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"Determination of Durability and Strength Behavior of Self Compacted Concrete Containing Industrial Waste"

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Abstract: ***An infrastructure* industry *is an important indicator of the development of country and now a day it is very fast-growing sector around world, and with a current production capacity of around 366 million tonnes, India is the second largest producer of cement in the world. [6] Also, concrete is main construction material because of its uniqueness property such as toughness, strengthening and durability etc. At present scenario concrete mix design prepare for more economic and technical benefits and self-compacted concrete (SCC) is given most significant benefits through avoidance of vibration even in congested high grid reinforcement because of its flow able property. Additionally, SCC technology has improved surface quality, strength, and durability and because of self-flowing concrete by its own weight, reduces vibration noise and improved safety. It improves the filling capacity of highly congested structural members like beam column joint in seismically active region, in bridge piers and abutments, in doubly – reinforcement beams, in shear walls etc. Additionally, SCC technology has improved the performance in terms of hardened concrete properties like surface quality, strength and durability.***
Findings: In this study, cement has been replaced with Fly-Ash from 40% to 50%. Fresh properties of concrete were tested for slump flow, T50 test and L box. The hardened properties of concrete were tested for compressive strength and durability. The tests were performed for 7, 28 and 91 days. The results indicate that the use of quaternary blend has improved the workability, compressive strength and durability properties of specimens than the control specimen. Application: The primary contribution is to fill the congested reinforcement and increase the durability and life span of the structure.

I. INTRODUCTION

Self-compacting concrete (SCC) is a flowing concrete mixture that is able to consolidate under its own weight. The highly fluid nature of SCC makes it suitable for placing in difficult conditions and in section with congested reinforcement. SCC was conceptualized in 1986 by prof. Okamura at Ouchi university, japan and popular in 2000 while SCC is used in prefabricated products, and ready mixed concrete (RMC). Concrete that must not be vibrated is a challenge to the building industry. The use of SCC offers a more industrialised production. Not only will it reduce the unhealthy tasks for workers, it can also reduce the technical costs of in situ cast concrete constructions, due to improved casting cycle, quality, durability, surface finish and reliability of concrete structures and eliminating some of the potential for human error. evaluation for the workability of fresh concrete [1].
In figure 1.1, workability means the degree of compaction of fresh concrete into the formwork and it was defined as the combination or balance between the flowability and the resistance to the segregation. This concept is applicable to both conventional concrete and self-compacting concrete (SCC). In this concept, the scale of the slump value is common. [13]

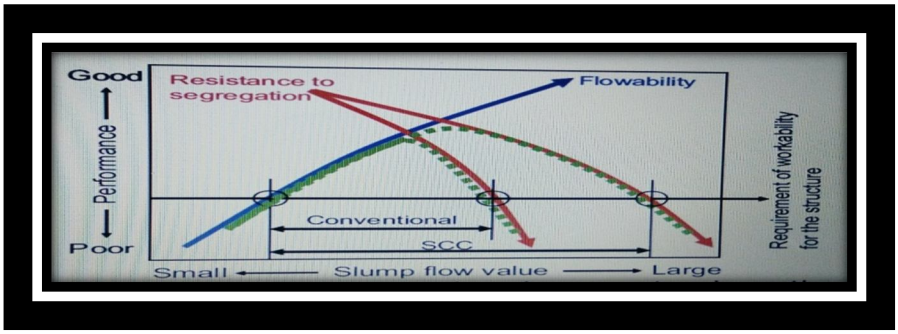

Figure 1.1:- SCC and Conventional Concrete Along the Common Scale for Workability

II. MATERIAL

A. Cement

53 grade OPC cement is used. The properties of cement are confirmed to IS 12269-2013(2).

B. Fine aggregate

Locally available river sand is used. Sieve analysis has been carried out. The results were as per IS 383-19709(3). River sand is of Zone II. The specific gravity and fineness modulus of the sand is 2.58 and 2.83.

C. Coarse aggregate

Natural aggregate of size 10mm and 20mm are used. The aggregate was tested and sieve analysis has been confirmed to IS 2386(Part 1, 2, 3) (4). The specific gravity and fineness modulus of coarse aggregate is 2.88 and 6.02.

