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Self-Compacted Concrete by Partial Replacement of Fine Aggregate with Foundry Sand

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Abstract: ***The objective of this experiment is to find the chemical properties of foundry sand and to find the optimum replacement of foundry sand as a fine aggregate in the following ratios of 0%, 10%, 20%, 30%, 40%. Also super plasticizer is added for self-compaction. Finally, the strength characteristics of concrete casted in foundry sand are being found. The study focuses on providing strength as equal as conventional concrete. Experiment leads to the study of strength parameters in the form of beam.***
Keywords: Compressive strength, concrete and shrinkage

I. INTRODUCTION

Self-compacting concrete, as the name indicates, is a type of concrete that does not require external or internal vibration for placing and compaction but it gets compacted under its self-weight. It is able to flow under its own weight, completely filling formwork and achieving full compaction, even in the presence of congested reinforcement. At the same time it is cohesive enough to fill spaces of almost any size and shape without segregation or bleeding. This makes SCC particularly useful wherever placing is difficult, such as in heavily reinforced concrete members or in complicated formwork. SCC was first developed in Japan to achieve durable concrete structures in 1980's. Foundry sand is high quality silica sand used as a moulding material by ferrous and non-ferrous metal casting industries. It can be reused several times in foundries but, after a certain period, cannot be used further and becomes waste material, referred to as used or spent foundry sand (UFS or SFS). The majority of spent moulding sands are classified as nonhazardous waste

II. REVIEW OF LITERATURE

Sahmaran et al. [6] concluded that in all curing ages, the compressive strength of the control mixtures with 0% SFS was higher than the one containing SFS. This holds true even at 100% SFS replacement level. Although SFS and FA reduce the strengths, it is still possible to produce SCC with compressive strengths around 40 MPa at 28 days and 50 MPa at 90 days by using both SFS and FA.
Strengths over 40 MPa can be reached even at 100% SFS replacement. Guney et al. [7] examined the influence of inclusion of WFS as partial replacement of fine aggregates on the compressive strength of concrete up to the age of 56 days. Fine aggregates were partially replaced with 0, 5, 10 and 15% WFS. It was observed that the concrete with 10% waste foundry sand replacement exhibited highest compressive strength at the age of 56 days. Compressive strength decreased with an increasing amount of foundry sand.
Siddique et al. [3] studied the properties of concrete mixtures in which fine aggregate (regular sand) was partially replaced with used-foundry sand (UFS). The concrete with 10% waste foundry replacement may indicate the optimum reallocation amount of waste foundry sand. This may indicate that the particle size distribution of the mixture with 10% waste foundry sand has sufficient adherence than the other mixtures with waste foundry sand.

III. METHODOLOGY

A. Cement

The choice of the type of cement and its substance depend on strength. In present study Ordinary Portland bond of BIRLA 43 Grade conforming it with IS 8112-1989 is used. The specific gravity was observed to be 3.15.

B. Water

Versatile water was utilized as a part of present investigation for both casting and curing.

C. Fine Aggregate

The sand used for the investigative work was locally procured and conformed to with Indian Standard Specifications IS: 383-1970. The sand was first sieved through 4.75 mm strainer to remove any particles more prominent than 4.75 mm and afterwards washed to expel the dust. The fine aggregate belonged to grading zone III. The specific gravity was observed to be 2.6.

D. Coarse Aggregate

The material which is held on IS sieve no. 4.75 is named as a coarse aggregate. The crushed stone is generally used as a coarse aggregate. The way of work chooses the most maximum size of the coarse total. Locally accessible coarse aggregate having the maximum size of 10-12.5 mm was utilized as a part of our work. The aggregates were washed to remove dust and mud be dried to surface dry condition. The aggregates were tested according IS: 383-1970. The specific gravity was observed to be 2.74.

E. Foundry Sand

Foundry sand is a byproduct of ferrous and non-ferrous metal casting industries. Foundries effectively reuse the sand many times in the foundry. At the point When the sand can no longer be reused in the foundry, it is expelled from the foundry and is named as utilized foundry sand.

