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To Study the Partial Replacement of Cement by Eggshell, Chalk Powder with Addition of Basalt Fiber

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Abstract: ***In concrete cement of Portland the aggregate are mixed with water and dry cement, they form a fluid of mass that mould easily into desired shape. The cement chemically react ingredient and water to form a matrix hard which the materials bind together into durable property stone that might use for many purpose. Use of chalk powder is also eco-friendly as the waste limestone or chalk material from industries as well as from schools and colleges, are effectively being used to form quality building materials. Basalt fiber is another solid strengthening material, which has wonderful mechanical properties and furthermore an eco-accommodating assembling process. Significantly number of examination has been directed on basalt fiber strengthened cement and has generally watched out for its mechanical properties. On the basis of previous researches which has been done we make a comparison of strength properties of concrete made with replacement and conventional concrete. Cement is replaced by Chalk, eggshell powder with addition of basalt fiber. Different specimens of the material are tested for strength. The result shows that concrete workability is fine and within limits after replacing cement with Chlak,eggshell powder with adding basalt fibers. However, workability gets reduced at higher replacement of materials. The strength parameters such as compressive strength, flexural strength, and split tensile strength also increase and show an optimum value at 8&8% cement replacement and 1.8% Addition of basalt fibers respectively. Test results are satisfactory up to 8&8% and 1.8% replacement. After this, there is a decrease in the strength of concrete. So, after this research work, we are able to find out that the replacement can be done to this extent but there may be chances of higher percentage of replacement by doing further investigations.***

Keywords: CP (CHALK POWDER), ESP (EGG SHEEL POWDER), BF (Basalt Fibers) workability, compressive strength, Split Tensile strength, Flexural strength

I. INTRODUCTION

Any activity of construction requires several materials such as steel, bricks, concrete, wood, clay, mud and so on. However, concrete cement remain the main material construction used in industries of construction. For the adaptability and suitability with respect to the environment changing, the concrete must be such that it can safe the environment, conservation of resources, economize and lead to proper energy utilization. To achieve this, main emphasis must be laid on the use of wastes and byproducts in concrete and cement used for new construction. The 75 percent of concrete are made of aggregates. Concrete is a composite material compose of coarse granular materials (the filler or aggregate) embedded in a hard matrix material (the binder or cement) that fill the spaces between the particles of aggregate and glues them together. It is estimate that the concrete consumption in the earth is order of 10 billion ton (11.5 billion tons) per year. We are also considering concrete as a material of composite that essentially binding material which are fragment of aggregates and embedded particles. Most term of 'concrete' refer to Portland concrete cement or to concrete made with other cements of hydraulic.

A. EGG Shell Powder

Also, utilizing eggshell powder in place of cement will reduce carbon dioxide emissions during the production of cement and decrease air pollution. This will lead to the economic growth and development of countries. Eggshell waste evolves from poultry farms, restaurants, and hotels where there is the consumption of eggs. Eggshells are rich in calcium and have the same limestone composition as cement. Researchers have reported that eggshell mainly contains calcium in the form of Calcium Carbonate (90%) and the remaining masses contain Phosphorus, Magnesium, traces of sodium, zinc, manganese, iron, and copper. The research done so far suggests that eggshell powder shows the binding property of the cement. So, the need arises for the bioconversion of waste into usable energy. Eggshell powder is also a cheap alternative material in place of cement which can reduce the overall cost of construction and impact on the environment to a large extent.

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B. Chalk Powder

Chalk used is a fine whitish colored powder composed of calcium carbonate (CaCO3), a form of limestone and is obtained by fine grinding of limestone present at Manasbal area. It can also be obtained from sedimentary rocks and marble waste powder. The chemical formula for chalk is CaCO3, and having molecular weight equal to 100.0869 amu. Chalk is the most popular material among all. In schools, colleges chalk is used to deliver lecture on a black color board. Chalks that are used in schools and universities usually comes in the form of cylindrical sticks. These chalk sticks easily crumbles and leaves the particles that have the capability to stick loosely on the rough surface, hence permitting it to write on the rough surface which can be easily erased. These writings on the rough surface when erased give the chalk in the form of powder. In India, in almost every colleges and school teachers deliver the lesson on black board using chalk, as this method is economical as well as easy.

