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Experimental Study on Rubberized Concrete using Zeolite and Geopolymer

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Abstract: In Earth, as we know that there is a lot of minerals and ores are present. This is also containing soil and aggregates in it. Nowadays, as we know that there is depletion of concrete materials which is available now days. So, in this project we are going to create or making some concrete with some admixtures and partially replacing with some other materials and making an economical concrete and obtain the concrete which is giving us a good result also. In this project we are going to study the effects of rubberized concrete using zeolite and geopolymer and at the end we are going to compare the results with the normal concrete. In this we are also going to use an alkaline activator. With the help of this activator the geopolymers act as a Cementous material when this alkaline activator mix aur react with Industrial waste or natural material. As we had studied from the previous papers that with the help of rubberized concrete using zeolite and geopolymer which conclude that this type of concrete had a good binding property with iron bars and this concrete is not affects the reinforcement bars as compared to our normal concrete.
Keywords: Rubber, water cement ratio, UTM, Geopolymer, Concrete, Compressive Loads, Cement, Sand, Aggregate, Alkaline activator.

I. INTRODUCTION

As we know that India is a developing country and there is a lots of construction work is also going on. Which is lead to a shortage of construction material specially the materials which is used in concrete, due to this shortage the major effects which is happening I the delay of work which is not suitable for the owner as well as the contractor.

Due to this problem, there is a lot of study had been done for the partially replacement of the concrete material with some waste material or some other material which is available in the bulk in our environment, and which is also makes our environment healthy. So, in this, project we are going to prepare a concrete which is made up of geopolymer and zeolite generally from the previous researchers we came to know that this concrete is act like a rubbery concrete.

1) *Zeolite:* we are going to use Zeolite in our project because, zeolite has a good absorption capacity and strange things is that it can absorb its own weight also, which is approximately 40%. As well as it has a quality to cure concrete and it improves the property of concrete such as durability, permeability.

Fig: - Zeolite

2) *Geopolymer:* Aluminates and silicate-containing materials are combined with a caustic activator, such as fly ash or slag from the manufacturing of iron and metal, to create geopolymer concrete. It may also serve as a viable OPC replacement. Geopolymer concrete is more suitable and healthier because it emits lower CO2 as compared to OPC Cement concrete. Hence this is also known as Green Concrete As this is ecofriendly in nature.

Glimpse of Crumb rubber

3) *Rubber:* Generally, this type of Rubber is obtained from the old and used rubber tire which is obtain from the car trucks etc. Because this type of tire and rubber if we burn them then it pollutes the environment also.
4) *Alkaline Activator:* This is an Alkaline material which is used for improve or making the geopolymers quality as Cementous. With the help of this activator the geopolymers quality also getting improves.

II. SCOPE OF THE PROJECT AND OBJECTIVES

1) Reduction of harmful gases which is obtained due to conventional concrete.
2) Making the concrete Economical and cheaper.
3) To improve the durability of concrete.
4) To create a concrete which is flexible also.
5) To get better workability of concrete.

III. WORK DONE

A. *Testing of Materials*

Aggregate sieve analysis = well graded aggregate sizes.
Bulk modulus of sand test = 10.52% bulk modulus
Slump cone test on concrete = True slump.
Specific gravity of Rubber = 0.96 kg/m3
Casting of convectional concrete block. (18 kg aggregate, 9kg sand, 9kg cement)
M25 grade 1:1:2 ratio.

B. *Testing of Convectional Concrete Block.*

1) strength of M25 (366KN) concrete at 7 days is 16.25N/mm$^{2.}$
2) strength of M25 (506KN) concrete at 14 days is 22.5N/mm$^{2.}$
3) strength of M25 (642KN) concrete at 28 days is 25.68N/mm$^{2.}$

Casting of Rubberized geopolymer concrete block

C. *Testing of Rubberized geopolymer concrete block*

1) Strength of M25-5% replacement of rubber (358KN) concrete at 7 days is 14.32N/mm^2.
2) Strength of M25-10% replacement of rubber (388KN) concrete at 14 days is 15.52N/mm^2.
3) Strength of M25-15% replacement of rubber (422KN) concrete at 28 days is 16.88N/mm^2

