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Strength gain Analysis of high volume fly ash concrete using stone dust and recycled aggregates

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Abstract: ***The addition of fly ash to concrete enhances the mechanical properties of fly ash. The addition of fly ash not only lowers the cost of concrete production but also gives it a sustainable approach. The study undertakes the analysis of high volume fly ash concrete specimen. In addition to high volume fly ash content stone dust and recycled aggregates were also varied at the concentration of 5%, 10% and 15%. The concrete specimens were tested at 3 days, 7 days and 28 days after the curing of concrete specimen under controlled laboratory condition. The testing was done to determine the compressive strength of concrete. The study concluded that addition of fly ash at high volumes accelerates the rate of gain of strength of concrete.***
Keywords: Fly ash, mechanical properties, compressive strength, rate of gain of strength

I. INTRODUCTION

Fly ash is the waste product generated from thermal power plants which are the source of energy of day to day life. The stoned dust is the resultant of demolition of old and deteriorated buildings and traffic infrastructure, and their substitution with new ones. The main reasons for this situation are changes of purpose, structural deterioration, rearrangement of a city, expansion of traffic directions and increasing traffic load, natural disasters (earthquake, fire and flood), *etc*. For example, about 850 million tons of construction and demolition waste are generated in the EU per year, which represent 31% of the total waste generation. In the USA, the construction waste produced from building demolition alone is estimated to be 123 million tons per year. The most common method of managing this material has been through its disposal in landfills. In this way, huge deposits of construction waste are created, consequently becoming a special problem of human environment pollution. For this reason, in developed countries, laws have been brought into practice to restrict this waste: in the form of prohibitions or special taxes existing for creating waste areas. The research has been around to enhance the concrete properties by infusion of cheap materials like fibre, fly ash, stone dust without compromising the strength of concrete. [Roohul et. al., Saman et. al]

II. MATERIALS

A. Cement

In the present study, 53 grade Ordinary Portland Cement (OPC) of a single batch was used throughout the investigation. The physical and chemical properties of OPC as determined are given in table 1. The cement satisfies the requirement of IS: 12269-1987.

B. Fine aggregate

The fine aggregate used was locally available river sand, which was passed through 4.75 mm. The specific gravity of fine aggregate is 2.74 and fineness modulus is 2.87.

C. Coarse aggregate

Two aggregate sizes (20 and 10 mm) were used in this investigation. The specific gravity of coarse aggregate was 2.76 for both the fractions. The 20 and 10 mm aggregate were mixed in the ratio of 60:40.

D. Stone dust

Stone dust was obtained from local stone crushing units of Uttar Pradesh. It was initially dry in condition when collected and was sieved before mixing in concrete. Specific gravity of stone dust was 2.50 and water absorption was 0.5%.

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III. METHODS AND METHODOLOGY

An experimental investigation was conducted on HVFAC to get the strength of specimens (cubes) made with the use of stone dust and recycled aggregates as partial replacement of fine aggregates and coarse aggregates respectively. The strength of conventional concrete and other mixes were determined at the end of 7 and 28 days of water curing. To study the effect of stone dust and recycled aggregates inclusions, cubes of a design mix M25 grade concrete were cast. The 150 mm cubes were tested for compressive strength. The M25 mix proportion was (1:1.56:2.91) at w/c ratio of 0.40.

IV. RESULT AND DISCUSSION

The concrete specimens were tested for the compressive strength. The compressive strength was determined at 3 days, 7 days and 28 days after curing. The results were obtained and plotted together for analysis and comparison. The figure 1-4 represent the strength gain analysis of HYFAC with stone dust. The figure 1 represents HVFAC with 0% stone dust and serves as control specimen to distinguish the strength gain by fly ash or stone dust.