D. Chemical admixture

To reduce the water cement ratio admixture, Master Glenium sky 8630 used. The dosage of admixture has been decided by marsh cone test.

E. Water

Fresh water with PH 6.68is used for casting and curing.

F. Nano silica(NS)

Table2.1:- Chemical Composition and physical properties of Nano-Silica

Chemical composition (%)	
SiO_2	99.9%
Al_2O_3	-
Fe_2O_3	-
Cao	-
MgO	-
SO_3	-
K_2O	-
Na_2O	-
LOI	0.1
Physical Properties	
Specific surface (m^2/g)	160
Particle size	15(nm)

III. EXPERIMENTAL METHOD

A. Mix Proportions

The various mix proportions of SCC have been shown in table 3.1.

Table 3.1: Mix proportions of SCC

Design mix	OPC (Kg/m^3)	Fly-Ash(F.A.) (Kg/m^3)	Fine aggregate (Kg/m^3)	Coarse aggregate (Kg/m^3)		Water (L/m^3)	SP (kg.)
				10mm	20mm		
A0	425	-	997	362	543	161.5	8.9
A1	255	170	997	362	543	161.5	8.9
A2	247.5	191.25	997	362	543	161.5	8.9
A3	212.5	212.5	997	362	543	161.5	8.9
For M45							
B0	436	-	1005	364	546	152.6	10
B1	261.6	174.4	1005	364	546	152.6	10
B2	239.8	196.2	1005	364	546	152.6	10
B3	218	218	1005	364	546	152.6	10
For M45							
C0	450	-	1008	365	548	148.5	11.25
C1	270	180	1008	365	548	148.5	11.25
C2	247.5	202.5	1008	365	548	148.5	11.25
C3	225	225	1008	365	548	148.5	11.25

B. Workability

The functional requirements of a fresh SCC are different from those of a vibrated fresh concrete. It can be resumed by three requirements:

1) *Filling Ability:* Complete filling of formwork and encapsulation of reinforcement and inserts. Substantial horizontal and vertical flow of the concrete within the formwork with maintained homogeneity. In this study, the filling ability was measured by slump flow.
2) *Passing Ability:* Passing of obstacles such as narrow sections of the formwork or closely spaced reinforcement without blocking caused by interlocking of aggregate particles. In this study, passing ability was measured by the L-Box.
3) *Flowing Ability:* T500 time is a test to assess the flowability and the flow rate of self-compacting concrete in the absence of obstructions. The T500 time is also a measure of the speed of flow and hence the viscosity of the self-compacting concrete.

IV. RESULTS AND DISCUSSIONS

A. Rheological properties

Table 4.1: Fresh Property Ranges of SCC as Per EFNARC Specification

Sr No	Method	Unit	Typical Range of Value	
			Minimum	Maximum
1	Slump flow	Mm	650	800
2	T50cm slump flow	Sec	2	5
3	V-funnel	Sec	6	12
4	V-funnel at T5min	Sec	0	3
5	L-BOX	H2/H1	0	1
6	U-BOX	(H2-H1) mm	0	30