F. Super Plasticizer

Chemical admixture CONPLAST SP 430 is used. CONPLAST SP 430 depends on sulphonated naphthalene polymers and provided as a brown colored fluid in a flash dispersible in water. Conforming in with IS 9103 -(1999). This caries from 0.84%.

IV. RESULTS

From the experiment carried out on M30 grade of self compacting concrete with foundry sand following results are obtained:

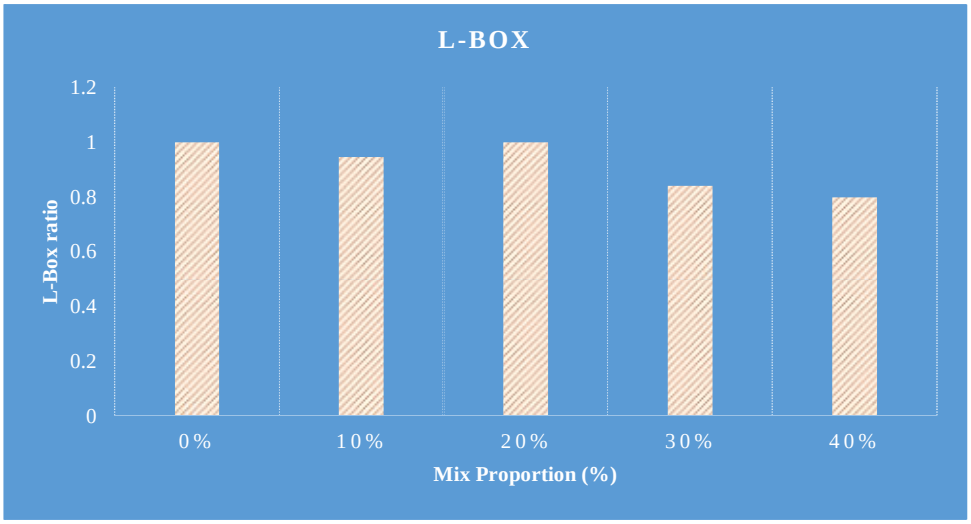

Figure 1: L-Box test for Self compacted concrete

From the above figure it is observed that for L-box test the mix proportion upto 20% is optimum as compared to other proportions.

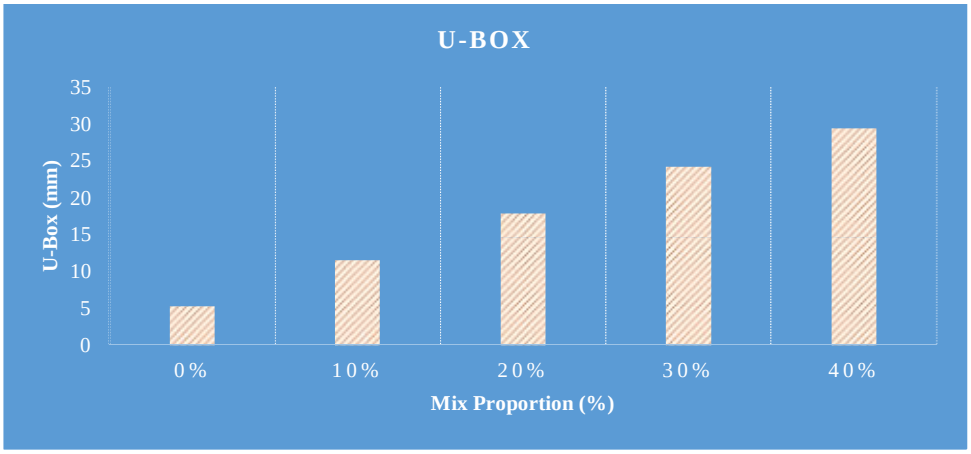

Figure 2: U-Box test for Self compacted concrete

From the above figure it is observed that for U-box test the mix proportion upto 20% is optimum as compared to other proportions.

