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A Comparative Study of Micro Silica Based Concrete using IS Method and DEO Method

Kavita[1], Dr. Praveen Barwal[2]
[1, 2]*Civil Engineering Department, BRCM College MDU University*

Abstract: ***High performance concrete – concrete mixture possess high strength and durability as compare to conventional concrete. HPC contains one or more cementitious materials such as fly ash, micro silica or ground granulated blast furnance slag and a super plasticizer. It would be difficult to produce high –strength concrete mixtures without using chemical admixture. The super plasticizer gives the concrete adequate workability at low water- cement ratio, leading to concrete with greater strength. These admixtures can be used to a limit at which these gives max strength, beyond that limit strength is decrease. In the present experiment work is done on replacement of cement with micro silica as 0%, 7.5% and 10% with addition of super plasticizer. M50 grade of concrete is used for experiment work.***
Two method of design is used-
INDIAN STANDARD method (IS 10262:2009)
DEPARTMENT OF ENVIRONMRNT method (British method)
Comparison of these two methods is carried out for compressive strength of concrete for 7days and 28days. Also comparison of consistency and setting time of cement (OPC 43) with 0%, 7.5% and 10% replacement with micro silica is carried out.
7 days compressive strength with 10% replacement of cement by micro silica show max strength for both IS method and DOE method Compressive strength increases 9.787% as per IS method and 7.540 % as per DOE method.
For 28 days 7.5% replacement increases 7.587% compressive strength as per IS method and 7.598% as per DEO method
For 28 days DOE method gives 1.657% more strength than IS method but the cost of DEO method is more so we can say that IS method is more economical than DEO method.
Keywords: Micro silica, compressive strength, IS method and DOE method

I. INTRODUCTION

Concrete is widely used construction material than any other types of material available because concrete have high strength, durability and can be manufactured at site in any desired shape and size. Concrete can be used in any environment condition like polluted, industrial and aggressive. Different type of material is used in the design of concrete. High performance concrete is designed by using admixtures in concrete like fly ash, micro silica and rice husk. HPC having following advantage as compare to conventional concrete-

1) Ease of placement
2) Compaction without segregation, long life in severe environments.
3) Long term mechanical properties with early age strength
4) High strength with high durability.

M S SHETTY defines the HPC as it is a concrete which possess high workability, high strength .high density, low permeability and resistance to chemical attack. AS defined by M.S.shetty Mix Design is the process of selection of suitable material and suitable amount of each material to produce concrete of minimum required strength, workability and durability in economical way.

A. Design Mixes

M.S. Shetty describes various design codes, these are as follow:

1) Maximum Density Method
2) Fineness Modulus Method
3) High strength concrete mix design
4) ACI committee 211 method
5) DEO method
6) Indian Standard Recommended Method IS 10262:2009

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II. PROPOSED METHOD

In our study we used two method IS 10262; 2009 and DOE method

1) IS 10262:2009- Step to be followed in this mix design is as follow:
a) Find the target mean strength of concrete
b) Determine the water/binder ratio
c) Determine binder (cement, micro silica) content from IS 456:2000
d) Determine of desirable contents of super plasticizer
e) Determine the proportion of coarse and fine aggregates
2) DOE method(British method) -Step to be followed in this mix design is as follow:
a) Find the target mean strength of concrete
b) Determine the water/binder ratio from curved or SP 23 CODE
c) Get the value of cement
d) Determine the value of wet density
e) Determine quantity of super plasticizer
f) Determine the value of total aggregate required and value of fine and coarse aggregates

A. AIM of Present Study

In present study we work on comparison of micro silica based HPC using IS and DOE method.
In our comparative study we use micro silica and super plasticizer as admixture
M50 grade of concrete is designed with partial replacement of cement with micro silica as 0% , 7.5% and 10% and compressive strength of concrete is compared by IS method and DOE method.
Material used

1) *Cement:* Ordinary Portland cement (ULTRATECH cement) is use for this experiment work. Test to be carried out before work is specific gravity, fineness of cement and consistency as 3.15, 2.01% and 27.5(0%)

Fig-1-Weighing of OPC

2) *Fine Aggregates:* fine aggregate of Zone II as per IS 383:1963 with Specific gravity, fineness modulus and water absorption, 2.80, 2.81 and 1.2% respectively.

Fig2- weighing of fine aggregates

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3) *Coarse Aggregates:* Two type of aggregates is used of 20mm and 10mm size in present study. For IS method 65% and 35% ratio of 20mm and 10mm is used and 55% and 45% in DEO method. Specific gravity, fineness modulus and water absorption of 20mm is 2.88, 6.89 and 0.40% respectively and for 10mm is 2.88 ,6.88 and 0.50% respectively.

