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Experimental Investigation on Concrete Containing Bentonite Sludge as a Mineral Admixture & Replacement

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Abstract: ***The present investigation deals with effect of Bentonite sludge on concrete. The concrete was produced by partial replacement and addition of OPC-53 with mineral admixture Bentonite sludge in percentages of 3%, 6%, 9%, 12%, 15%, 18% and 21%. The M20, M30 & M40 grade of concrete was designed.***
The compressive strength, split tensile strength and Durability were found for the specimens. The present investigation is to study the effect of Bentonite sludge on concrete.
Keywords: Bentonite Sludge, Cement, Workability, Compressive Strength, Tensile Strength.

I. INTRODUCTION

Concrete is one of the most widely used construction material in the world. It can be cast in diverse shapes. Concrete is a composite material formed by the combination of cement, sand, coarse aggregate and water in a particular proportion in such a way that the concrete produced meets the needs as regards its workability, strength, durability and economy. It is found to be versatile and hence gained importance in building materials.

The stabilizing action of Bentonite Sludge was first exploited by the oil industry for drilling and stabilizing wells without the use of casing. Today sodium, or western, Bentonite Sludge is used regularly to aid diaphragm wall placing, pile driving, caisson sinking, and soil grouting. In addition to speeding construction, Bentonite Sludge avoids the noise and vibration problems that influence conventional foundation operations in urban areas.

Bentonite Sludge also allows closer working to boundary lines. Bentonite Sludge is derived from montmorillonite clay and is usually supplied in paper bags as a finely ground, free flowing powder. Like Portland cement, it must be stored under reasonably dry conditions.

When the powder is dispersed in water it breaks down into a very fine colloidal clay. This clay continues to absorb free water so that it gels on standing. Bentonite Sludge can repeatedly become fluid on agitation. Yet it will regain its gel structure when left undisturbed. In foundation work, the gel penetrates around individual soil particles and maintains them in position by adhesion. The quality of Bentonite Sludge needed to make a slurry with water varies from about 4 precents by weight for use in stiff clays to about 10 precents by weight for open gravels. Chemical additives can be included to increase or decrease the penetrating and gelling properties of a slurry. The preferred method of mixing is by high-speed stirrer for at least two minutes.

A. Objective

1) Effectively utilization of Bentonite Sludge.
2) To find out optimum percentage of Bentonite Sludge use in concrete.

B. Materials Used

1) Cement
2) Bentonite Sludge.
3) Water
4) Fine Aggregate (Sand).
5) Coarse Aggregate.

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II. EXPERIMENTAL WORK

These include one control mix which was prepared without addition of Bentonite sludge and the remaining seven mixes were prepared with different proportions of bentonite sludge as admixture &replacement of cement in concrete. Bentonite mixes include 3%, 6%, 9%, 12%, 15%, 18% and 21% of Bentonite sludge in admixture &replacement mode by weight of cement. Test carried out on aggregate specific gravity, sieve analysis, water absorption, Impact value test, all these test conduct on Bentonite Sludge aggregate sample. The mix was designed for Workability, Compressive Strength, Tensile Strength and Acid Attack of 20 MPa, 30 MPa and 40 Mpa. The details are summarized in Table 1,Table 2 And Table 3 .

Table -1: MIX DESIGN M20

Water	Cement	Sand	Aggregate. Proportions as per table 2 of IS 383	
			0.60	0.40
			(20mm)	(10mm)
191.60	348.364	554.22	795.864	530.576
0.55	1	1.59	2.29	1.51

Table -2: MIX DESIGN M30

Water	Cement	Sand	Aggregate. Proportions as per table 2 of IS 383	
			0.60	0.40
			(20mm)	(10mm)
191.60	425.78	499.80	788.61	525.74
0.45	1	1.17	1.85	1.24

Table -3: MIX DESIGN M40

Water	Cement	Sand	Aggregate. Proportions as per table 2 of IS 383	
			0.60	0.40
			(20mm)	(10mm)
136	340	543.62	901.30	600.86
0.40	1	1.60	2.65	1.77

III. TEST SPECIMENS AND TEST PROCEDURE

Cement, sand and aggregate were taken in mix proportion as per mix design M20 grade of concrete respectively. The 150mm x 150mm x 150mm size concrete cubes were used as test specimens to determine the compressive strength, split tensile respectively. Cast the cubes with different mix proportion and put in water curing tank for 28days. After complete curing done the compressive and tensile strength.

