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Experimental study on Behaviour of Concrete by using Silica Fume and Saw Dust in Concrete

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Abstract: ***The most widely used construction material on the planet is concrete. Day by day varied transformation is taking place in the type and quality of concrete being used. High performance concrete is one of the modern concretes which is able to achieve such type of properties at better extent. Concrete is the backbone of every country for its development work. The quality and type of concrete being used have undergone diverse revolution The major transformation in the concrete technology includes the enhanced strength of concrete, which increased performance of concrete and introduction of various mineral admixtures Various tests were conducted to evaluate the effect of Silica fume and Saw Dust on compressive, splitting tensile and flexural strength test. Silica fume was used as a partial replacement of cement at the percentage of 2.5%, 5%, 7.5%, 10% 12.5%, 15%, 17.5% and Saw Dust was used as replacement of sand for the percentages mentioned above. Slump flow was carried out for rheological properties and compressive strength, split tensile and flexure tests were carried out to know the mechanical properties.***

Keywords: Silica Fume, Saw Dust, SCM, admixture, Mechanical properties.

I. INTRODUCTION

Any activity of construction requires several materials such as steel, bricks, concrete, wood, clay, mud and so on. However, in concrete, cement remains the main material which is used in industries of construction. For the adaptability and suitability with respect to the environment changing, the concrete must be such that it can save the environment, conservation of resources, economize and lead to proper energy utilization. Concrete is a nuclear family or we can say household of this dissimilar material like binding material (cement Fly-ash, Rice husk ash) fine aggregate, coarse aggregate and water. Concrete is the backbone of every country for its development work. The quality and type of concrete being used have undergone diverse revolution

Concrete is a composite material compose of coarse granular materials (the filler or aggregate) embedded in a hard matrix material (the binder or cement) that fill the spaces between the particles of aggregate and glues them together. It is estimate that the concrete consumption in the earth is order of 10 billion ton (11.5 billion tons) per year. In India, the cost of cement is increasing day by day. In order to fight for the scarcity of cement and also for the increase in cost of concrete under these Circumstances the use of recycled, Cement Kiln Dust, solid wastes, agricultural wastes, and industrial by products like fly ash, blast furnace slag, silica fume, rise husk ash, quarry dust etc. came into use.

II. RELATED WORK

1) N. K. Amudhavalli1, Jeena Mathew (2012) studied EFFECT OF SILICA FUME ON STRENGTHAND DURABILITY PARAMETERS OF CONCRETE. Portland cements the most important ingredient of concrete and is a versatile and relatively high-cost material. Large scale production of cement is with causing environmental problems on one hand and depletion of natural resources on other hand. This is threat to ecology has led to researchers to use industrial by products as supplementary cementations &material in making concrete. The main parameter investigated in this study is M35 grade concrete with partial replacement of cement by silica fume by 0, 5, 10,15and by 20%. This paper presents a detailed experimental study Compressive strength, split tensile strength, flexural strength at age of 7 and 28 day. Durability study on acid attack was also studied and percentage of weight loss is compared with normal concrete. Test results indicate that use of Silica fume
2) Lakhbir Singh1, Arjun Kumar, Anil Singh (2016) made a detailed study of partial replacement of cement by silica fume. Silica fume were used to replace 0% to 15% of cement, by weight at increment of 5%for both cube and cylinder. The results showed that partial replacement of cement with silica fume had significant effect on the compressive strength of cube and split tensile strength cylinder. The strength of concrete increases rapidly as we increase the silica fume content and the optimum value of compressive strength is obtained at 10% replacement.