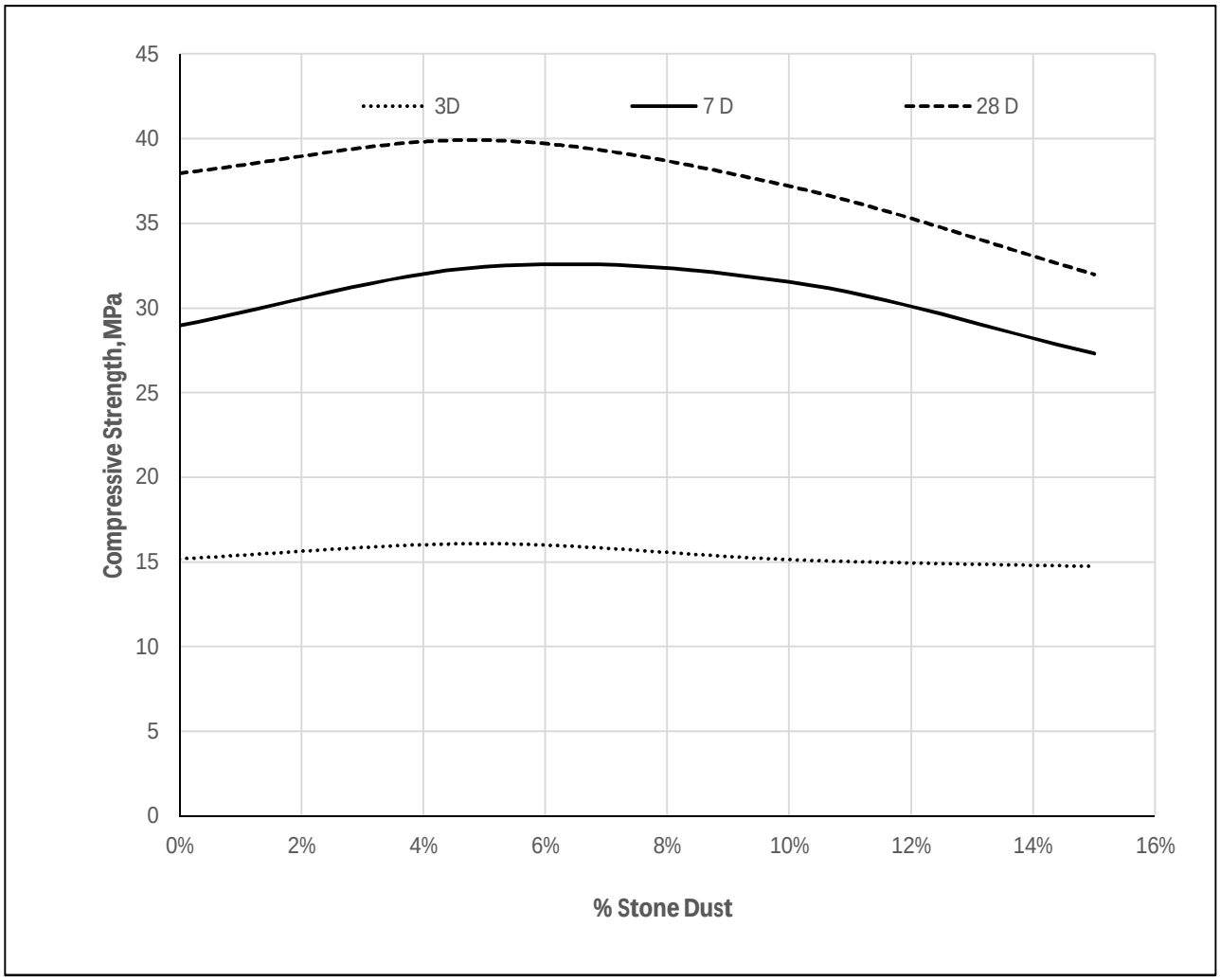

Figure 1 Compressive Strength of high volume fly ash concrete with 0% recycled aggregates

The Figure 1 represents the Compressive strength of high volume fly ash concrete. The concrete specimens were tested at 3days, 7 days and 28 days to analyse the rate of gain of strength. At 3 days the rate of gain of strength was 61%, 65%, 61% and 59% for the design mix of M25 for 0%, 5%, 10% and 15% stone dust respectively. At 7 days the rate of gain of strength was 115%, 130 %, 126% and 9% for the design mix of M25 for 0%, 5%, 10% and 15% stone dust respectively. At 28 days the rate of gain of strength was 152%, 159%, 148% and 128% for the design mix of M25 for 0%, 5%, 10% and 15% stone dust respectively.

