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Effect of Lime on Engineering Properties of Expansive Soil

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Abstract: Black cotton soil was collected from Hulsoor, Dist. Bidar, Karnataka. The lime is collected from near basaveshwar circle Humnabad Dist. Bidar. The lime is added to soil with varying percentages of lime are 2, 5, 9 and 12% .To know the basic properties of the
Soil Laboratory tests have been conducted. They are Atterberg's limits, Light compaction test, Unconfied compressive strength test, Specific
Gravity, Moisture content test and Sieve analysis and California bearing ratio test. From results we came to know that the liquid limit, plastic limit and specific gravity of lime are decreases. In the addition of lime, the optimum moisture content and maximum dry density are increased at 9% lime. Then unconfined compressive strength and California bearing ratio values are also increased at 9% lime.
Keywords: Expansive soil, Lime, OMC, MDD, UCS, CBR (Unsoaked).

I. INTRODUCTION

Black cotton soil is available everywhere in India. Black cotton soils are highly argillaceous, very fine grained and this soil Containing high proportion of calcium and magnesium carbonates. These soils are poor in nitrogen, phosphorus and organic Matter. They exhibit high rate of swelling and shrinkage when exposed to changes in moisture content.
Lime is good material, It gives comfort environment, and it provides good durability and workability and energy conservation than cement. Slaked Lime is highly effecting to the soils.
Lime is mainly used for pavement. Soil is mixed with lime and carried out various tests Such as Sieve analysis test, Moisture content test, Atterberg's limit, Specific gravity test, light compaction test, Unconfined Compaction test, free swell test and California bearing ratio test.

II. LITERATURE AND REVIEW

1) *Shailendra Singh et.al(2013) [1]:"*Stabilization of black cotton soil by using lime", In this study, stabilization of black Cotton soil has been carried out by mixing lime in varying percentages (4% and 6%), in addition of both 4% and 6% ofLime liquid limit is decreased and swelling pressure also decreased. The maximum dry density decreases and optimum moisture content does not change with decrease of 14.3% in OMC was observed at 6% lime. Then the CBR Value is increased in addition of both 4% and 6% of lime respectively.
2) *Sujit Kawade et.al(2014)[2]:"*Stabilization of black cotton soil with lime geogrid",This study was done to improving the strength of black cotton soil blocks with varying percentages of lime (5%, 10% and 15%) by adding the geogrid.The Strength of soil increases by adding lime. In the curing period of 28 days is observed to yield the maximum compressive strength of BC soil blocks reinforced with 15% lime content and geo-grid.
3) *Brajesh Mishra(2013)[3]:"* A Study on engineering behaviour of black cotton soil and its stabilization by use of lime", In this study, varying percentages of lime (3% and 5%) is used to stabilize the black cotton soil. In addition of lime the Liquid limit values are goes on decreasing in both 3% and 5% of lime respectively. The CBR values are increasing in both 3% and 5% of lime respectively.
4) *Pankaj R. Modak et.al(2012)[4]:"*Stabilization of black cotton soil using admixtures", In this study, when soil is stabilized with lime and fly ash CBR value is increases and the thickness of pavement decreases.

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III.MATERIALS AND METHODS

A. *Materials*

1) *Black Cotton Soil:* Soil was collected from Hulsoor, Dist. Bidar (Karnataka) at a depth of 1.0m from the ground level. Laboratory tests to be conducted as shown in table.1.

Table.1.Properties of black cotton soil

SL.N0	Properties	B.C soil
1	Natural moisture content (%)	22.33
2	Specific gravity	2.68
3	Sieve analysis % Gravel % Sand % Silt and clay	 0 28 38
4	Free swell index(%)	45
5	Liquid limit (%)	66
6	Plastic limit (%)	27.20
7	Shrinkage limit (%)	8.23
8	Classification	CH
9	Maximum dry density(g/cc)	1.47
10	Optimum moisture content (%)	20
11	CBR (Unsoaked, %)	2.77
12	UCS(Kg/sq.cm)	0.55
13	Color	Dark black

2) *Lime:* - Lime powder is collected in lime shop near Basaweshwar circle, Humnabad, Dist. Bidar.It is a white powder or colorless crystal. Calcium hydroxide is used in food preparation and many other applications. Lime is added to soil with varying percentages of lime from 2%, 5%, 9% and 12%.