IV. RESULTS AND DISCUSSION

A. Slump Test

Slump test is done before casting of each mix, Slump of concrete is increase respectively increase of Bentonite Sludge in concrete. Reason of slump decrease was less water absorption of Bentonite Sludge. Slump test results are Replacement of add Bentonite Sludge with Cement shown in figure 1 and Addition of add Bentonite Sludge with Cement shown in figure 2.

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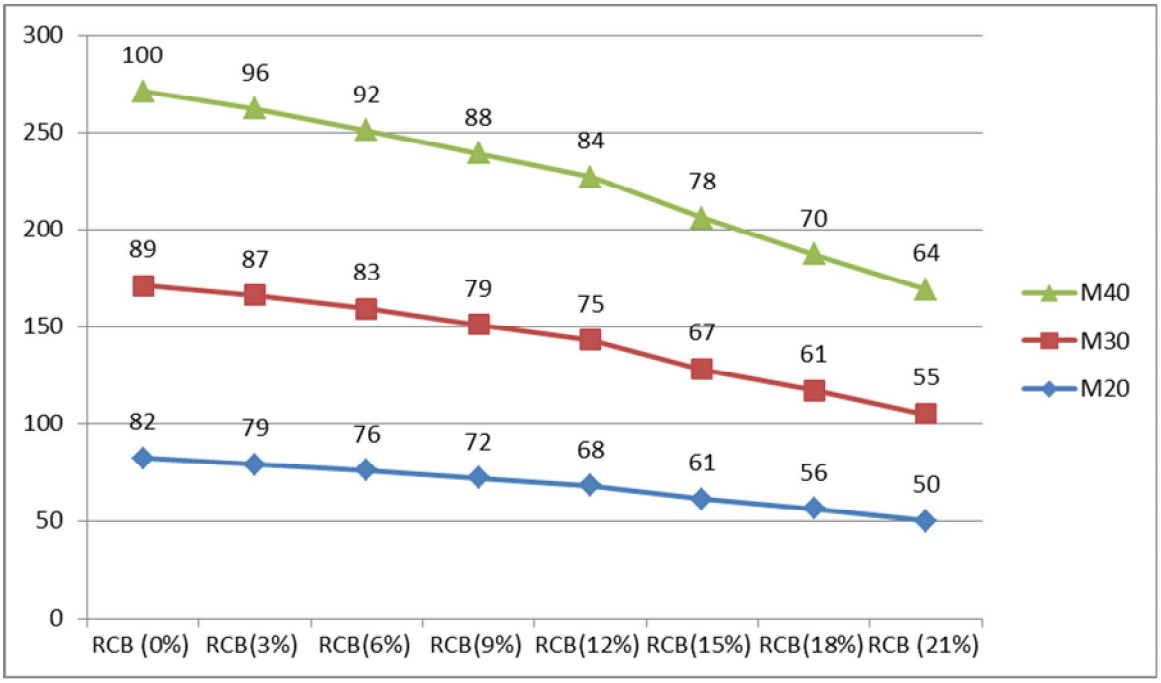