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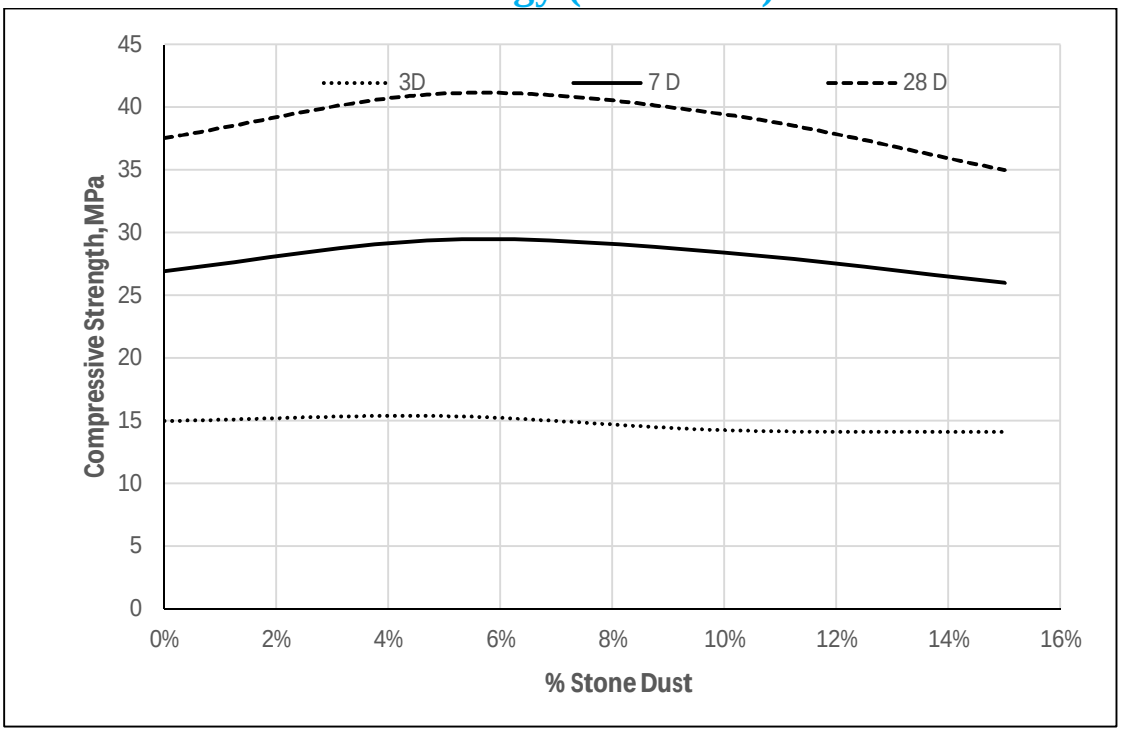

Figure 2 Compressive Strength of high volume fly ash concrete with 5% recycled aggregates

The Figure 2 represents the Compressive strength of high volume fly ash concrete with 5% stone dust. The concrete specimens were tested at 3 days, 7 days and 28 days to analyse the rate of gain of strength. At 3 days the rate of gain of strength was 60%, 62%, 57% and 56% for the design mix of M25 for 0%, 5%, 10% and 15% stone dust respectively. At 7 days the rate of gain of strength was 107%, 117 %, 113% and 104% for the design mix of M25 for 0%, 5%, 10% and 15% stone dust respectively. At 28 days the rate of gain of strength was 150%, 164%, 157% and 156% for the design mix of M25 for 0%, 5%, 10% and 15% stone dust respectively.

