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Comparative Study of BIS and ACI Method of Concrete Mix Design using Alccofine as a Partial Replacement of Cement

Mr. Nitesh Kumar Chandel, Mr. Rohit Sahu[2], Dr. Pankaj Singh[3]
[1]Student - M.Tech (Structural Engineering), [2]Assistant Professor, [3]Associate Professor, Department of Civil Engineering
RKDF Institute of science and Technology Bhopal, M.P., India

Abstract: ***This paper presents a comparison of BIS, and ACI methods of concrete mix design, combining the test results of these methods. The M40 and M50 grades of concrete have been designed for comparison using alccofine.***
In this project we replaced the cement by varying percentage of alccofine ranging from 0%, 5%, 10%, 15% and 20% by weight and MASTER POLYHEED 8632 as admixtures and British code, American concrete institute method, and Indian standard method is used to design and comparison of results..In this paper the results found that the at 10% the strength will be maximum after that the strength decreases.ACI method gives more strength that BIS method.
Keywords: Bureau of Indian Standard, American concrete Institute method, Alccofine, Mater polyheed, Admixturres

I. INTRODUCTION

In all over the world the use of concrete is increases day by day .Therefore the uses of high strength and uses in high rise building and multistory building. Master Polyheed is a type of polycarboxylic ether and it is economical type .this product is developed for making application in ready mix concrete. It reduces the water and also maintains the set of retardation. it is free from chlorine and it contains low alkaline. it is good with all types of cement.
This paper investigates the use of alccofine as partial replacement of PPC in M-40 and M-50 grade of concrete. The percentage replacement of PPC by alccofine was 0%, 5%, 10%, 15% and 20%. The test specimens (cubes) casted and tested as per relevant IS code of practice British code and American concrete institute method for 28 days compressive strength.

II. LITERATURE REVIEW

A. As per Siddharth P. Upadhyay
"Studied that the Compressive strength of high performance concrete with the replacement of cement with Alccofine and Fly ash, and also with natural sand to manufactured sand The concrete specimens were cured on normal moist curing under normal atmospheric temperature. The compressive strength was determined at 3, 7 and 28 days. The addition of Alccofine shows an early strength gaining property and that of Fly- ash shows long term strength. The ternary system that is Ordinary Portland cement-fly ash-Alccofine concrete was found to increase the compressive strength of concrete on all ages when compared to concrete made with fly ash and Alccofine alone.

B. As per Sharandeep Singh
Studied that a comparison of DOE, ACI, BIS and USBR methods of concrete mix design, combining the test results of these methods. . M35 and M40 grades of concrete were used to carry out the comparison based on the mechanical properties of concrete. The observations showed that all the methods achieved the target mean strength either, in case of M40 or M35 except the ACI method in case of M40 for which the cement content has to be raised by an amount of 15 kg/m3, to fulfill the minimum requirements of compressive strength. Nevertheless, the USBR method attained the highest compressive strength either at 7 days or after 28 days, which was 123.31% of the target strength required. Whereas, the outcomes obtained by BIS and DOE method cannot be overlooked. The USBR method attained maximum flexure strength for M35 grade, whereas, BIS achieved highest values of flexure for M40 grade

C. As per Saurabh Gupta

Studied that Effect on compressive strength of high performance concrete incorporating alccofine and fly ash" the Compressive strength of high performance concrete with the replacement of cement with Alccofine and Fly ash, and also with natural sand to manufactured sand. The compressive strength was determined at 3, 7 and 28 days. The addition of Alccofine shows an early strength gaining property and that of Fly- ash shows long term strength. The ternary system that is Ordinary Portland cement-fly ash-Alccofine concrete was found to increase the compressive strength of concrete on all age when compared to concrete made with fly ash and Alccofine alone.

D. As per M.S. Pawar

" Studied that the comparison of the properties of self compacting concrete with fly ash and Alccofine to that of standard one. With fly ash The main variable is proportion of Alccofine keeping cement, fly ash, water, coarse aggregate, fine aggregate and super plasticizer contents constant The addition of Alccofine in SCC mixes increases the self compatibility characteristic like filling ability, passing ability and .resistance to segregation. Fresh Properties and harden Properties of SCCs with 10% Alccofine are superior than SCCs with 5% and 15% of Alccofine.