Figure 1 Slump test Results: Replacement of add Bentonite Sludge with Cement

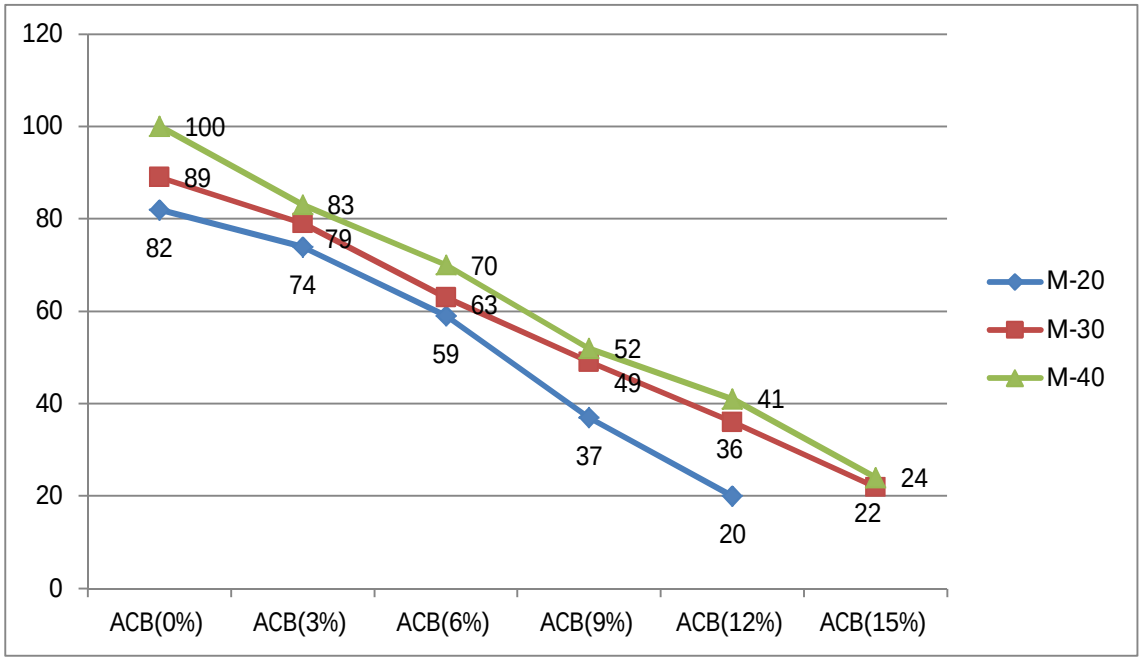


Figure 2 Slump test Results: Addition of add Bentonite Sludge with Cement

B. Compressive Strength

The present investigation compressive strength of concrete produced by replacing and adding Bentonite sludge is goes on increasing up to 21% replacement and addition of Bentonite sludge. In compressive strength results increase compressive strength up to 21% by replacing and in addition both. The Compressive Strength results are Replacement of add Bentonite Sludge with Cement shown in figure 3 and Addition of add Bentonite Sludge with Cement shown in figure 4.

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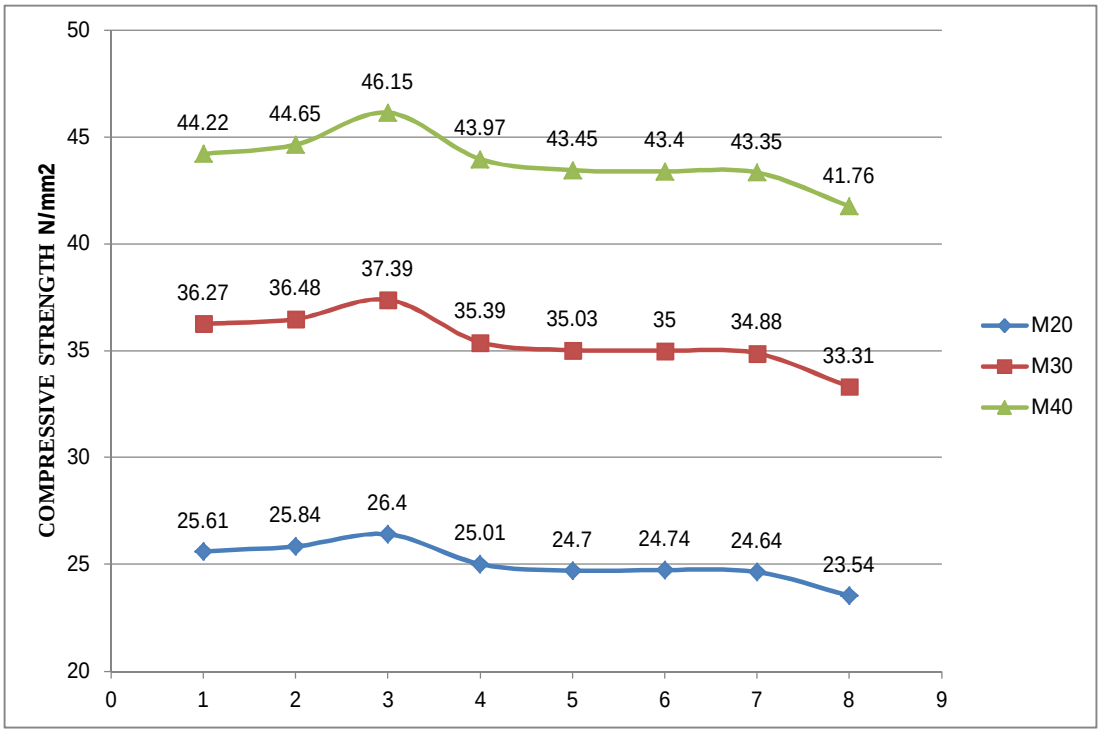