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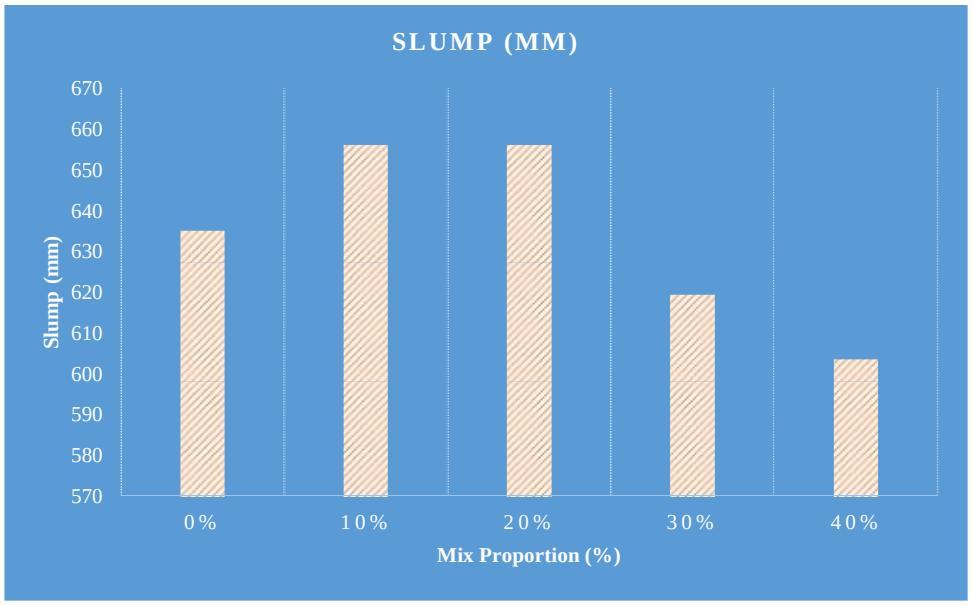

Figure 3: Slump test for Self compacted concrete

From the above figure it is observed that for slump test the mix proportion upto 20% is optimum as compared to other proportions.

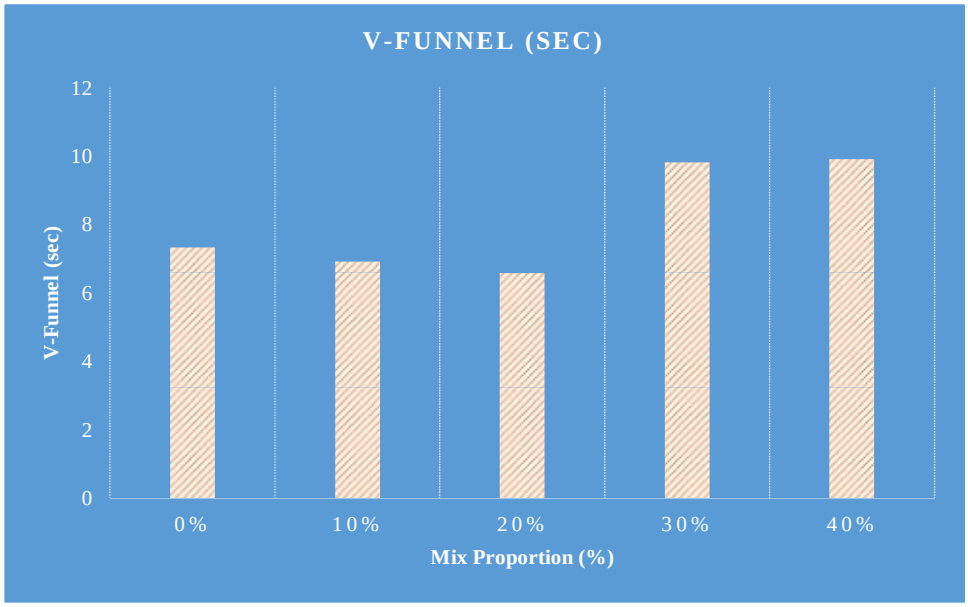

Figure 4: V-funnel test for Self compacted concrete

From the above figure it is observed that for V-funnel test the mix proportion upto 20% is optimum as compared to other proportions.