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IV. EXPERIMENTAL RESULTS

Geopolymer rubberized concrete mix proportioning, casting, and curing nine mixtures in all are synthesised for this study. First, a traditional geopolymer concrete mix is made by combining natural crushed stone and river sand for the aggregate, fly ash and ggbs for the binder components, and NaOH and Na2SiO3 for the alkaline activators. Two batches of synthesizers create the remaining mixes. The two batches are made up of geopolymer concrete mixtures created with binders consisting of 35% fly ash, 5% zeolite powder, and 60% ggbs (constant for all the mixes), coarse stone aggregate replaced by 2.5% by weight of rubber chips (constant for all the mixes), and river sand substituted by 5%, 10%, 15%, and 20% by weight. In contrast, rubber particles are introduced straight into the mix in the first batch. The rubber particles in the second batch are treated with a 1M NaOH solution. The tested qualities, the age of the concrete used in the study, and other factors.

Table no.1: - Testing Parameters

Properties	Tests	Codes	Test Ages	Cubes Sizes in mm
Mechanical	Compressive Strength	IS:516-1959	28	100 x 100 x 100
	Split Tensile Strength	IS:5816-1999	28	100 dia x 200 height
	Impact Resistance Strength	ACI committee 544.2R-89	28	100 x 100 x 500
Durability	Freeze-Thaw	ASTM C666 2008 C	28	100 X 100 X 100

Table No. 2: - Designations

S0- Normally Cement Concrete

Replaced Quantities
S1-5% rubber crumble in F. A
S2-10% rubber crumble in F. A
S3-15% rubber crumble in F. A

V. RESULTS

The created geopolymer concretes are allowed to cure for 28 days at room temperature before being tested. The specimens are subsequently subjected to a compressive strength test after 28 days; the results are depicted in figures compressive strength falls as the amount of rubber powder in the mixture rises. At 28 days, the similar trend was seen. In all of the mixes from 28, a compressive strength enhancement of about 10-12% has been seen. It's possible that there was insufficient bonding between the geopolymer paste and the rubber particles, which caused the strength to diminish when rubber powder was added to the mixtures. The fundamental cause of this weak bonding is the hydrophobic characteristic of rubber. Surprisingly, when the mixes were first treated with a 1M NaOH solution before being added to the mixes, the compressive strength rose at both 28. The better adhesion between the geopolymer paste and rubber particles may be caused by the rubber particles' enhanced hydrophilic character after being treated with NaOH solution. The developed geopolymer concrete has a compressive strength that ranges from 59.38 to 80 MPa at 28 days.

Table No. 3: - Comparison between the compressive strength on Normal Cement Concrete and Conventional Geopolymer concrete with Fine aggregate replaced by Crumb Rubber

Compressive Strength of M25 Concrete after 28 days (N/mm^2)				
Sample	M25 Concrete	5% Replacement.	10% Replacement.	15% Replacement.
S1	25.68	16.53	14.56	13.59
S2	25.72	16.72	15.24	14.42
S3	25.50	16.58	14.22	13.02
Average	25.63	16.61	14.67	13.68