Figure 3 Compressive Strength Results: Replacement of add Bentonite Sludge with Cement

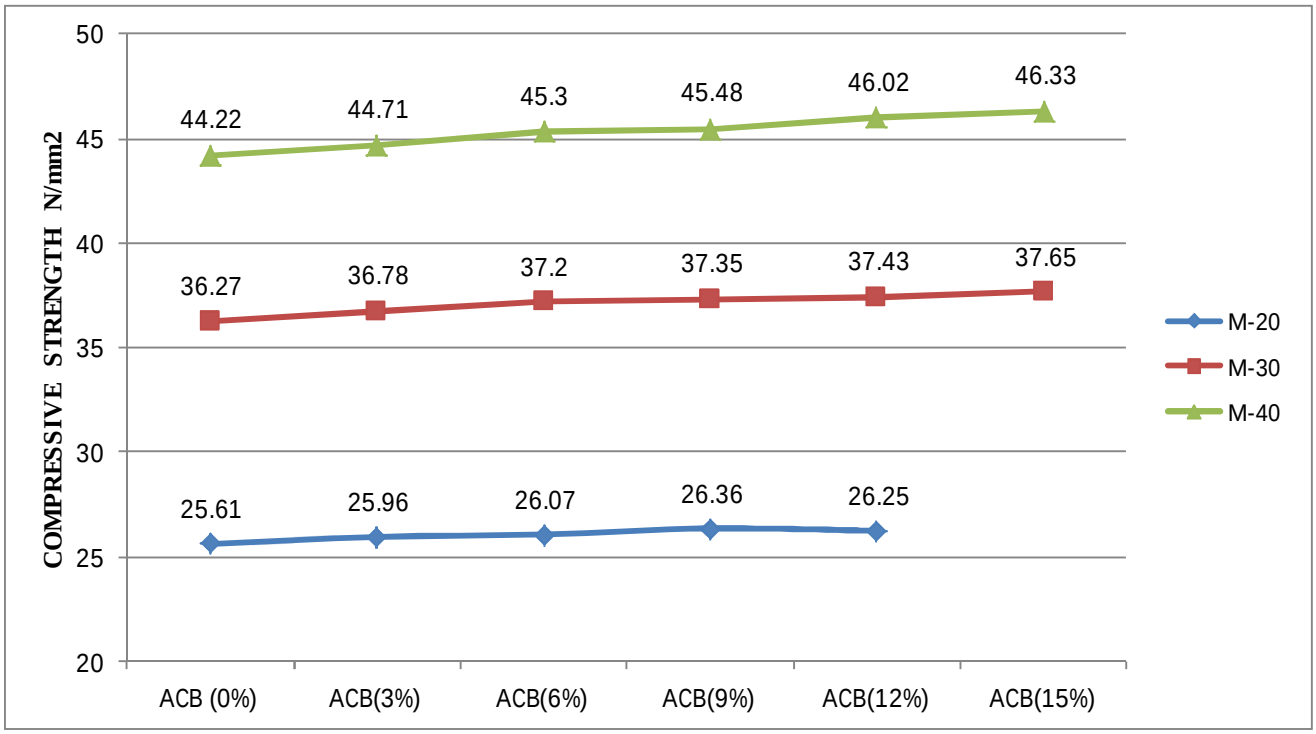


Figure 4 Compressive Strength Results: Addition of add Bentonite Sludge with Cement

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C. Tensile Strength

The present investigation Split Tensile Strength of concrete produced by replacing and adding Bentonite sludge is goes on increasing up to 21% replacement and addition of Bentonite sludge. In Split Tensile strength results increase Split Tensile strength up to 21% by replacing and in addition both. The Split Tensile Strength results are Replacement of add Bentonite Sludge with Cement shown in figure 5 and Addition of add Bentonite Sludge with Cement shown in figure 6.

