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EFFECT ON CHARACTERISTICS STRENGTH OF CONCRETE COMBINED WITH GLASS FIBRE AND BOTTOM ASH.

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Abstract - *In this paper the reasonable aggregate in concrete mixture has been replaced with bottom ash and glass fiber is additionally used to improve the strength features of concrete. The concrete mixture design is done for M20 grade concrete and is organized for different combinations of 0%, 10%, 20%, 50% and 100% of replacement of sand by bottom ash with 0%, 0.3%, 0.5%, 0.7% and 1% of glass fibers by weight of cement. The cube size is 150mm x150mm x150 mm. The mechanical properties were compared with concrete mixture and it was found that the optimal combination as 10% bottom ash and 0.7% glass fibers. Flexural strong point was compared by testing beams of size 750 mm x 150 mm x 150 mm beneath two points loading. Results displayed that there was no dreadful conditions of strength for beams with bottom ash as replacement for reasonable aggregates. Bottom Ash produced by coal-fired boilers can be mainly used in different of construction and manufacturing applications. These applications contain structural and engineering fill,cement raw material, aggregates for concrete and asphalt products and general reclamation purposes. With the increased use of bottom ash, there is a big interest in dry cooling and dry removal of ash from the lower part of the boilers.*

Key Words: *Bottom ash, Concrete, Glass fibre, Flexure, Compressive, Tensile Strength.*

1.INTRODUCTION

Nowadays the usage of bottom ash as replacement for reasonable aggregates shows degradations in characteristic compressive strength of concrete apart from increasing the workability of concrete. Plain cement concrete holds a very low tensile strong point, limited ductility and little resistance to fast. Recently concrete technologies are used to increase the workability, strong point and resistance to smaller cracks in the concrete. The fibers of small length and small diameters can be used in concrete to convert its brittle nature to flexible one. In case the mixture of combination of glass fibers and bottom ash are more suitable and reasonable for showing the results that the increase in the compressive strength, tensile strength and flexural strength (due to their various mixing proportions).

2. RESEARCH SIGNIFICANCE

The presented research is aimed at studying the properties like optimum percentage of bottom ash and glass fibre with partial replacement of sand to determine the optimum concrete mix. The optimum concrete mix is used to determine the compressive strength, flexural strength and split tensile strength. The study also aims at determining the flexural strength of the concrete beams based on the cross sectional dimensions, span and amount of Bottom Ash + Glass Fibres used and compared with actual strength obtained based on experimental results. The research findings will help engineers to understand the overall performance of concrete for compressive strength, flexural strength and split tensile strength.

3. EXPERIMENTAL PROGRAM & SETUP

The report deals with the test results in which they are presented and discussed. The test results cover the compressive strength, flexural strength, workability of concrete and compaction factor. The main aim of this experimentation is to study the effect of partial replacement of Sand by Bottom ash and Glass fiber on the properties of concrete. The experimental program is divided in four phases.

a) Concrete mix design as per IS 10262-2009 for M20 grade of concrete. Bottom ash and Glass fibers after partial replacement of cement with varying percentages

b) Casting of cubes and beams.

c) Curing of cubes and beams for 7 days and 28 days.

d) Testing of all beam specimens with point loading for flexural strength and compressive strength for all cubes. Each test result plotted in the figures or given in the tables is the mean value of results obtained from at least three specimens.

4. MATERIAL AND METHODS

4.1 Glass fibers

Glass fiber is a material that has many fibers of glass, which are fine in texture. They are readily produced from raw materials, which are available in virtually unlimited supply. On a specific strong point basis, glass fiber is one of the strongest and most commonly used structural materials. The common use of this material is that of for sound, thermal and electrical insulation. In addition to this, a good reinforcing agent is added to many products of the polymer family. It has the advantages of being cheap and less brittle over some of the other reinforcing agents such as the carbon fiber. All glass fibers described in this article are derived from compositions containing silica. They exhibit useful bulk properties such as hardness, transparency, resistance to chemical attack, stability and inertness as well as desirable fiber properties such as strength, flexibility and stiffness.

4.2 Types of Glass fibers

These are of two categories, low-cost general-purpose fibers and premium special purpose fibers. Over 90% of all glass fibers are general-purpose products. These fibers are known as E-glass and are subject to ASTM specifications. The remaining glass fibers are premium special-purpose products.

4.3 ASTM standards for E-glass

Compositions containing 5 to 10 % by weight of Boron Oxide are certified for printed circuit boards and aerospace applications. Compositions containing 0 to 10 % by weight of Boron Oxide are certified for general applications. According to these standards, E-glass compositions for either type of application may also contain 0 to 2 % by weight of alkali oxide and 0 to 1 % by weight of fluoride. The recent boron-free E-glass variants may also be fluorine free.