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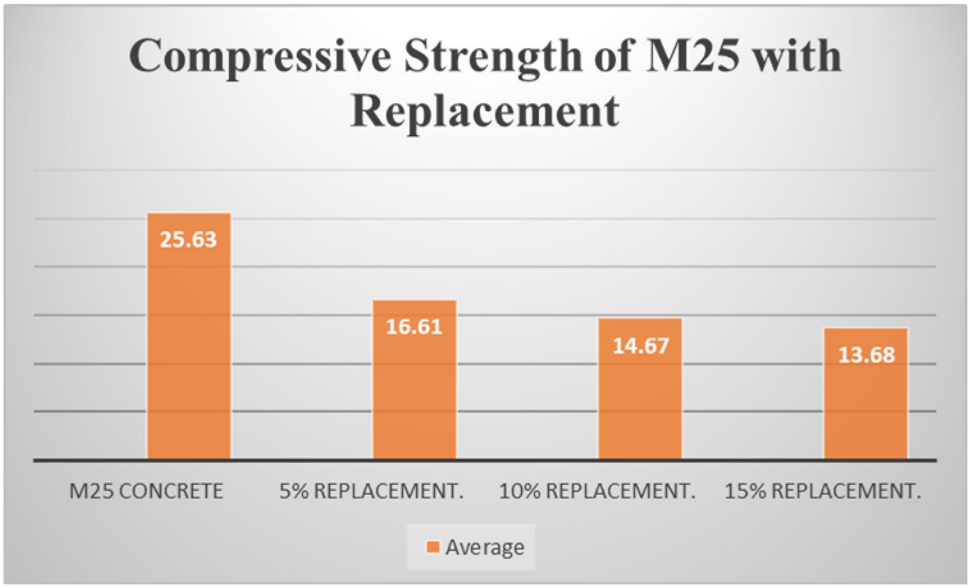

Fig no. 1: Comparison chart from table no. 3

Compression test: - Specially some concrete is cast and used only to take the compressive force of the structure as we all know that concrete is weak in tension but strong in tension. The above results were obtained after the compression test. In this test the specimen is set in the UTM (universal testing machine) and then a compressive load is applied in it and the load is applied on it until the specimen is break down and at the time of failure, we must note down the readings at what load the specimen is fail. This is knowns as the compressive strength at what load our specimen is failed.

Table No. 4: - Comparison between the tensile strength on Normal cement concrete and Conventional Geopolymer concrete with Fine aggregate replaced by Crumb Rubber

Tensile Strength of M25 after 28 days (N/mm^2)				
Sample	M25 Concrete	5% Replacement.	10% Replacement.	15% . Replacement.
S1	5.78	5.02	5.44	3.59
S2	5.88	4.96	5.24	4.42
S3	5.57	5.00	4.22	4.20
Average	5.74	4.99	4.97	4.07

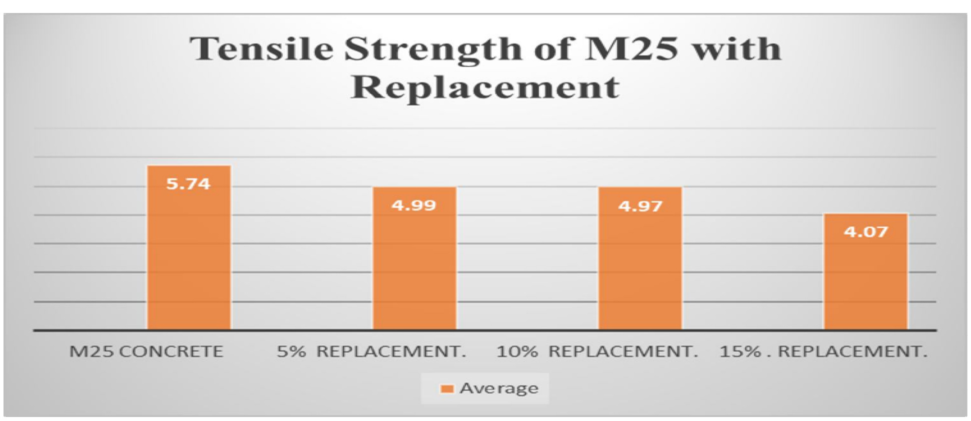

Fig no. 2: Comparison chart from table no. 4

Table No. 5: - Comparison between the Impact Resistance on Normal Cement Concrete and Conventional Geopolymer concrete with Fine aggregate replaced by Crumb Rubber

Sample	Impact Resistance Initial Crack	Impact Resistance Final Crack
M 25	9	12
5% Replacement	16	20
10% Replacement	29	29
15% Replacement	43	43