Fig3- Coarse Aggregates

4) *Water:* Potable water free from impurities is used for mixing of concrete and also for curing of specimen.
5) *Micro Silica:* Micro silica for this work is obtained from PRECISION DRAWELL PVT LTD. NAGPUR (MH). It is of gray colour and specific gravity 2.2 with 0%, 7.5% and 10% by weight of cement.
6) *Super Plasticizer:* Used as a chemical admixture BASF MASTER POLYHEED 8100M, light brown in colour.

III.RESULT

Experimental work is investigated on M50 grade concrete by designing of two method IS method and DEO method .All material used for both method are same. Partial replacement of 0%, 7.5% and 10% of cement with micro silica by weight , Super plasticizer by weight of cement 2.0% is used for workability of concrete.

MIX PROPORTION OF BOTH METHOD ARE SHOWN IN TABLE 1.

S no	Material	Mix proportion	
		IS method	DEO method
1	Cement	1	1
2	Fine aggregates	1.54	1.24
3	Coarse aggregates	2.19	2.03
4	Water	0.34	0.41
5	MS	0%, 7.5% and 10% by weight of cement	
6	SP	2% by weight of cementitious content	

A. Quantity of Materials in Both Methods

TABLE 2 QUANTITY OF MATERIAL REQUIRED IN IS METHOD AND DEO METHOD

S no	Materials	Quantity	
		IS method	DOE method
1	Cement	500	545
2	Fine aggregates	772.632	677.31
3	Coarse aggregates	1097.45	1109.79
4	Water	170	225
5	MS	0%, 7.5%,10% by weight of cement	
6	SP	2% by weight of cementitious cement	

Accurate weighing of material for all trial is done as requirement of batches. Drum type mixer is used for mixing of material .150mmx150mmx150mmcat iron and oil coated insides is used for cube specimen. Cubes are demoulded after 24 hours and placed in curing tank. 7days and 28 days strength is tested on compression testing machine of 2000KN. Average of 3 cubes is taken as final reading for that mix comparison of two methods.

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Fig4-Compression testing machine

B. Result of compressive Strength

S NO	Method	7days compressive strength (N/mm²)			28days compressive strength (N/mm²)		
		0%	7.5%	10%	0%	7.5%	10%
1	IS method	42.40	45.50	46.55	57.20	61.54	58.09
2	DEO method	43.50	45.92	46.78	58.14	62.56	60.21

