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Partial Replacement of Fine Aggregate by Glass Powder in Concrete

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Abstract: ***The concrete trade is one in every of the biggest customers of natural resources because of that property of concrete trade is underneath threat. The environmental and economic concern is that the biggest challenge the concrete trade is facing, the problems of environmental and economic concern are self-addressed by the utilization of waste glass as partial replacement of fine aggregates in concrete. In order to improve the mechanical properties of concrete fine aggregates will be replaced by waste glass powder as 20% ,25 and 30% weight for M-45 design mix. The concrete specimens will be tested for compressive strength at 7 ,14 and 28 days respectively and Split tensile Strength at 7 and 28 days and Compressive Strength test at 28 days also the results obtained will be compared with those of traditional concrete.***
Keywords: Glass powder, Flexural Strength Test, Split Tensile Test Compressive Strength Test, Tensile Strength Test

I. INTRODUCTION

In order to form concrete business property, the utilization of waste materials in situ of natural resources is one in every of the simplest approaches. A massive amount of waste glass is generated all round the world. In India, 0.7% of total urban waste generated includes of glass. GBP produces over 4 million heaps of waste glass annually. Waste glass is crushed into given sizes to be used as mixture in numerous applications like water filtration, grit application, sand protect sport turf and sand replacement in concrete. Concrete is most generally used imitation construction material and its demand is increasing day by day.

Glass is a waste material which is abundantly discarded after use though a considerable quantity is recycled. Disposing of glass may cause environmental hazards as it does not decompose. Hence in the recent years use of glass powder in concrete is found to be advantageous in making it a sustainable construction material. Glass powder has not only ben used as fine aggregate replacement, but also as cement replacement as some researchers have reported that it has some pozzolanic reaction. Depending on its fineness and composition of the raw material it exhibits different degrees of pozzolanic reactivity. Based on durability parameters, studies show that the rapid chloride penetration of concrete containing glass is less compared to conventional concrete. It is also evident from researchers that finer glass powder used up to 30% replacement to cement has been very effective in mitigating alkali silica reaction in concrete. In this study, the strength characteristics of an economical high strength concrete. The focus on the experimental investigation in this study is to determine the improvement in the properties of a high strength with glass powder and to study the durability parameters which will enable the researchers and construction industry to use these materials in their construction.

II. METHODOLOGY & EXPERIMENTAL INVESTIGATION

A. *Material Used*

1) *Cement, Water, Aggregate:* Concrete is prepared by mixing various materials like cement, Water, aggregates etc. which are economically available. IS 8112 is used for the work. The fine aggregate used in this investigation was clean river sand, whose maximum size is 4.75 mm, conforming to grading zone II. Machine crushed granite stone is used as coarse aggregate . Two size of coarse is used; one 10 mm passing through 4.75 mm retained and other 20 mm passing through 10mm retained. As per IS: 2486 – 1964 recommendations the following properties of coarse aggregates were determined.
2) *Glass Powder:* Waste glass is easily available in shops is collected and made glass powder. Before adding this glass material into concrete we have to crush it first into desired size. For study glass powder size more than 800 µm and less than 1200 µm.

B. *Methodology*

Cementations composites satisfy various civil engineering requirements such as high durability or impact load resistance. To study the behaviour of reinforced concrete with different volume ratios, nearly 36 specimens were cast and tested for compressive test,24 specimens were cast and tested for tensile strength test and 12 specimens were cast and tested for Flexural test.

