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Study of Paver Blocks for Low Volume Traffic with Fly Ash

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Abstract: ***The solid and hollow paver blocks prepared from precast cement concrete is understood to be versatile, attractive looking, useful as well as value effective opportunity to traditional road production practices. Paver blocks have utility in exceptional sort of traffics from low traffic very heavy traffic. Paver blocks are advanced to standard avenue practices in the fact that there's little or no renovation. when manufactured and laid with care. there are two areas of concern - failure due to wearing of surface, and considerable variance in mechanical strength of these blocks. Paving block is a popular method in construction of pathways which are generally suitable for applications like driveways, paths, patios, public utility areas, garage, etc.IS 15658 : 2006 says that paver blocks can used in Low Volume Traffic Roads at the same time as it is casted thru M 35 grade of concrete and 60 mm thick. In this test 60 mm thick and paver blocks of M 35 concrete grade is casted. Fly ash that is waste product of stone enterprise*** *and generated as a waste during the reducing* ***and crushing of stones are going to use as first-combination on this venture. Fine mixture is going to replace with the aid of way of Fly ash (which is retained on 4.75 mm IS sieve) up*** *to a 40% at an interval of 10% and a look at like compressive energy together with flexural power is performed on paver blocks. Workability of the mixture is also like way checked.*

Keywords: concrete, compressive strength, M 35 Grade, Paver block, Fly ash, workability.

I. INTRODUCTION

Concrete block paving has been widely used now a days because of its diverse advantages. It is forms in rectangular shape accordance to bricks shape and now there are many various shapes of paving blocks. These blocks are a type of concrete with good in quality and durability due to the manufacturing and the right method of mixture. The concrete paving blocks also something interesting and versatile because of its great resilience, its strength in accommodate traffic flow, interesting aesthetic, and function, cost effective and do not need to be maintenance if the correct way installations from first phase.Paver block pavement is formed from individual solid blocks that match carefully subsequent to each other to shape a pavement surface. A regular paver block pavement is placed on a thin bed of sand overlaying a sub base. PAVER BLOCK PAVEMENT can be located with a variety of shapes and patterns.

There are joint areas among blocks. Concrete Block Paving is extraordinarily flexible, making it ideal for exceedingly trafficked pedestrian or automobile regions. The concrete paver blocks consist of paving thicknesses from 60mm, suitable for mild car and pedestrian trafficking, via to 80mm thick paving which is able to withstand trafficking from overwhelming vehicles in applications alongside ports, air terminals, holder yards and other business. These areas are filled with sand having suitable grading. The blocks are confined from facets by edge restraints.

The material that use for paving blocks has been widely changed where there are many of paving blocks are added or replaced with the used materials or wastes materials to reduce environmental pollution besides can improve its strength and also their mechanical properties. From the literature study, there are many researchers use waste materials as the aggregate and cement replacement to create paving blocks.

The materials used are plastic, fly ash, bottom ash, tin, limestone dust, tiles, rubber, coconut fiber, glass and so on which these materials are available in cheaper price or free of charge.However, there are several weaknesses in the common paving blocks which required high cost for its creation. In addition, the paving blocks that made from gravel with full quantities are heavy. Therefore, the purpose of this study was to review that waste materials such as flyash can be reuse as additives and replacement material in paving blocks. In addition, it is also intended to protect the environment from the accumulation of waste materials that can affect the ecosystem and environment especially to wildlife and humans. Objective of the study that wishes to be achieved is to produce paving blocks from flyash and to identify the most economical cost of paving blocks. This studied also want to achieve thelighter paving blocks and prove their durability with using compression test.[2].

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Figure 1: Different types of paver blocks

II. MATERIALS AND METHODS

In this study paver block is manufactured for experimental work.60 mm thick Paver block of M-35 grade is stable for the experimental work. The basic tests cared out on materials used for casting paver block samples are discussed in this chapter, followed by a brief description about mixing of materials and curing procedure adopted. At the end, the various tests conducted on the specimen are discussed.