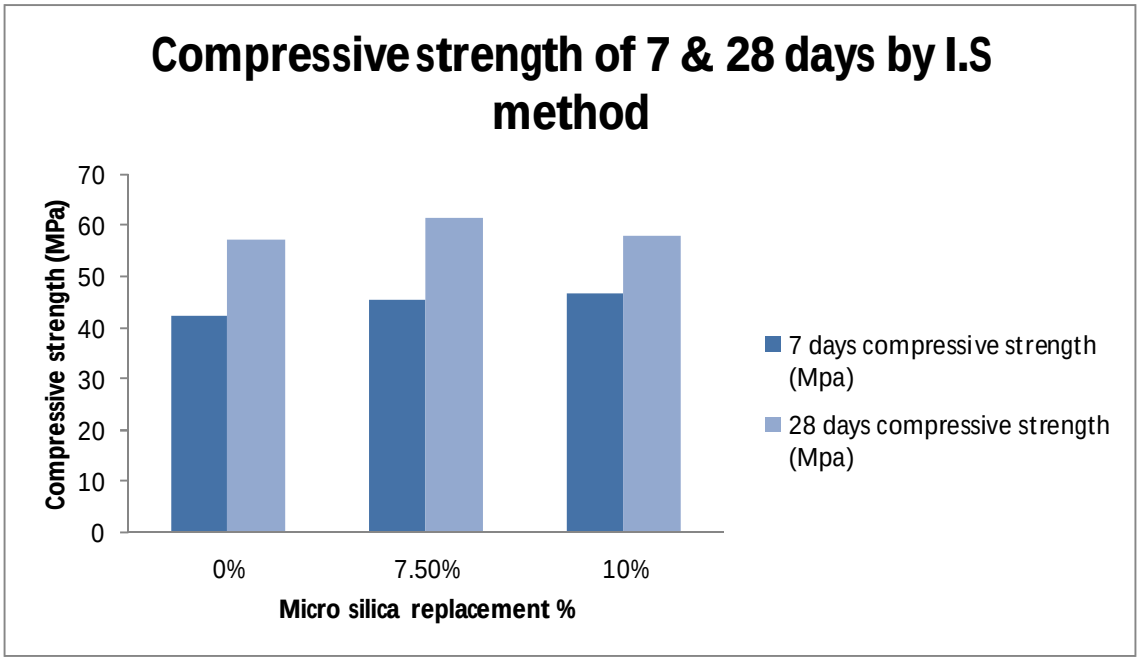

Fig5- Compressive strength of 7and 28days by IS method

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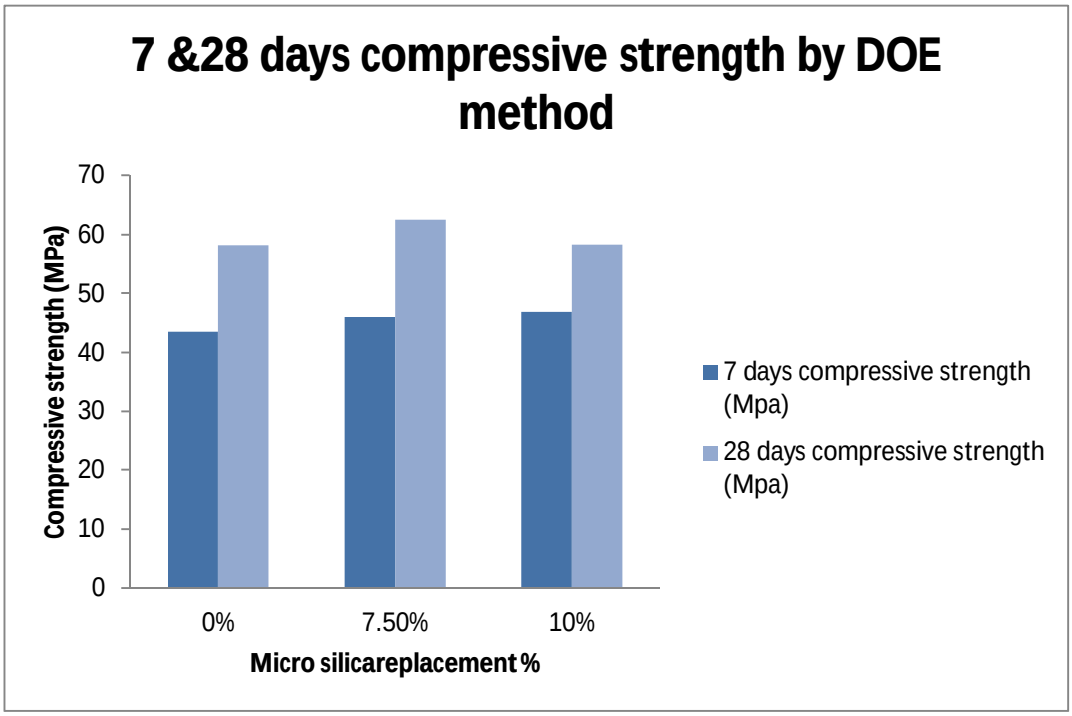