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C. Test

1) Tests on Cement

In Cement, the tests conducted were:

a) Fineness test by sieve analysis
b) Standard consistency test using Vicat apparatus
c) Initial and final setting time by using Vicat apparatus

2) Tests on Fine Aggregate

a) Specific gravity
b) Sieve Analysis

3) Test On Final Product

Testing of specimen

a) Casting detail of specimen
b) Compression test for glass powder mix concrete
c) Split Tensile Test for glass powder mix concrete
d) Three Point Load Test for glass powder mix concrete

4) Compressive Strength Test

For compression test, Total 36 cube specimens of size 150 x 150 x 150 mm were cast for M45 grade of concrete. The moulds were filled with different proportions of cement, glass powder. Vibration was given to the moulds using table vibrator. The top surface of the specimen was leveled and finished. After 24 hours the specimens were demoulded and were transferred to curing tank wherein they were allowed to cure for 7,14,28 days. After 7,14,28 days of curing, these cubes were tested on compression testing machine as per I.S. 516-1959. The failure load was noted. The cubes were tested and their average value is reported. The formula used for compessive strength calculation:

Compressive strength (MPa) = Failure load / cross sectional area

5) Tensile Strength Test

For Tensile Strength test, Total 24 cylinderical specimens of size 300 x 150 mm were cast for M45 grade of concrete. The moulds were filled with different proportions of cement, glass powder. Vibration was given to the moulds using table vibrator. The top surface of the specimen was leveled and finished. After 24 hours the specimens were demoulded and were transferred to curing tank wherein they were allowed to cure for 7 and28 days. After 7 and28 days of curing, these cubes were tested on compression testing machine as per I.S. 5816-1999. The failure load was noted. The cubes were tested and their average value is reported. The formula used for tensile strength calculation:

$$f_{ct} = \frac{2P}{\pi ld}$$

Where,
P=maximum load in Newtons applied to the noted before testing.
I = length of the specimen (in mm), and d = cross sectional dimension of the specimen

6) Flexural Test

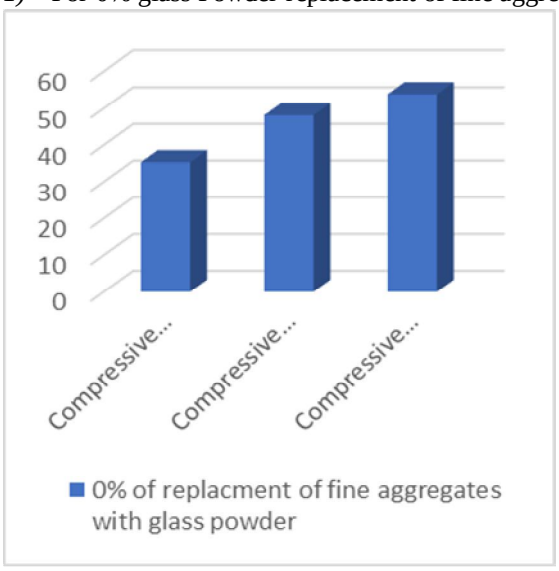
For Flexural test, Total 12 beam specimens of size 750 x 150 x 150 mm were cast for M45 grade of concrete. The moulds were filled with different proportions of cement, glass powder. Vibration was given to the moulds using table vibrator. The top surface of the specimen was leveled and finished. After 24 hours the specimens were demoulded and were transferred to curing tank wherein they were allowed to cure for 28 days. After 28 days of curing, these cubes were tested on three point load testing machine as per I.S. 516-1959. The failure load was noted. The beam were tested and their average value is reported.

