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Partial Replacement of Sand by Crusher Dust and Mild Steel Scrap in Concrete

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Abstract: ***This research focuses on studying the effect of Mild Steel Scrap and Crusher Dust on the Properties of Concrete Mixes as a partial replacement of Sand. The trend of mixing several kinds of additional materials such as Glass powder, plastic, Quarry dust, Copper slag, Steel scrap, in building engineering is now growing. Consumption of Crusher dust and Mild steel scrap are one of the lively research area that include the effectiveness of replacement in all the aspects of construction materials. It is very significant to develop eco-friendly concrete from ceramic waste. This Research deals with the experimental study on the mechanical strength properties of M20 grade concrete with the partial replacement of fine aggregate by using crusher dust and mild Steel Scrap. In order to analyze the mechanical properties such as Compressive Strength, Spilt tensile strength, and Workability the samples were casted with mild steel scrap having constant proportion of 5% and crusher dust having 10%, 15% ,20% 25%, 30%, 35%, 40% partial replacement. In second category sand has been partially replaced by mild steel scrap proportion of 10%, 15%, 20%, 25%, 30%, 35% and crusher dust by 20%, 25%, 30% 35% at a different periods of curing 7 days, and 28 days. The optimal of percentage addition of Crusher dust and Mild steel scrap are analyzed considering the needs of mechanical properties of concrete.***

Keywords: Crusher Dust, Mild Steel Scrap, Compressive Strength, Spilt tensile Strength, Mechanical properties,

I. INTRODUCTION

Concrete is a mostly used construction material which is a mixture of cement and filler mix along with water.For improving the properties of fresh concrete and harden concrete various engineer and scientist are trying to search a material which give equal strength to concrete and we called it Additional material. The genuine cost of concrete is related to cost of materials essential for produce a minimum mean strength called characteristic strength that is specific by designer of the structures. This depends on the quality control measures but there is no doubt that quality control add to the cost of concrete. The level of quality control is often an cheap assistance and depends on the size and type of job nowadays researchers, engineers and scientists are trying to improve the strength of concrete by adding the several other economical and waste material as a partial substitute of cement, fine aggregate or as a admixture fly ash, silica fume, steel slag steel chips etc are the few examples of these types of materials. These materials are generally by-product from further industries .

If the large amount of waste material generated is used instead of natural material in the construction and industry, there would be three benefits:

1) Conserving natural resources
2) Disposing of waste materials and
3) Freeing up valuable land for their uses

II. MATERIAL USED

1) *Cement*- The cement used in this experimental project was 43 Grade ordinary Portland cement (OPC) conforming to IS 8112-1989 for casting the specimensof all concrete mixes.
2) *Fine Aggregate*- The fine aggregate used for study belongs to the zone I, was procured from the local fine aggregate suppliers and conform all requirements as per IS: 383-1970.
3) Coarse aggregates- Coarse aggregate of 10 mm and 20 mm sizes were used in this study and they conform all requirements as per IS: 383-1970.
4) *Water*- Ordinary water available in the laboratory was used in this investigation both for mixing and curing the concrete specimen as per IS: 456-2000 and as per IS: 3025 – 1964 part 22 throughout the investigation.

5) *Crusher Dust*- Crusher dust is a common by product of mining and quarrying, rather being unnecessary as a waste material it can be used in construction work. White colour crusher dust was collected from Centre for Development of Stones (CDOS). It was initially dry in condition and thoroughly retained on IS 150 µ sieve before preparation of mix. The crusher dust also confirmed zone III of IS 383-1997.
6) *Mild Steel Scrap*- Mild steel scrape is Purchased from IndiaMart Online .it is ductile material ,it indicate yielding before fracture ,I used this scrape material because its coefficient of thermal expansion is almost equal to the coefficient of thermal expansion of concrete ,this scrapes having young's modulus which nearly same to concrete.

III. METHODOLOGY

The methodology adopted to complete the objective of the experimental study and execution of work was done in step by step as follow Experimental work had been conducted on concrete mixes by using a different proportion of Mild Steel Scrap and Crusher Dust of different percentages of partial replacement of fine aggregates.