E. As Per Deepa A. Sinha

Concrete mix design is the process of choosing suitable ingredient of concrete and determining their relative quantities with the object of producing as economically as possible concrete of certain minimum properties, notable workability, strength and durability. It should be explained that an exact determination of mix proportions by means of table or computer data is generally not possible. The main objective of the study was to design M25 concrete mix and find the compressive strength using different mix design methods like IS10262-1982, IS 10262-2009, ACI method and DOE method. We conclude that in above four methods minimum cement content used in DOE methods and it gives desire compressive strength of concrete economical way .

III. EXPERIMENTAL INVESTIGATION

A. Materials Cement

In this experimental investigation Portland pozzolana cement was used.

B. Fine Aggregates

The fine aggregates used in this investigation was Natural River sand passing through 4.75 mm sieve with specific gravity of 2.61. The percentage of passing is within the limits as Indian Standard Specification. The fine aggregate corresponds to the zone II gradation as per IS 383:1970.

C. Coarse Aggregates

Normal crushed broken stone aggregate angular in shape was used as coarse aggregates. Only one fraction of coarse aggregates were used, 20mm size having specific gravity of 2.64.

D. Alccofine

Alccofine has unique properties to enhance the 'performance of concrete' in fresh and hardened stages due to its much finer particle size. Alccofine is manufactured by some controlled conditions with special technique to produce micro fine size. Alccofine is generally two types one is low calcium silicate which is Alccofine 1203 and other is high calcium silicate which is Alccofine 1101.

E. Water

Ordinary tape water clean, potable free from suspended particles and chemical substance was used for both mixing and curing of concrete.

F. Master Polyheed 8632

Master polyheed is a type of polycarboxylic ether and it is economical type .this product is developed for making application in ready mix concrete. It reduces the water and also maintains the set of retardation. it is free from chlorine and it contains low alkaline. it is good with all types of cement.

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TABLE 1: CONSTITUENTS OF DIFFERENT MIXES FOR M-40 GRADE, ACCORDING TO IS METHOD

Mixes	M-40-IS 0	M-40-IS 5	M-40-IS 10	M-40-IS 15	M-40-IS 20
Cement (kg/m3)	345	361	342	323	304
Water (kg/m3)	137	136	137	136	136
Sand (kg/m3)	685	672	673	673	673
Coarse aggregate (kg/m3)	1261	1240	1240	1241	1241
Alccofine (kg/m3)	0.00	18.97	37.95	56.92	75.90

TABLE 2 CONSTITUENTS OF DIFFERENT MIXES FOR M-40 GRADE, ACCORDING TO ACI METHOD

Mixes	M-40-ACI 0	M-40-ACI 5	M-40-ACI 10	M-40-ACI 15	M-40-ACI 20
Cement (kg/m3)	361	343	325	307	289
Water (kg/m3)	132	132	131	131	131
Sand (kg/m3)	863	862	865	870	873
Coarse aggregate (kg/m3)	1050	1050	1050	1050	1050
Alccofine (kg/m3)	0	18.05	36.10	54.15	72.20

TABLE 3 : CONSTITUENTS OF DIFFERENT MIXES FOR M-50 GRADE ACCORDING TO IS METHOD

Mixes	M-40-IS 0	M-40-IS 5	M-40-IS 10	M-40-IS 15	M-40-IS 20
Cement (kg/m3)	394	411.30	389.7	368	346
Water (kg/m3)	136.67	136.70	136.70	136.67	136.68
Sand (kg/m3)	667	654	654	656	656
Coarse aggregate (kg/m3)	1230	1206	1206	1206	1207
Alccofine (kg/m3)	0.00	21.65	43.30	64.95	86.60

TABLE 4 : CONSTITUENTS OF DIFFERENT MIXES FOR M-50 GRADE ACCORDING TO ACI METHOD

Mixes	M-50-ACI 0	M-50-ACI 5	M-50-ACI 10	M-50-ACI 15	M-50 ACI 20
Cement (kg/m3)	392	373	353	333	314
Water (kg/m3)	132	131	131	131	131
Sand (kg/m3)	858	854	857	860	863
Coarse aggregate (kg/m3)	1050	1050	1050	1050	1050
Alccofine (kg/m3)	0	19.60	39.20	58.80	78.40