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III. RESULTS AND DISCUSSION

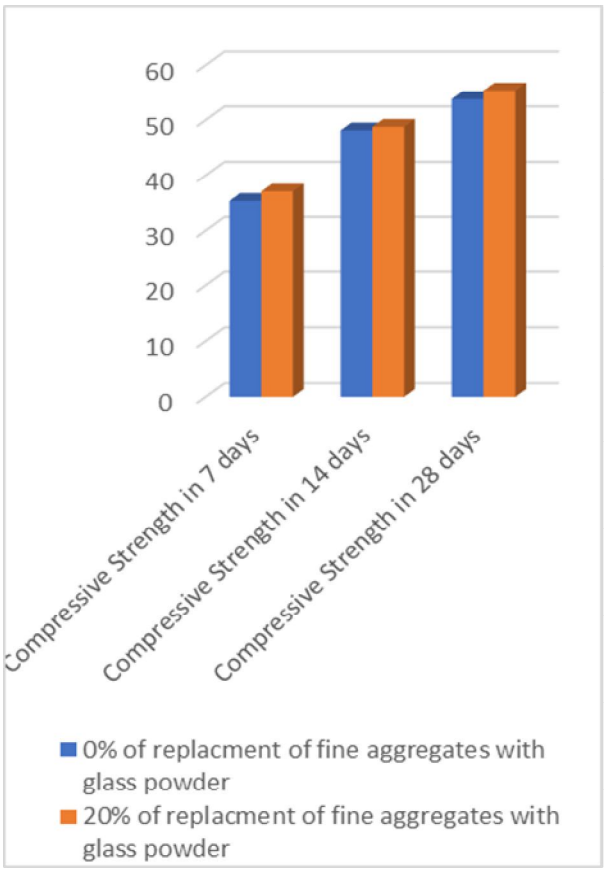
A. *Compression Test*

1) For 0% glass Powder replacement of fine aggregate:



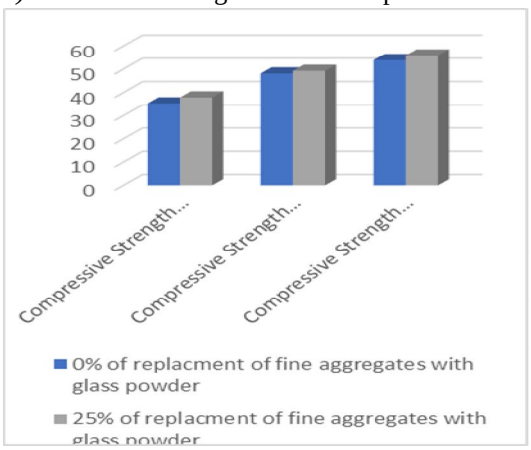
% of replacment of fine aggregates with glass powder	Compressive Strength in N/mm2(7 Days)	Compressive Strength in N/mm2(14 Days)	Compressive Strength in N/mm2(28 Days)
0%	35.33	48.12	53.83

2) For 0%& 20% glass Powder replacement of fine aggregate:



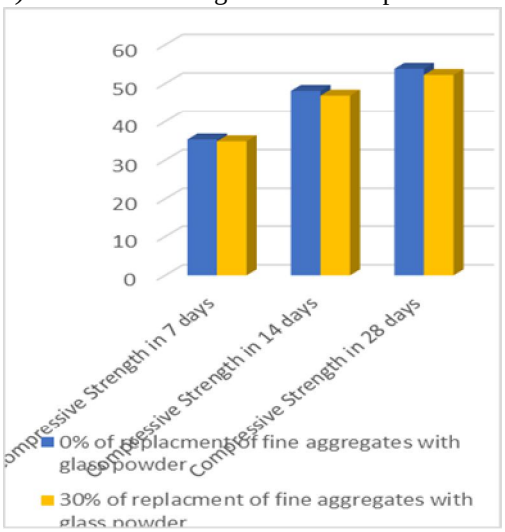
% of replacment of fine aggregates with glass powder	Compressive Strength in N/mm2(7 Days)	Compressive Strength in N/mm2(14 Days)	Compressive Strength in N/mm2(28 Days)
0%	35.33	48.12	53.83
20%	37.07	48.78	55.37

3) For 0%& 25% glass Powder replacement of fine aggregate:



% of replacment of fine aggregates with glass powder	Compressive Strength in N/mm2(7 Days)	Compressive Strength in N/mm2(14 Days)	Compressive Strength in N/mm2(28 Days)
0%	35.33	48.12	53.83
25%	37.86667	49.23	55.85667

