fig -2: COMPRESSIVE STRENGTH TEST 28

F. Split Tensile Strength Test

The specimen used for this test is cylindrical and its dimension is 150 mm in diameter and 300mm in length. The instrument used for this testing is universal testing machine. The fresh concrete is prepared in according to the required grades and respective mix proportion. The fresh concrete is filled in mould in layers and each layer is tamping with standard tamping rod with 25 blows for each layer. After the day the mould is removed and specimen is placed in the curing tank for 7,14 days and 28 days in this research at the temperature 27+ 2°c. Then draw the line on the specimen.

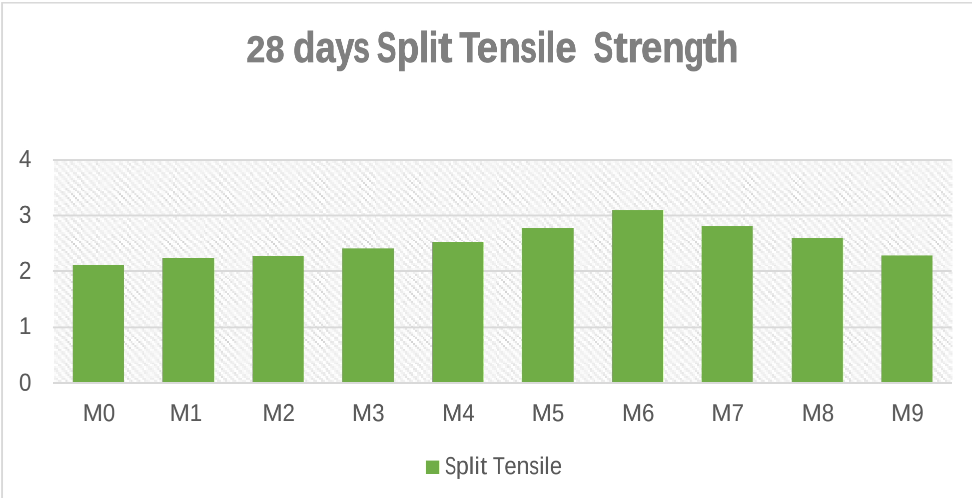

Fig -3: Split Tensile Strength Test 28

G. Flexural Strength Test

The concrete is prepared at required rate of mass element the mould is filled with concrete in layers and blows 25 times with standard tamping rod. After the day or we can say 24 hours the mould is removed and specimen placed in the water tank for curing at a temperature of 27 + 2 C. Depending upon the requirement the test specimen is removed from the water tank and wipe it properly for 7,14 and 28 days for testing.

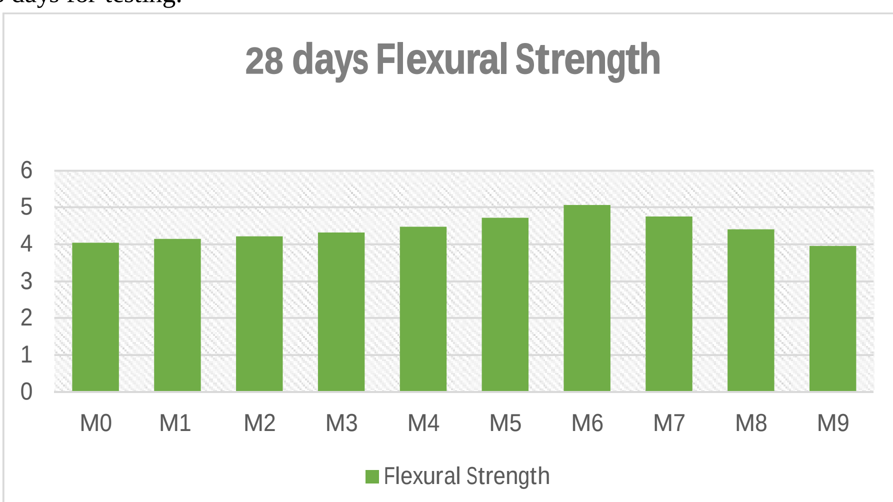

Fig -4: Flexural Strength Test 28

V. CONCLUSION

1) By replacing the cement with the Tobacco waste ash and Bamboo leaf ash with addition Sugar cane fiber strengths get increased.
2) The replacement can be taken into consideration up to certain percentage workability factors gets enhanced as well.
3) The compressive strength of the concrete on comparing with conventional concrete gets increased till 12&12% of cement was replaced Tobacco waste ash and Bamboo leaf ash and for reinforcement 0.6% of addition Sugar cane fiber was used.