Table 1: Compressive strength (MPa) for Self compacting concrete with foundry sand

Mix	Compressive strength (Mpa)		
%	7 days	14 days	28 days
0%	29.40	32.55	36.75
10%	32.34	35.81	40.43
20%	35.57	39.39	44.47
30%	32.02	35.45	40.02
40%	28.81	31.90	36.02

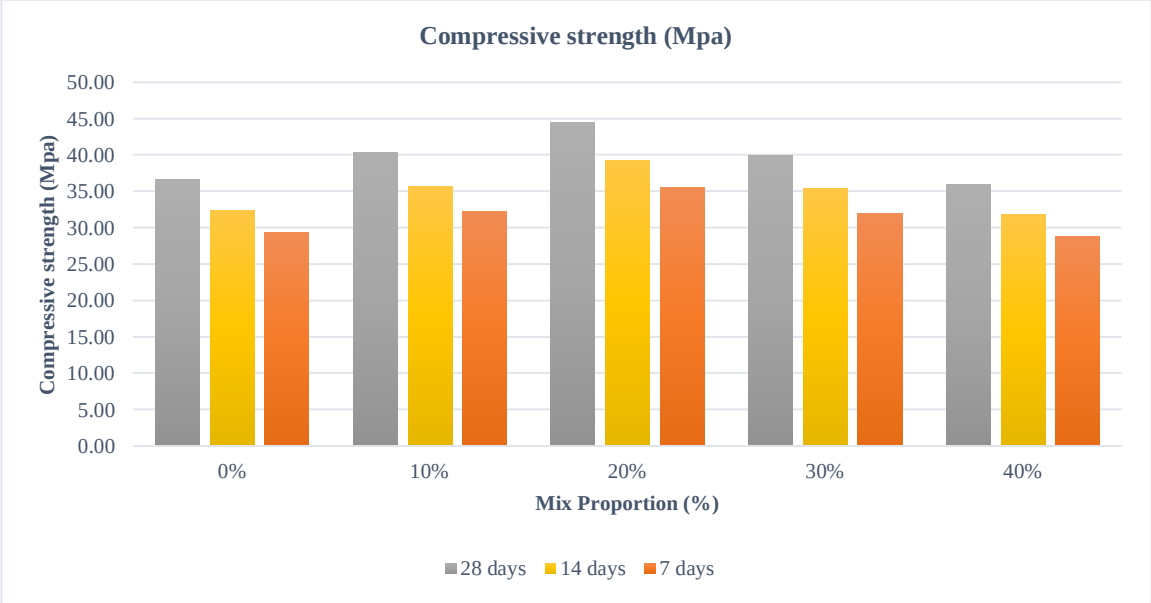

Figure 5: Compressive strength (MPa) for Self compacting concrete with foundry sand

From the above figure it is observed that the compressive strength (MPa) for self compacting concrete with foundry sand is maximum in the case of the 20% mix proportion with the highest value of 44.47 MPa and then it goes on decreasing.

Table 2: Split tensile strength (MPa) for Self compacting concrete with foundry sand

Mix	Split tensilee strength (Mpa)		
%	7 days	14 days	28 days
0%	2.21	2.36	2.89
10%	2.47	2.65	3.23
20%	2.77	2.96	3.62
30%	2.49	2.67	3.26
40%	2.24	2.40	2.93