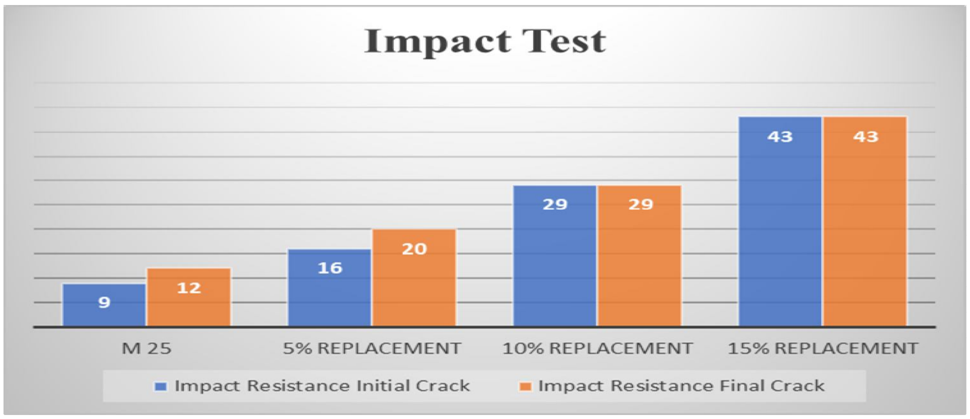

Fig no. 3: Comparison chart from table no. 5

Table No. 6: - Comparison between the compressive strength on Normal Cement Concrete and Zeolite concrete with Fine aggregate replaced by Crumb Rubber.

`Compressive Strength of M25 Concrete after 28 days (N/mm^2)				
Sample	M25 Concrete	5% Replacement.	10% Replacement.	15% Replacement.
S1	25.24	16.45	14.45	13.45
S2	25.27	16.23	14.65	13.96
S3	25.48	16.18	14.40	13.74
Average	25.33	16.29	14.50	13.72

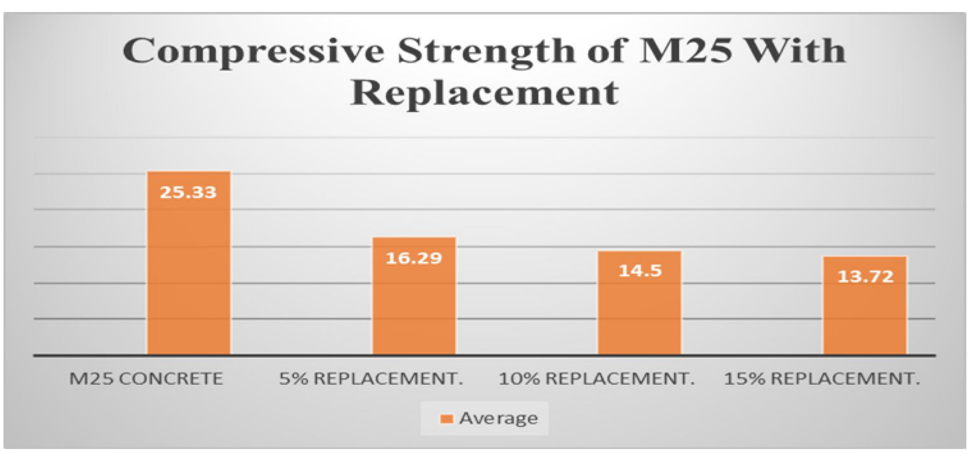

Fig no. 4: Comparison chart from table no. 6

Compression test: - Specially some concrete is cast and used only to take the compressive force of the structure as we all know that concrete is weak in tension but strong in tension. The above results were obtained after the compression test. In this test the specimen is set in the UTM (universal testing machine) and then a compressive load is applied in it and the load is applied on it until the specimen is break down and at the time of failure, we must note down the readings at what load the specimen is fail. This is knowns as the compressive strength at what load our specimen is failed.

Table No. 7: - Comparison between the tensile strength on Normal cement concrete and Zeolite concrete with Fine aggregate replaced by Crumb Rubber.