4) After 28 days of curing, maximum compressive strength obtained was 32.37 N/mm^2.
5) The flexural strength of the concrete on comparing with conventional concrete gets increased till 12&12% of cement was replaced Tobacco waste ash and Bamboo leaf ash and for reinforcement 0.6% of addition Sugar cane fiber was used.
6) After 28 days of curing, maximum flexural strength obtained was 5.06 N/mm^2.
7) After 28 days of curing, maximum tensile strength obtained was 4.17 N/mm^2.
8) In case of tensile strength, the optimum percentage that was noticed, was at 12&12% of cement was replaced Tobacco waste ash and Bamboo leaf ash and for reinforcement 0.6% of addition Sugar cane fiber was used.

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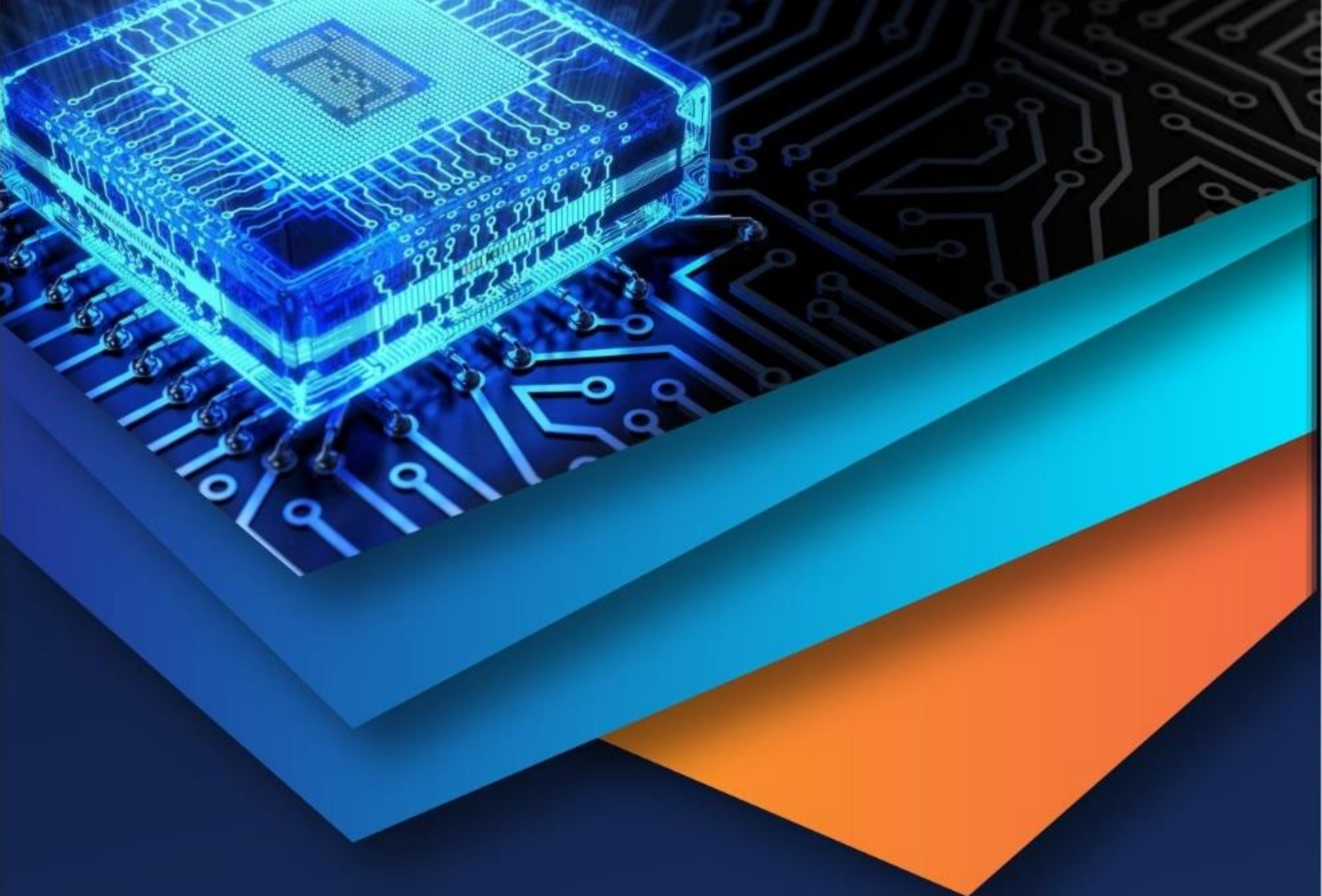

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