C. Basalt Fibers

Basalt fiber is another solid strengthening material, which has wonderful mechanical properties and furthermore an eco-accommodating assembling process. Significantly number of examination has been directed on basalt fiber strengthened cement and has generally watched out for its mechanical properties. In past explores the examination don't propose that the strands are viable in expanding the break opposition.

It has likewise been considered that the plain basalt filaments experiences absence of sturdiness in solid that is presented to basic condition. By utilizing Basalt fiber strengthened cement agreeable usefulness can be kept up with the expansion of basalt fiber up as far as possible. When contrasted and the ordinary cement, there is increment in durability and effect quality for the basalt fiber strengthened cement. On utilizing basalt fiber strengthened cement the method of disappointment gets changed from weak to malleable disappointment, when exposed to pressure, effect and bowing.

II. LITERATURE REVIEW

Kamran Basit et al. (July 2019): This paper studies the various strength parameters of concrete made with varying proportions of egg shell powder viz 0%, 5%, 10%, 15% and 20% as replacement of cement and concluded that the highest strength is achieved at 10% replacement of cement with ESP. Also concluded that split elastic qualities of ESP cements were practically similar to traditional cement up to 15% ESP replacement. The workability characteristics of the concrete with varying ratio of ESP were also studied through slump cone test. Compressive strength test, flexural strength test and split tensile strength test were performed to get the results and conclusion of replacement of cement with ESP.

KANAKA RANYA et al. (August 2019): This paper focused on various parameters of M40 concrete made with partial replacement of cement with ESP in the following percentages as 5%, 10% and 15% and percentages of fine aggregates with Quarry dust are 25%, 50% and 75%. compressive strength test, flexural strength test and split tensile strength tests were performed to get the results. It is reported by the data of test results that the optimum percentages are 10% for ESP replacement with cement and 50% for Quarry dust with fine aggregates. The percentage increase in split tensile strength is 5.5% with 10% ESP and 50% Quarry dust when compared with normal mix and flexural strength is increased by 7.1%.

Wenzhong Zhu 2005 This paper describes a research of the impact of several types of limestone and chalk powders used as fillers in self-compacting concrete (SCC) on superplasticizer demand and the strength qualities of concrete mixtures. All of the specified limestone and chalk powders were found to be suitable for the production of SCC mixtures, with only minor changes to the superplasticizer dosage required. Superplasticizer dosages were often greater for SCC using chalk powder than for SCC using limestone powder. The fineness of the powders has no effect on the demand for superplasticizer. At the same water/cement ratio, the compressive strength of the SCC mixes containing the limestone and chalk powders was much higher than that of the traditional vibrated reference concrete, especially at early ages.

(G.K Geethanjali 2012) in research paper entitled "Disfigurement attributes of Basalt Reinforced cement with Super Plasticizer" considered the impact of the SPs and basalt fiber on flexural and compressive quality of the fiber fortified cement. It was seen that there is an expansion in the flexural and pressure quality of the example at 3, 7 and 28 days of restoring with expansion of SPs and basalt filaments. NDT and UPV test on solid blend under different pressure were recorded.

(Mustapha Abdulhadi et al 2012) in research paper entitled "A similar Study of Basalt and Polypropylene Fibers" considered the compressive and the elastic conduct of M30 evaluation of solid blend arranged by fortifying in with basalt and polypropylene filaments. The filaments were included the level of 0% to 1.2% by the volume division by weight of the concrete and afterward tried the split rigidity just as the compressive quality lastly acquired the connection between them.

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III. MATERIALS

A. Cement

In this research project the binding materials used were Ordinary Portland Cement grade 43. The cement used was Khyber Cement, which is processed by Khyber cement private limited. Cement is a substance that when immersed in water exhibits compact and adhesive properties that help hold aggregates together to form a concrete weight. It is also known as compression cement, as it finds its place to adhere to the complex hydration process that makes the water resistant.

B. Coarse Aggregates

The graded coarse aggregate is described by its nominal size i.e., 40 mm, 20 mm, 16 mm and 10 mm. Since the aggregates are formed due to natural disintegration of rocks or by the artificial crushing of rocks or gravel, they derive many of their properties from the parent rocks. 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

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 was extracted from Jammu. 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. Chalk Powder

Chalk Powder used in this investigation research was obtained from village Mansbal located in Ganderbal, Jammu and Kashmir. Chalk Powder is white in color and mainly derived from line stone. The quantity of lime present in chalk is higher than other constituents. Chalk being a base can be used as an antacid, because of the huge properties it can be used in number of ways.