B. *Methods*

1) Sample Preparation: - Black cotton soil is used in my project with lime. Soil samples were prepared as 2%lime+B.C.Soil,5%lime+B.C.Soil,9%lime+B.C.Soil and 12% lime+B.C.Soil after taking the proportions, treated UCS Specimens were prepared for each percentages and kept in desiccators for the curing periods of 1,3 & 7 days respectively.
2) Experimental Work: - Tests were carried out to know the strength of the soil. Specific gravity test, moisture content test,atterberg limits, wet sieve analysis test ,Free swell test, light compaction test , unconfined compressive test, California bearing ratio test.

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IV. RESULT AND DISCUSSIONS

Light compaction values, penetration values and unconfined compressive strength of lime with varying percentages.

Table.2. Combination results of soil with lime

Description	B.C.Soil	B.C.Soil+ 2%lime	B.C.Soil+ 5%lime	B.C.Soil+ 9%lime	B.C.Soil+ 12% lime
Specific gravity	2.68	2.37	2.0	1.99	1.66
Liquid limit (%)	66	39	36	34	32
Plastic limit (%)	27.20	20	18	15	16
Plasticity index (%)	38.80	19	18	19	1
MDD(g/cc)	1.47	1.34	1.43	1.50	1.45
OMC (%)	20	24	29	29	22.5
CBR (Unsoaked, %)	2.77	4.35	4.71	5.65	4.04
UCS(Kg/sq.cm)	0.55	0.62	0.63	0.66	0.64
UCS of 1 day period	0.57	0.655	0.675	0.71	0.695
UCS of 3 days period	0.59	0.66	0.68	0.81	0.735
UCS of 7 days period	0.60	0.69	0.74	0.85	0.75

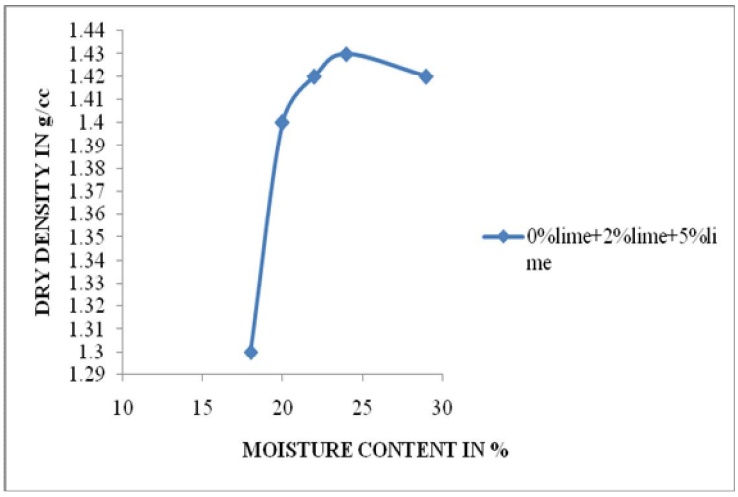

Fig.1 Graphical representation of compaction curve of 0,2 & 5% lime

The OMC and MDD with varying percentages of lime at 0% lime, comparing this in 2% lime OMC is increases and then MDD is decreased and then similarly at 5% lime OMC is increases and then MDD is decreases.