M 40-IS 0, M50-IS 0, M40 ACI 0& M50-ACI 0- concrete mix without any replacement.
M 40-IS 5, M50-IS 5, M40 ACI 5& M50-ACI 5 concrete mix with 5% replacement of PPC by alccofine.
M 40-IS10, M50-IS 10, M40 ACI 10& M50-ACI 10- - concrete mix with 10% replacement of PPC by alccofine.
M 40-IS 15, M50-IS 15, M40 ACI 15& M50-ACI 15- concrete mix with 15% replacement of PPC by alccofine.
M 40-IS 20, M50-IS 20, M40 ACI20 0& M50-ACI 20- concrete mix with 20% replacement of PPC by alccofine

G. Grade of Concrete

The mix proportion of this investigation was 1:1.98:3.65(W/C 0.39) and 1:2.39:2.90 (W/C 0.36) for M40 grade according to IS and ACI method respectively..and 1:1.69:3.12 (W/C 0.35)and 1:2.18:2.65 (W/C 0.35)for M50 grade according to IS and ACI method

respectively was adopted.

IV. PREPARATION OF SPECIMENS

The strength characteristics of concrete with varying percentage of alccofine were studied by casting cubes. The constituents of the concrete via, cement, fine aggregate and coarse aggregate were mixed to appropriate proportion by adding water Alccofine is added to the different mix in varying proportion as a partial replacement for cement. Moulds for cube of size 150 x 150 x 150mm were prepared and concrete was poured in to the mould layer by layer and compacted thoroughly. The specimens were removed from the moulds after 24 hours and then the specimens were cured with water for 28 days.

V. RESULT AND DISCUSSIONS

It was found from the experimental results that the compressive strength has increased for the specimens with varying percentage of alccofine as replacement for cement when compared with the conventional concrete at percentage of 10% after that adding of alccofine increases the strength decreases gradually. The optimal dosage at 10% gives the good strength. The test result obtained are presented in table

TABLE 5: 7AND 28 DAYS COMPRESSIVE STRENGTH OF CONCRETE CONTAINING VARIOUS PERCENTAGE OF ALCCOFINE BY IS AND ACI METHOD FOR M 40 GRADE OF CONCRETE.

Mix no.	7 days strength	28 days strength
M40 IS 0	19.40	28.83
M40 IS 5	23.94	32.48
M40 IS 10	26.60	38.20
M40 IS 15	23.11	35.30
M40 IS 20	21.42	33.03
M40 ACI 0	21.06	30.11
M40 ACI 5	25.61	33.56
M40 ACI 10	27.92	39.65
M40 ACI 15	22.45	34.17
M40 ACI 20	20.22	32.87

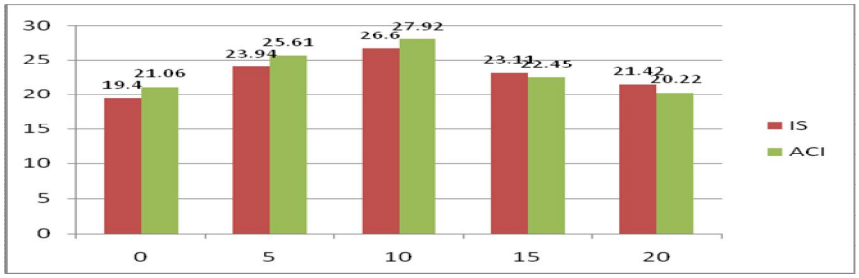

Fig. 1: Graphical representation of 7 days strength obtained for M 40 mixes

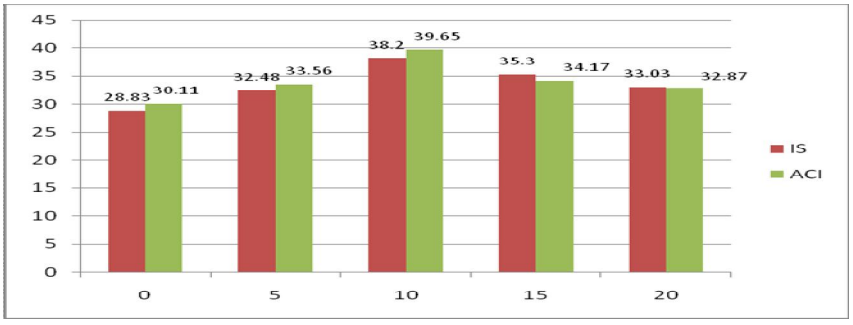

Fig. 2: Graphical representation of 28 days strength obtained for M40 mixes

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Table 6: 7and 28 days compressive strength of concrete containing various percentage of alccofine by IS and ACI method for M 50 grade of concrete.