Table no. 1 Properties of CP

Particular	Proportion
Silicon Dioxide (SiO_2)	6.50
Aluminum Oxide(Al_2O_3)	0.11
Ferric Oxide (Fe_2O_3)	0.06
Titanium Dioxide (TiO_2)	0.01
Calcium Oxide (CaO)	86.94
Magnesium Oxide (MgO)	0.04
Sulphur Trioxide (SO_3)	1.20
Potassium Oxide (K_2O)	0.72

E. Eggshell Powder

Eggshell waste evolves from poultry farms, restaurants, and hotels where eggs are consumed. Instead of damping, it can be used as supplementarymaterial in place of cement. Eggshells are rich in calcium and have the same limestone composition as cement. Eggshells were collected, cleaned, dried and then converted into fine powder to use as a supplementary material with cement. Eggshell powder passed through 90-micron sieve was used for cement replacement and the retained material was discarded

Table no. 2 Properties of ESP

Chemical Composition	Cement (%)	Eggshell Powder (%)
SiO2	21.8	0.09
Cao	60.1	52.1
Al2O3	6.7	0.04
Fe2O3	4.1	0.03
MgO	2.2	0.01
K_2O	0.4	-
Na_2O	0.4	0.15
SO3	2.2	0.62

F. Basalt Fiber

The basalt fiber that has been utilized in this exploration is appeared in Figure 3.6 and was bought online from site www.indiamart.com. The most extreme size of basalt fiber utilized in this exploration is 10mm.

The basalt fiber is an item that is extricated from the basalt rock, which is a characteristic stone found in the volcanic rocks which are additionally gotten from solidified magma. The volcanic rocks are difficult to the point that occasionally it has been utilized as a squashed stone in development stage. Since the stone is made from the solidified magma, it has best toughness, quality just as warm properties.

Table no. 3 Properties of BF

Properties	Values
Density (g/cm^3)	2.8
Elastic Modulus (GPa)	89
Tensile Strength (GPa)	2.8
Elongation at break (%)	3.15

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.

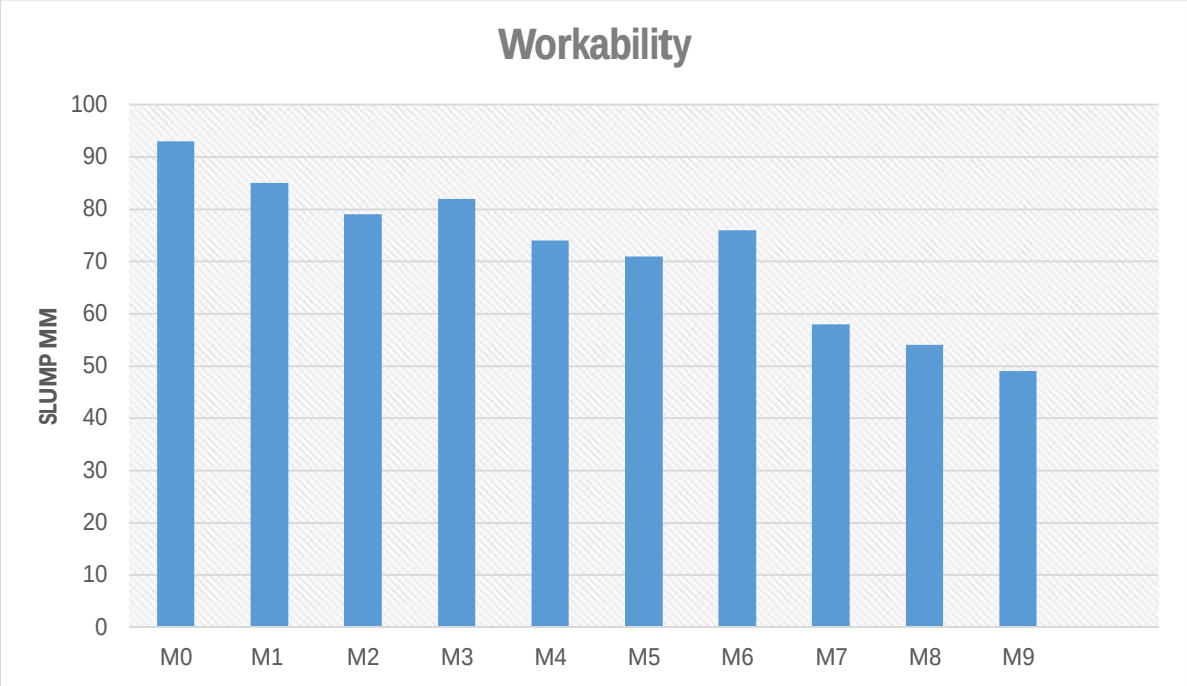

Fig -1: SLUMP CONE TEST

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.