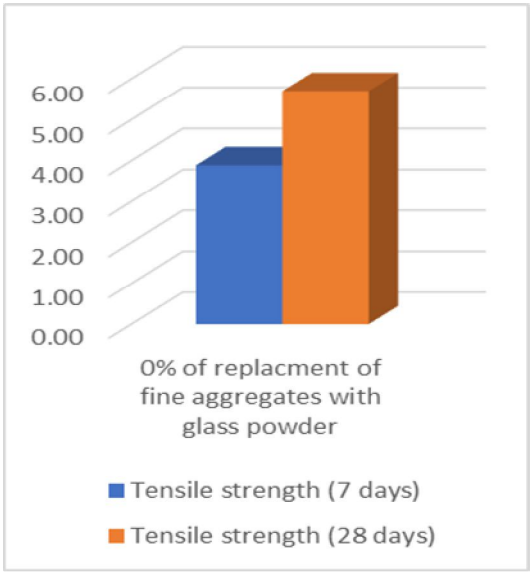
4) For 0%& 30% glass Powder replacement of fine aggregate:



% of replacment of fine aggregates with glass powder	Compressive Strength in N/mm2(7 Days)	Compressive Strength in N/mm2(14 Days)	Compressive Strength in N/mm2(28 Days)
0%	35.33	48.12	53.83
30%	34.86667	46.9	52.22667

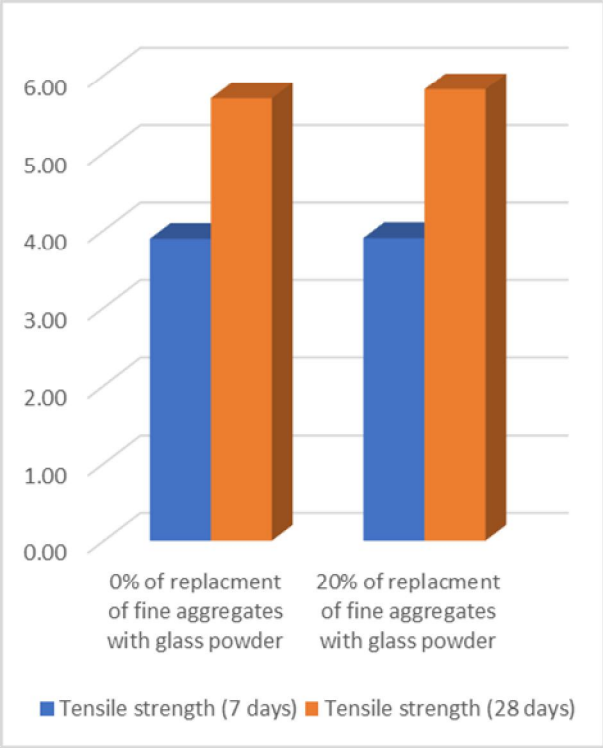
B. Tensile Strength Test

1) For 0% glass Powder replacement of fine aggregate:



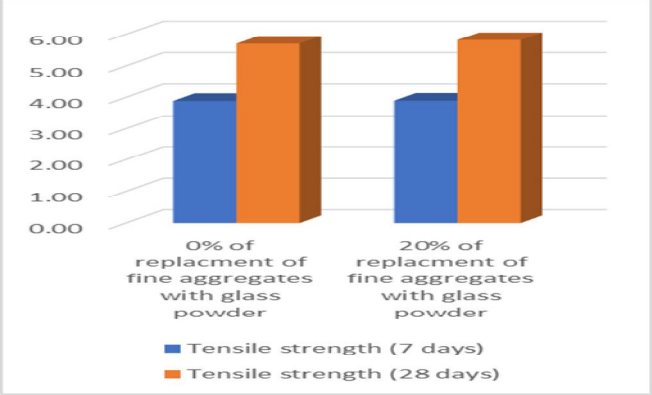
% of replacment of fine aggregates with glass powder	Tensile strength in N/mm2 (7 days)	Tensile strength in N/mm2 (28 days
0%	3.89	5.7

2) For 0% & 20% glass Powder replacement of fine aggregate:



