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Laboratory Investigation for Stabilization of Clayey Soil in Kashmir Valley

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Abstract: ***The main focus of this research was to improve the strength of clayey soil & to obtain a optimum amount of soil-Cement-Recron mix. The objective of study was to increase the strength of clayey soil using Cement & Recron fiber. As we know Recron act as a reinforcing material. As clay shows high shrinkage, swell characteristics & low bearing capacity especially under sub-grade, Therefore, there is a need to improve the strength characteristics of soil. So the main focus of this research was to increase the strength characteristics of soil. The tests performed in laboratory was Pycnometer test for specific gravity, Casagrande's test for liquid limit, plastic limit test, Standard proctor test for determination of OMC & MDD & modified proctor test. Proportion of the Recron used was 0.4, 0.7, 1.0, 2.0 & 4.0 % & proportion of cement was 3, 5, 7%. The cement was optimised at 5%, 6mm hollow recron fiber at 0.7%, . The CBR value was found peak at 7% cement content with value of 73.2, 0.7% 6mm recron fiber has 11.2. From the results it was verified that 0.7% Recron content is more economical than 5% cement content.***

Keywords : Recron fibre, Cement, Stabilization, Specific gravity, CBR, OMC, MDD

I. INTRODUCTION

Stabilization of soil is the process of varying the properties of soil to improve its engineering properties, so that it can be used in various works of civil engineering. The soil over which the construction is to be carried out should have enough strength to carry the design load, neither should failure occur. This problem mainly occurs when construction is to be done on clayey soil. This soil is considered poorest material from civil engineering point of view. Being volume-less in nature, replacement of soil is non engineered solution to tackle with the poor soil. Various techniques are used for improving the engineered properties of clayey soil, known as soil stabilization.

Improved sub-grade soil with higher CBR value reduces the pavement crust requirements. As an example for design traffic of 10 MSA pavement crust requirement reduces from 850 mm for sub-grade CBR of 2% to 540 mm for sub-grade CBR of 10%. Stabilization of clayey soils, being weakest with minimum CBR value, can bring economy in highway projects to a great extent.

II. LITERATURE REVIEW

The relevant literature on this study used in stabilization of soil was reviewed and presented here.

Santoni et al. (2001) in this study investigation was done on non-plastic cohesion less soil which was reinforced with monofilament polypropylene fiber with dia. = 4, 15, 20 fiber length= 13 to 51mm and fiber content = 0 to 1%. Ucs test was performed at 2.6% base moisture content and 14% saturation. From ucs the obtained results that 0.8% fiber is optimum. Whereas at fiber content less than 0.6% causes softening and more than 0.85% leads to cause hardening. Also compressive stress improves gets improved by increasing aspect ratio.

Kumae et al. (2008) in this study black cotton soil with properties (specific gravity =2.72, ll=68% pl=49.65% omc=29.4% and mdd=1.32gm/cc was reinforced with polyester synthetic. Also fly ash and are added to the soil. The investigation was done unconfined compression of randomly distributed fibers, and fly ash on the geotechnical characteristics of expansive soil. The result obtained shows that the fiber is more efficient when soil is subjected to tension rather than compression.

Pandey b. Et al. (2013) have studied that per year millions of tonnes of pozzolanic material known as fly ash is manufactured in our country. In this study black cotton soil properties are improved using fly ash, jute fiber, and water proofing compounds. No of proctor tests and cbr test were carried out including atterberg's limit test on soil mixed with fiber of dia. 2 – 8mm and lengths 0.5 - 2mm in different %age (0.2-1%) to find most favourable quantity and also fly ash varied like 10%, 15%, 20% and 25% and 1-5%. The best proportion after CBR test was obtained as 1% jute fiber+ 5% lime + 20% fly ash. This study has enormous benefits in soil stabilization of sub grade.

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chandra et al. (2008) in this study effect of polypropylene fiber was observed. three different types of soils; clay, slit and silty sand were reinforced with polypropylene fiber of 0.3mm dia. fiber was in cut pieces of length 15, 25, 30 mm and aspect ratio of 50, 80 and 100 respectively. the amount of fiber was 0.75, 1.5, 2.25, and 3% by dry weight of soil. static tri-axial test of unreinforced and reinforced soil were conducted and the results showed uni-axial compressive strength of 3.82, 4.83 and 9.73 mpa respectively.
mishra ravi and jawed s.m. ali (2014) have illustrated the possibility of utilization of fly ash generated at thermal plants from coal, by using it in ground improvement methods. In this study samples were prepared of various mixes of different percentage of soil-fly ash and were aimed to gain strength by adding geo-fiber.