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3) Abishek Narayanan, Hemnath G Sampaul K & Anne Mary (2017) studied REPLACEMENT OFFINE AGGREGATE WITH SAWDUST. This experimental study is aimed to create a concrete mixture consisting of sawdust which replaces the fine aggregate. It is also used to analyse the effect of sawdust concrete in terms of workability, adhesion of aggregates and etc. After preparing the concrete block, the difference in weight between the original concrete and the sawdust concrete block is also tested.
4) Tilak L.N, Santhosh Kumar M. et al (2018) made research on Use of Saw Dust as Fine Aggregate in Concrete Mixture. A concrete mix of 1:1.5:3 is used while sawdust was used to replace 10%, 20%, 50and 100% of sand by volume. The percentage reduction in density is 4.02%, 5.54%, 9.15% and 19.20%respectively while the corresponding percentage reduction in compressive strength was 28.54%, 53.95%,67.10%, and 75.92% respectively, with respect to conventional concrete mix.
5) Ghutke & Bhandari (2014) analysed & investigate the Effect of silica fume on concrete. The result That came out showed that S.F. came as a good substitute of cement. Amount of strength in silica fume in concrete is much. The workability of concrete declines as increase with percentage of S.F. The ideal value of compressive strength can be obtained in 10% substitute of silica fume. As power of 15% with substitute of cement by S.F is much then concrete. The ideal silica fumes placement percentage varies from 10 % to 15 %, replacement level.
6) Jain AND Pawade (2015) carefully observed the Quality of Silica Fume, concrete. High strength silica-fume concretes with its physical property & their care to cure procedures were assessed & compared with reference to Portland cement concretes, having may be the same concrete content as that of silica-fume. The Experimental program which is comprises six stages of silica-fume contents at the Zero %, Five%, Ten %, Fifteen %, Twenty %, & twenty-five %, with & with-out super-plasticizer. It does also get 2 mixes with 15% silica fume added to cement
7) Amar khail (2015) analysed the Impacts of Silica Fume on Properties of H.S.C. He observed that Ten (10%) cement could be substitute by adding silica-fume without disturbing the workability of concrete as concrete which contains 10% silica-fume replaced, it got the top most comp. strength which do followed by the 15% silica fume replacing done with a minor difference. Concrete which has 15% content of silica fume got the topmost strength. S.F. with 10% & 15% as replacement are found to be the ideal amount for the notable enhancement of comp. & flexural strength respectively
8) Sasikumar & Tamilvanan (2016) Did an Investigation based on the experimental research done on property of S.F. as a minor replacement of cement. The basic parameters on which this study was done is M30 grade with minor replacement of cement by silica fume as 0%, 25%, 30%, 40% & 50%. The normal density expands almost at 40% when silica fume % expands from 0% to 25%. The ideal 7-day and 28-day comp. strength is obtained in the replaced level of silica fume as 25 %. Moreover, the split-tensile strength is more when using 25% silica-fume. replacement for cement.

III. EXPERIMENTAL PROGRAMME

A. *Materials*

The various properties of concrete depend upon the factor like water cement ratio, shape size & type of aggregate. It is observed that type of aggregates increases its strength because concrete has 75% coarse aggregate.

B. *Cement*

OPC 43 grade Ultratech Cement confirming to IS: 8112 was used. All tests related to the ingredients of concrete and the entire research were performed at Laboratory. OPC 43 means that the cement is expected to reach a compressive strength of 43 MPa in a cube cast by 28 days. Similarly, OPC 53 reaches 53 MPa by 28 days

C. *Silica Fume*

It is produced by the after effect of the silicon metal as well as ferro-silicon's. Its main & beneficial use is that it is mainly used in concrete as an additive. Due to its properties, it becomes a highly reactively active pozzolan. It can be durable when it is mixed or poured in concrete in a proper mix design. It usually improves the properties of fresh as well as hardened stage of concrete as it makes the fresh stage as much cohesive.

D. *Saw Dust*

Sawdust (or wood shavings) is a by-product or waste product of woodworking operations such as sawing, sanding, milling, planning, and routing. It is composed of small chippings of wood.

These operations can be performed by woodworking machinery, portable power tools or by use of hand tools. Sawdust is the main component of particleboard.

IV. METHODOLOGY

In this experimental study, Cement will be replaced by Silica fume & sand will be replaced by saw dust at various Replacement Percentages of (0%,2.5%,5%,7.5%,10%12.5%,15%,17.5%) in the Concrete Production and following methodology will be adopted in this experimental Study

V. RESULTS AND DISCUSSION

A. Slump Cone Test

Rheological properties were determined: slump flow test was executed to evaluate fresh properties of concrete. The cohesiveness and the absence of segregation of the mixtures were visually estimated. Slump flow value is achieved were shown in Table-1 below.