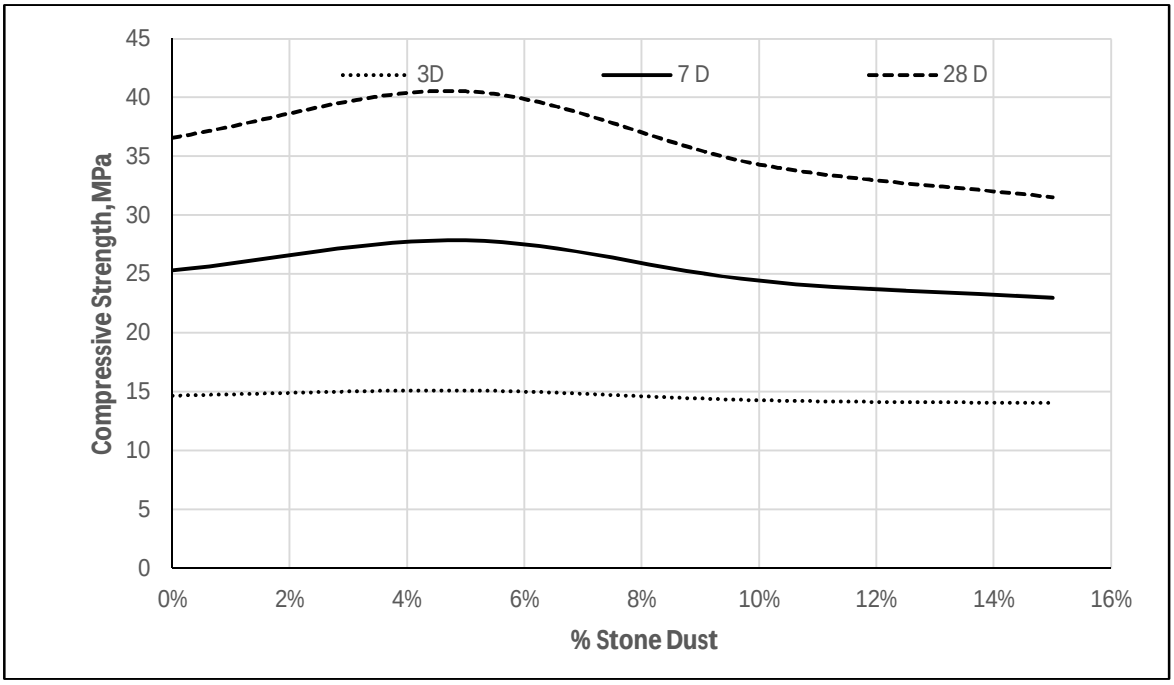

Figure 3 Compressive Strength of high volume fly ash concrete with 10% recycled aggregates

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The Figure 3 represents the Compressive strength of high volume fly ash concrete with 10% stone dust. The concrete specimens were tested at 3 days, 7 days and 28 days to analyse the rate of gain of strength. At 3 days the rate of gain of strength was 59%, 61%, 57% and 56% for the design mix of M25 for 0%, 5%, 10% and 15% stone dust respectively. At 7 days the rate of gain of strength was 101%, 112 %, 98% and 92% for the design mix of M25 for 0%, 5%, 10% and 15% stone dust respectively. At 28 days the rate of gain of strength was 146%, 162%, 137% and 126% for the design mix of M25 for 0%, 5%, 10% and 15% stone dust respectively.

