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FLEXURAL BEHAVIOUR OF RC BEAM USING FLY ASH AND GRANITE SLURRY

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ABSTRACT

In recent years thermal power plant generate fly ash and granite industries are generate granite slurry in large quantities. Recycling such waste by utilize them into concrete in a moderate solution for the pollution. The raw material such as fly ash and granite slurry is replaced as cement and fine aggregate. The replacement percentage of cement with fly ash is 0, 15, 25 & 35% and the replacement of fine aggregate with granite slurry is 0, 15, 25 & 35% of concrete volume. In this work we determined the basic hardened concrete properties such as compressive strength, split tensile and flexural strength of concrete using partial replacement of fly ash and granite slurry.

Keywords- *compressive strength, fly ash, flexural strength, granite slurryand split tensile strength*.

I. INTRODUCTION

Reuse of industrial wastes like fly ash and granite slurry is economically very important. The use of these waste materials in construction industry as an alternative to conventional materials. Such practice avoids mining of natural resources and reduces the space required for the landfill disposal and improves the quality of environment in future.

Fly ash is the waste obtained from thermal power plant. Fly ash is one such waste material which can be used as an alternative for cement. Due to its fineness it can show the property same as that cement.

Granite slurry is considered as a waste material which can be used in construction site as partial replacement of fine aggregate. This granite slurry is obtained from granite manufacturing industry. In order to reduce the deposition of granite slurry and also to provide an alternative material for sand it is proposed to study the capacity of granite slurry as replacement to fine aggregate.

II EXPERIMENTAL PROGRAM

1. FLY ASH

Fly ash is a binding material generally in the powder form that can be made into paste usually by addition of water. It should be free from limps and may be greenish grey or brown or black color. Properties of fly ash described in Table1

Table 1 Properties of fly ash

S.No	Properties	Result
1	Specific gravity	2.68
2	Initial setting time	180 minutes
3	Final setting time	230 minutes
4	Consistency	30%

II. GRANITE SLURRY

The granite waste is used as fine aggregates for casting the specimen. It should be free from limps and may be greenish grey or brown or black color. Properties of granite slurry described in Table 2.

Table 2 Properties of granite slurry

S.No	Properties	Result
1	Specific gravity	2.68
2	Porosity	Very low
3	Absorption	1.2%
4	Density	2500Kg/m^3
5	Crushing strength	2200Kg/m^3

III. COMPRESSIVE STRENGTH

In this compressive strength test conducted on hardened concrete based on IS 516:1959 shown in figure1. The inner size of the cube specimen is 150X150X150mm and the specimen were casted and after 24 hours of casting the specimens were demolded and kept in the clean water tank. After 7 days of curing the cube specimen was taken out from the curing tank and allowed to dry for about few hours. Then the specimen was placed in 2000 kN capacity of compression testing machine the lead was applied in uniform rate until the specimen is failed then load at failure has been noted.

$$\text{Compressive Strength} = \frac{load}{Area}\ \text{N/mm}^2$$

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Fig 1: compressive strength test

From the test results, it has been observed that the 7 days' compressive strength increases with an increase of fly ash and granite slurry up to 15%, 25%, and 35% of replacement of cement and fine aggregate. The experimental and results obtained for various specimens listed in Table 3

Table 3 Average compressive strength

S. No	**Replacement Mix percentage (%)**	**Percentage volume of replacement of cement by fly ash**		**Percentage volume of replacement of fine aggregate by granite slurry**		**Average compressive strength N/mm²** (7 Days)
		Cement	**flyash**	**F.A**	**G.S**	
1	0	100	0	100	0	11.22
2	15	85	15	85	15	12.44
3	25	75	25	75	25	10.95
4	35	65	35	65	35	10.7

The compressive strength of the cube for different percentage of fly ash and granite slurry with 0.5 water cement ratio at 7 days were plotted in the graph. The relationship between compressive strength in N/mm^2 taking along Y axis and percentage of replacement along X axis at 7 days shown in figure2.