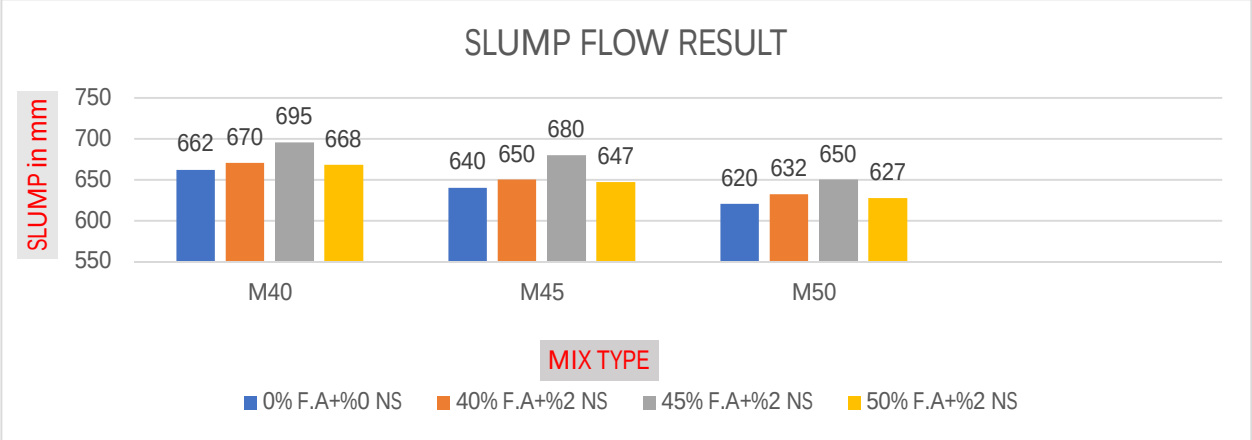

Figure 4.1:- Slump Flow Result of SSC Mixes

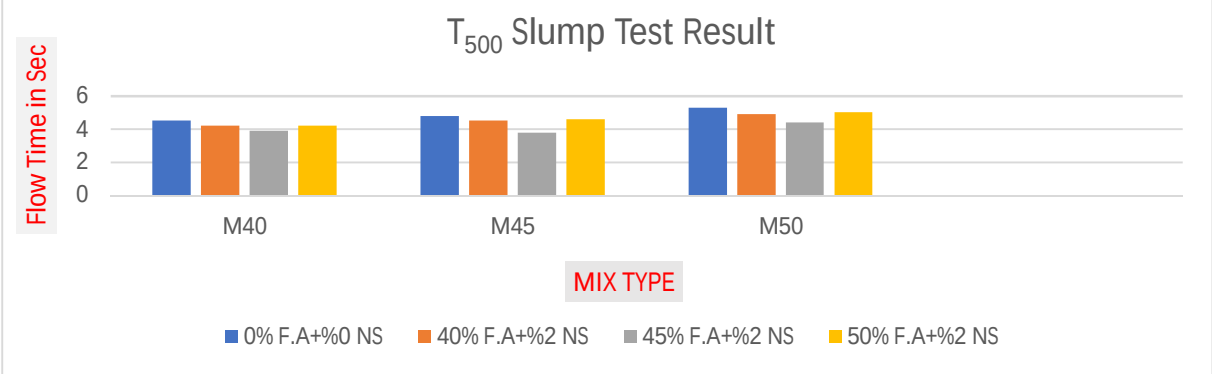

Figure 4.2:- T_{500}Slump Flow Result of SSC Mixes

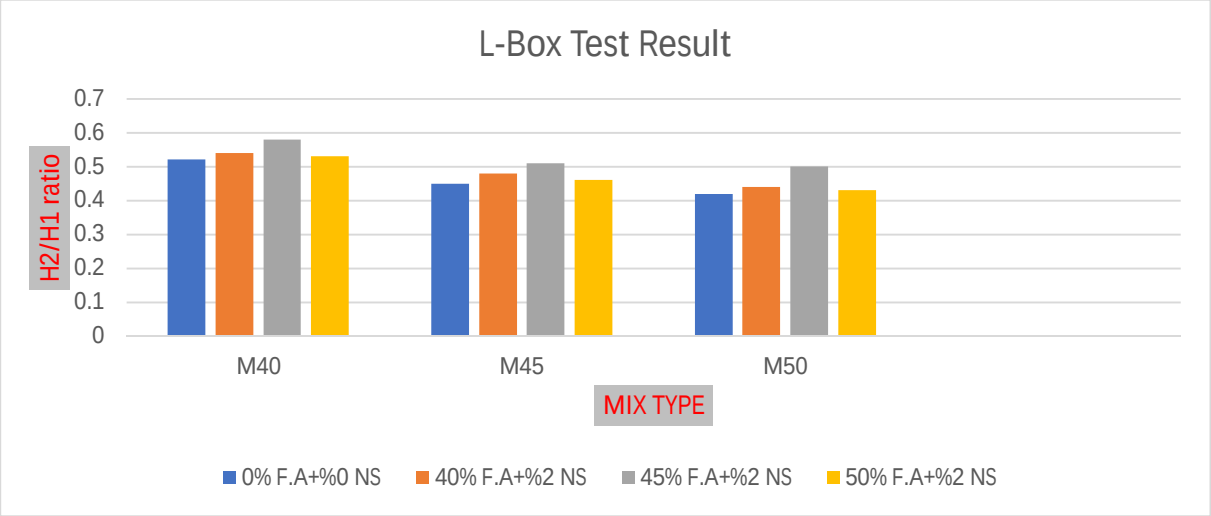

Figure 4.3 :- L-BOX Test Result of SSC Mixes

B. Strength Behavior

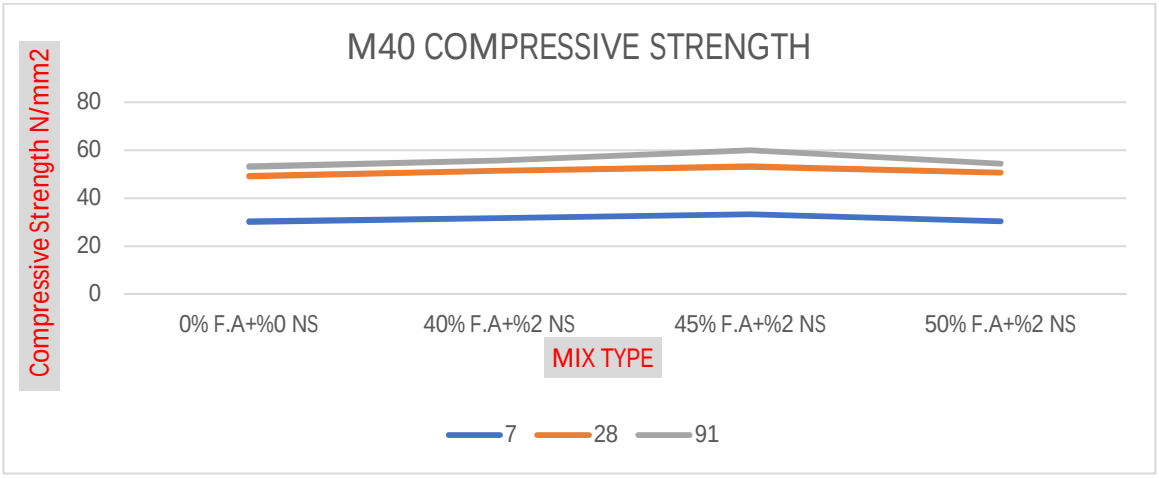