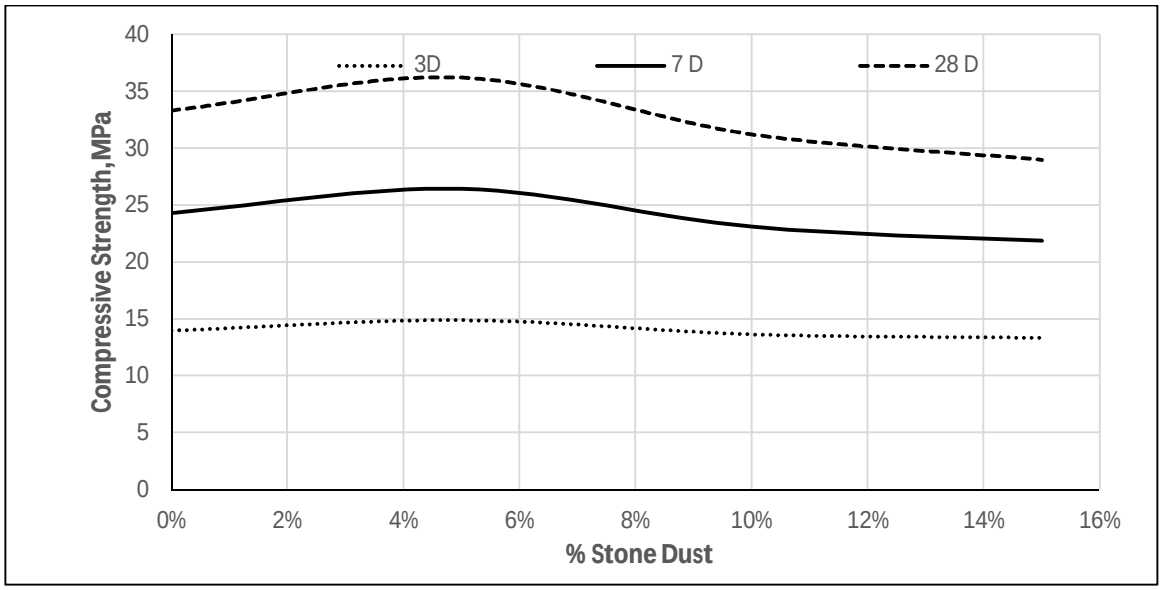

Figure 4 Compressive Strength of high volume fly ash concrete with 15% recycled aggregates

The Figure 4 represents the Compressive strength of high volume fly ash concrete with 15% stone dust. The concrete specimens were tested at 3 days, 7 days and 28 days to analyse the rate of gain of strength. At 3 days the rate of gain of strength was 56%, 60%, 55% and 53% for the design mix of M25 for 0%, 5%, 10% and 15% stone dust respectively. At 7 days the rate of gain of strength was 98%, 105 %, 92% and 87% for the design mix of M25 for 0%, 5%, 10% and 15% stone dust respectively. At 28 days the rate of gain of strength was 133%, 144%, 125% and 116% for the design mix of M25 for 0%, 5%, 10% and 15% stone dust respectively.

V. CONCLUSION

Strength gain analysis accelerates with addition of fly ash at 40% in HVFAC. And was about 150% at 0% stoned dust. It can be concluded that even without adding stone dust rate of gain of strength can be accelerated by addition of fly ash in high volumetric concentrations.

When stone dust is incorporated at the rate of 5%, 10% and 15% to replace natural aggregates. The rate of gain of strength was maximum at 5% to achieve 159% of original design mix. Though other variations of 10% and 15% also achieve higher gain of strength than conventional concrete but they could not surpass the gain of strength of the control specimen with fly ash content of 40%. Hence the optimum dosage of stone dust with HVFAC at 40% fly ash will 5%.

Analysing the effect of recycled stone aggregates into concrete along with stone dust at 5%. The optimum dosage to accelerate the rate of gain of strength 5% of stone dust and 5% of recycled aggregates. For all the cases of recycled aggregates the optimum dosage was 5% as the rate of gain of strength at other recycled aggregates as they cannot surpass the stone dust rate of gain of strength.