1) *Concrete Mix*- M20 grade of concrete as per the guidelines given in IS: 10262 (2009) and IS: 456 (2000). The design mix of 1:1.5:3 is adopted for casting specimens. Stone dust.
a) *Two Separate Types Of Concrete Mixes Were Prepared:* In first category sand has been partially replaced by mild steel scrap having constant proportion of 5% and crusher dust having 10%, 15% ,20% 25%, 30%, 35%, 40% partial replacement. In second category sand has been partially replaced by mild steel scrap proportion of 10%,15%,20%,25%,30%, 35% and crusher dust by 20%, 25%, 30% 35% and 40% replacement, several cubes have been cast for determine the compressive strength, workability spilt tensile strength
2) *Weighing*- The quantity of all ingredients of the concrete i.e. cement, quarry dust, Mild steel scrape, fine aggregate, coarse aggregate and water for each batch was determined as per the mix design ratio and weighed using weighing machine available in laboratory.
3) *Mixing*- Process of mixing of different ingredients adopted as per IS: 516-1959 and hand mixing process was adopted for mixing the concrete.
4) *Preparation of Moulds* - Before casting the specimens, all cube, moulds was cleaned, screwed tightly and oil was applied to all surfaces to prevent adhesion of concrete during casting.
5) *Compaction*- Placing of concrete in oiled moulds was done in three layers and each layer tamped 25 times with the tamping rod. After tamping the moulds, they were compacted using vibratory machine.
6) *Curing*- After 24 hours of curing period, all the casted specimens were demoulded from the moulds and marked (to identify the casting batch) and immediately put into the curing tank for a period of 7 and 28 days..
7) *Testing*- Specimens were taken out from the curing tank after 7 and 28 days to perform various tests. Three numbers of specimens in each sample were tested and the average value was calculated. Fresh concrete property like workability was examined during casting by slump cone test. compressive strength and spilt tensile strength test were also observed at 7 & 28 days

IV. RESULTS AND DISCUSSION

In this section I have found various change in compressive strength and split tensile strength test .We analyse that the addition of crusher dust and mild steel scrap in sand provide a good compressive as well as split tensile strength. In this result section there is two set of mix called set 1 and set 2 having different proportion of mild steel scrap and crusher dust is used to replace the amount of sand.

A. Proportions Of Mild Steel Scrap And Crusher Dust(Set 1)

In first category sand has been partially replaced by mild steel scrap having constant proportion of 5% and crusher dust having 10%, 15% ,20% 25%, 30%, 35%, 40% partial replacement..Set 1 mix having a 5 mixes of mix1,mix2 ,mix3 ,mix4 , mix5. In this mixes there is variation in proportion of crusher dust and mild steel scrap which partially replaced sand to check its compressive strength, split tensile strength.

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Table-1

S.no.	Sand %	Crusher Dust %	Mild Steel % Scrap	Mass Of F.A	Mass of crusher Dust	Mass Of mild Steel Scrap
1	55	40	5	367.82	284.10	74.68
2	60	35	5	401.26	248.59	74.68
3	65	30	5	434.70	213.08	74.68
4	70	25	5	468.14	177.56	74.68
5	75	20	5	501.58	142.05	74.68

B. Proportion Of Crusher Dust And Mild Steels {Set-2}

In second category sand has been partially replaced by mild steel scrap proportion of 10%,15%,20%,25%,30%, 35% and crusher dust by 20%, 25%, 30% 35% and 40% replacement Set2 mix having a 5 mixes of mix1,mix2 ,mix3 ,mix4 ,mix5. In this mixes there is variation in proportion of crusher dust and mild steel scrap which partially replaced.

Table-2

S.no.	Sand %	Crusher Dust %	Mild Steel % Scrap	Mass Of F.A	Mass of crusher Dust	Mass Of mild Steel Scrap
1	50	40	10	334.38	284.109	149.37
2	50	35	15	334.38	248.59	224.065
3	50	30	20	334.38	213.08	298.753
4	50	25	25	334.38	177.56	373.44
5	50	20	30	334.38	142.054	448.13

C. Slump Cone Test

Slump test is done to check the workability of concrete .workability show the ease to transport and compact concrete at desire location .In This Thesis slump test is done to check the workability of given sample of set 1 and set 2, In each set there is 5 mixes having name of mix 1, mix 2, mix 3, mix 4, mix 5 respectively and analyses the slump value . Slump of all mixes were taken and shown in graphical form. Many variations have been seen while checking for slump of different concrete mixes.