Figure 4.4:- Compressive Strength of M40 Grade SSC

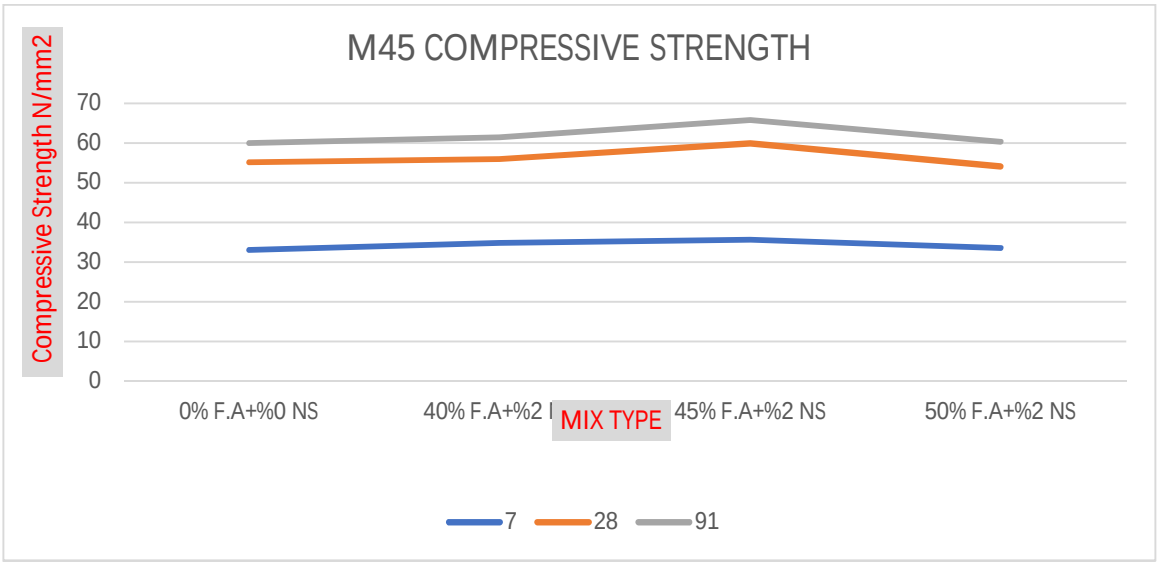

Figure 4.5:- Compressive Strength of M45 Grade SSC

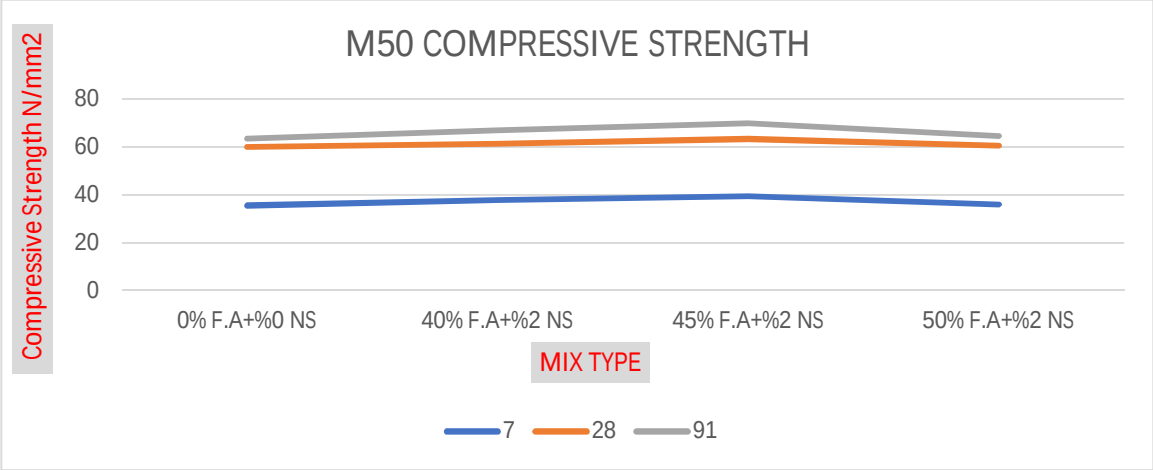

Figure 4.6:- Compressive Strength of M50 Grade SSC

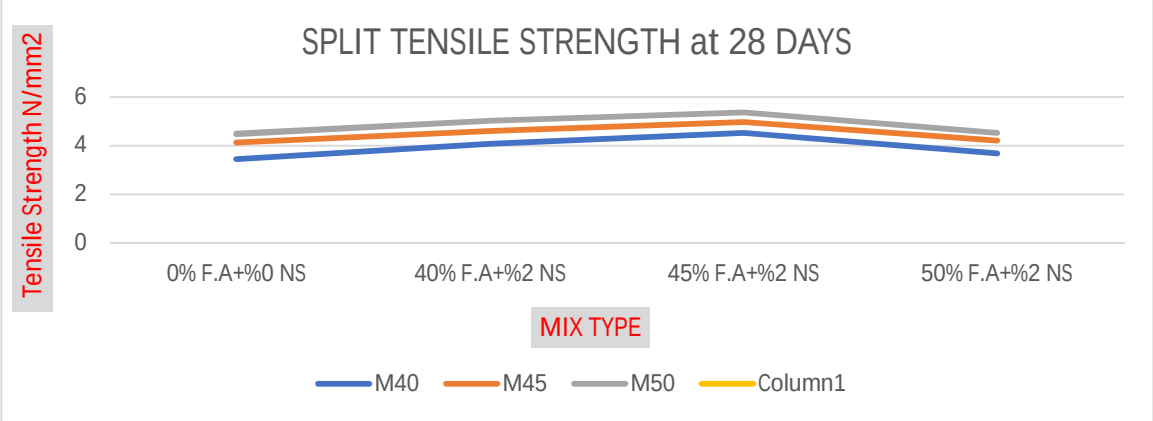

Figure 4.7: - Split Tensile Strength of SSC Mixes

V. CONCLUSION

A. With help of fly-ash and Nano-silica we can increased the durability and flowability or compatibility of self-compacted concrete.

B. Increased Nano silica up to 2% by replacement of cement and fly-ash up to 45% by replacement of cement there was increment in compressive strength and tensile strength of concrete.