Mix no.	7 days strength	28 days strength
M50 IS 0	24.21	34.70
M50 IS 5	29.26	40.47
M50 IS 10	33.60	47.95
M50 IS 15	30.03	44.34
M50 IS 20	26.49	37.96
M50 ACI 0	24.47	35.10
M50 ACI 5	28.38	41.98
M50 ACI 10	34.89	48.65
M50 ACI 15	31.55	43.12
M50 ACI 20	26.10	36.26

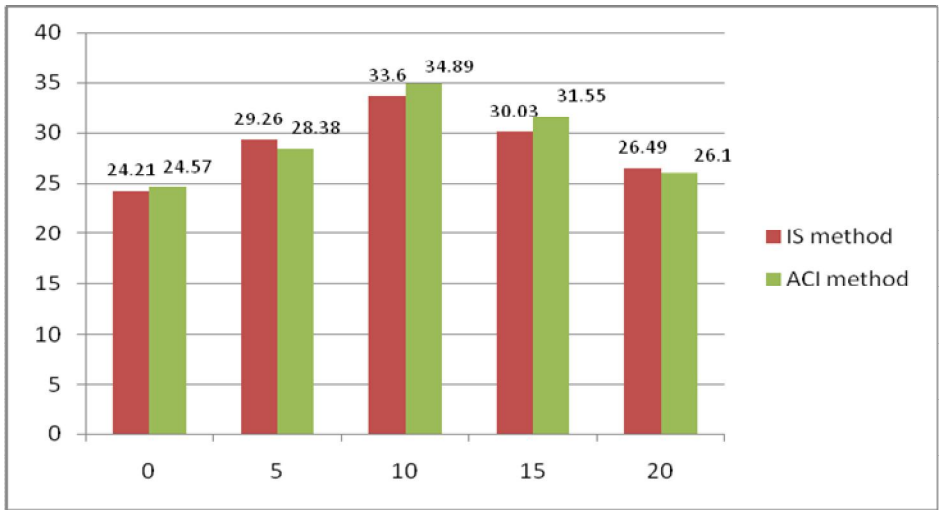

Fig. 3: Graphical representation of 7 days strength obtained for M50 mixes

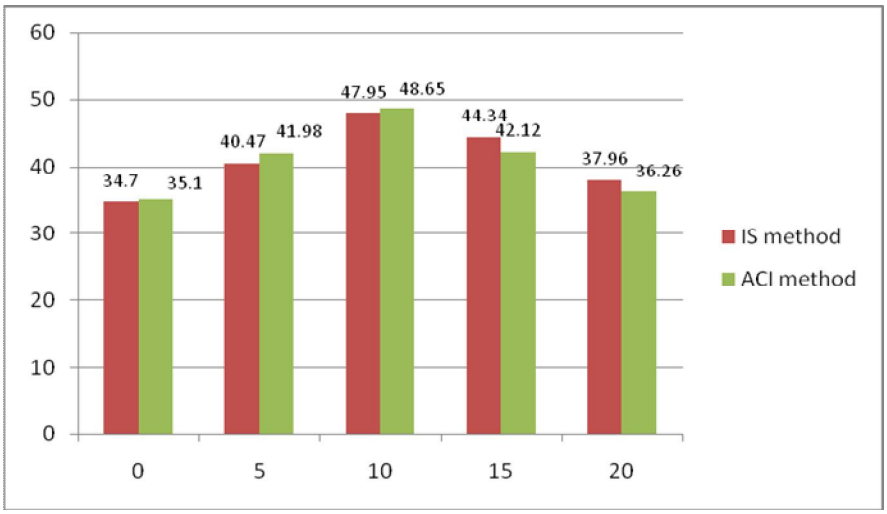

Fig. 4: Graphical representation of 28 days strength obtained for M50 mixes

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Table 7 . SLUMP OF CONCRETE CONTAINING VARIOUS PERCENTAGE OF ALCCOFINE BY IS AND DOE (BS)METHOD FOR M 40 GRADE OF CONCRETE

MIXES	SLUMP
M40-IS-0	55
M40-IS-5	42
M40-IS-10	30
M40-IS-15	15
M40-IS-20	07
M40-AI-0	50
M40-AI-5	36
M40-AI-10	22
M40-AI-15	10
M40-AI-20	04