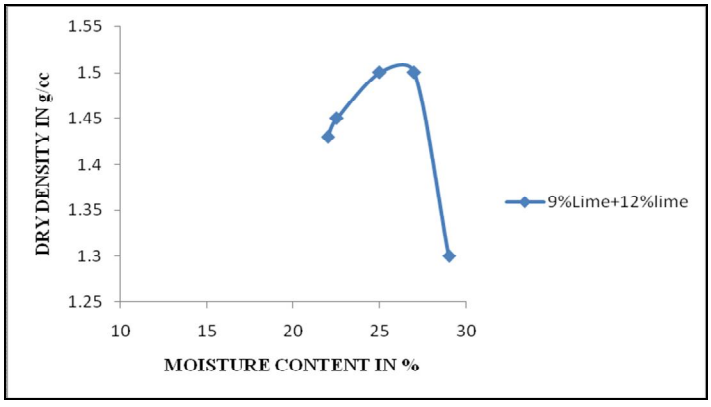

Fig.2 Graphical representation of compaction curve of 9 & 12% lime

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In this fig.2 graphical representation of compaction curve of 9 and 12%lime in this 9%lime is having high values than the 12% lime.

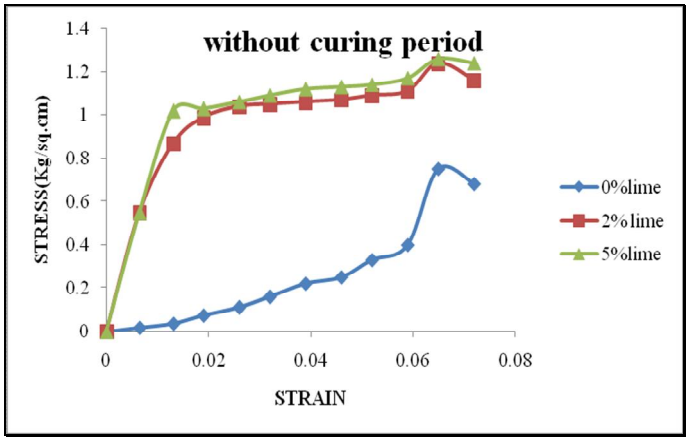

Fig.3 Graphical representation of unconfined compressive strength curve of 0,2 &5%lime without curing period

In this fig.3Graphical representation of unconfined compressive strength curve of 0, 2 and 5% lime in this the 5% lime is showing the high strength of the soil as compared to 0 and 2% of lime.

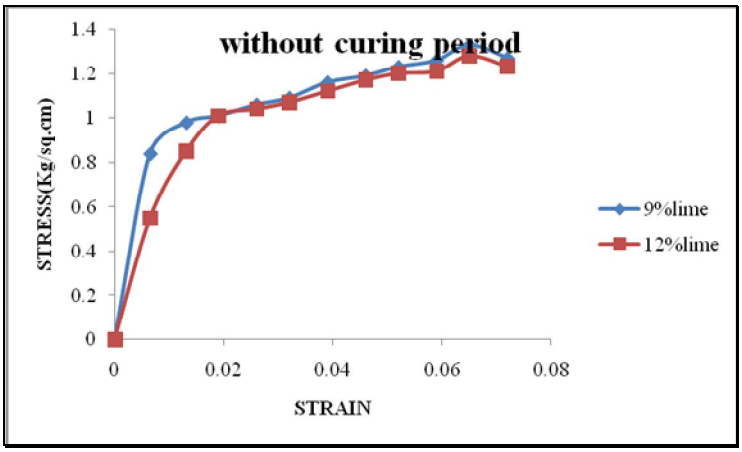

Fig.4 Graphical representation of unconfined compressive strength curve of 9 &12% lime without curing period

In this fig.4 graphical representation of unconfined compressive strength curve of 9 and 12%lime in this the 9% lime is showing the high strength of the soil as compared to 12% of lime.