A. Dimension of the Paver Blocks

Firstly, for production of paver blocks dimension is decided, which is consistent with producer is given under:
Shape: I section
Length: 230 mm
Width: a hundred and sixty mm
Thickness = 60 mm
Aspect ratio (L/T) = 200/80 = 2.5 <4.0, as in step with IS 15658 : 2006

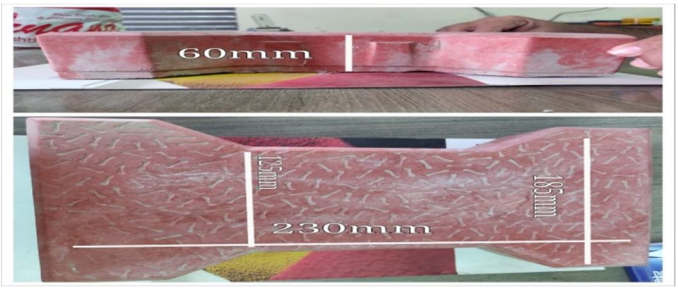


Figure 2: Dimension of Paver Blocks (All Dimensions are in mm)

Area shall be calculated by as per IS 15658: 2006 their method and regard are given under.
Plan Area (A_{sp}) (Method 1)
The test specimen shall be weighted, while suspended by metal wire, and completely submerged in water, and the weight shall be recorded in **N** to nearest 0.01N (W_a). They shall be removed from water and allowed to drain for one minute by placing them on a 10mm coarser wire mesh. Visible water on the specimen could be eliminated with a damp cloth The specimen shall be at once weighed and the load for every specimen stated N to the nearest zero.01N (W_W) the volume of example will be computed as takes after:
Volume = (WW – Wa) 10-3 m3

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The volume should be partitioned by utilizing thickness to obtain arrange put in mm2.
Volume = 0.0018 m^3
Area= 0.03 m^2 = 30000 mm^2
Plan Area (A_{sp})(Method 2)
The specimen shall be positioned, sporting face dealing with up, on cardboard and its perimeter is traced with the pencil. The form shall be reduce accurately with the scissors and weighted to the closest 0.0001N, and the result recorded as mass (m_{sp}). A rectangle measuring 200mm x 100mm reduce out from identical cardboard shall additionally be weighted to nearest 0.0001 N, and result recorded as mass (m_{std}) the plan area for the block shall be calculated from the formula:

$$A_{sp} = \frac{20000\, m_{sp}}{m_{std}} mm^2$$

Msp= 0.2062 N
Mstd= 0.1373 N
Area (Asp) = 30036.41 mm^2

III. MATERIALS

The materials used in the projects for making concrete mixture are cement, Fine aggregate, coarse aggregate, Sand Stone chips, are detailed describe below:

A. Cement

The cement used in this experimental investigation was OPC 43 gradeand Properties of OPC Cement are as listed below in table 1.

Table 1: Testing on Cement

Sr. No.	Physical Property	Results
1.	Initial setting Time	41 minutes
2.	Final Setting Time	390 minutes
3.	Specific Gravity	3.168
4.	Compressive strength 21 days	32 N/mm^2

B. Fine Aggregates

Fine aggregate (FA) used in this investigation was the natural river sand, passing completely through 4.75 mm aperture size sieve and conforming to zone II as stated by IS:383-1970 specification. Properties of Fine aggregates are listed below in table 2.

Table 2: Properties of Fine Aggregates

S. No.	Test	Result
1.	Specific gravity	2.62
2.	Fineness Modulus	2.64
3.	Water Absorption	0.5%

C. Fly Ash

Fly ash is a by-product of the combustion of pulverized coal in thermal power plants. It is removed by the dust collection system as a fine particulate residue from the combustion gases before they are discharged into the atmosphere. The variety of particle sizes in any given fly ash is basically determined with the support of the sort of dust series equipment used. The fly ash from boilers at some older plants, where mechanical creditors by myself are employed, is coarser than from plants the usage of electrostatic precipitators.

Table 3: Physical properties of fly ash

Sr. No.	Physical Property	Results
1.	Specific Gravity	2.34
2.	Bulk Density	1110 kg/m^3

D. Water

Potable water was used for mixing the concrete mix in entire investigation and for curing the mixture in the determination of the optimal percentage of as fly ash replacement.

