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Appraisal of Suitability of Irrigation Tank Sediment for Use in Pavement and Embankment Construction

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Abstract: ***Indian subcontinent with a vast area and typical topography has most of its population living in rural areas. Hence, it is essential to improve roads and irrigation facilities for development of rural population and to have development of country. The huge expenditure for lying of roads and improvement of irrigation facilities is seriously affecting the government for developing rural areas. As a result there is need for exploiting the local resources in constructing the said facilities. The reservoir receives sediments from various sources such as tunnels, rivers, lakes and thereby the capacity of reservoirs is decreasing year after year. The reservoir sediment needs to be removed frequently to have its full capacity and carter to the indeed needs. In the present study sediment material collected from irrigation tank located in mangalpalem village, vizianagaram has been assessed for its suitability as construction material for laying payments and Embankments. Extensive laboratory investigations have been carried out on sediment material and its suitability for use in road formation and canal or highway embankment construction is assessed based on IRC/MORTH Specifications. Based on study results sediment material is found suitable for construction of Embankments of heights up to 6m.***
Keywords: Rural Roads , Tank Embankments.

I. INTRODUCTION

Road connectivity and irrigation facilities plays a key role in development of a country‘s overall development and rural road Must be laid to connect every corners of a country for better productivity and sufficient irrigation facilities must be developed which needs major allocation of funds for these development and for reducing the costs of construction and improving the existing facilities suitable methods have to be adopted and utilization of locally available soil material for the construction is a better alternative for economical construction.

In the present need for expanding rural roads and strengthening of irrigation tank bunds has been presented. For conducting the present study soil obtained from an irrigation tank in Mangalpalem village, kothavalsamandal, vizianagaram district and laboratory tests are performed to assess its suitability for laying of rural roads and strengthening of irrigation tank bunds is presented and suitable ground improvement facilities are suggested.

A. Aims Amd Objectives

1) ***Aims*****:** To assess the suitability of the collected material for use in formation of sub-grade in rural roads and strengthening of irrigation tank bunds by studying the properties of the soil sample and determining its suitability for the purpose according to the specifications and guidelines given by PMGSY and to find out other advanced techniques to stabilize the soil and make it fit for use of bed material in formation of Roads and Embankments.

B. Objectives

1) To study the engineering properties of soil material collected from the bed of the minor irrigation tanks.
2) To collect literature pertaining to suitability of soils in formation of rural roads and strengthening of tank bunds.
3) Studying the Specification of material for reservoir bund formation. Assessment of suitability of bed soil for using road sub grade and embankment works.
4) To suggest methods for using bed soil as construction material in sub grade for rural roads and embankments by adopting advanced techniques.

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II. STUDY METHODOLOGY

A. *Of Bed Material For Possible Use*

Table 2.1: MORTH Specifications for road subgrade and embankments

S.no	Engineering properties	Embankments	Road Sub Grade
1	Grain size (mm)	< 75	< 50
2	Liquid limit (%)	< 70	< 70
3	Plastic Limit (%)	< 45	< 45
4	Differential Free Swell (%)	< 50	< 50
5	Maximum Dry Density kN/c.m	≥ 15..2 (for height ≤ 3mm) ≥ 16.0 (for height > 3mm)	≥ 17.5
6	California Bearing Ratio (%)	No restriction upto 6 m height	≥ 3

If the collected soil sample does not satisfy these criteria it is considered to be unsuitable for the required purposes.

III. DETAILS OF STUDY

A. *General*

In this chapter, the engineering properties of soil used in the subgrade formation of roads and strengthening of tank bunds determined from the laboratory tests presented. Their suitability for use as sub grade material for rural roads and bund strengthening and feasibility of using bed material in construction of roads and tank bunds is discussed.

B. *Engineering Properties Of Tank Bed Material*

The material used for experiment has been collected from irrigation tank in mangalapalem village, kothavalasamandal, vazianagaram district. Extensive laboratory investigations have been carried out on the sample to obtain the engineering properties. The details of tests are given below.