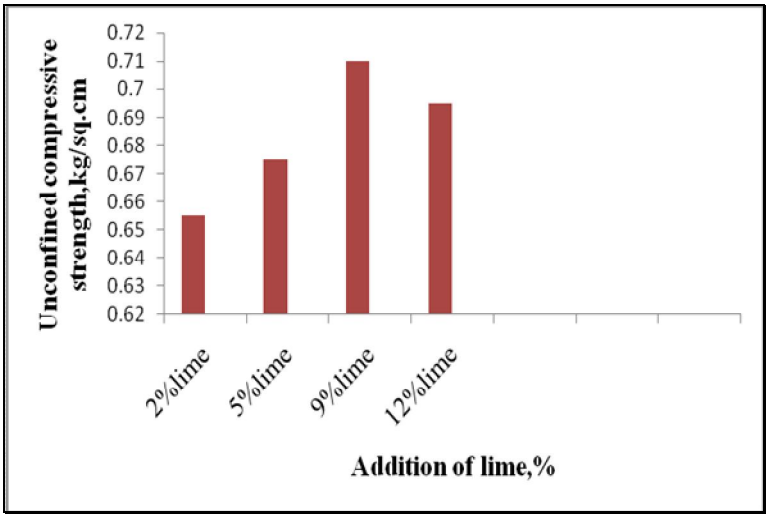

Fig.5 Graphical representation of unconfined compressive strength readings of 2,5,9 &12% lime 1 day curing period

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In this fig.5 graphical represenatation of unconfined compressive strength readings of 2,5,9 & 12% lime,in this 9% lime is showing high value as compared to 0,2,5 & 12% lime.

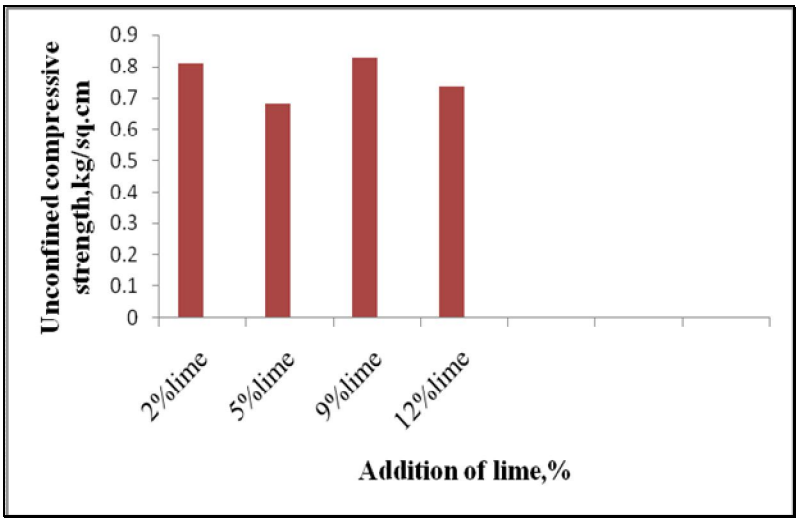

Fig.6 Graphical representation of unconfined compressive strength readings of 2,5,9 & 12% lime with 3 days curing period

In this fig.6 graphical represenatation of unconfined compressive strength readings of 2,5,9 & 12% lime,in this 9% lime is showing high value as compared to 0,2,5 & 12% lime

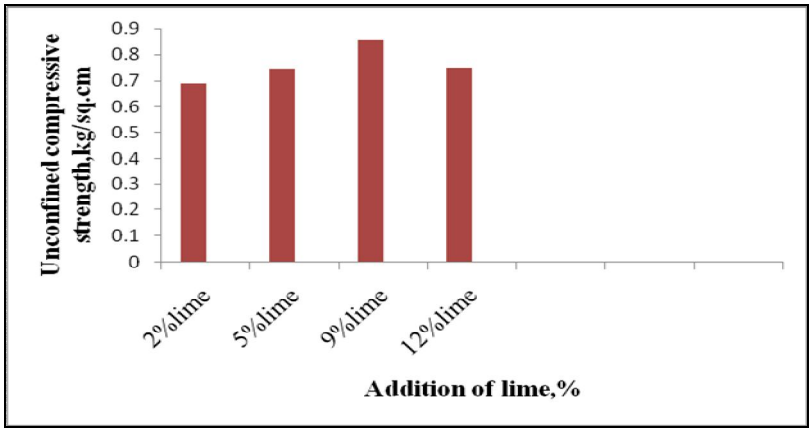

Fig.7 Graphical representation of unconfined compressive strength readings of 2,5,9 & 12% lime with 7 days curing period