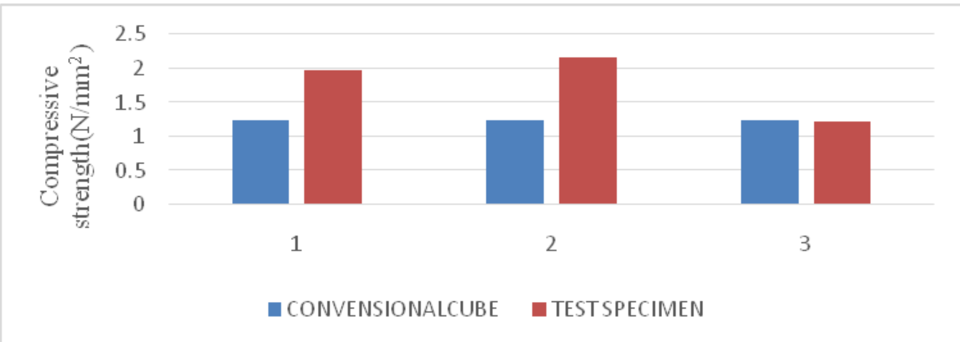

Fig 2: Compressive strength (7days)

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IV. SPLIT TENSILE STRENGTH

In this split tensile strength test conducted on hardened concrete based on IS 516:1959 shown in figure 3. The inner size of the cylinder specimen is 150mm diameter and 300mm height and the specimen were casted and after 24 hours of casting the specimens were demolded and kept in the clean water tank. After 7 days of curing the cylinder specimen was taken out from the curing tank and allowed to dry for about few hours. Then the specimen was placed in 2000 kN capacity of compression testing machine the lead was applied in uniform rate until the specimen is failed then load at failure has been noted.

$$\text{Split tensile strength} = \frac{2p}{3.14\,dl}\ \text{N/mm}^2$$

Fig 3: Split tensile strength test

From the test results, it has been observed that the 7 days' split tensile strength increases with an increase of fly ash and granite slurry up to 15%, 25%, and 35% of replacement of cement and fine aggregate.

The experimental and results obtained for various specimens listed in Table 4.

Table 4 Average split tensile strength

S. No	Mix percentage (%)	Percentage volume of replacement of cement by fly ash		Percentage volume of replacement of fine aggregate by granite slurry		Average Split tensile strength N/mm^2 (7 Days)
		Cement	fly ash	F.A	G.S	
1	0	100	0	100	0	1.24
2	15	85	15	85	15	1.98
3	25	75	25	75	25	2.16
4	35	65	35	65	35	1.22

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The split tensile strength of the cylinder for different percentage of flash and granite slurry with 0.5 water cement ratio at 7 days was plotted in the graph. The relationship between split tensile strength in N/mm^2 taking along Y axis and percentage of replacement along X axis at 7 days shown in figure 4.

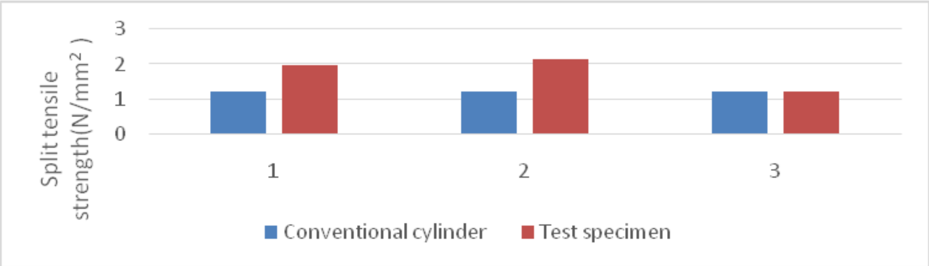

Fig 4 Split tensile strength (7days)

V. FLEXURAL STRENGTH

The objective of flexural strength test was to determine the first crack and ultimate load deflection and crack pattern. Cracking is mostly due to restrained a shrinkage temperature gradient. Beams were tested under 2-point loading based on IS 516:1959 shown in figure5. The specimen were casted and after 7 days curing of concrete the test specimen was allowed to dry and placed in the universal testing machine. Beams were simply supported over a span of 1100mm the load was applied to the upper most surface as cast in the mould along the two lines spaced one third of the span apart the axis of the specimen was aligned carefully with the axis of loading device the load was applied without shock and increased continuously at a uniform rate until the specimen fails.

For finding the deflection under the two point loading the dial gauge were placed in the center of beam to measure the mid deflection at each stage of loading the maximum load at failure deflection and cracking pattern was noted. The details about the experimental study were carried out to compare the flexural strength of composite beams to that of control beam.