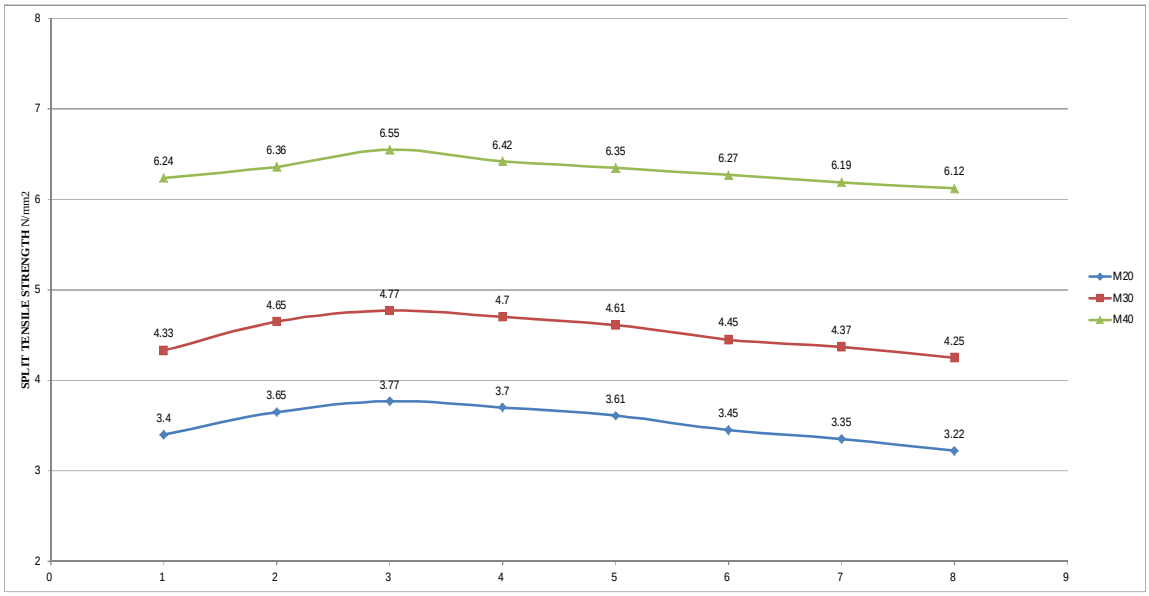


Figure 5 Spilt Tensile Strength Results: Replacement of add Bentonite Sludge with Cement

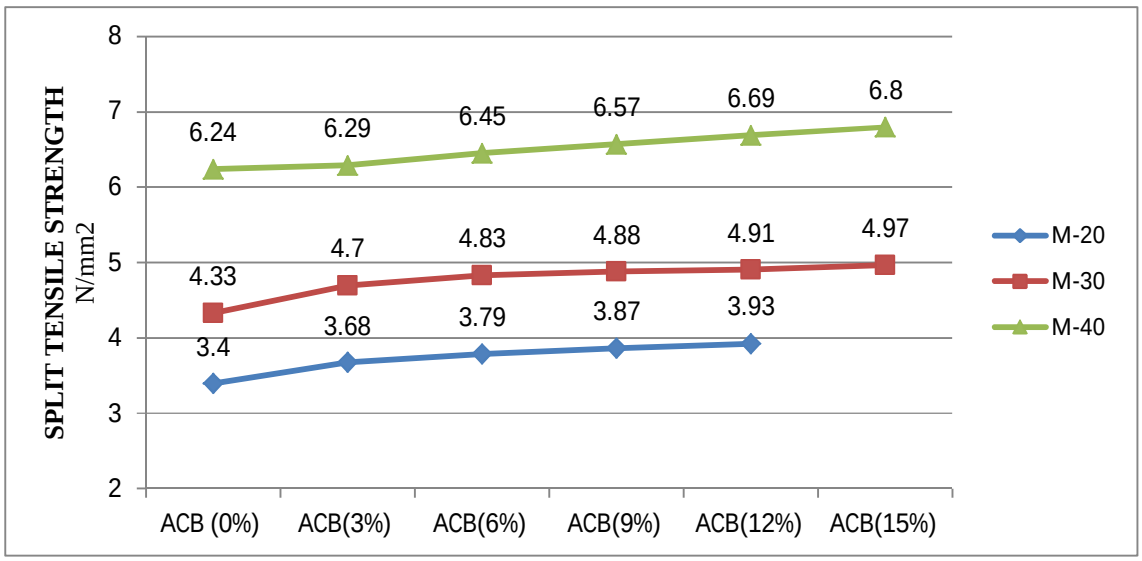


Figure 6 Spilt Tensile Strength Results: Addition of add Bentonite Sludge with Cement

V. CONCLUSIONS

After conducting all the tests on the specimen, it has been observed that up to 21% replacement of cement with Bentonite sludge proved to be good in Compression, as well as in Tension, whereas the concrete properties with equal proportion of Bentonite sludge and conventional cement confirmed to be inefficient. It is identified that Bentonite sludge can be disposed by using them as construction materials in concrete. Increase the Compressive Strength up to 21% addition of Bentonite sludge. but as per IS addition up to 15% used after then workability is very low. Increase to decreased the Compressive Strength up to 21% replacement of Bentonite sludge.