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IV. EXPERIMENTAL PROCEDURE

All materials were brought to room temperature before commencing the results. According to desired density first all the materials (Cement, Fly Ash, Sand, Water) are weighed for 1m3 quantity and then these weights are converted into volume by dividing the weights of materials with its specific gravity and For paver block producing initial step is blending and in this venture hand blending is favored for assembling of paver blocks, The blend of the materials, including water, cement, aggregates and e-waste is blended by weighted, The amount of cement, aggregate, e-waste and water for every group might be determine by weight, to an exactness of 0.1% of the mixture weight of the bunch. The concrete should be blended by hand or ideally in a research facility clump blender, in such a way as to stay away from loss of water or different materials. For hand blending the concrete clump should be blended on a water tight, non-retentive stage with a scoop, trowel or comparative appropriate execute, technique embraced for mixing is, cement and fine aggregate is probably combined until the mix give uniform shading Fly ash and blended with the cement and fine aggregate is consistently appropriated all through the cluster.



Figure 3: Casting of paver block

V. RESULTS AND ANALYSIS

In this analysis the casted paver block analyzed under various examinations to estimate the strength and other properties of the casted paver blocks. The primary intention of the investigation is to optimize the established strength achieved by the material mix at several testing days from curing. Usually appropriate production and curing of concrete cubes will enhance the strength of the block. For this investigation separately test is performed with 3 samples for every mix ratio and tested at required curing days. Curing stages taken 7 days, 21 days and 28 days. Then the average values are used for the analysis. Details of performed experiments are explained below:

A. Slump Cone Test

This experiment is executed to confirm the workability of newly casted paver block material. This test independently executed on newly casted paver block and the fly ash replacing with cement to find the workability. This test is conducted immediately after the concrete has been made. Workability is the ease of work of concrete, and their result is shown in table 12 and graph 1-2, for this study workability of concrete is checked byslump cone take a look at, it has been located that creation of Fly ash in concrete decreases the workability of concrete. As the percentage of Fly ash is increases in concrete, workability of concrete is decreased, control concrete mix (CC) possess 92 mm slump whereas goes down to 42 mm when sand is completely replaced by Fly ash. Procedure of slump cone test which is followed for this project is given below

Table4: Slump value of Concrete Mix

% Replacement	Slump Value
0%	92 mm
10%	91 mm
20%	91 mm
30%	90 mm
40%	88 mm
50%	86 mm

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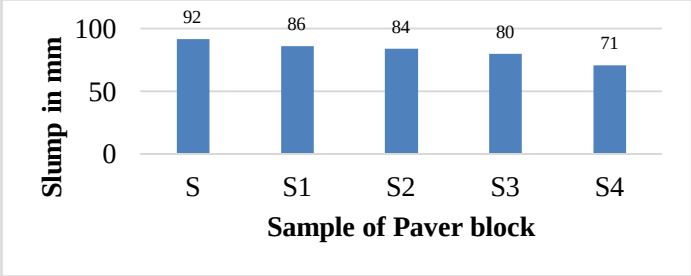


Figure 4: Slump Test values

Various test conducted on concrete paver block Paver blocks were casted confirming to the mix proportion and followed the recommendations laid down in is 15658:2006. the size of paver block 250 x 125 x 60. Total 56 paver block were casted. The samples were cured in water for 7 days, 21 days and 28 days. Compressive strength, water absorption test and flexural strength test is done as per codal recommendation. The test specimen required for the particular test as per IS: 15658

Table 5: Minimum Specimen for Test

Test	Minimum specimen
Compressive strength test	3
Water absorption test	3
Flexural strength test	3

These tests are conducted as per IS: 15658:2006 given in ANNEXURE C, D and F for Water Absorption, Compressive Strength and Flexural Strength test respectively.

B. Compressive Strength Test

In this Experimental investigationpaver block were tested and the average strength is compared with nominal mix of M35 Mix. Compressive strength investigation evaluated the heavy compressive load a material can stand below facture limit. Combined compressive strength at 7 days, 21 days and 28 days are shown in table and graphical representation of the same in graph.