*4.*4 Concrete

The concrete mix design was prepared according to IS 10262-1982 method to have characteristic compressive strength of 30MPa with w/c ratio 0.43 and slump of 60mm. Specific gravity of cement, fine aggregate and coarse aggregate are 2.1, 3.63 and 3.65 respectively. The filter analysis for fine and coarse aggregate as per IS: 383-1970 gave the fineness modulus as 3.85 and 7.506.

4.5 Bottom Ash

Bottom ash is a part of the non-combustible residue of combustion in a furnace. In an industrial context, it usually refers to coal combustion. The most common type of coal-burning furnace in the electric utility industry is the dry, bottom pulverized coal boiler. When pulverized coal is burned in a dry, bottom boiler, about 80 percent of the unburned material or ash is entrained in the flue gas and is captured and recovered as fly ash. The remaining 20 percent of the ash is dry bottom ash, a dark gray, granular, porous, predominantly sand size minus 12.7mm material that is collected in a water-filled hopper at the bottom of the furnace. When a sufficient amount of bottom ash drops into the hopper, it is removed by means of high-pressure water jets and conveyed by sluiceways either to a disposal pond or to a decant basin for dewatering, crushing, and stockpiling for disposal or use.

5. TEST RESULTS

5.1 Compressive Strength Test

The cube compressive strength for different mixes at period of 7 and 28 days

Fig -1: Compressive Strength Test

5.2 Cylinder Split Tensile Strength Test:-

The split tensile strength for different mixes at period of 7 and 28 days.

Fig -2: Split Tensile Strength Test

5.3 Flexural Strength Test:-

The load-deformation pattern was plotted and maximum load applied to the specimens were recorded.

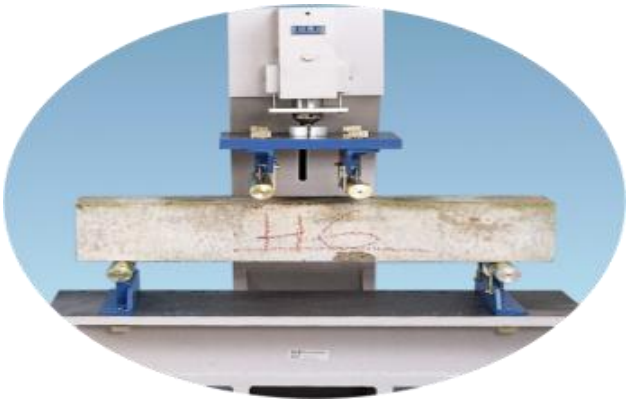
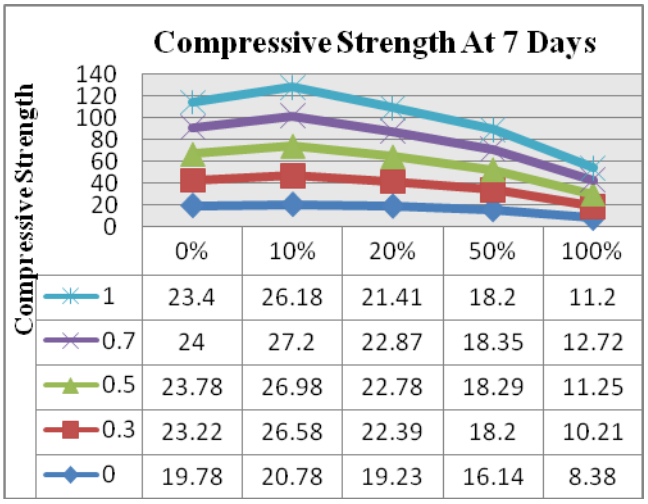