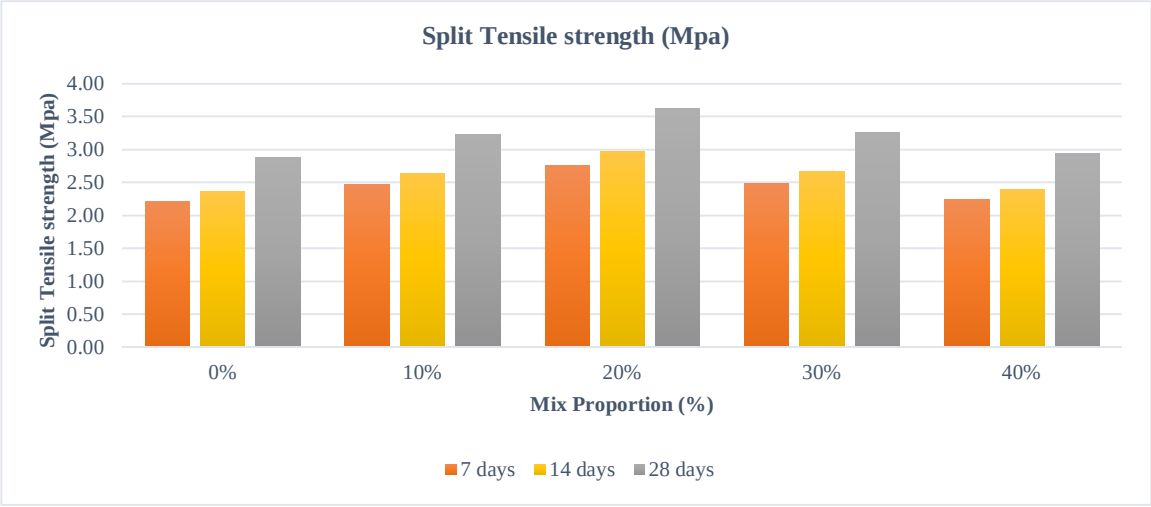

Figure 5: Split tensile strength (MPa) for Self compacting concrete with foundry sand

From the above figure it is observed that the Split tensile strength (MPa) for self compacting concrete with foundry sand is maximum in the case of the 20% mix proportion with the highest value of 3.62 MPa and then it goes on decreasing.

Table 3: Flexural strength (MPa) for Self compacting concrete with foundry sand

Mix	Flexural strength (Mpa)		
%	7 days	14 days	28 days
0%	2.56	2.69	2.82
10%	2.95	3.10	3.25
20%	2.39	2.51	2.63
30%	2.45	2.57	2.70
40%	2.56	2.69	2.82

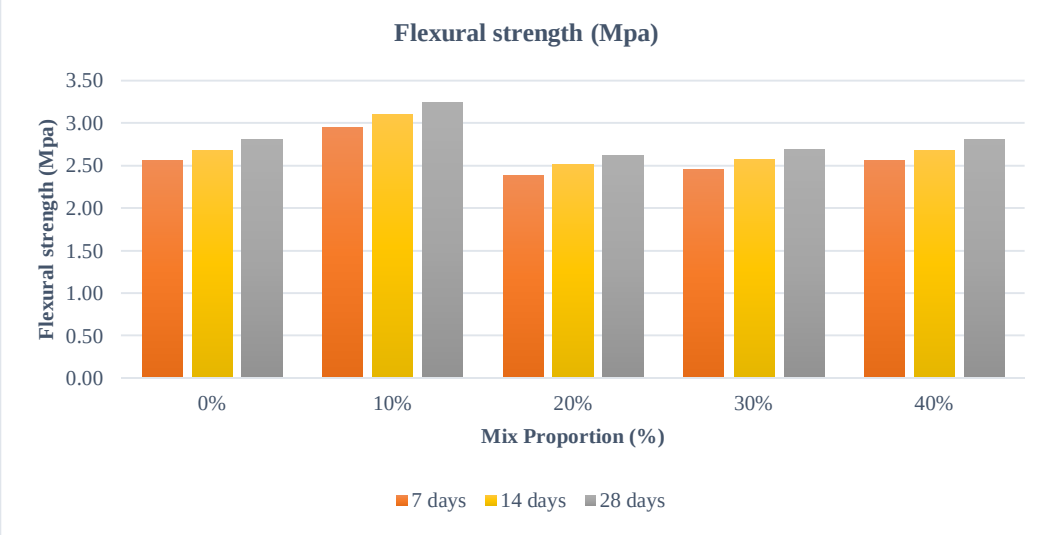

Figure 6: Flexural strength (MPa) for Self compacting concrete with foundry sand

From the above figure it is observed that the Flexural strength (MPa) for self compacting concrete with foundry sand is maximum in the case of the 10% mix proportion with the highest value of 3.25 MPa and then it goes on decreasing.

V. CONCLUSION

The conclusions from the above study are as follows:

A. The From the above results it is observed that the compressive strength (MPa) for self compacting concrete with foundry sand is maximum in the case of the 20% mix proportion with the highest value of 45 MPa and then it goes on decreasing.
B. From the above results it is observed that the Split tensile strength (MPa) for self compacting concrete with foundry sand is maximum in the case of the 20% mix proportion with the highest value of 3.62 MPa and then it goes on decreasing.
C. From the above results it is observed that the Flexural strength (MPa) for self compacting concrete with foundry sand is maximum in the case of the 10% mix proportion with the highest value of 3.25 MPa and then it goes on decreasing.
D. The foundry sand found suitable upto 20% maximum percentage replacement of natural sand in self compacting concrete.
E. The self compacting concrete with foundry sand found to be suitable and gives good results.