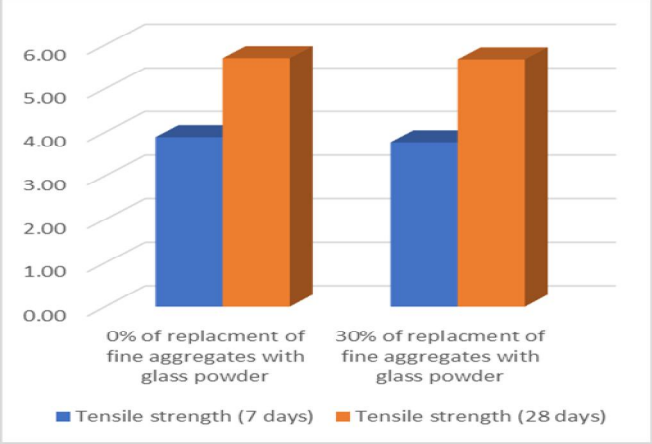
% of replacment of fine aggregates with glass powder	Tensile strength in N/mm2 (7 days)	Tensile strength in N/mm2 (28 days
0%	3.89	5.7
20%	3.90	5.816667

3) For 0% & 25% glass Powder replacement of fine aggregate:



% of replacment of fine aggregates with glass powder	Tensile strength in N/mm2 (7 days)	Tensile strength in N/mm2 (28 days
0%	3.89	5.7
25%	3.93	6

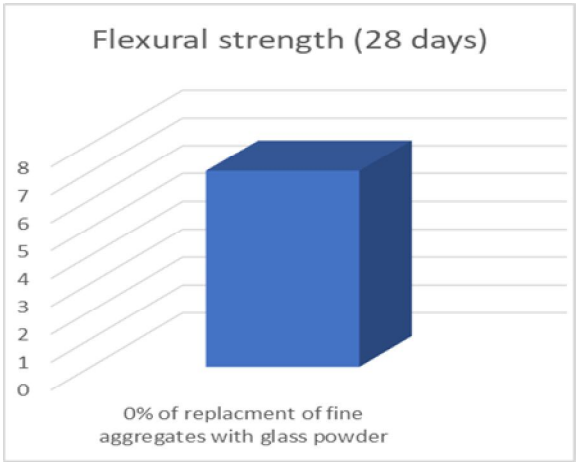
4) For 0% & 30% glass Powder replacement of fine aggregate:



% of replacment of fine aggregates with glass powder	Tensile strength in N/mm2 (7 days)	Tensile strength in N/mm2 (28 days
0%	3.89	5.7
30%	3.77	5.673333

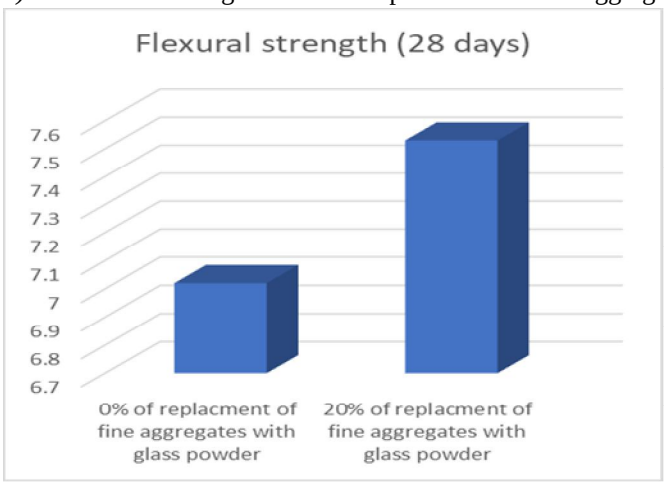
C. Flexural Test

1) For 0% glass Powder replacement of fine aggregate:



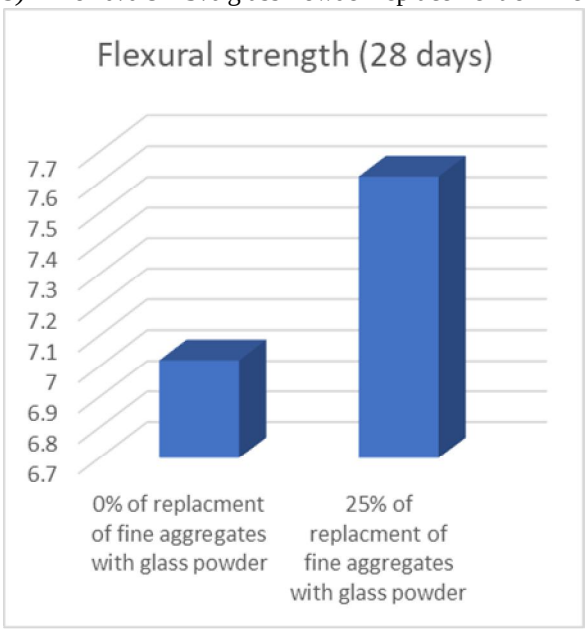
% of replacment of fine aggregates with glass powder	Flexural strength in N/mm2 (28 days)
0%	7.02

2) For 0% & 20% glass Powder replacement of fine aggregate:



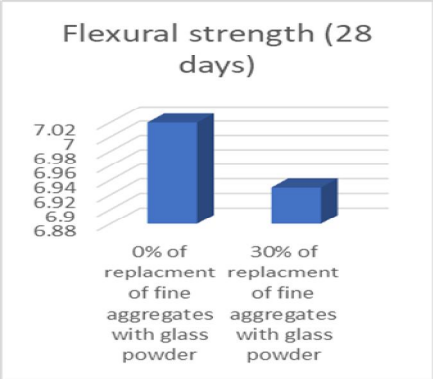
% of replacment of fine aggregates with glass powder	Flexural strength in N/mm2 (28 days)
0%	7.02
20%	7.53

3) For 0% & 25% glass Powder replacement of fine aggregate:



% of replacment of fine aggregates with glass powder	Flexural strength in N/mm2 (28 days)
0%	7.02
25%	7.62

4) For 0% & 30% glass Powder replacement of fine aggregate:



% of replacment of fine aggregates with glass powder	Flexural strength in N/mm2 (28 days)
0%	7.02
30%	6.93

IV. CONCLUSION

This investigation intent to evaluate the effective utilization of glass powder on concrete. A concrete grade M45 was designed as per IS 10262:2000 for this concrete mix. The water cement ratio 0.33 was adopted. The main aim of this investigation to find the improvement in compressive strength,tensile strength and flexural strength of a given mix by replacement of fine aggregate with glass powder at proportion 20%,25% and 30%.