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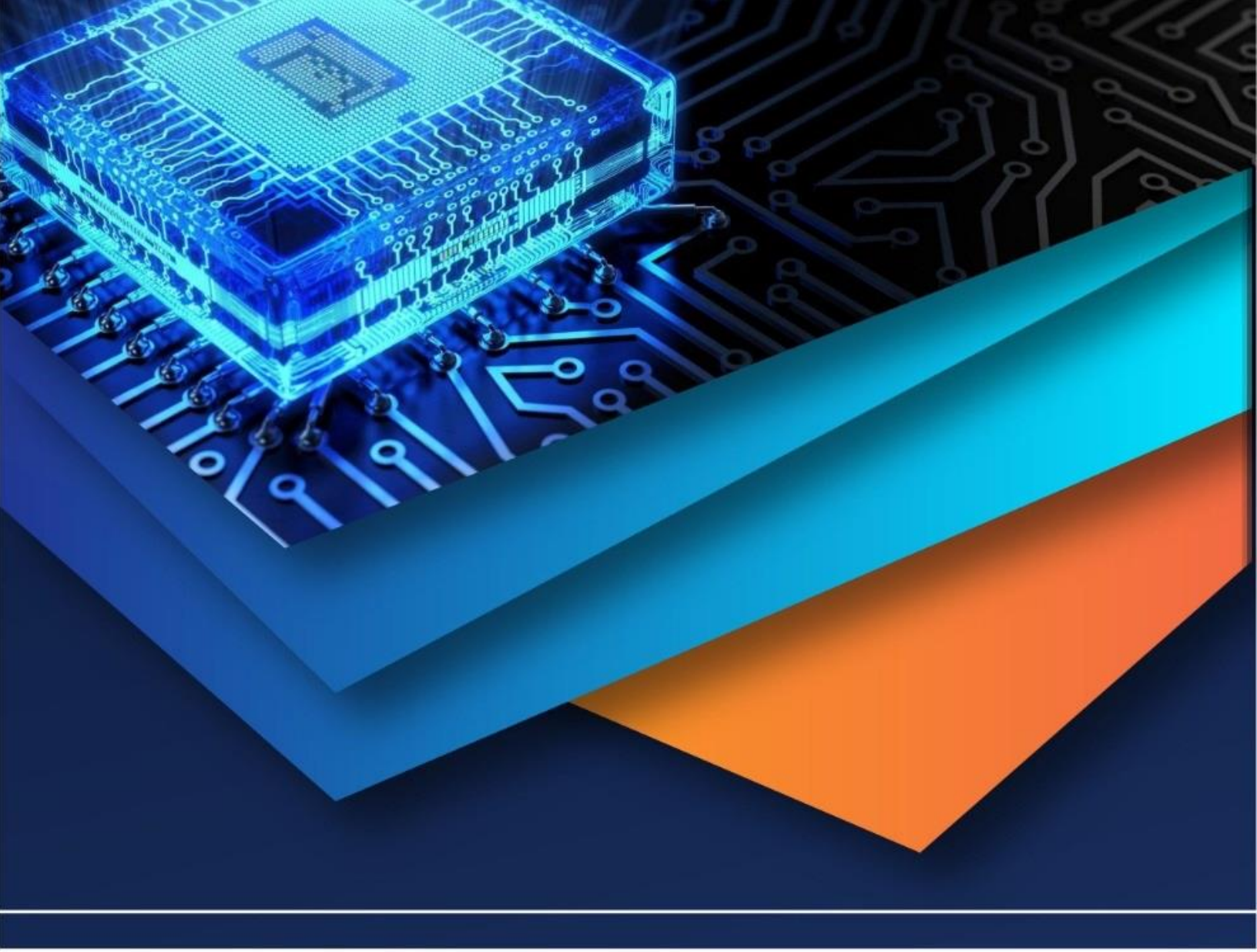

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