C. For Flowing ability (T_{500} Slump test), passing ability (L-box test values) and filling ability (V-Funnel test),45% replacement of Fly-ash is optimum.

VI. FUTURE RESEARCH

A. Rapid Chloride Penetration Test and Mercury Porosity Test will conduct for same design mix, with same replacement.

B. Self compacted concrete already in progress and would be communicate in future mega projects.

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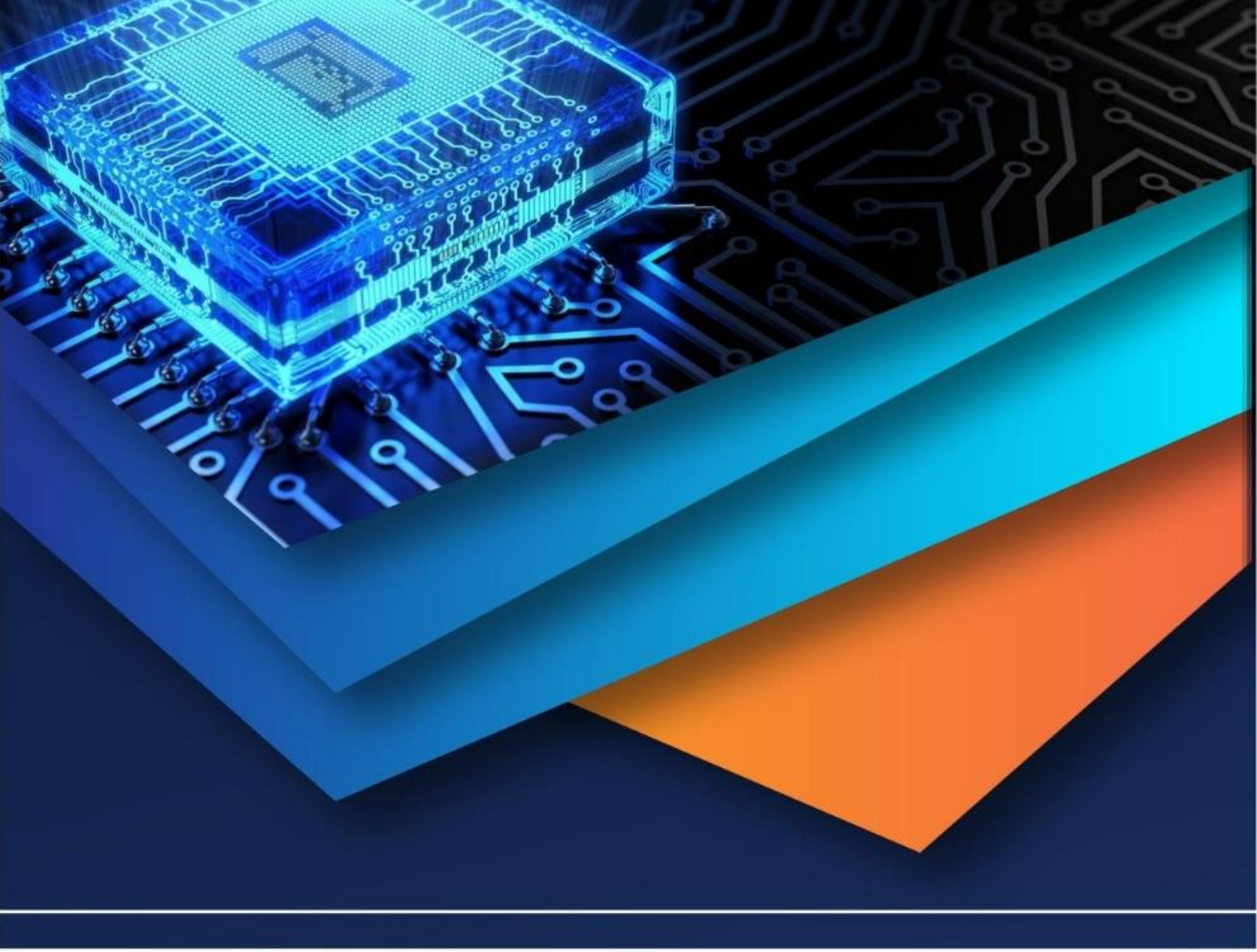

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