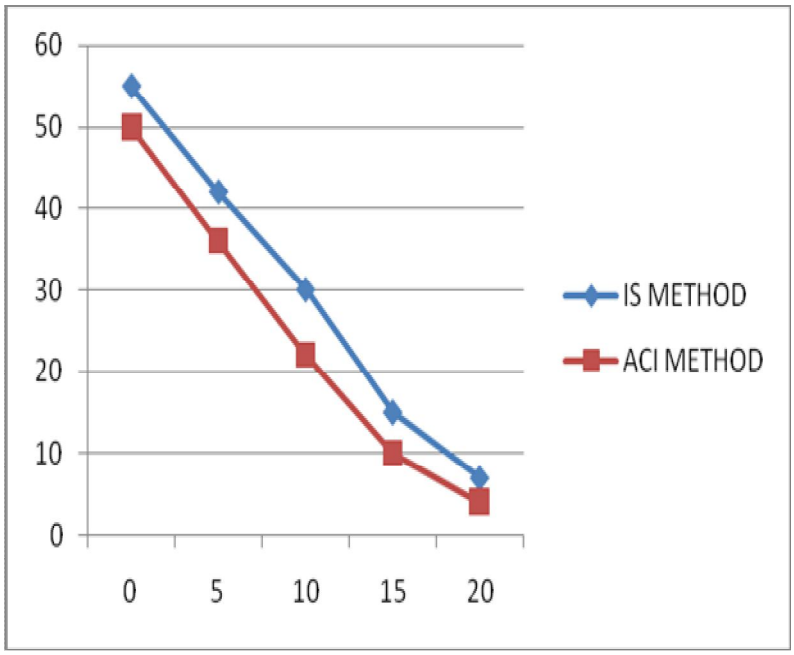

Fig..5: Graphical representation of Slump for M40 grade at varying % of alccofine

Table 8. SLUMP OF CONCRETE CONTAINING VARIOUS PERCENTAGE OF ALCCOFINE BY IS AND DOE (BS)METHOD FOR M 50 GRADE OF CONCRETE

MIXES	SLUMP
M50-IS-0	51
M50-IS-5	36
M50-IS-10	28
M50-IS-15	12
M50-IS-20	04
M50-AI-0	48
M50-AI-5	34
M50-AI-10	21
M50-AI-15	09
M50-AI-20	03

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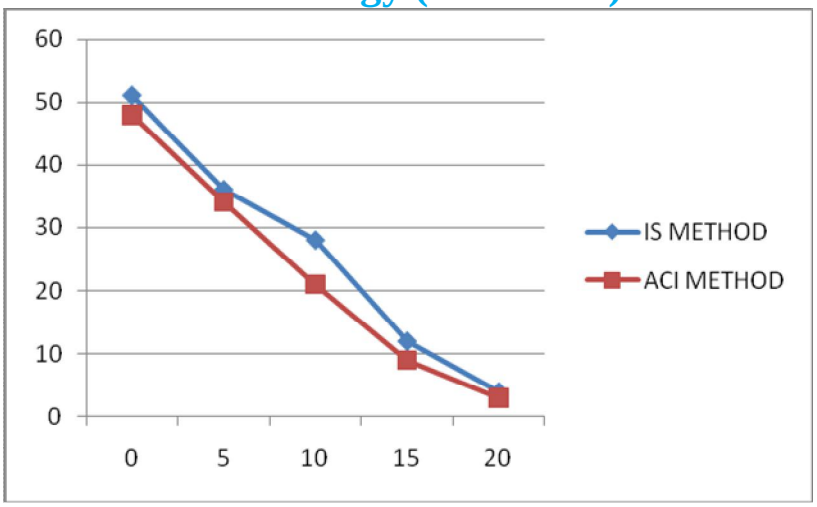

Fig..5: Graphical representation of Slump for M50 grade at varying % of alccofine

VI. CONCLUSIONS

In this study series of the experiments have been conducted on concrete with the addition of alccofine as partial replacement of PPC. In the alccofine was used as partial replacement of PPC in different percentage that is 0%, 5%, 10%, 15% and 20% of the dry weight of the cement. The experiments were conducted on M-40 AND M50 grade of
concrete as per relevant IS code of practice. Based on the test results obtained from this study the following conclusion can be drawn.

A. According to these results Super Plasticizers, for high-strength concretes by decreasing the w/c ratio as a result of reducing the water content by 20–30%.