With Silica Fume in cement	Slump (mm)	With Saw Dust in sand	Slump (mm)
0%	81	0%	83
2.5%	83	2.5%	85
5%	88	5%	88
7.5%	89	7.5%	90
10%	92	10%	92

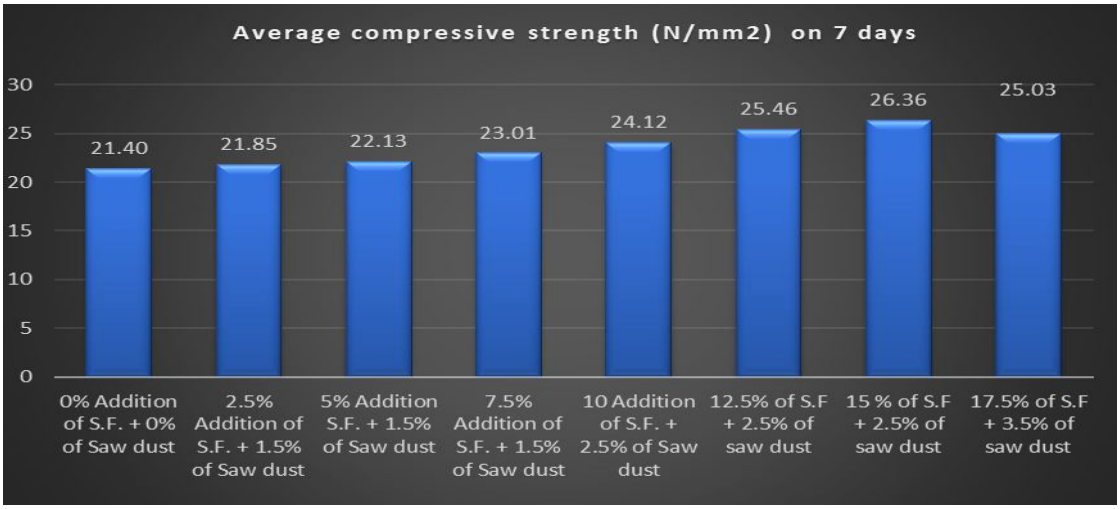
B. Effect on Compressive Strength

1) Compressive Strength test will be conducted on 150×150×150 mm size cubes.

2) Specimens are tested by compression testing machine after 7 days curing or 28 days curing. Load should be applied gradually at the rate of 140 kg/cm2 per minute till the specimens fails

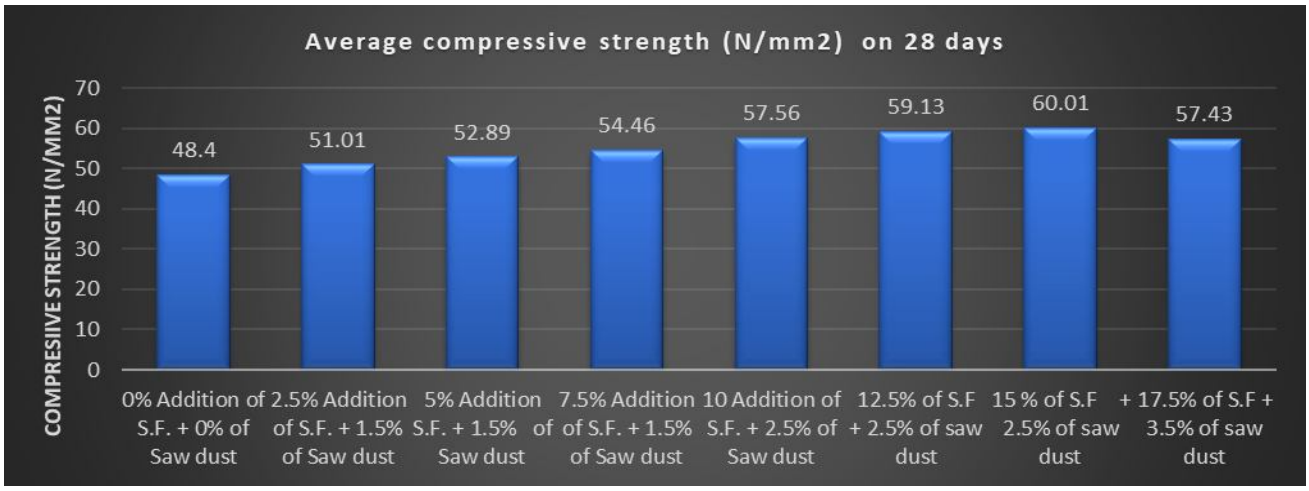
Mix Sample	Average Compressive Strength (N/mm^2)	
	7 days	
0% Addition of S.F. + 0% of Saw dust	21.33	21.40
	21.42	
	21.45	
2.5% Addition of S.F. + 1.5% of Saw dust	21.30	21.85
	22.07	
	22.18	
5% Addition S.F. + 1.5% of Saw dust	22.05	22.13
	22.12	
	22.23	
7.5% Addition of S.F. + 1.5% of Saw dust	22.87	23.01
	23.36	
	22.82	
10 Addition of S.F. + 2.5% of Saw dust	23.11	24.12
	24.23	
	25.07	
12.5% addition of S.F.+ 2.5% of Saw dust	24.03	25.46
	25.56	
	26.86	
15% addition of S.F.+ 2.5% of Saw dust	25.67	26.36
	26.69	
	26.50	