In this fig.7 graphical represenatation of unconfined compressive strength readings of 2,5,9 & 12% lime,in this 9% lime is showing high value as compared to 0,2,5 & 12% lime.

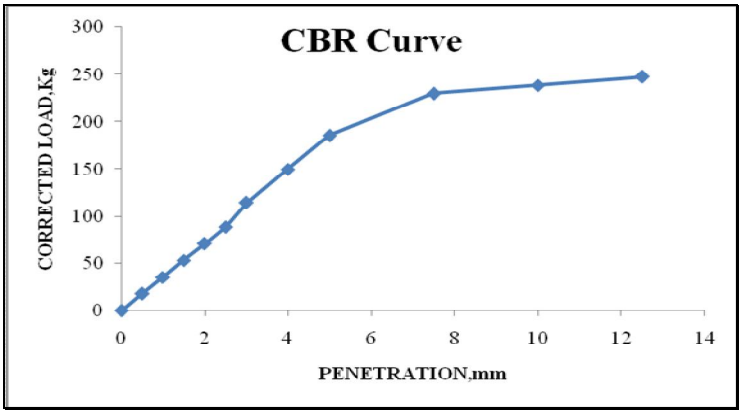

Fig.8 Graphical representation of california bearing ratio curve of 0% lime

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In this fig.8 graphical representation of california bearing ratio curve of 0% lime giving less value than all other percentages of lime.

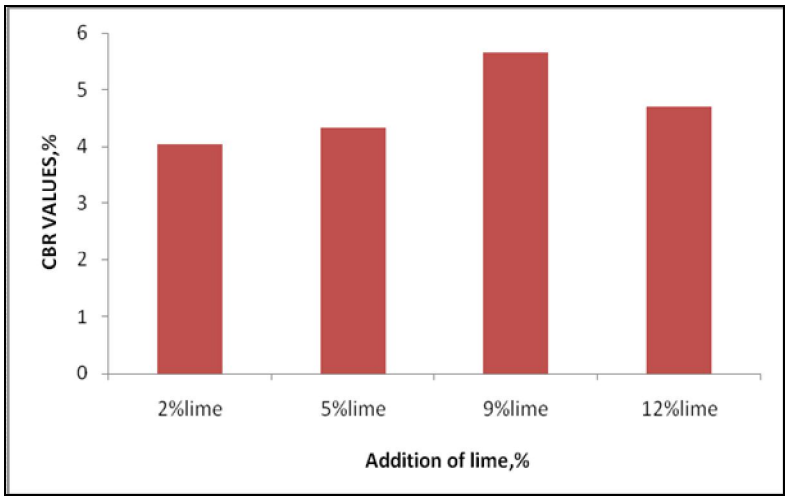

Fig.9 Graphical representation of california bearing ratio curve of 2 ,5 ,9 & 12 %lime

In this fig.9 graphical representation of CBR curve of 2,5,9 & 12% lime ,in this the 9% lime showing high values than the 2, 5 & 12% lime.

V. CONCLUSIONS

A. The Optimum moisture content is increased in addition of lime at the percent of 9.
B. The Maximum dry density value is increased in addition of lime at the percent of 9.
C. The Unconfined compressive strength of soil is mixed with lime is increased at the percent of 9.
D. The CBR (Unsoaked), % value of soil is mixed with lime is increased as compared to soil.
E. The Specific gravity of soil with lime is decreased as compared to black cotton soil.
F. The Liquid limit of soil with lime is decreased as compared to black cotton soil.