1) *Specific Gravity:* The Specific Gravity test is carried out on the soil sample using density bottle experiment according to IS:2720 Part – 1. The Specific Gravity of the sample found from laboratory test are presented in the Table 3.1
2) *Grain Size Analysis:* The Grain Size distribution is carried out by conducting Sieve Analysis. The analysis is carried out according to IS:1498-1970. The classification details are shown in the table 3.1
3) *Hydrometer analysis::*The hydrometer analysis is carried out for the fine grained soil particles passing through 75M.
4) *Liquid Limit :*Liquid Limit of the soil sample is determined by conducted experiment on Cassagrande's apparatus and ASTM tool in the laboratory . the liquid limit of the sample is presented in the Table 3.1.
5) *Shrinkage Limit:* The Shrinkage limit of soil sample is determined in the laboratory and the test results are presented in the Table 3.1.
6) Plastic Limit: The plastic limit of soil sample is determined in the laboratory and the test results are presented in Table 3.1
7) Compaction Test: IS light compaction test is conducted on soil sample as per IS -2720 Part – 8. The compaction characteristics of the soil are shown in the Table 3.1. the compaction curve for the soil is presented in the Graph3.1
8) *Differential free swell test:* The Differential Free Swell test is conducted on the soil sample and the result is presented in the Table 3.1.
9) *Unconfined compressive strength test:* The unconfined compressive strength test is a special form triaxial test used to determine the maximum compressive strength of the sample . the result is presented in table 3.1 and results are also represented in graph 3.2
10) *Permeability test:* Laboratory determination of permeability of fine grained soil as per IS: 2720 – 1986, part 17 . The result in table 3.1.
11) *California bearing ratio test:* California bearing ratio test is conducted on the soil samples compacted to their OMC as per IS Code on soaked soil sample and result is presented in the table 3.1 The CBR curve for the soil is presented in the Graph 3.3.

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Table 3.1 Engineering Properties of Tank Bed Soil Used in Roads and Tank bunds :

S.NO.	Engineering property	Value
1	Specific Gravity	2.70
2	Grain Size Analysis Gravel fraction (%) Sand fraction (%) Fines fraction (%)	 0 16 84
3	Hydrometer Analysis Slit fraction (%) Clay fraction (%)	 79.7 4
4	Plasticity characteristics Liquid Limit (%) Plastic Limit (%) Shrinkage Limit (%)	 54 33.2 20.23
5	IS Classification symbol	CH
6	Compaction characteristics (IS Light compaction) Maximum Dry Density (g/cc) Optimum Moisture Comtent (%)	 1.67 24.07
7	Differential free swell index (%)	54
8	Unconfied compressive strength Undrained cohesion	1.10
9	Permeability (cm/s)	3X10-6
10	Californa bearing ratio Soaked (%)	1.83

C. Assessment Of Suitability Of Bed Material

For Use As Grade For Rural Road The suitability of bed material for its use as sub grade for rural roads is based on its engineering properties and by comparing with the specifications given by Indian Road Congress and MORTH Specifications for roads and bridges.

1) *Grain Size:* For the formation of rural roads sub grade, IRC specifies the coarser fine sub grade soil should not be greater than 50mm. The sediment material has 99.9% Fine at 4.75mm sieve. Hence it satisfies the criteria and suitable for construction of road sub grade.
2) *Liquid Limit:* For the formation of rural roads sub grade, IRC specifies the Liquid Limit of sub grade soil should not be greater than 70%. The sediment material has 54%. Hence it satisfies the criteria and suitable for construction of road sub grade.
3) *Plastic Limit:* For the formation of rural roads sub grade, IRC specifies the Plastic Limit of sub grade soil should not be greater than 4%. The sediment material has 33.2%. Hence it satisfies the criteria and suitable for construction of road sub grade.

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4) *Differential Free Swell:* For the formation of rural roads sub grade, IRC specifies the Differential free Swell of sub grade soil should not be greater than 50%. The sediment material has 54%. Hence it satisfies the criteria and un-suitable for construction of road sub grade.
5) *Maximum Dry Density:* For the formation of rural roads sub grade, IRC specifies the Maximum Dry Density of sub grade soil should be greater than17.5kN/m. The sediment material has 16.74kN/m. Hence it not satisfies the criteria and un-suitable for construction of road sub grade.
6) *California Bearing Capacity:* For the formation of rural roads sub grade, IRC specifies the California Bearing Ratio of sub grade soil should be greater than 3%. The sediment material has CBR value of 1.83%. Hence it not satisfies the criteria and un-suitable for construction of road sub grade.