Table 6: Comparison of compressive Strength Analysis

Mix	Compressive Strength at 7 days (N/mm^2)	Compressive Strength at 21 days (N/mm^2)	Compressive Strength at 28 days (N/mm^2)
S	32.75	36.59	38.40
S1	41.39	42.03	38.83
S2	51.52	54.83	51.20
S3	45.22	46.51	42.45
S4	21.12	27.41	24.96

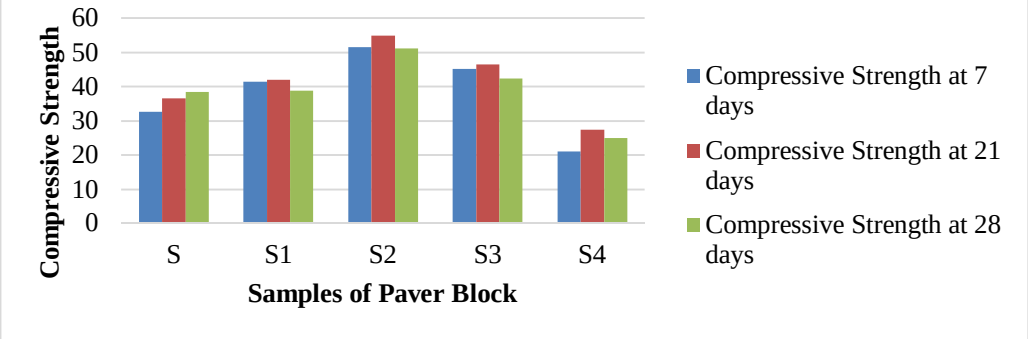


Figure 5: Comparison of compressive Strength Analysis

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C. Water Absorption Test [IS15658:2006]

The paver blocks after casting were immersed in water for 28days curing. They were then weighted and this weight was noted as the wet weight of the paver block. These specimens were then oven dried at the temperature110^{0}C until the mass became constant and again weighed. This weight was noted as the dry weight of the paver block.

%Water Absorption = [(WW –DW)/DW] x100

Where, WW = Wet Weight of paver block,

DW =Dry Weight of paver block.

Table 7: Comparison of water Absorption test results

Mix	Water Absorption at 7 days	Water Absorption at 21 days	Water Absorption at 28 days
S	0.593	0.596	0.596
S1	0.646	0.676	0.66
S2	0.54	0.566	0.556
S3	0.593	0.646	0.646
S4	0.54	0.673	0.683

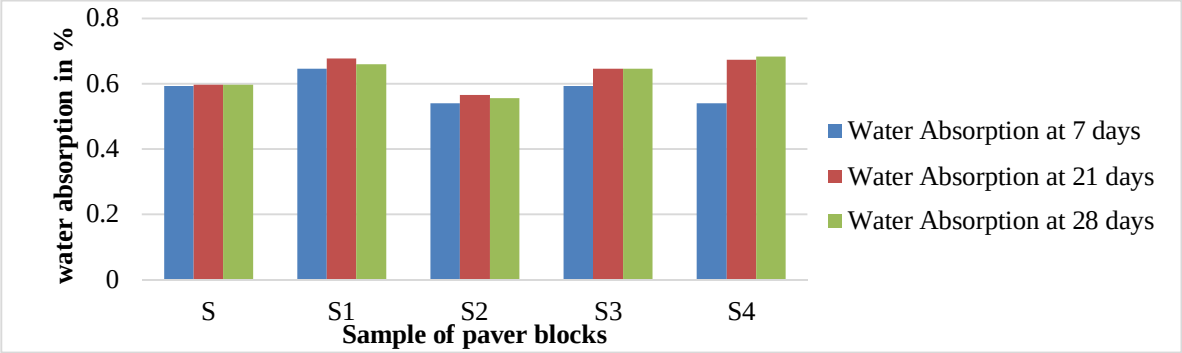


Figure 6: Comparison of water Absorption test results

D. Flexural Strength

Flexural strength also called as modulus of rupture. In concrete flexure is the bending moment caused by the applied load, in which a paver block has compression at top and tensile stress at the bottom side. Flexural strength test of concrete paver block specimens was determined at 28days of age. For that age four specimens were tested for each. The load was applied from the middle of the specimen. Three points loading is applied for this test as per codal provision.