1) *Slump of set 1:* Slump Test is carried out as per the guidelines of IS: 1199-1959. Figure-1 depict the behavior of slump on the basis of different percentage of mild steel scrap and crusher dust mixes of different Proportion of concrete.

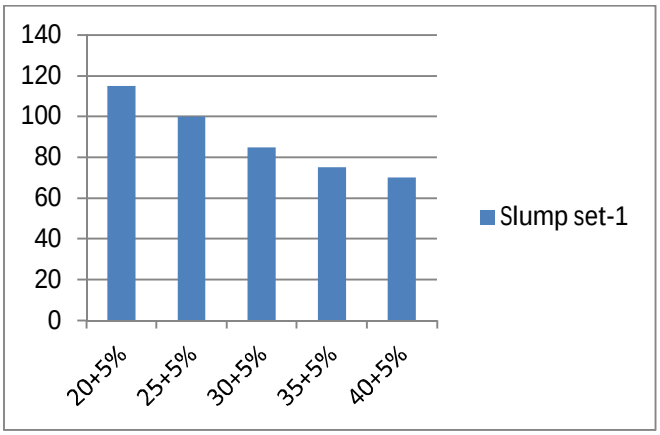


Figure-1

2) *Slump of set 2:* Now in set 2 there is change in proportion of mild steel scrape and crusher dust so the slump value increase due to increase percentage of mild steel scrap Behavior of slump on the basis of different percentage of mild steel scrap and crusher dust of set 2 are shown in Figure-2

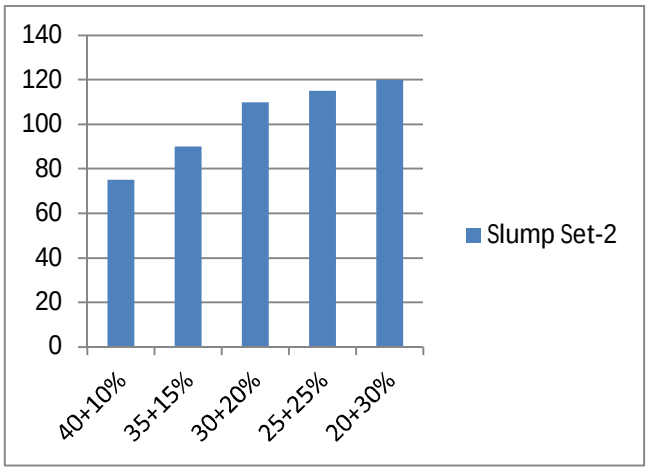


Figure-2

D. Compressive Strength Of Set 1

The compressive strength of all mixes were tested on Compression Testing Machine on cubes of size 150mm x 150 mm x 150mm for 7 and 28 days after curing and test result are as followed as per IS 516: 1959 of set 1 and set 2.In set 1 graph, we see the different proportion of mild steel scrap and crusher dust where mild steel scrap is constant of 5% in every mixes and crusher dust get variation of 20 to 40 %.For checking compressive strength we have 3 specimen for each mixes and it is tested on 7th days and 28 days. The variation in compressive strength in set 1 is shown below in table as well as graph

Table-3 Variation in compressive strength set-1

	20+5%	25+5%	30+5%	35+5%	40+5%
7 days	16.2	17.8	18.52	16.78	15.4
28 days	22.5	23.5	24.8	22.7	21.9