Table 3.2 Suitability of Bed Material for use as Sub Grades for Rural Roads :

S.No	Property	Value	Requirement as per IRC/MORTH	Suitability
1	Maximum dry density kN/m	16.7	>17.5	Not Satisfactory
2	Liquid limit %	54	<70	Satisfactory
3	Plastic limit %	33.3	<45	Satisfactory
4	Differential Free Swell %	54	<50	Not Satisfactory
	California Bearing Ratio %	1.83	>3	Not Satisfactory

D. Assessment Of Suitability Of Bed Material For Construction Of Tank Bunds

The suitability of bed material for its use as Embankment material is based on its engineering properties and by comparing with the specifications given by Indian Roads Congress MORTH Specifications for roads and bridges.

1) *Grain Size:* For the formation of Embankment bunds, IRC specifies the coarser fine sub Embankment soil particle size should not be greater than 75mm. The sediment material has 99.9% Fine at 4.75mm sieve. Hence it satisfies the criteria and suitable for construction of road Embankments.
2) *Liquid Limit:* For the formation of Embankment, IRC specifies the Liquid Limit of Embankment soil should not be greater than 70%. The sediment material has 54%. Hence it satisfies the criteria and suitable for construction of Embankments.
3) *Plastic Limit:* For the formation of Embankment, IRC specifies the Plastic Limit of Embankment soil should not be greater than 45%. The sediment material has 33.19%. Hence it satisfies the criteria and suitable for construction of Embankments.
4) *Differential Free Swell:* For the formation of Embankment, IRC specifies the Differential free Swell of Embankment soil should not be greater than 50%. The sediment material has 54%. Hence it is not satisfies the criteria and un-suitable for construction of Embankments.
5) *Maximum Dry Density:* For the formation of Embankments, IRC specifies the Maximum Dry Density of Embankments soil should not be lesser than15.2kN/m for bund height less than 3m and should not be lesser than 16.0 kN/m for bund height greater than 3m.The sediment material has 16.7kN/m. Hence it not satisfies the maximum criteria and suitable for construction of Embankments.
6) *California Bearing Capacity:* For the formation of Embankments, as per TRH Specifications there is no restriction for California Bearing Ratio of construction material for heights upto 6m. The sediment material has CBR value of 1.8%. Hence it not satisfies the criteria and suitable for construction ofEmbankments.TRH Satisfaction of construction material of embankments are presented in table 4.3.

Table 3.3

S.No	Height of Embankments(m)	Embankments
1	0-6	No Restriction
2	6-9	3

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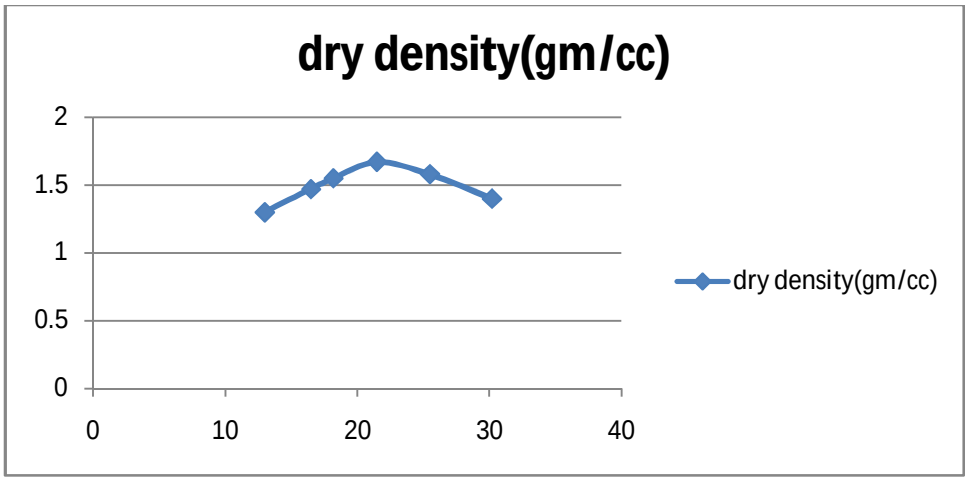
3	9-15	5
4	15	7