In this research we had found that

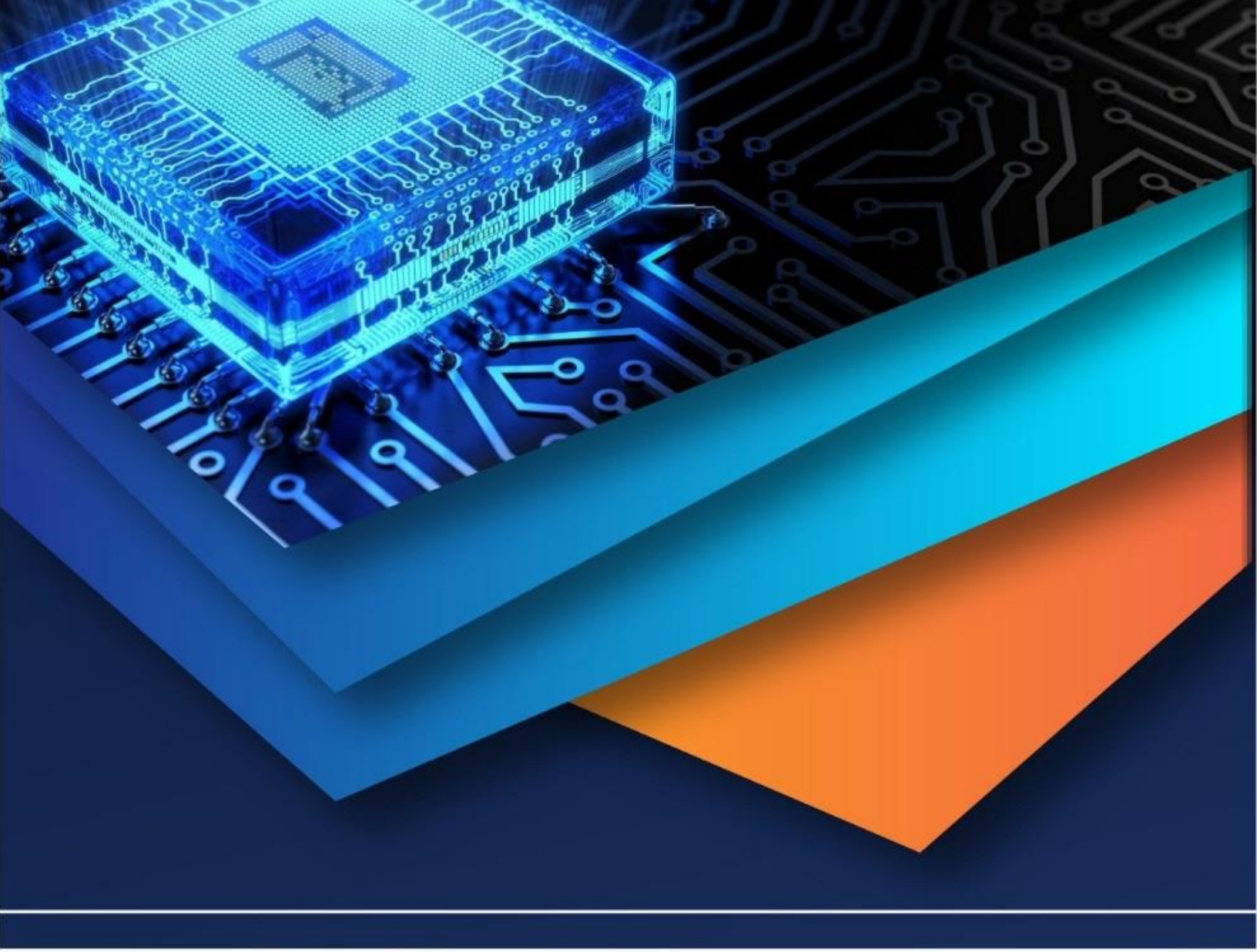
1) For M45 grade of concrete using replacement of fine aggregates with glass powder at proportion 20%,25% and 30% . It was found that the compressive strength of concrete for 7,14 and 28 days were increased at 20% and 25% replacement of fine aggregates with glass powder about 1.29% and 2.31% as compared with conventional concrete at 28 days.

2) Tensile strength concrete of M45 grade of concrete using replacement of fine aggregates with glass powder at proportion 20%,25% and 30% for 7 days and 28 days. . It was found that the compressive strength of concrete for 7 and 28 days were increased at 20% and 25% replacement of fine aggregates with glass powder about 2.11% and 5.27% as compared with conventional concrete at 28 days.

3) Flexural strength of M45 grade of concrete using replacement of fine aggregates with glass powder at proportion 20%,25% and 30% for 28 days. . It was found that the compressive strength of concrete for 28 days were increased at 20% and 25% replacement of fine aggregates with glass powder about 4.14% and 8.55% as compared with conventional concrete at 28 days. From the above results discussion it is concluded that replacement of fine aggregates with glass powder at proportion 25% gives better result of compressive, tensile as well as flexural strength as compared to the conventional concrete.

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