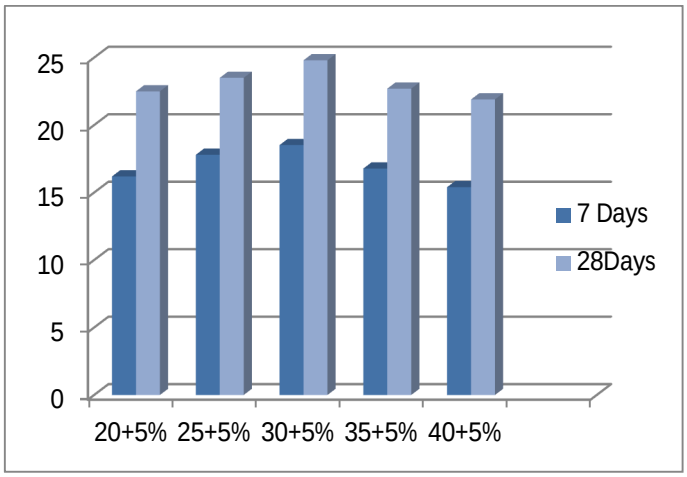


Figure-3

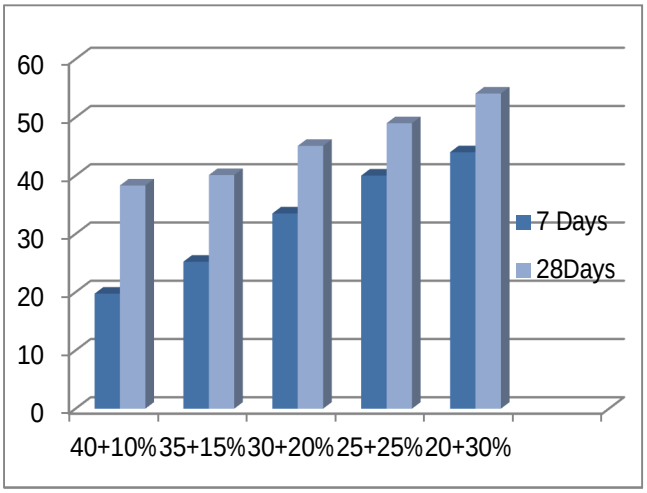
The above graph show the variation in strength in set 1 .we see the compressive strength is increasing from 16.20 to 18.52 N/mm2 for 7 days and 22.5 to 24.8 N/mm2 for 28th days respectively and after that sudden decrement observe in compressive strength of concrete.

E. Compressive Strength Of Set 2

The compressive strength of all mixes were tested on Compression Testing Machine of cubes size 150mm x 150 mm x 150mm for 7 and 28 days. After curing test result are followed as per IS 516: 1959 of set 2.In set 2 graph, we see the different proportion of mild steel scrap and crusher dust where mild steel scrap is varies From 10 to 30% in mixes and crusher dust get variation of 20 to 40 %. For checking compressive strength we have 3 specimen for each mixes and it is tested on 7th days and 28 days. The variation in compressive strength in set 2 is shown below the table and in graph which show the strength of compressive strength increases up to 30% of mild steel scrape and 20 % of crusher dust.

Table-4 Variation in compressive strength set-2

	40+10%	35+15 %	30+2 0%	25+25%	20+30%
7 days	19.75	25.25	35.52	40.02	44.04
28 Days	38.33	40.12	45.12	49.02	54.12



The above graph show the variation in strength in set 2 .we see the compressive strength is increasing From 19.75 to 44.04 n/mm2 in 7 days and 38.33 to 54.12 N/mm2 for 28th days respectively and this compressive strength is more than of nominal mix concrete of m20.

F. Spilt Tensile Strength Test

1) Split Cylinder Test Set 1: IS 5816:1999 was used to evaluate splitting tensile strength of concrete. The size of cylindrical specimen was 300mm (length) x 150mm (diameter).The specimens were tested after curing for 7 and 28 days. The test was performed on universal testing machine.

Table-5 Variation in Spilting Tensile strength set-1

	20+5%	25+5%	30+5%	35+5%	40+5%
7 days	2.1	2.3	2.8	1.98	1.96
28 Days	3.25	3.357	3.89	3.15	3.1

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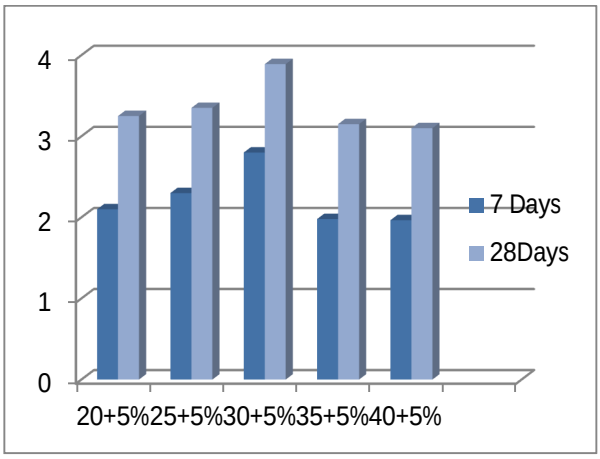

Figure-5

The above graph show the variation in strength in set 1. We see the split tensile strength is increasing 2.1 to 2.8 for 7 days, 3.25 to 3.89 for 28 days respectively, after that decrement occur in split tensile test.