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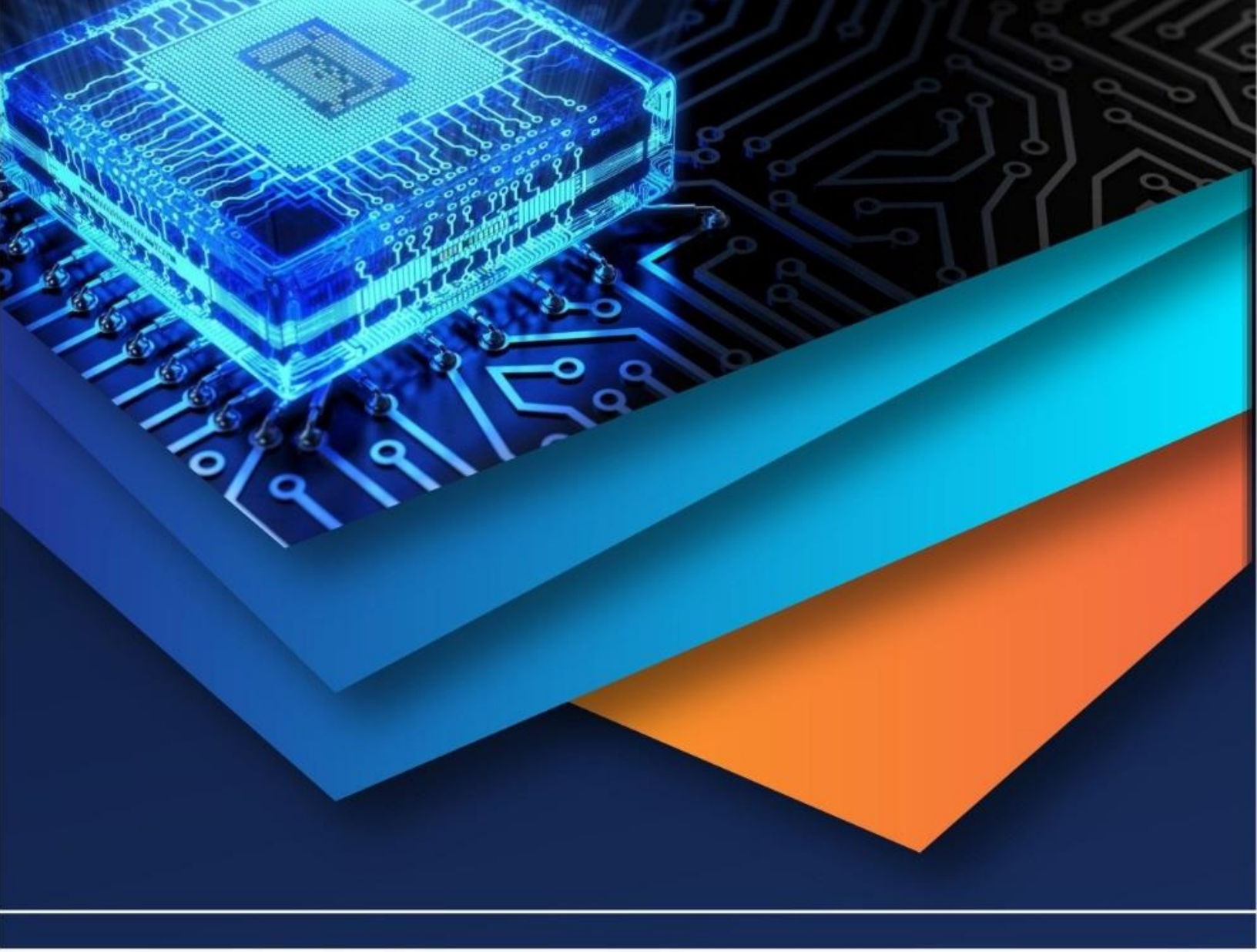

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