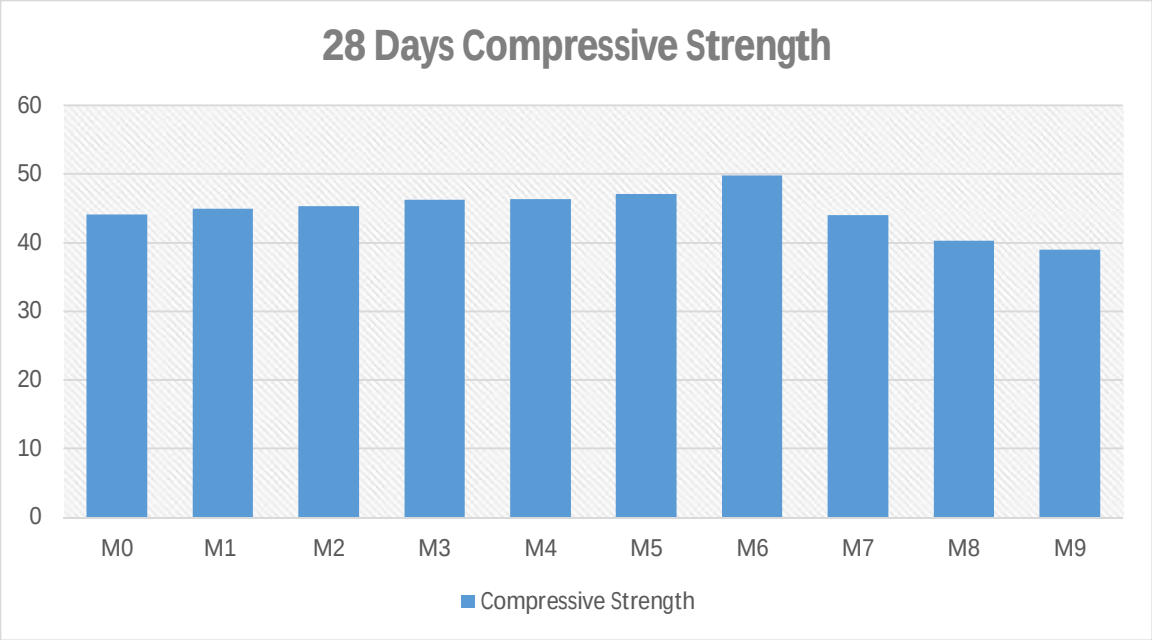

Fig -2: Compressive Strength Test 28

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.