17.5% addition of S.F.+ 2.5% of Saw dust	24.73	25.03
	24.99	
	25.38	



Mix Sample	Avg. Compressive Strength (N/mm^2)	
	28 Days	
0% Addition of S.F. + 0%Saw dust	48.36	48.40
	48.43	
	48.41	
2.5% Addition of S.F. + 1.5% Saw dust	50.48	51.01
	50.65	
	51.93	
5% Addition of S.F. + 1.5% Saw dust	51.95	52.89
	52.82	
	53.90	
7.5% Addition of S.F. + 1.5% Saw dust	54.10	54.46
	54.25	
	55.10	
10% Addition of S.F + 2.5% Saw dust	57.15	57.56
	57.60	
	57.81	
12.5% Addition of S.F + 2.5% Saw	59.03	59.13

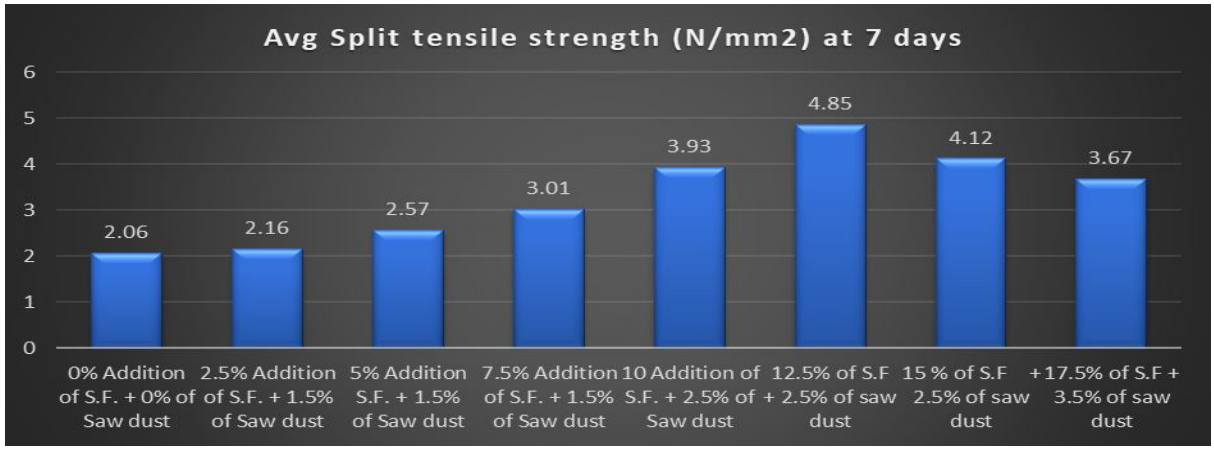
dust	59.23	
	59.19	
15% Addition of S.F + 2.5% Saw dust	58.58	60.01
	60.49	
	61.23	
17.5 % Addition of S.F + 3.5% Saw dust	56.97	57.43
	56.99	
	58.70	