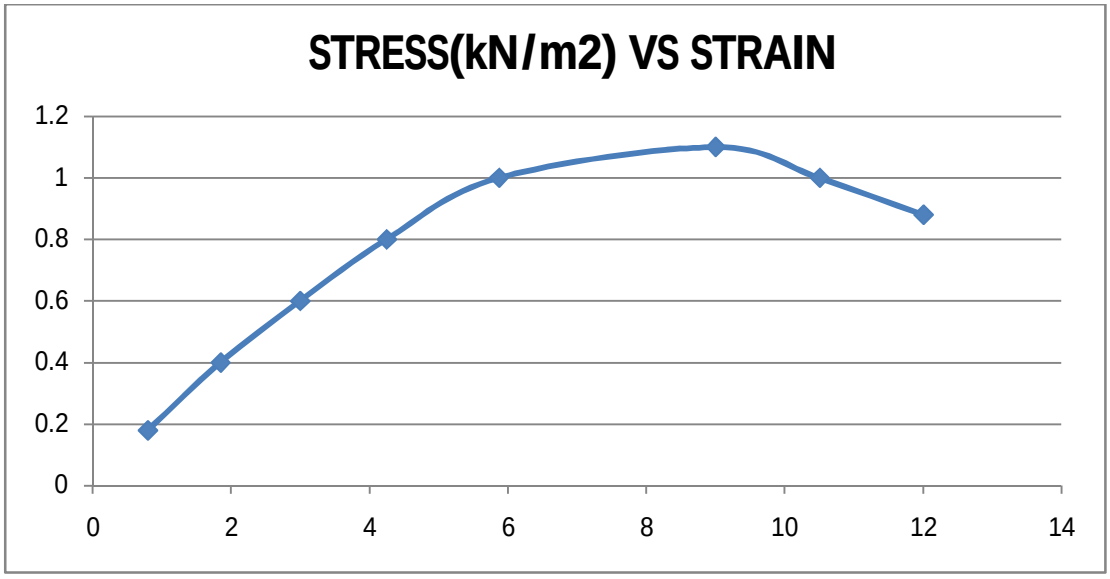
Table 3.4 Suitability of Bed Material for use as Construction of Tank Bunds :

S.NO.	Property	Value	Requirement as per IRC/MORTH	Suitability
1	Maxium dry density KN/m3	16.7	≥ 15.52(Height <3m) ≥ 16.0(Height >3m)	Satisfactory
2	Liquid Limit %	54	<70	Satisfactory
3	Plastic Limit %	33.2	>45	Satisfactory
4	Differential Free Swell %	54	>50	Not Satisfactory
5	California Bearing Ratio %	1.83	No Restriction upto 6m	Satisfactory

Graphs



Graph 3.1 Compaction Curve (dry density vs water content)



Graph 3.2 Unconfined Compressive Strength Curve

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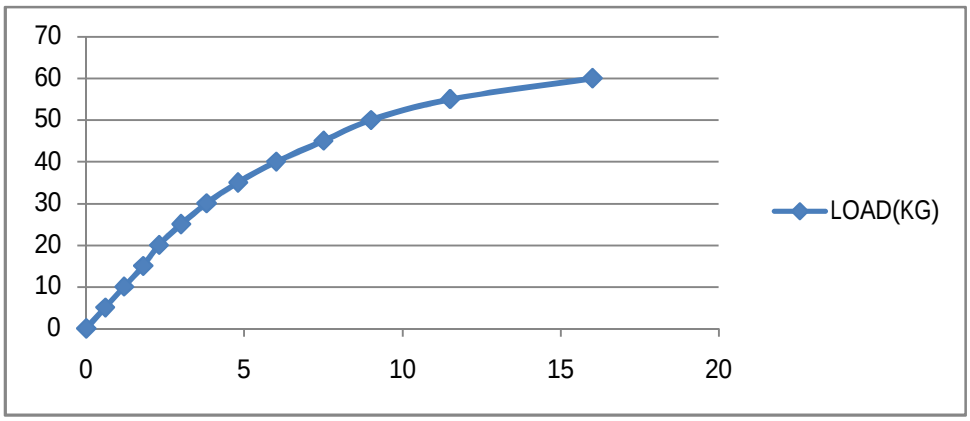