Fig6- compressive strength of 7and 28 days by DEO method

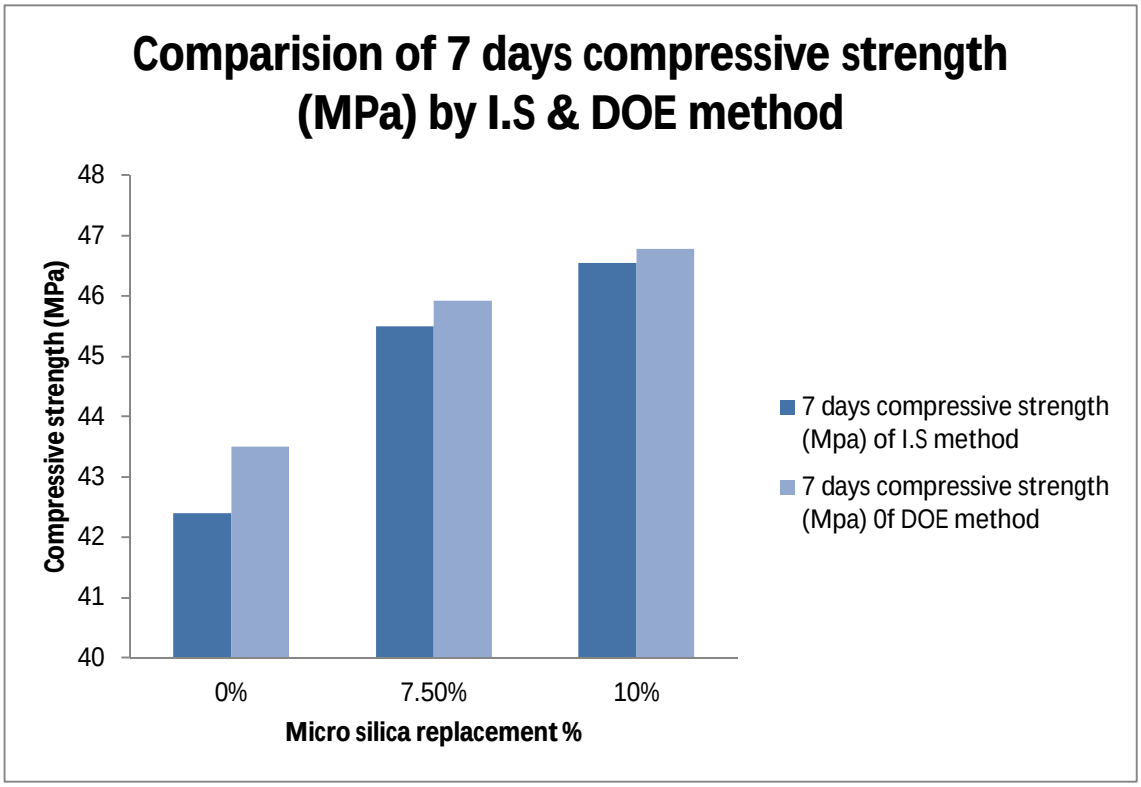

Fig7- Comparison of 7days compressive strength by I.S and DEO method

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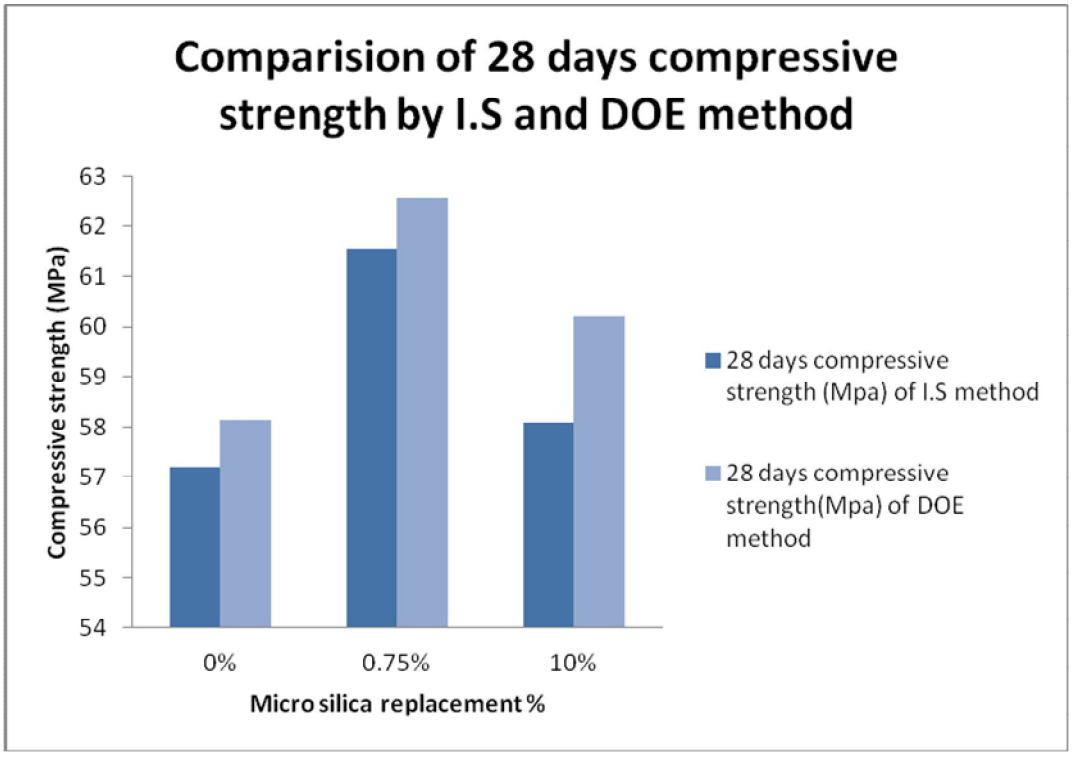