Table 8: Flexural Strength Test Results at 28 Days

Mix	Load (KN)	Average Load (KN)	Flexural Strength (N/mm^2)
S	11.3		
	11	11.13	4.17
	11.1		
S1	12.8		
	13.3	13.03	4.89
	13		
S2	15.6		
	15	15.36	5.76
	15.5		
S3	14.2		
	14.7	14.3	5.36
	14		
S4	11.1		
	10.3	10.73	4.024
	10.8		

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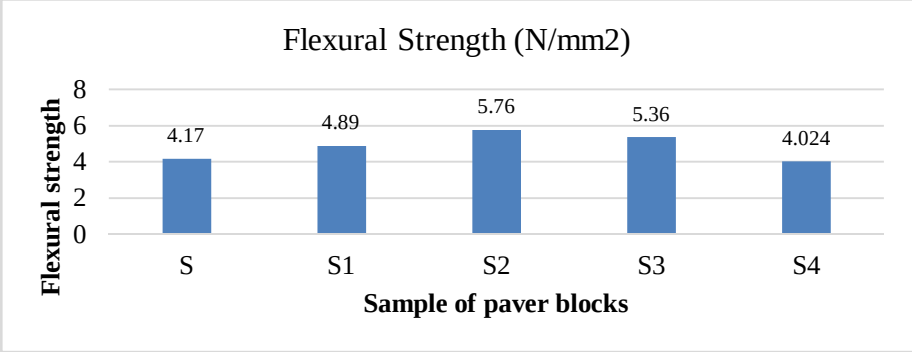


Figure.7**:** Flexural Strength at 28 Days

VI. CONCLUSION

Conclusion drawn from this study is given below

A. Workability of the concrete is checked by slump cone test; it has been observed that replacement of Fly ash with sand gives decrement to slump value of concrete, for this project concrete is designed for 100 mm slump and its control concrete mix (CC) gives slump value of 92 mm which goes on decreasing with the percentage of increases Fly ash in the composition of concrete. It shows decrement of 71 mm slump.

B. Water absorption of block found optimum results on S2 i.e. 20% replacement of fly ash in block. Values of water absorption on 7 days is 0.593% which is increases from 0.54 %, on 21 days is 0.646% which is increases from 0.566 % and on 28 days is 0.556% which is increases from 0.646 %.

C. Compressive strength of the fly ash paver blocks, results shows that compressive strength fly ash paver blocks increases when fly ash is replaced by cement in the composition of paver blocks and after correction as per IS 15658 recommendation gives optimum value of 20%. Concrete mix gives compressive strength of 51.52 N/mm^2 at 7 days of curing, 54.83 N/mm^2 at 21 days of curing, 51.20 N/mm^2 at 28 days of curing when 20% fly ash is added by the weight of the cement, it attains maximum compressive i.e. 47.24 N/mm^2, gives optimum value of fly ash 20%, further fly ash added in the composition compressive strength goes down to 42.45 N/mm^2 at 28 days as whole it is concluded that for M35 characteristic mean strength is 51.20 N/mm^2 at 28 days and as per IS 15658 : 2009, minimum average 28 days compressive strength should be F_{ck} + 0.825 * 0.5 (standard deviation), so minimum compressive strength required for paver blocks is 35.41 N/mm^2, in this case 20% of the fly ash can be replaced by cement in the composition of paver blocks.

D. Flexural strength of the blocks increases when fly ash is added in paver blocks composition and gives optimum value of 20%. Concrete mix gives compressive strength of 5.76 N/mm^2, when 20% fly ash is added by the weight of the cement, it attains maximum compressive i.e. 5.76 N/mm^2, gives optimum value of fly ash 20%, further fly ash added in the composition compressive strength goes down to 5.36 N/mm^2. As per IS 15658 : 2006 minimum breaking load is 10.73 kN and flexural came out from this breaking load is 4.024 N/mm^2, so all the mix is acceptable.