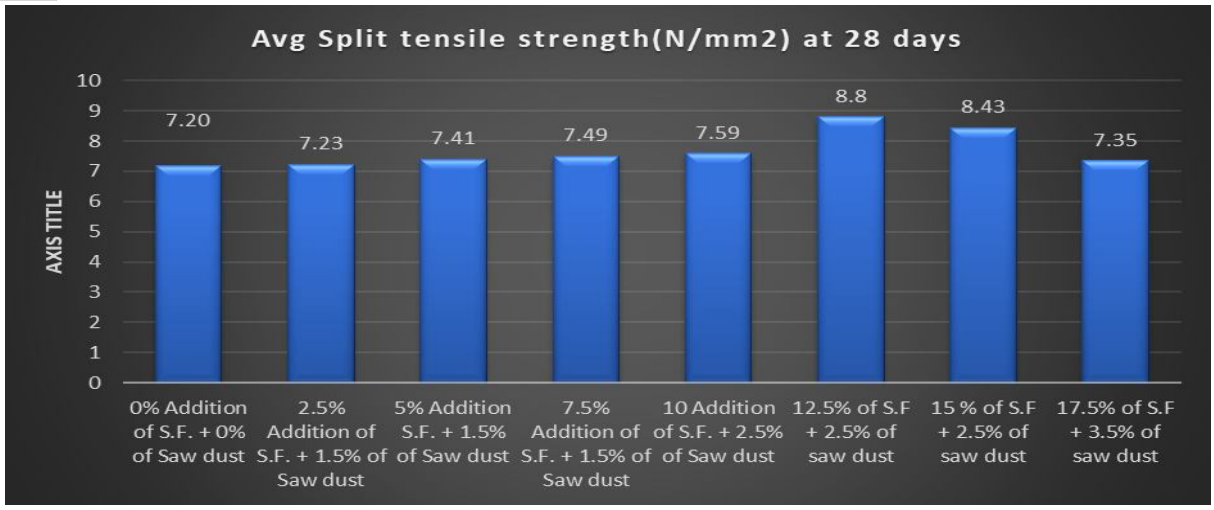


With increase in the percentage replacement of silica fume + saw dust, compressive strength also increased and the maximum value of compressive strength (peak value) was observed at 15% for 7 days whereas for 28 day highest strength was also observed at 15 %. After adding more silica fume & saw dust into mix its strength starts decreasing.

C. Split Tensile Strength

The Split Tensile Strength test is an indirect tensile test generally used to determine the tensile strength of concrete. In the present study, cylindrical specimens of 100 mm diameter and 200mm long were casted to determine the split tensile strength. Cylinder specimens were casted for each percentage of granite powder and foundry sand content separately to be tested after 14 and 28 days. Each set consisted of 3 cylinders to give the split tensile strength as the average strength of 3 specimens. The rest results are presented in the Graph below:

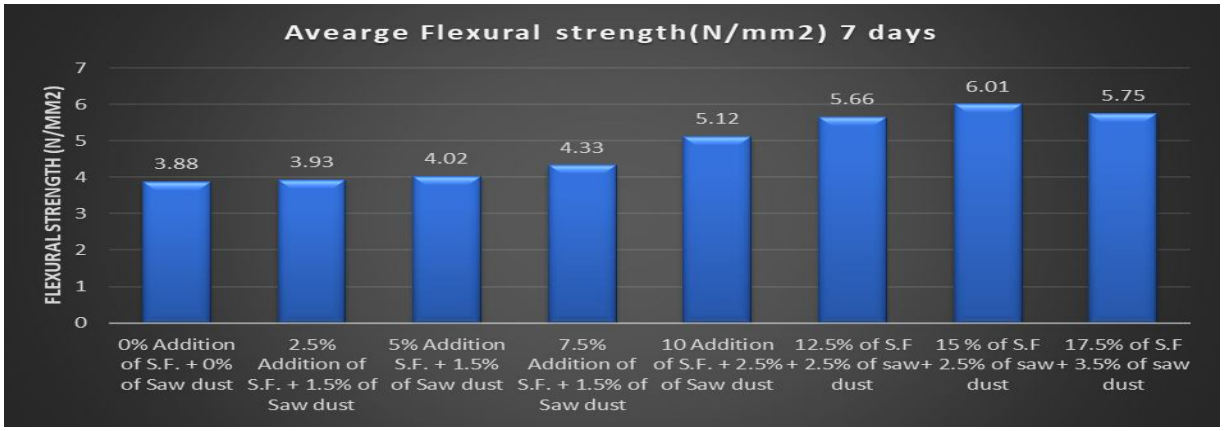


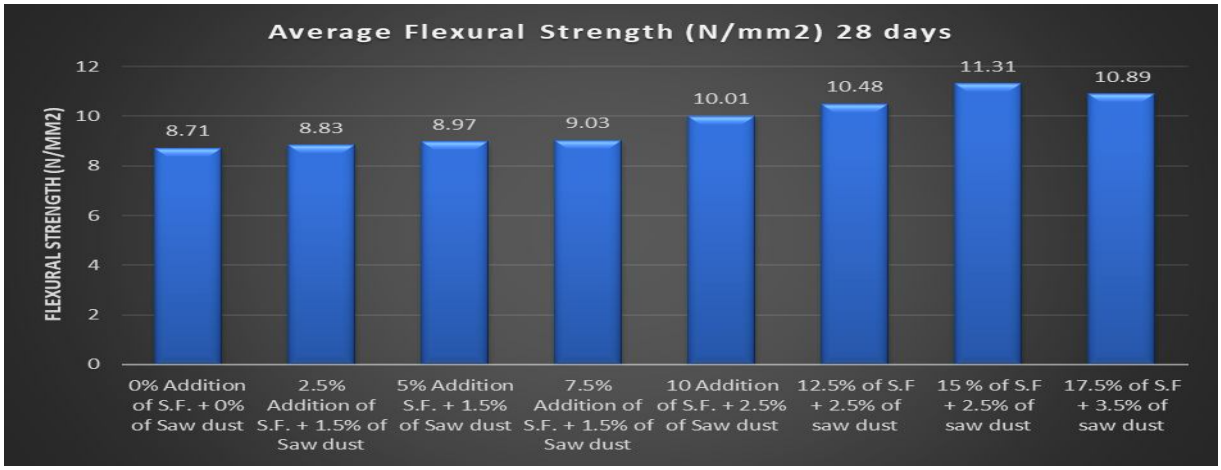


With increase in the percentage replacement of silica fume with cement + saw dust with sand, split tensile strength also increased and the maximum value was observed at 12.5 %

D. Flexural Strength

The Flexural strength of concrete is the ability of concrete beam or slab to resist failure in bending. In the present study, Flexural test concrete beams of size 100 x 100 x 500 mm were casted and tested as per IS:516-1959. Flexural strength of beam specimens was taken as the average of three specimens for different percentage of silica fume and alccofine content separately to be tested after 7 and 28 days





With increase in the percentage replacement of silica fume + saw dust, flexural strength also increased and the maximum value of flexural strength was observed at 15% after adding mixture of 3.5% with 17.5% the strength of mix starts depreciating

VI. CONCLUSIONS

1) The compressive strength increases as compared to reference mix as the varying percentage of silica fume & saw dust combined is increased up to 15 % for 7 days & for 28 days it was also max at 15 % strength of design mix goes on increasing for its varying percentage with respect to reference mix.