Graph 3.3 Load penetration curve in California Bearing Ratio test (load vs penetration)

E. Feasibility of Using Bed Material as Construction of Road

1) *Sub Grades and Tank Bunds:* Since replacement of poor sub grade with good material may not be cost effective so lime stabilization is economical and is applied in all types of roads from city streets to highways. Bed material can be considered for use in construction of payments and embankments are followed by some techniques
2) *Lime Stabilization:* By adding 6-8% of lime to the sediment soil makes the bed material suitable for formation of subgrade and in construction of embankments of height more than 6m.
3) *Thermal Stabilization:* By heating the sediment soil at high temperatures of 400°C , the soil properties will change completely . In turn making suitable use in construction of payments and embankments.
4) *Geo Cell Mattress:* As the CBR Value is below 2% ,adopt Geo Cell Mattress in the payment section in lower portion of sub base , then the pavement construction material gets the CBR Value greater than 3%.

IV. SUMMARY AND CONCLUSIONS

A. General

The chapter summarizes the total work carried out. The properties of the bed material determined for tests are summarized and potential for possible use in construction of rural roads and irrigation tank bunds are stated.

B. Properties Of Bed Material

Referring to the section 4.2 the sediment material from bed of irrigation tank is classified as high compressible clay with maximum dey density of 16.74%KN/m3 and differential free swell index of 54% , it has liquid limit of 54%, and is impervious soil of permeability (3x10-6) the soil has low California Bearing Ratio Value (1.83%).

C. Summary On Use Of Bed Material As Construction Material For Rural Roads

Referring to section 4.3, though the bed material satisfied the grain size, plasticity requirements it did not fulfill the requirement of Differential Free swell , Maximum dry density and California bearing ratio . Hence the sediment material cannot be considered for formation of sub grades of pavements .

D. Use Of Bed Material As Construction Of Irrigation Tank Bunds

The bed material satisfy the criteria of maximum dry density and California bearing ratio for irrigation tank bund construction up to height 6m. but this bed material fails to satisfy the criteria of Differential Free Swell Index , specified in Indian road congress for its use in sub grade formation of rural roads . hence it is suitable for use in except in top 0.5 m height of irrigation tank bunds .

V. CONCLUSIONS

Based on the laboratory tests and assessment work carried out in the study , the following conclusions are drawn

A. Irrigation tank bed material is fine grained in nature and is classified as high compressible clay (CH)
B. The Irrigation tank sediment material has very high amount of fines (84).
C. Hence possess low permeability and high compressibility.
D. The sediment has very high Swell potential (54%) .

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E. The collected bed material is suitable for formation of road sub grades as the soaked CBR value is lesser than 3% .

F. The collected bed material is suitable for construction of irrigation of tank bunds of height upto 6m based on the criteria of California Bearing Ratio .

G. The collected bed material failed to satisfy the criteria of Differential Free Swell Index (54%).

VI. LIMITATIONS OF STUDY

A. The assessment carried out is applicable for the soil collected from the Irrigation tank in Mangalpalem village , Kothavalsamandal , Vizianagaram district

B. In the present study , the suitability of bed material used as construction material for roads and embankments , its suitability for brick making is not delt .

REFERENCES

[1] Arora K.R. (2004) ," Soil mechanics and foundation engineering " , Standard publishers Distributors , Delhi .
[2] S.K . KHANNA and C .E.G .JUSTO (2001) , " Highway Engineering " Standard Publishers ,Roorkee .
[3] IS : 2720 (Part 5) -1995: Determination of liquid and plastic limit for soil .
[4] IS : 2720 (Part 16) -1997: Laboratory determination of Soaked CBR for soil .
[5] IS :2720 (Part 13) -1986: Laboratory determination of Direct shear test for soil .
[6] IS :2720 (Part 4) -1985: Standard Method of sieve analysis .
[7] IS:2720 (Part 8) -1983: Heavy Compaction Test .
[8] Indian Road Congress (IRS) Specifications .
[9] MORTH Specifications on Roads and Bridges.
[10] Specification for rural roads , MORD (2004)
[11] Rural Roads manual IRC :SP -20-2002.
[12] Jewell. R.A.(1996) Soil Reinforcement with Geotextiles , Construction industry Research and information Association (CIRIA) Publication , LONDON.
[13] TRH 9-1982: Construction of Road embankments , Technical Recommendation for Highways , South Africa , PPL-42.
[14] Sedimentation of sand and mud in reservoir in rivers by Leo.C.VanRijin.(www.Leovanrijn.sediment.com)