B. ACI method gives max. Strength as comparison of IS method.

C. By adding of alccofine at 0, 5, 10, 15, 20% at 10% gives optimal result and increases strength up to 10% and after 10% it addition strength decreases.

D. The slump value is decreases by adding increase percentage of alccofine.

E. ACI method gives higher quantity of fine aggregate which increases water demand and hence its affect the strength of HSC which is not acceptable..

F. ACI method gives more binder content with more proportion of fine aggregate, leading to reduced strength of the mix.

G. In the ACI method the coarse aggregate content is constant for all grades of concrete, whereas in BS and IS methods it is variable.

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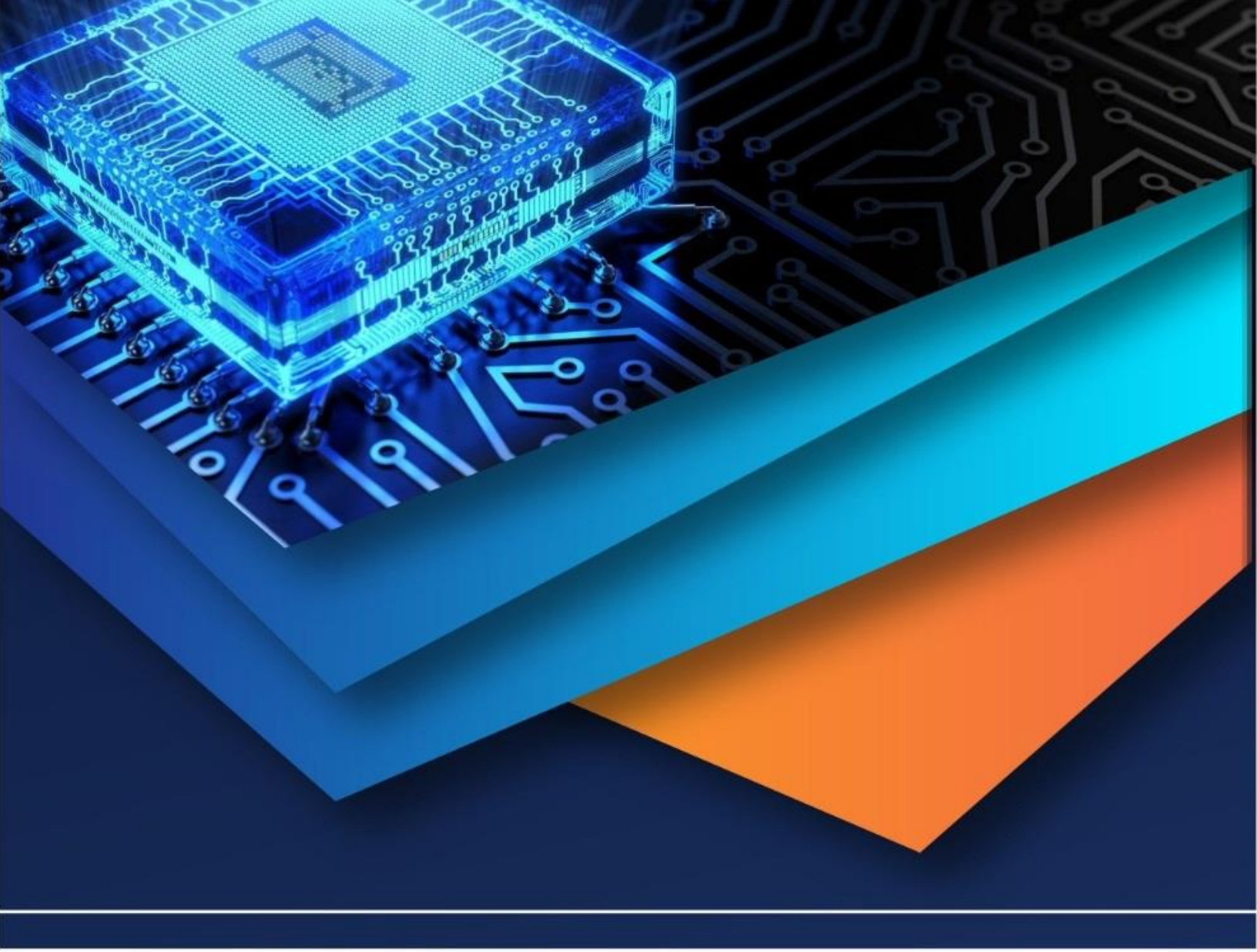

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