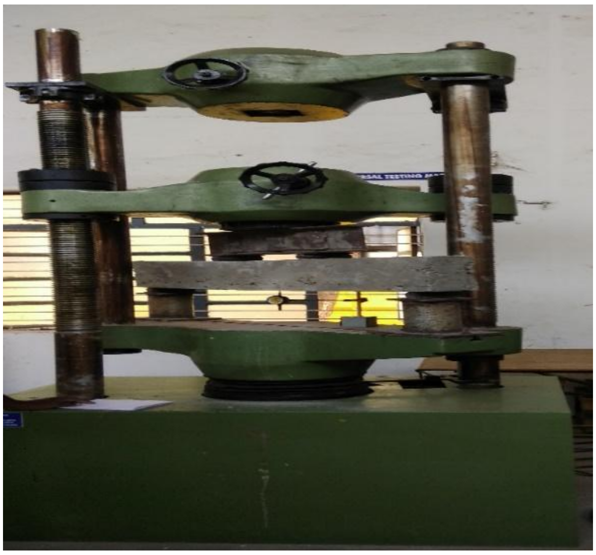

Fig 5: flexural strength tes

5.1 Load-axial deflection diagrams

The basic observations from experimental tests are the load and corresponding axial deflection for M20 grade of concrete.

The experimental and analytical results obtained for various specimens listed in Table 5

Table 5 Load and deflection

Load (kN)	Deflection (mm)		
	Conventional beam	Control beam 1	Control beam 2
10	0.03	0.22	0.28
20	0.8	0.65	0.75
30	0.68	1.12	1.28
40	1.13	1.62	1.87
50	1.68	2.18	2.45
60	2.12	2.75	3.27
70	2.66	3.50	4.8
80	3.32	4.4	5.4
90	4.32	6.8	7.8
100	5.4	8.3	9.6

The load and deflection curve for different percentage of fly ash and granite slurry with 0.5 water cement ratio at 7 days were plotted in the graph. The relationship between deflection in mm taking along Y axis and load along X axis at 7 days shown in figure 6.

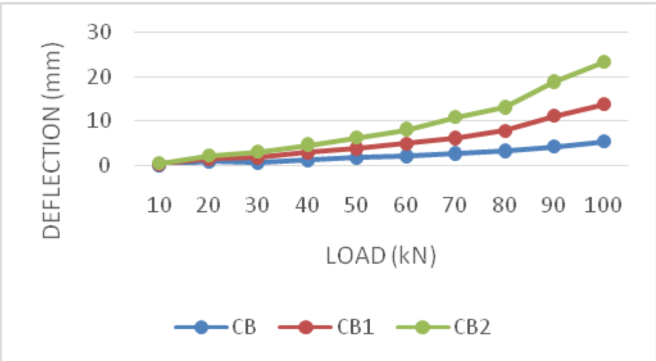

Fig 6: Load and deflection curve

5.2 First crack load

Third point static load was applied on all beams and at each increment of load deflection were noted. The load was recorded at initial crack of all the beams and shown in the Figure 7. In conventional beam initiation of crack take place at a load of 20kN. In beam CB-1 initiation of crack take place at a load of 25 kN which is lower than beam CB-2 in which crack initiation starts at 27kN.

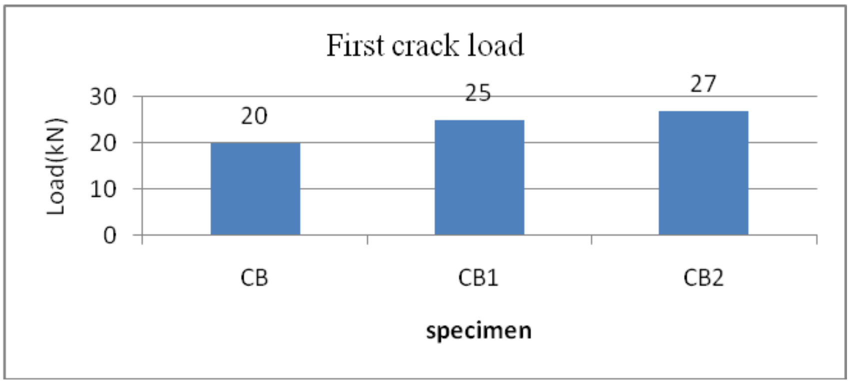

Fig 7: First crack load

5.3 Ultimate load

The load carrying capacity of control beam and strengthened beam was recorded and is shown in the Figure 8. The conventional specimen was loaded up to their ultimate load. It was noted that of all the beams, the strengthened beams are CB-1, CB-2. In conventional beam, ultimate failure takes place at a load of 60kN. In beam CB-1 ultimate load was 65kN, in beam CB- 2 ultimate load was 70kN.