III. OBJECTIVES OF THE STUDY

In the present study, "Laboratory Investigation For Stabilization of Clayey Soil in Kashmir Valley" an attempt is made to study how Cement, Recron fibres may be effectively utilized in combination with clayey soil, to get an improved quality of composite material which may be used as better sub-grade for highways.

A. The specific Objectives of the Research Work Include

1) To collect clayey soil from land of City Budgam, State J&K.
2) To determine the index properties of the clayey soil including LL, PL and PI.
3) To study the clayey sub-grade soil sample under proctor compaction test to determine the maximum dry density and optimum moisture content.
4) To study the CBR value of clayey sub-grade soil at optimum moisture content and maximum dry density.
5) Stabilizing agent cement is mixed with clay soil in varying percentages and optimal dose is obtained from proctor compaction and CBR tests.
6) Clayey soil mixed with Recron fiber (6 mm) in varying percentages and optimal dose is obtained from proctor compaction and CBR tests.
7) Combined effect of optimal dose of different stabilizers (cement, and Recron fibre) on CBR value of clayey soils also studied.

IV. MATERIALS USED

A. Clayey Soil

In order to study the behaviour of clayey soil with different stabilizers a sample of Clayey sub – grade soil is collect from District Budgam, State J&K.

B. Cement

Ordinary Portland Cement (43 grade); manufactured by Khyber Cement is used in the present study as one of stabilizer. The cement bag of 50 kg bag was purchased from local market of Chadoora @ of Rs.500 per bag. Properties of the cement tested in laboratory are given in Table 1.

Table 1. Properties of Ordinary Portland Cement

Properties	Result Obtained	As per IS:8112-1989 specifications
Normal consistency	29%	25-35%
Initial setting time(min)	105	30(min)
Final setting time(min)	410	600(max)
Fineness retained on 90 µm	2.5%	10(max)
Specific gravity	3.17	…

C. Recron Fiber

Polyester staple Recron Fiber in 6 mm length are used in this study. The fibers are received from Reliance industries Ltd. New Delhi. Market price of the fiber is Rs. 230 per kg. Figure 1 shows the loose 6 mm polyester staple Recron Fiber and Manually mixing of fiber in the clay respectively.
The length of fiber is 6mm. The Fiber is randomly mixed with soil in varying percentage (0.4 %, 0.7%, 1.0%, 2.0%, 4%) by weight of dry soil. The properties of Recron fiber, as obtained from the manufacturer is mentioned in the Table 2.

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Table 2. Properties of Recron Fiber

Type	
Shape	Elliptical
Diameter	40-50 microns
Tensile Strength	>450 Mpa
Length of Fiber	6/12 mm
Specific Gravity	1.31-1.40
Elongation	>35%
Melting point (°C)	250-265



Fig. 1. Loose 6mm polyster Recron Fiber

V. METHODOLGY

Laboratory tests (Atterberg's limit, compaction, CBR) were carried out on clayey soil sample, and on combination of soil with Recron fiber and cement to determine the properties of soil sample.

The stabilization of clayey soil with Recron fiber is carried out by blending the soil with different percentages of Recron fiber(0.4%, 0.7%, 1%, 2%, 4%) and Cement (3%,5%,7%), and optimum amount is found out.

VI. RESULTS AND DISCUSSIONS

After the determination of basic properties of clayey soil, soil stabilized with Recron fiber and Cement, the strength parameters were determined by conducting proctor compaction tests and CBR tests.