2) *Split Tensile Strength Test Set 2:* IS 5816:1999 was used to evaluate splitting tensile strength of concrete. The size of cylindrical specimen was 300mm (length) x 150mm (diameter).The specimens were tested after curing for 7 and 28 days. The test was performed on universal testing machine.

Table -6 Variation in Spilting Tensile strength set-2

	40+10%	35+15%	30+20%	25+25%	20+30%
7 days	1.8	1.9	2.75	2.01	2.08
28 Days	2.42	2.68	2.72	2.75	2.85

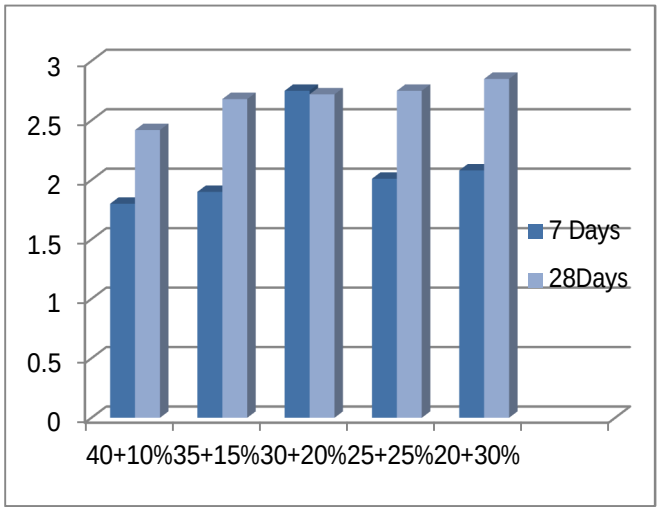

Figure-6

The above graph show the variation in strength in set 2. We see the split strength is increasing 1.8 to 2.08 for 7 days and 2.4 to 2.85 for 28 days respectively, after that decrement occur in split tensile test.

V. CONCLUSION

After analyzing the results for all tests including Slump test, Compressive Strength test, Splitting Tensile Strength test ,Following conclusions have been drawn in set 1 having 5 mixes (mix1,mix2,mix3,mix4,mix5) in which crusher dust and fine aggregate having different proportion and mild steel scrape having 5% (constant)proportion .

A. Conclusion Of Set 1

1) Mix ratio of M20 (cement: aggregate: sand+ crusher dust + m.s.s) give the optimum strength in this study.

2) As the percentage of crusher Dust +mild steel scrape gradually increases, the Compressive strength of concrete will also increase with condition that percentage of crusher dust (30%) +mild steel scrap (5%) should not exceed (30+5) % and the strength is 18.52 N/mm2 for 7 days and23.8N/mm2 in 28 days. After this proportion a slight decrement was observed which is shown in table 5.5 and 5.6.

3) The compressive strength of concrete increase with the increase of age of maturity.

4) The split tensile strength of set 1 also tend to increase up to 30% after that a decrement is observed in strength of concrete.

5) According to the value of compressive strength collected, the value is high and it show that crusher dust +mild steel scrap suitable to use as sand replacement up to(30+5)%. All the value of compressive strength surpasses the minimum value of compressive strength for normal concrete So, crusher dust +mild steel scrape can apply as sand replacement in concrete mix for construction industry .

6) The workability of concrete is decreased by adding % of crusher dust. But it is compensate by adding metallic dust, because it increase workability

B. Conclusion Of Set 2

The strength characteristic and split tensile strength of concrete work have been analyze .In This thesis work ,replacement of sand by crusher dust and mild steel scrape of proportion (40+10),(35+15),(30+20),(25+25),(20+30) percentage replaced in sand .After analyzing the results for all tests including Slump test, Compressive Strength test, Splitting Tensile Strength test ,Following conclusions have been drawn in set 2 having 5 mixes (mix1,mix2,mix3,mix4,mix5) in which crusher dust and mild steel scrape having different proportion and sand having 50% (constant) proportion.

1) The compressive strength is gradually increased as the %of crusher dust (20% decrease) and mild steel scrap (30% increased) is increased and the value of compressive strength is 44.04 N/mm2 for 7 days and 54.12N/mm2 in 28 days.