Tensile Strength of M25 after 28 days (N/mm^2)				
Sample	M25 Concrete	5% Replacement.	10% Replacement.	15% . Replacement.
S1	5.12	5.00	4.33	3.58
S2	5.18	4.98	4.50	3.86
S3	5.05	4.26	4.32	3.44
Average	5.17	4.74	4.38	3.63

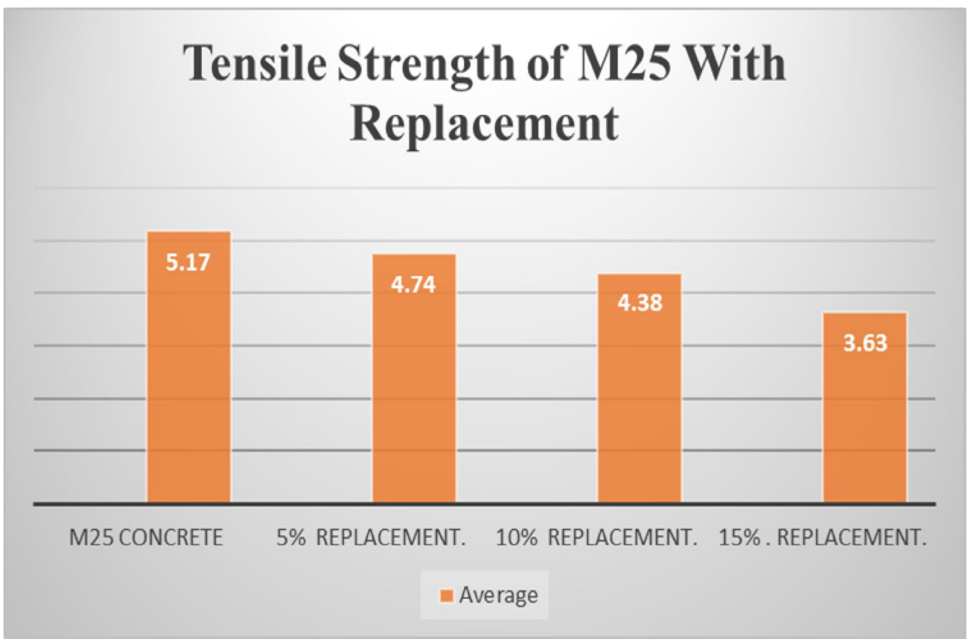

Fig no. 5: Comparison chart from table no. 7

Table No. 8: - Comparison between the Impact Resistance on Normal Cement Concrete and Zeolite concrete with Fine aggregate replaced by Crumb Rubber.

Sample	Impact Resistance Initial Crack	Impact Resistance Final Crack
M 25	9	12
5% Replacement	14	21
10% Replacement	28	30
15% Replacement	33	33

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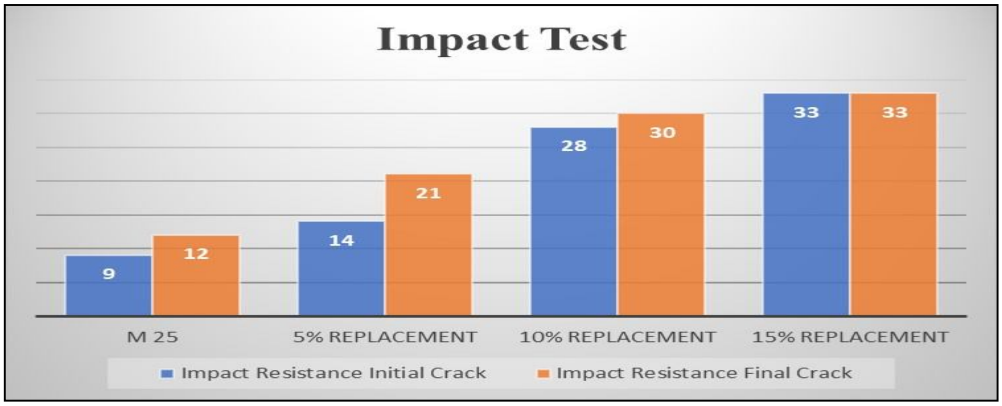

Fig no. 6: Comparison chart from table no. 8

VI. CONCLUSION

1) As we increased the quantity of rubber and zeolite in the concrete the compressive strength is fall continuously.
2) The 5% and 10% replace sample shows the satisfactory results.
3) Same as Compressive strength the tensile strength of the sample getting down with increasing in the rubber and zeolite.
4) The highest quantity of rubber and zeolite will give good results in the impact test. In impact test as we increase the ratio of rubber and zeolite the impact resistance of the sample also increases.