From above points, flexural strength and compressive strength it is clear that 20% of cement in concrete of paver blocks will be replaced by Fly ash.

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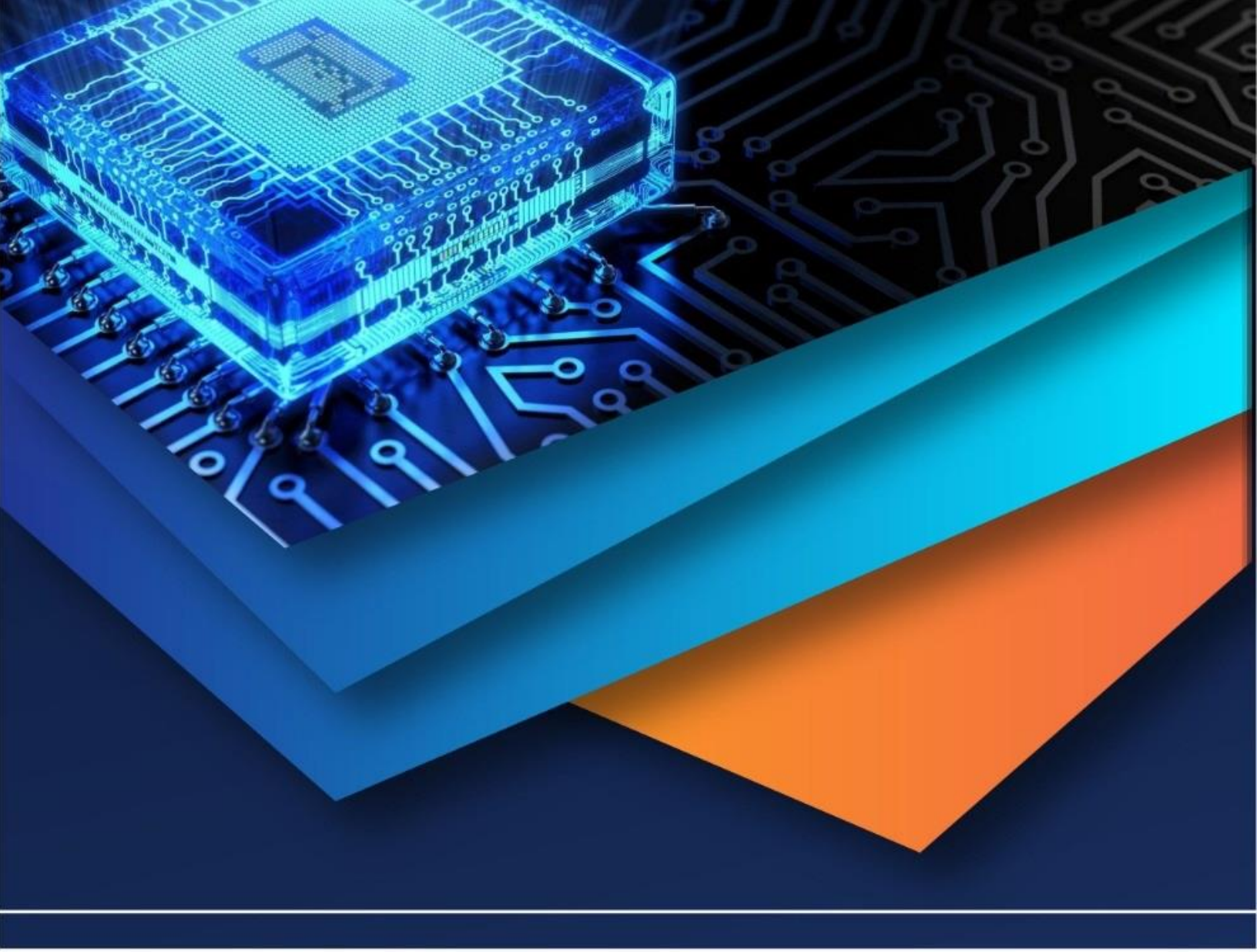
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