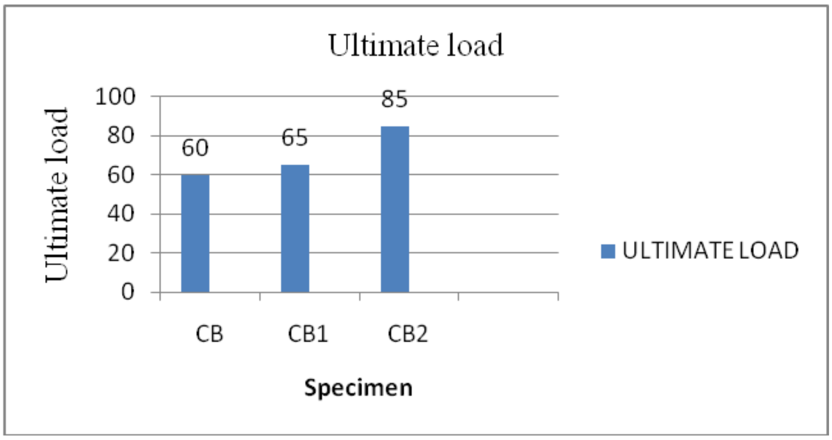

Fig 8: Ultimate load

5.4 Ductility factor

Ductility is the ratio between deflections at ultimate load to that at the onset of yielding. The ductility factor of conventional specimen was found to 1.75, The ductility factor CB-1 was found to 1.6, The ductility factor CB-2 was found to 2.14, Figure 9 shows the variation in ductility factor.

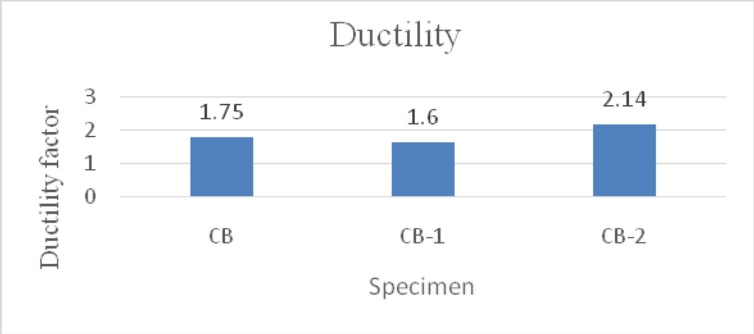

Fig 9: Ductility factor

5.5 Energy absorption

Energy absorption is the area under the load deflection diagram. The strengthened beams exhibit an increase in energy absorption capacity with reference to after strengthening of specimen. Figure 10 shows the variation in energy absorption capacity of beams.

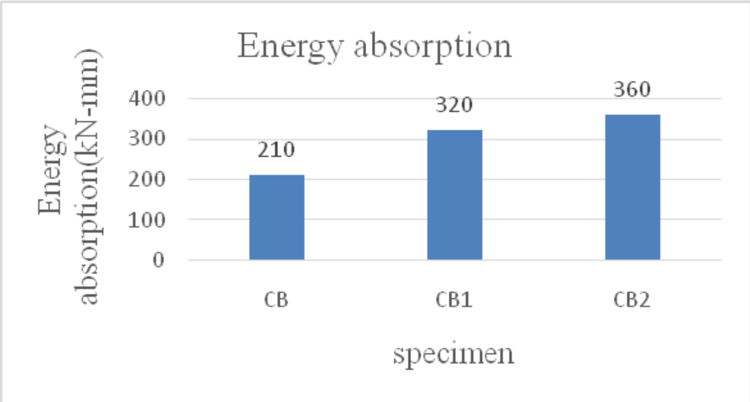

Fig 10: Energy absorption

Table 6 Experimental results of RC beams under two-point loading

Beam designation	First Crack Load (kN)	First Crack Deflection (mm)	Ultimate Load(kN)	Maximum Deflection (mm)	Ductility Factor	Energy Absorption (kN-mm)
CB	20	0.8	60	2.12	1.75	210
CB-1	25	0.85	65	2.85	1.6	320
CB-2	27	1.12	85	5.4	2.14	360

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III. CONCLUSION

- From the above experimental results, it is proved that, fly ash and granite slurry used as alternative material for the cement and fine aggregate
- Based on the results the compressive strength, split tensile strength and flexural strength are increased as a percentage of fly ash and granite slurry are increased.
- As we have seen fly ash and granite slurry is good replacement to cement and fine aggregate in some cases and serves effectively but it can't replace completely.
- Even though it replaces partially it gives very good results and a greater approach in construction and sustainable development.

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