Fig8- Comparison of 7days compressive strength by I.S and DEO method

IV. CONCLUSION

Micro silica replacement is used now a day which is a waste product and used in place of cement. It has cementitious properties and hundred times finer than cement. Micro silica particle fill the void of cement and make it less permeable than conventional concrete. Due to filling of voids with micro silica particles the strength of concrete mix also increase. In this study compare the two design method IS method and DEO method. The conclusion of present study is discusses under-

A. In 7days compressive strength , for 7.5% replacement there is 7.311% increase in strength by IS method and 5.563% by DEO method

B. In 28days compressive strength , for 7.5% replacement there is 7.857% increase in strength by IS method and 7.602% by DEO method

C. In 7days compressive strength , for 10% replacement there is 9.787% increase in strength by IS method and 7.540% by DEO method

D. In 28days compressive strength , for 10% replacement there is 1.555% increase in strength by IS method and 3.560% by DEO method

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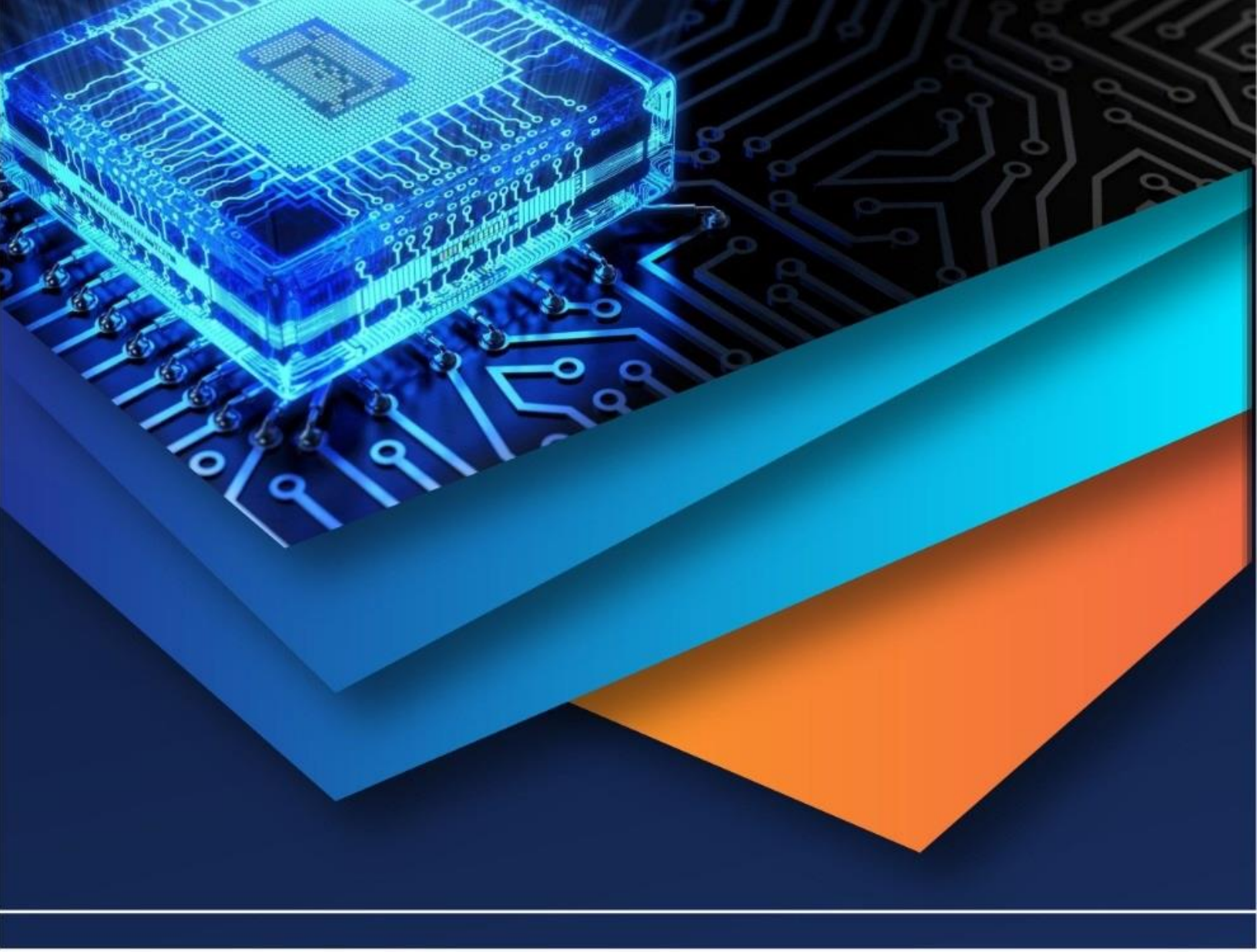

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