A. Results of Standard Proctor Test for Clayey Sub-grade Soil

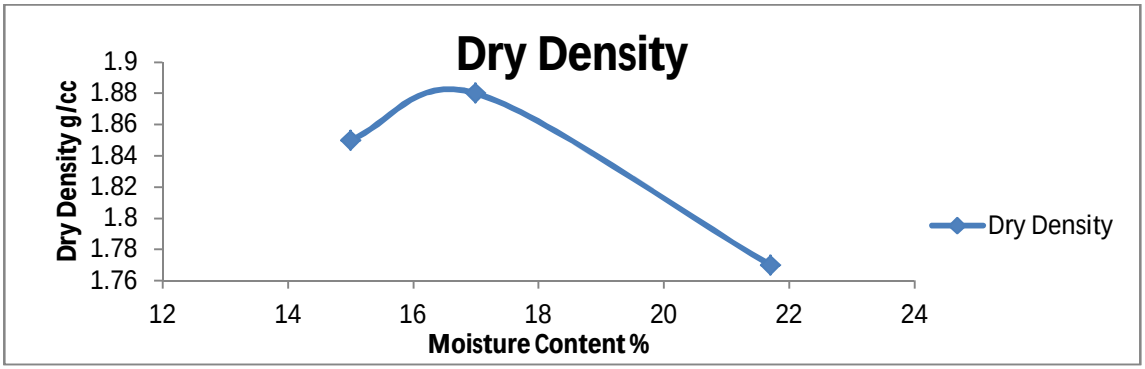


Figure – 2. Proctor compaction Test on clayey sub-grade soil

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From the test MDD is obtained as 1.88 g/cc and corresponding OMC is 17 %.

B. Results of standard proctor test for Clayey Sub-Grade soil Mixed with Cement

Table 3. MDD and OMC values of clayey soil and cement

Variation in MDD and OMC with Cement Stabilizers	Maximum Dry Density g/cc	Optimum Moisture Content (%)
Pure Clay	1.880	17
Clay + 3% Cement	1.865	14.1
Clay +5% Cement	1.860	15.2
Clay +7% Cement	1.850	15.5

From Table 3, it is observed that addition of 3%, 5%, and 7 % cement (by weight of dry soil)in clay, decreased the maximum dry density from 1.880 gm /cc to 1.850 gm/cc whereas OMC varies between 14.1 to 17%with no absolute trend.

C. Results of Standard Proctor Test for Clayey Sub-grade Soil mixed 6mm Recron Fibre:

Table 4 MDD and OMC values of Clayey soil and 6mm Recron Fiber

Variation in MDD and OMC with 6mm fiber	Maximum Dry Density (g/cc)	Optimum moisture Content (%)
Clay only	1.880	17
Clay + 0.4 % fiber	1.944	13.9
Clay + 0.7 % fiber	1.962	12.6
Clay + 1.0 % fiber	1.906	13.2
Clay + 2.0 % fiber	1.872	13.6
Clay + 4.0 % fiber	1.820	14.3

From table 4, it is observed that addition of 0.4%, 0.7%,1.0%, 2.0% and 4.0% 6mm Recron fiber (by weight of dry soil) in clay, MDD initially increases upto 0.7% then it starts decreasing and OMC varies between 12.6% to 17% with no absolute trend.

D. Results of Standard Proctor Test for Clayey Sub-grade Soil mixed with Cement and 0.4% Recron 6mm Fiber:

Table 5 MDD and OMC values of Clayey Soil + Cement + 6 mm Recron Fiber

Variation in MDD and OMC with 6mm Fiber	Maximum Dry Density (g/cc)	Optimum Moisture Content (%)
Clay Only	1.875	17
Clay+1.0% Cement +1% + 0.4% Fiber	1.885	13.9
Clay+1.0% Cement +2% + 0.4% Fiber	1.843	17.2
Clay+2.0% Cement +1% + 0.4% Fiber	1.840	17.7
Clay+2.0% Cement +2.0% + 0.4% Fiber	1.837	18.4

From Table 5, it is observed that addition of various proportion of cement and mixed with 0.5% 6mm Recron Fiber(by weight of dry soil) in clay, MDD initially increases for 1.0% C + 0.4% F then it starts decreasing and OMC initially decrease for 1.0% C + 0.4% F then it starts increasing for other combination as a percentage of and Cement increases with a constant 0.4% 6mm Fiber.

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E. Effect of a Combination of Cement and 0.4% Recron Fiber (6mm) soil stabilizer on CBR value of Clayey Soil under Un-soaked condition