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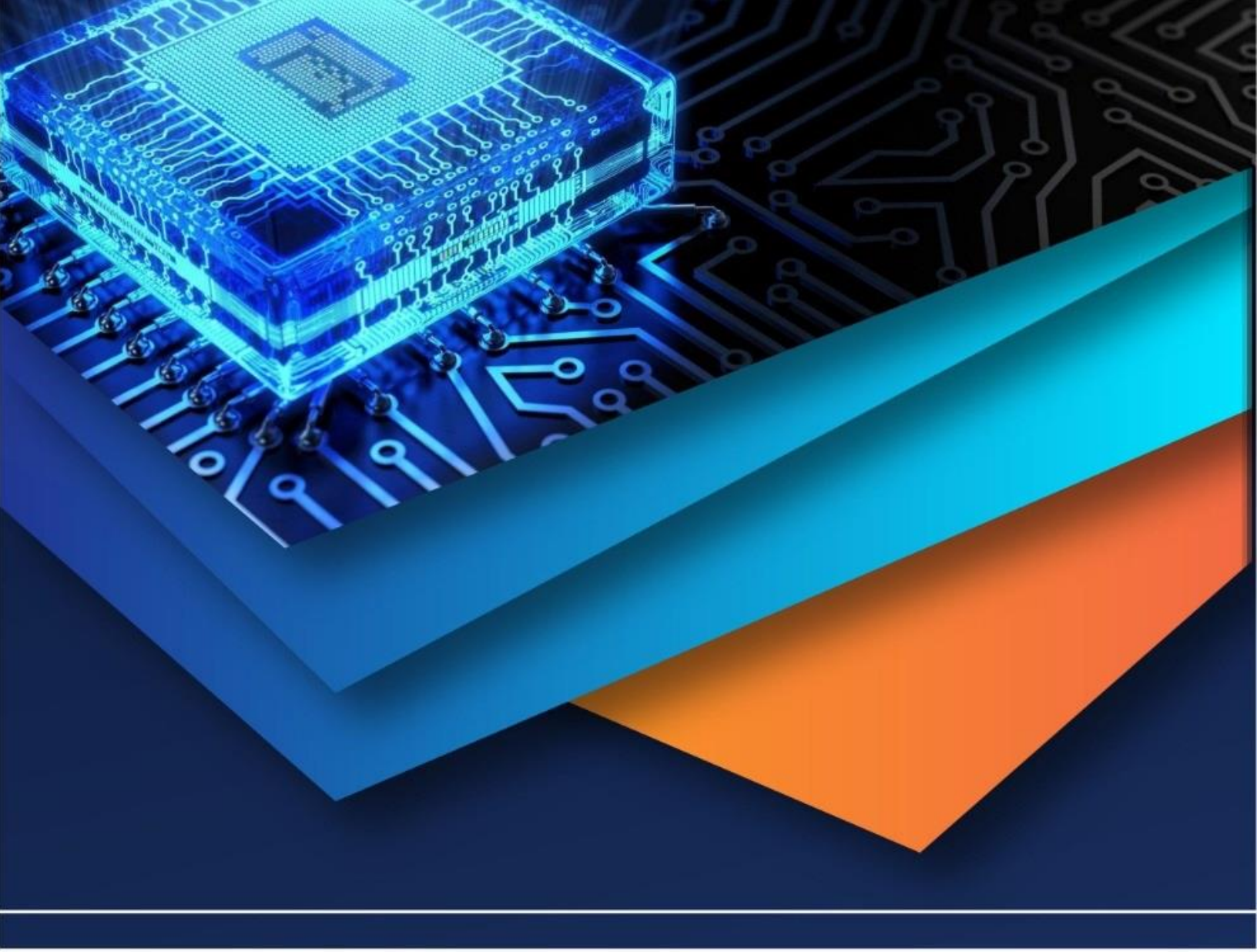

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