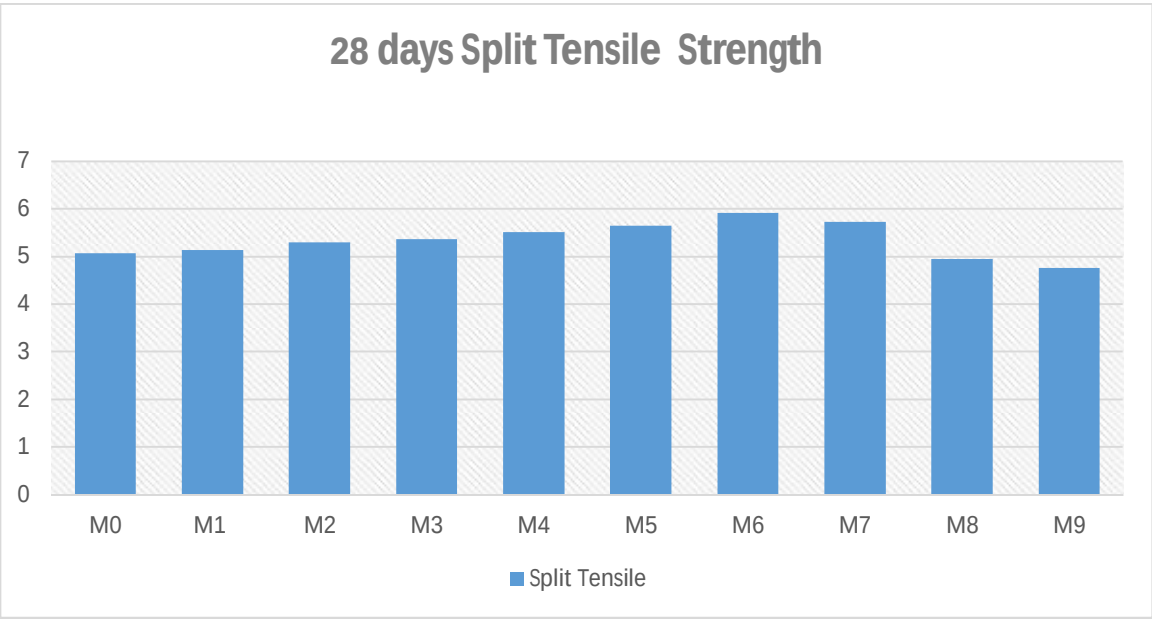

Fig -3: SPLIT TENSILE STRENGTH TEST 28

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.

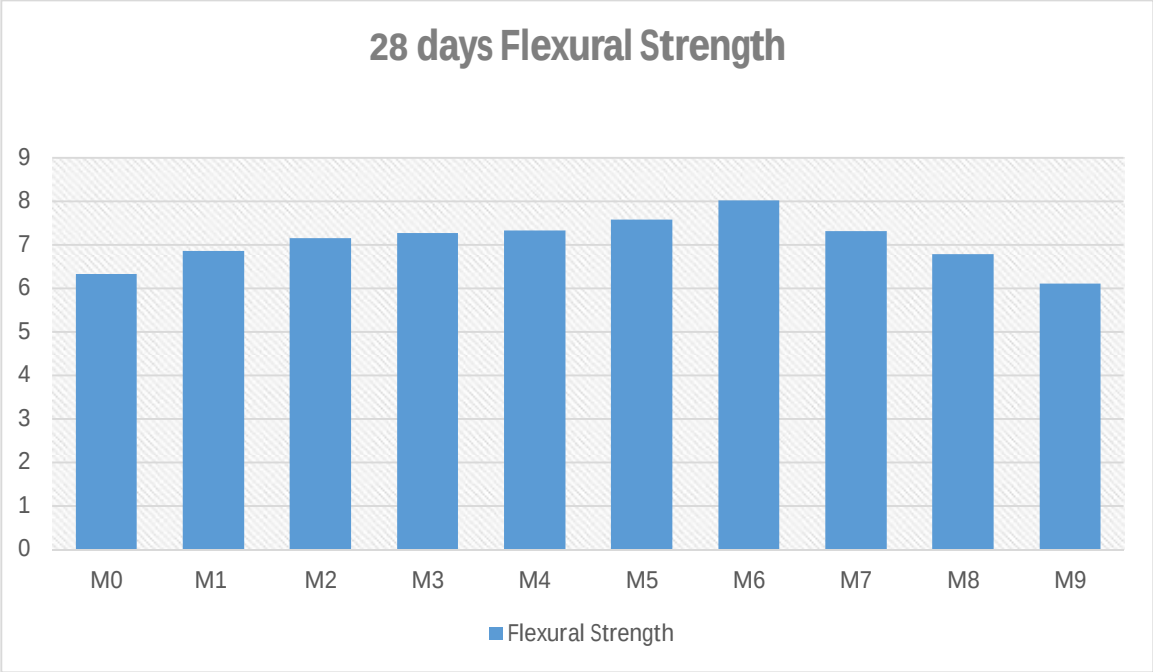

Fig -4: Flexural Strength Test 28

V. CONCLUSION

1) Basalt fibers acted as a reinforcement and hence acted as resistance to the cracks, thus increasing the flexural strength.

2) By replacing the cement with the Chalk Powder & Egg shell powder and addition with Basalt fibers strengths get increased, also the replacement can be taken into consideration up to certain percentage workability factors gets enhanced as well.

3) After 28 days of curing, maximum compressive strength obtained was 47.14 N/mm^2.

4) In case of compressive strength, the optimum percentage that was noticed, was at 8&8% of cement was Chalk Powder & Egg shell powder and for reinforcement 1.8% of basalt fiber was used.