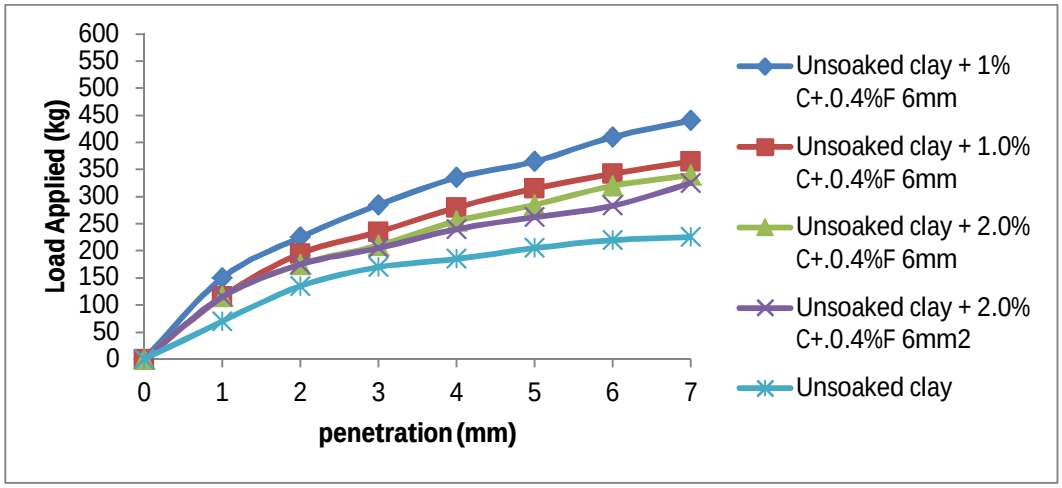


Figure 3 CBR value of Clayey Sub-grade Soil mixed with Cement 0.4% Recron Fiber (6mm)under Un-soaked condition

From Figure 3, it is observed, in un-soaked condition at 2.5 mm penetration the CBR value sharply increases with the addition of 1.0% Cement + 0.4 % F in the Clayey Soil thereafter it starts decreasing with variations in other combination as a percentage of Cement and increases with a constant 0.4% 6 mm fibre.

F. Effect of a Combination of Cement and 0.4% Recron Fiber (6mm) soil stabilizer on CBR value of Clayey Soil under soaked condition

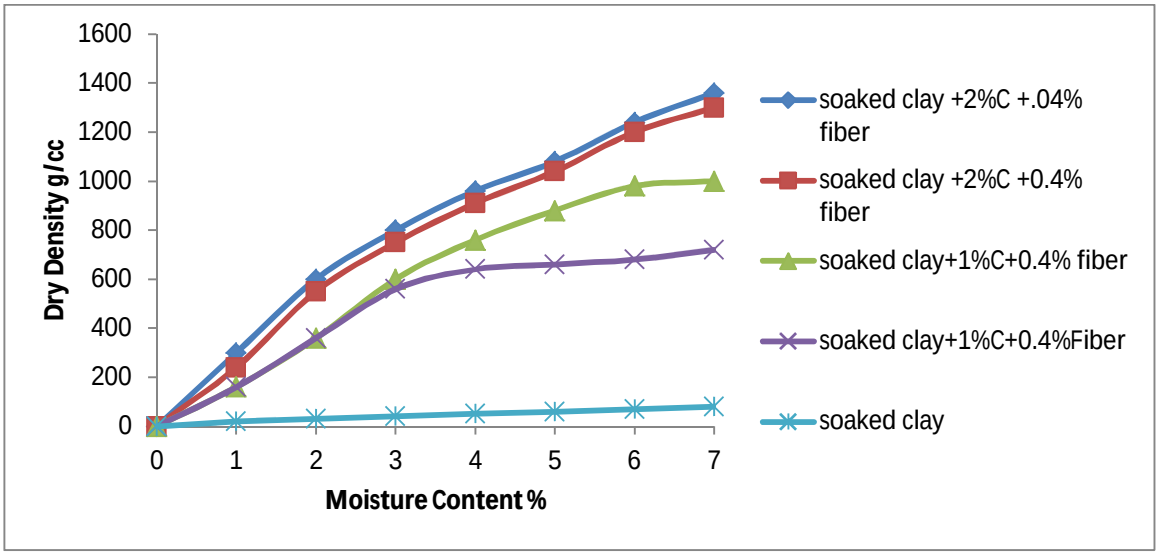


Figure 4 CBR value of Clayey Sub-grade Soil mixed with Cement 0.4% Recron Fiber (6mm)under soaked condition

From Figure 4, it is observed that, in soaked condition at 5.0mm penetration the CBR value increases with the increase in percentage of and Cement content with a constant 0.4% 6mm fiber.

VII. CONCLUSIONS

The present study on topic "Laboratory Investigation For Stabilization Of Clayey Soil in Kashmir Valley'' has been carried out to assess the effect of different soil stabilizers on California Bearing Ratio of Clayey sub-grade soil through trials in different proportions. The Stabilizers used in the study are Cement and Recron fiber with 6mm length. The clayey soil sample is collected from Budgam . The Proctor compaction test and CBR tests on clayey soil and clayey soil mixed with stabilizers are conducted in laboratory to meet out the objective of the study. This main conclusion drawn on the basis of test results, are given below.

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A. With the present cost of Recron Fibre @230/kg it may be viable to use it for improvement of sub-grade CBR value as compared to cement.