2) The split tensile strength is also increased at increase percentage of mild steel scrap and decrease % of crusher dust is 2.08N/mm2 for7 days and 2.18N/mm2 in 28 days.

3) The early age strength gains higher as compare to normal mix.

4) The split tensile strength of set 2 tend to increase up to (20+30)%

5) This study has brought out positive results that compressive strength and split tensile strength is increased as the crusher dust and mild steel scrape increased.

6) The workability of concrete is decreased by adding % of crusher dust. But it is compensate by adding metallic dust, because it increase workability.

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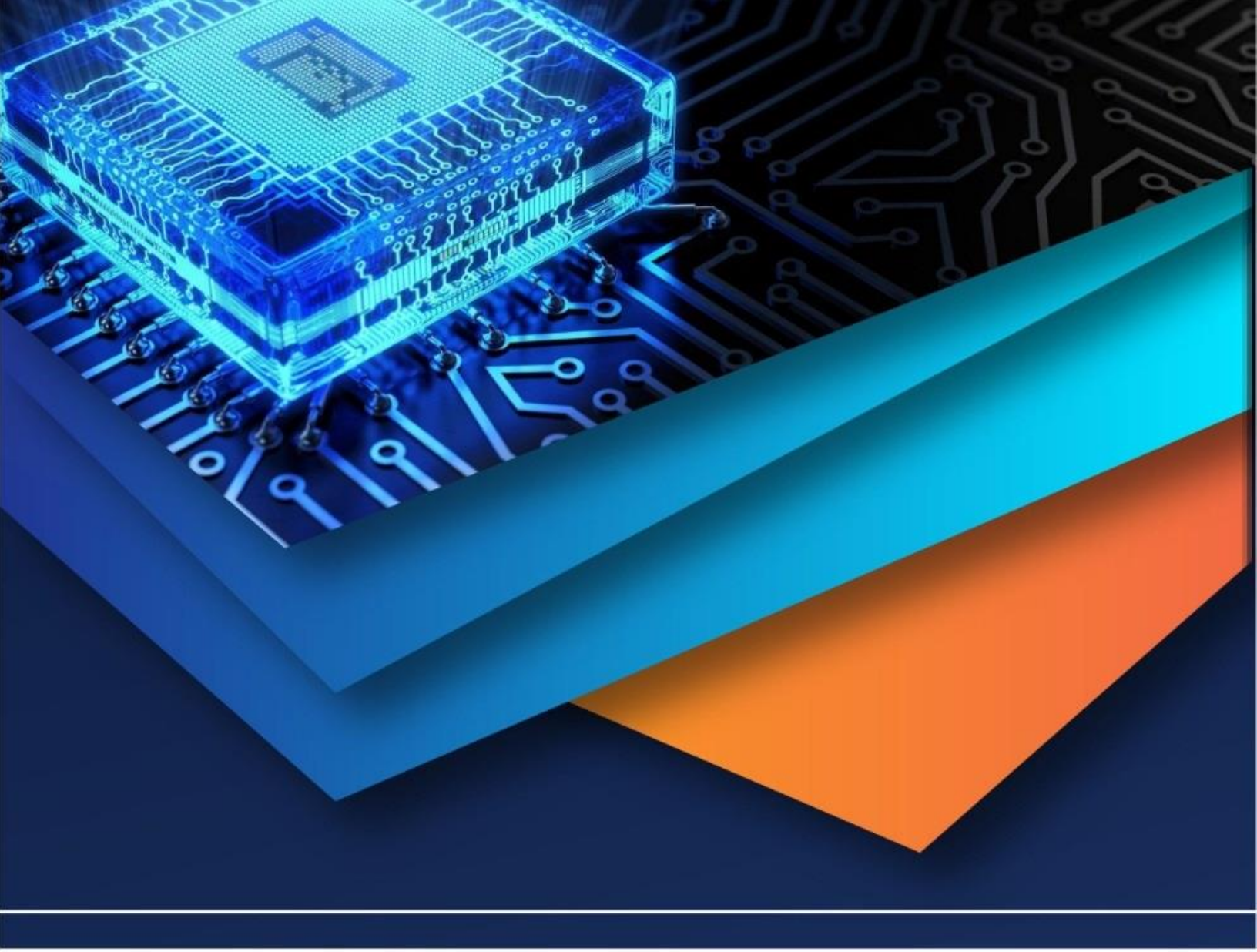

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