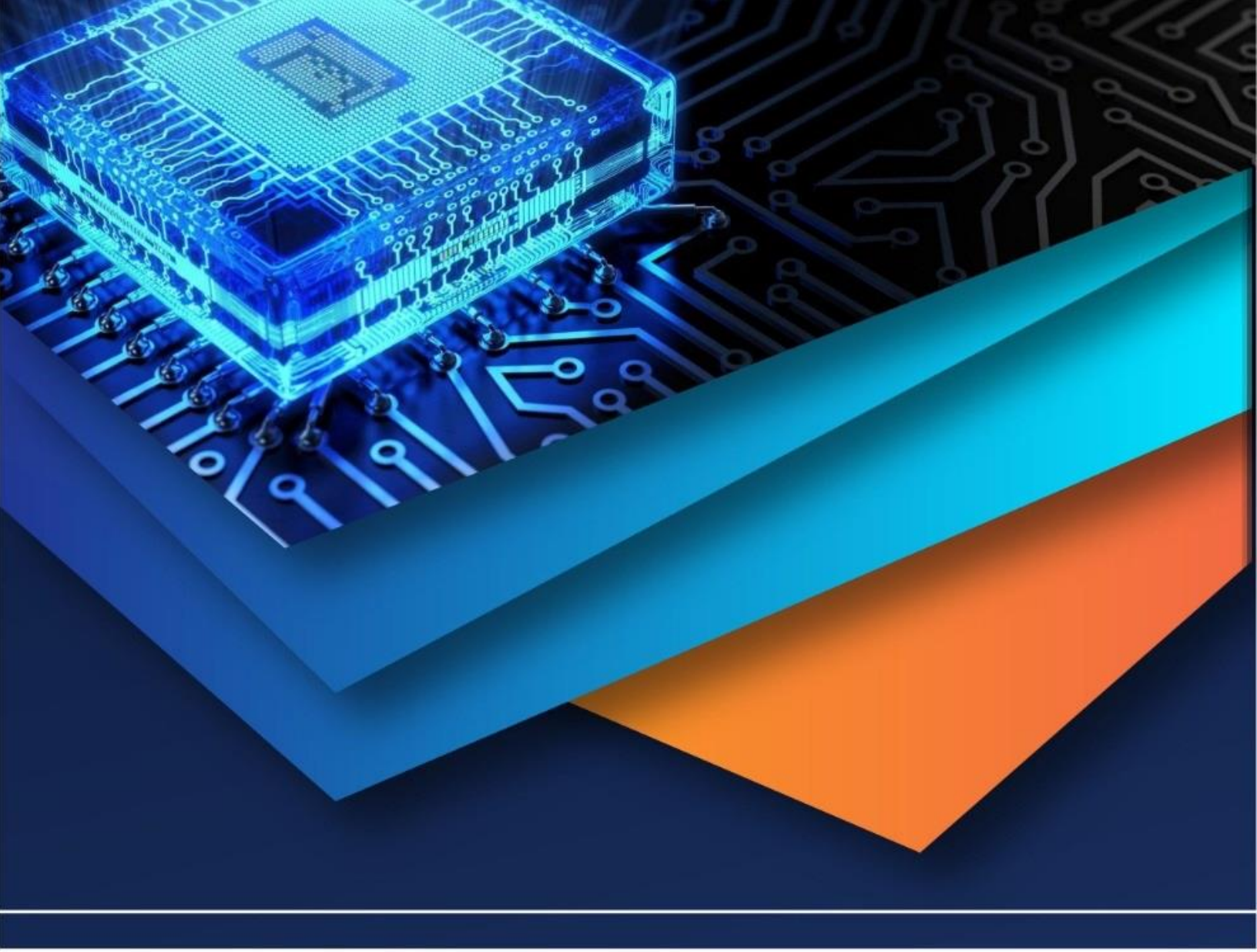
2) The percentage increase of compressive strength at 7 days for 2.5%, 5%, 7.5% ,10%, 12.5%, 15% ,17.5 % silica are 21.85, 22.13, 23.01 ,24.12 ,25.46, 26.36 & 25.03% at 28 days it was 52.89, 54.46, 57.56, 59.13, 60.01, & 57.43% respectively .

3) With increase in the percentage replacement of silica fume and saw dust, flexural strength also increased and the maximum value of flexural strength was observed at 15 %.

4) The study illustrate that it is possible to design M-30 grade of concrete using silica fume and saw dust as a supplementary cementitious material.

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