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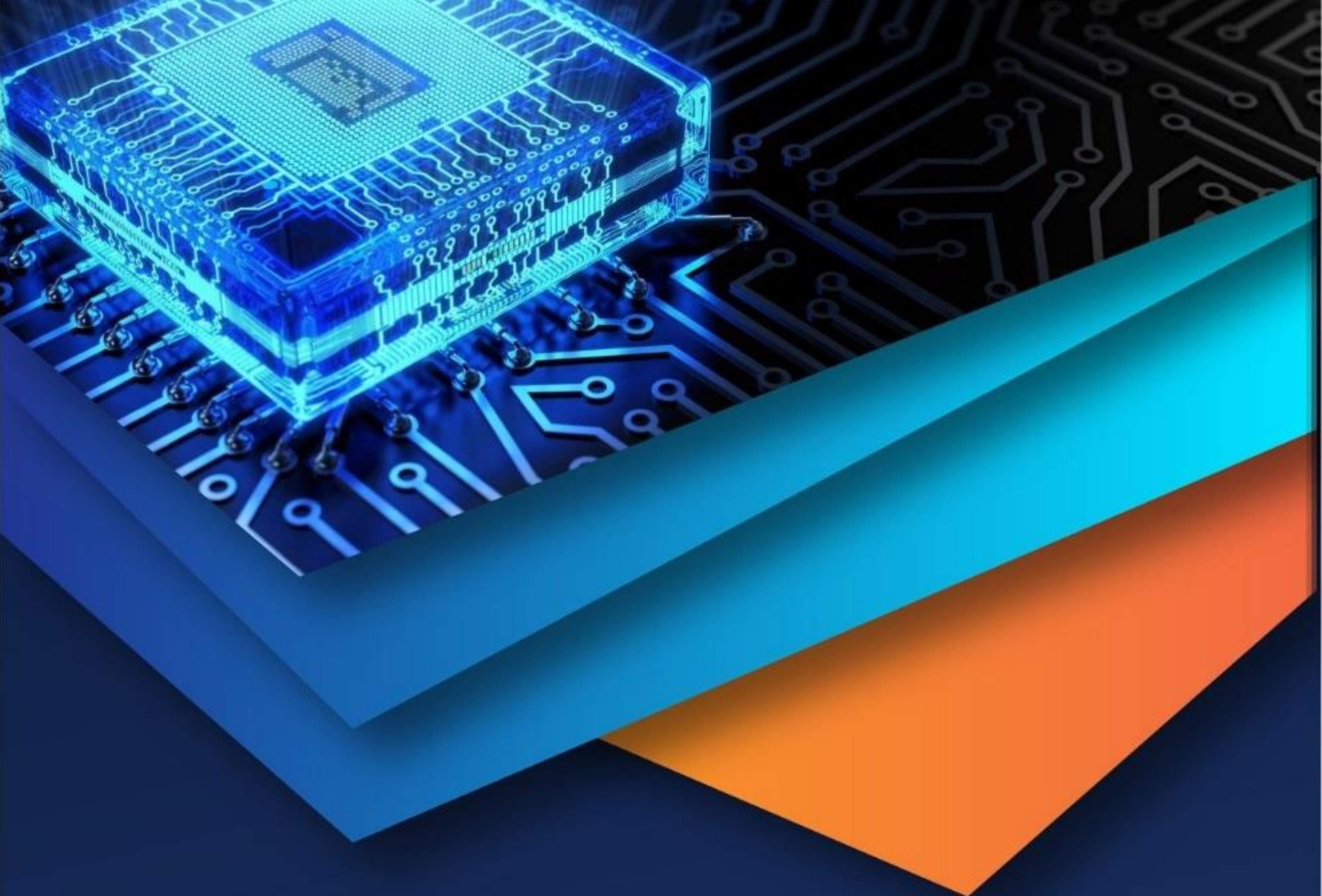

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