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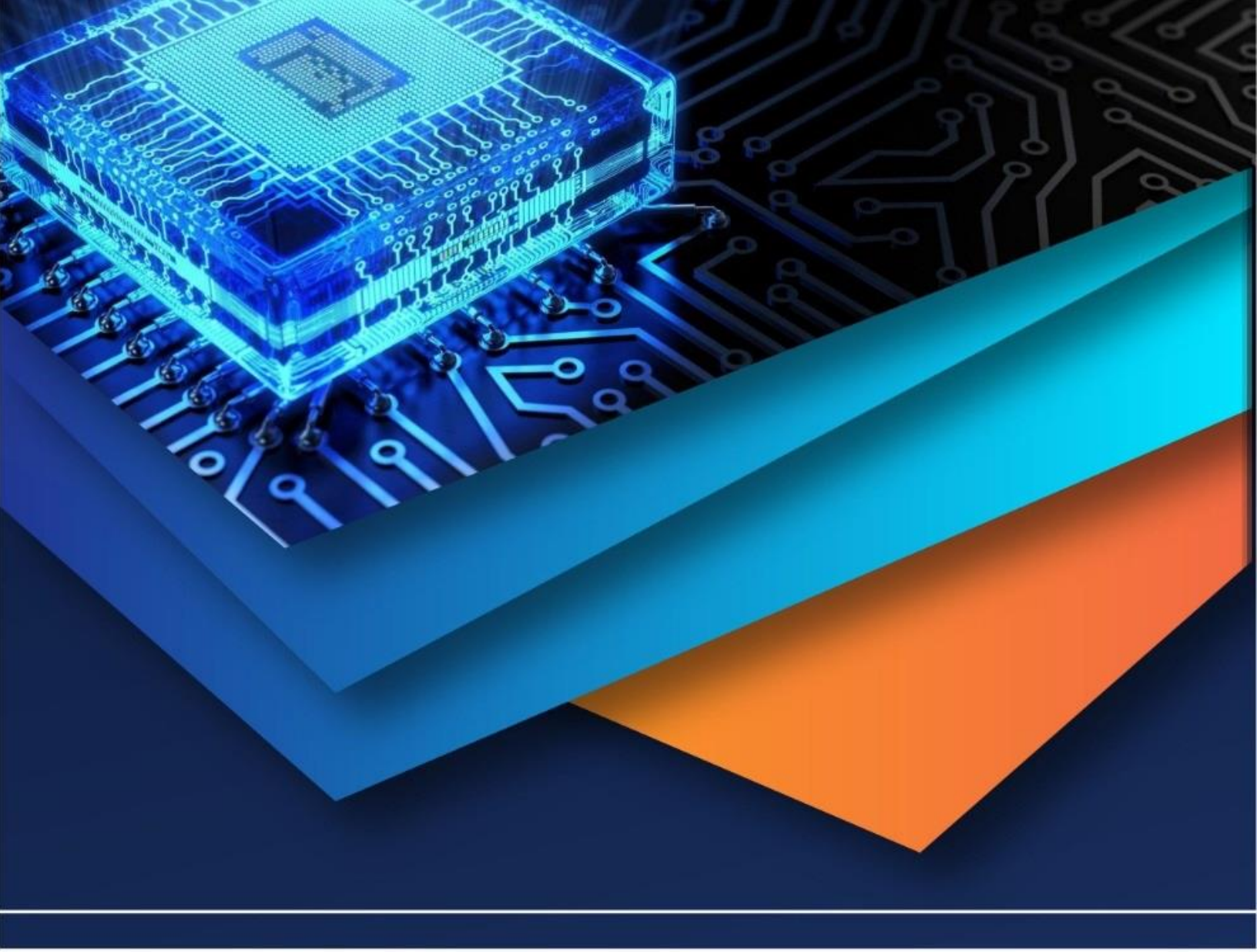
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