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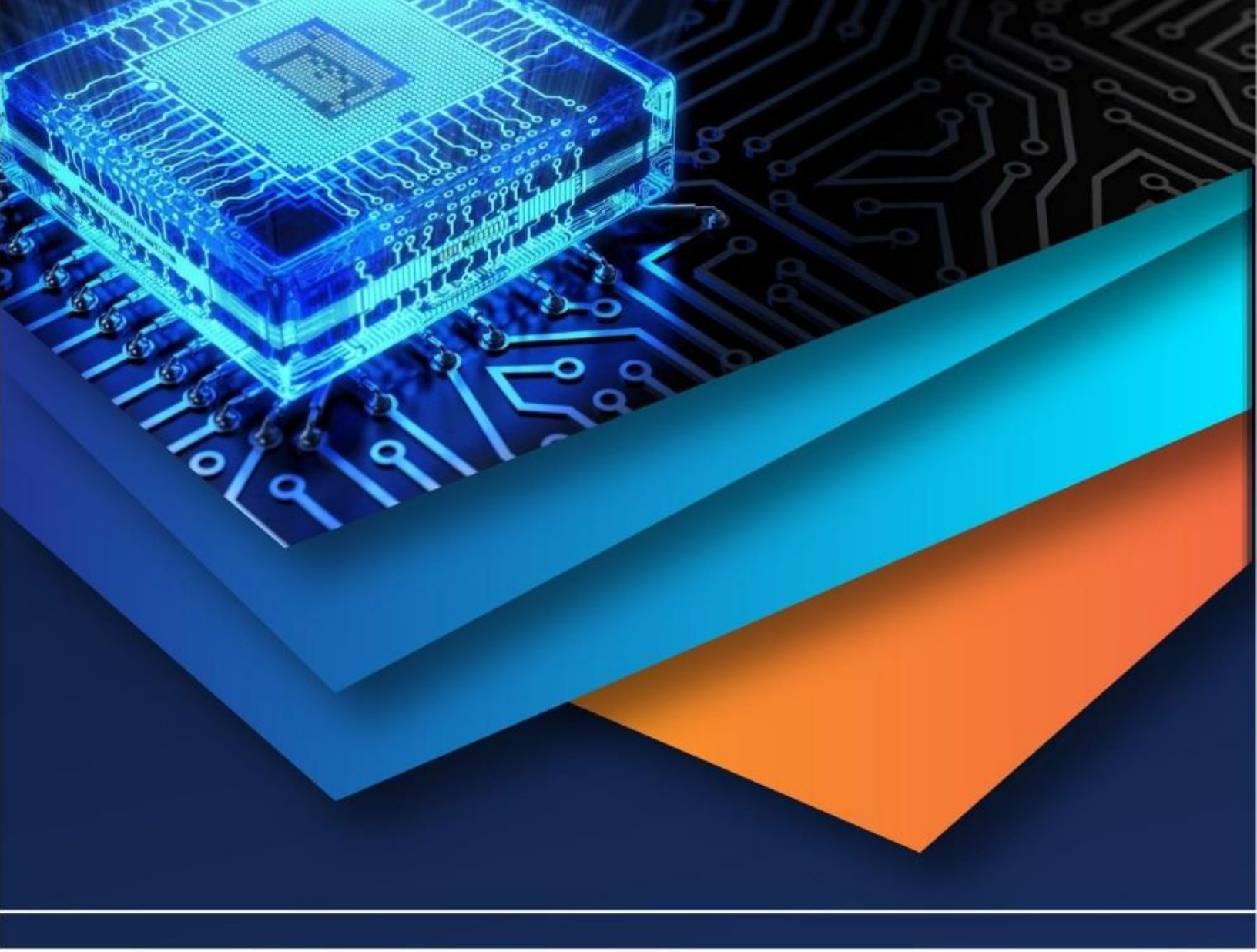

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