B. Saturation and clay sample took soaking of 17 days. However clay sample with addition of 5% and 7% of cement could not be saturated even after 30 days

C. Best result under soaked condition are obtained with 7% of cement. However, the difference between the CBR value by addition of 5% and 7% cement is not much. Therefore from economical consideration addition of 5% cement gives the best result after soaking period of 30 days.

D. Addition of 6mm long Recron fiber, upto 0.4% increases the CBR value and at higher percentage specimen becomes pervious in nature resulted in reducing soaking period and saturated CBR value.

E. It can also be concluded that the use of Recron fiber results in considerable increase in strength of subgrade economically, which is the need of hour

VIII. ACKNOWLEDGEMENT

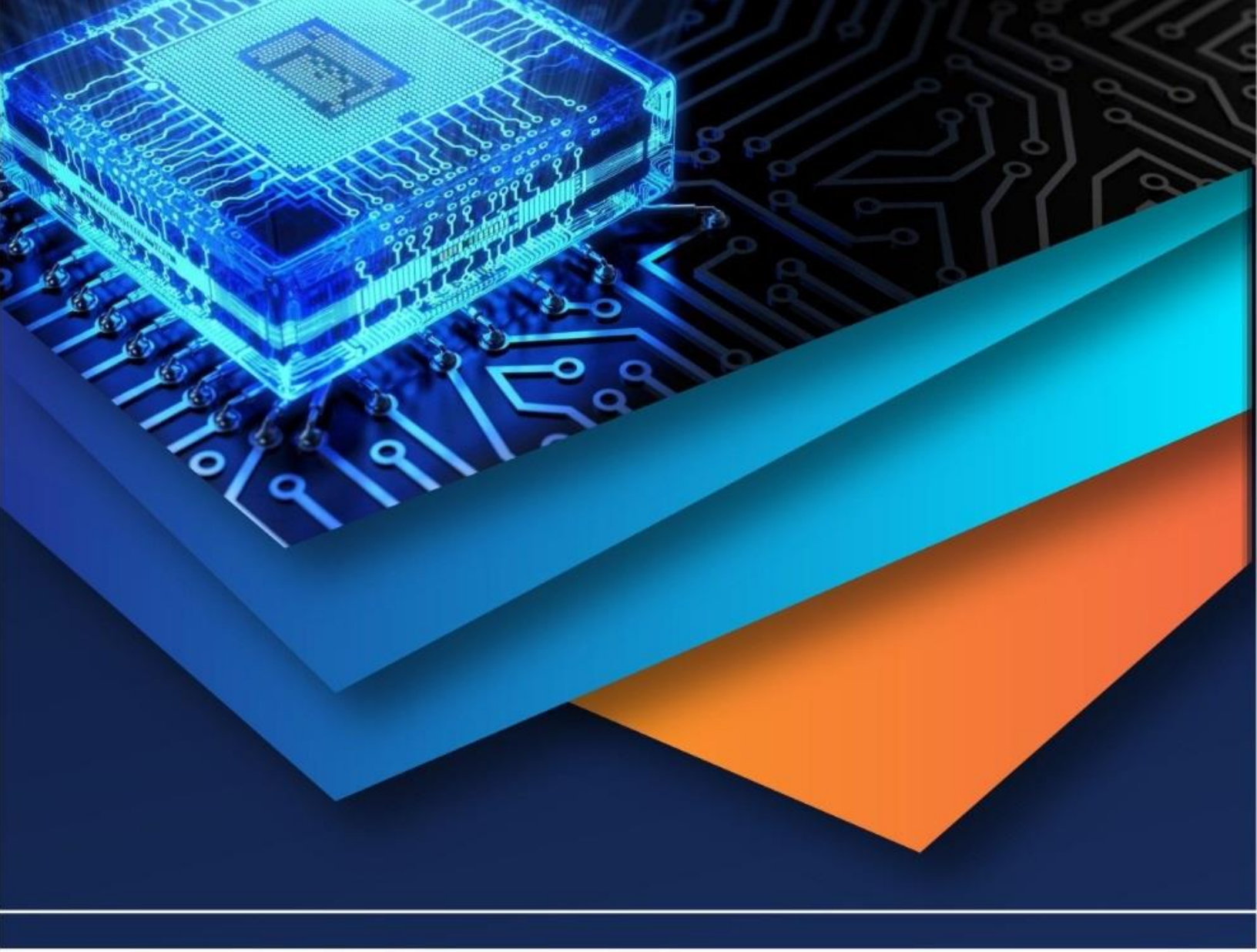
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