5) The flexural strength of the concrete on comparing with conventional concrete gets increased till 8&8% of cement was Chalk Powder & Egg shell powder and for reinforcement 1.8% of basalt fiber was used.

6) After 28 days of curing, maximum flexural strength obtained was 6.81 N/mm^2.

7) After 28 days of curing, maximum tensile strength obtained was 5.03 N/mm^2.

8) In case of tensile strength, the optimum percentage that was noticed, was at 8&8% of cement was Chalk Powder & Egg shell powder and for reinforcement 1.8% of basalt fiber was used.

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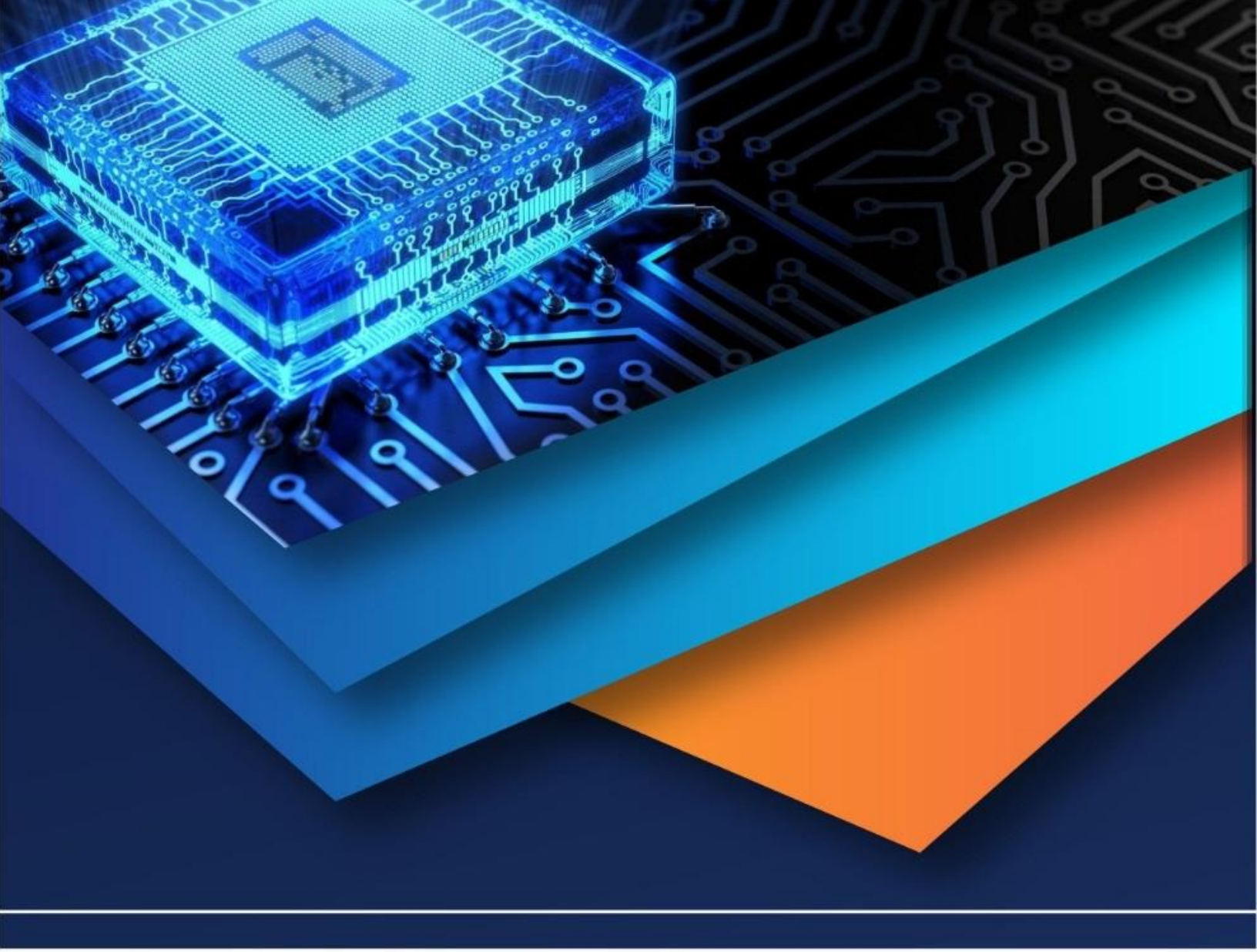

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