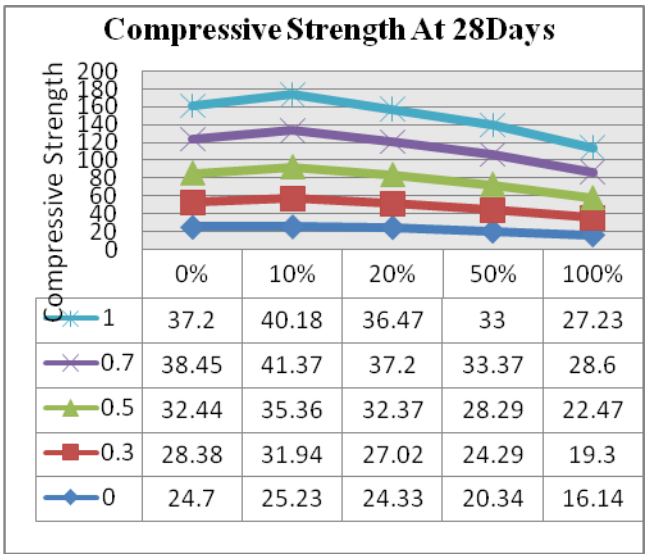
Fig -3: Flexural Strength Test

6.Results And Discussion



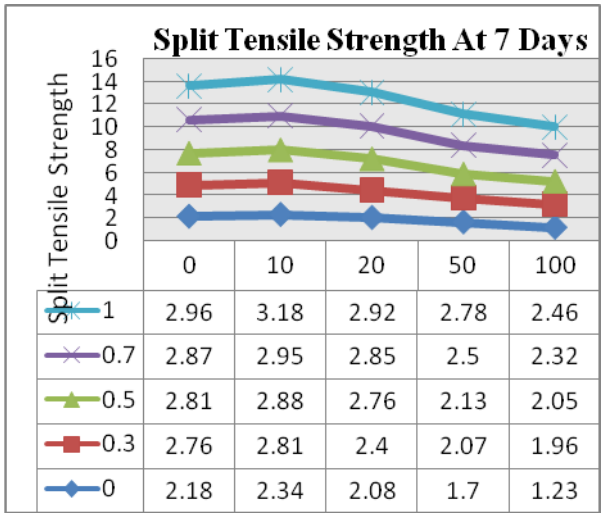
	0%	10%	20%	50%	100%
1	23.4	26.18	21.41	18.2	11.2
0.7	24	27.2	22.87	18.35	12.72
0.5	23.78	26.98	22.78	18.29	11.25
0.3	23.22	26.58	22.39	18.2	10.21
0	19.78	20.78	19.23	16.14	8.38

Chart -1: Compressive Strength at 7 days



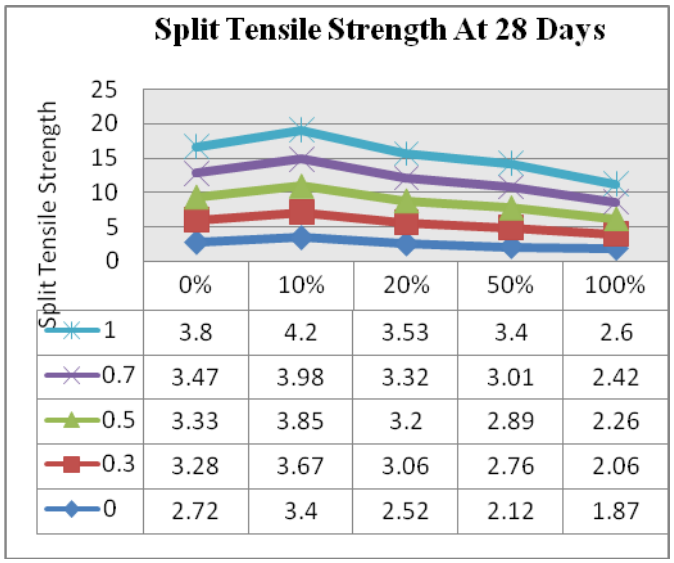
	0%	10%	20%	50%	100%
1	37.2	40.18	36.47	33	27.23
0.7	38.45	41.37	37.2	33.37	28.6
0.5	32.44	35.36	32.37	28.29	22.47
0.3	28.38	31.94	27.02	24.29	19.3
0	24.7	25.23	24.33	20.34	16.14

Chart -2: Compressive Strength at 28 days



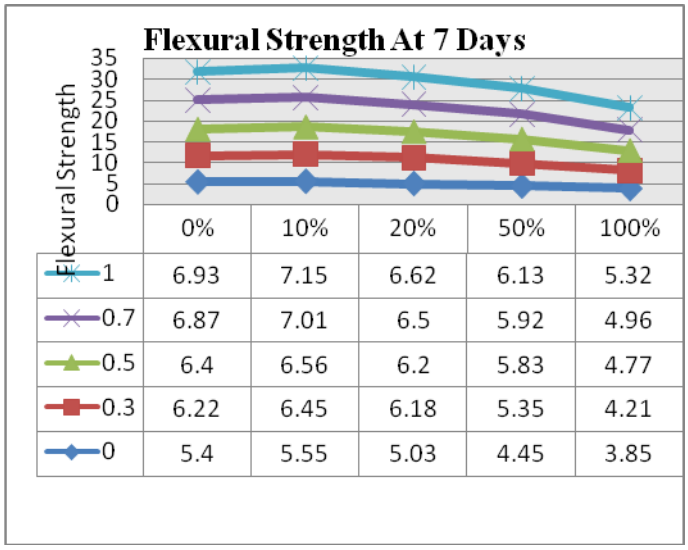
	0	10	20	50	100
1	2.96	3.18	2.92	2.78	2.46
0.7	2.87	2.95	2.85	2.5	2.32
0.5	2.81	2.88	2.76	2.13	2.05
0.3	2.76	2.81	2.4	2.07	1.96
0	2.18	2.34	2.08	1.7	1.23

Chart -3: Split tensile Strength at 7 days



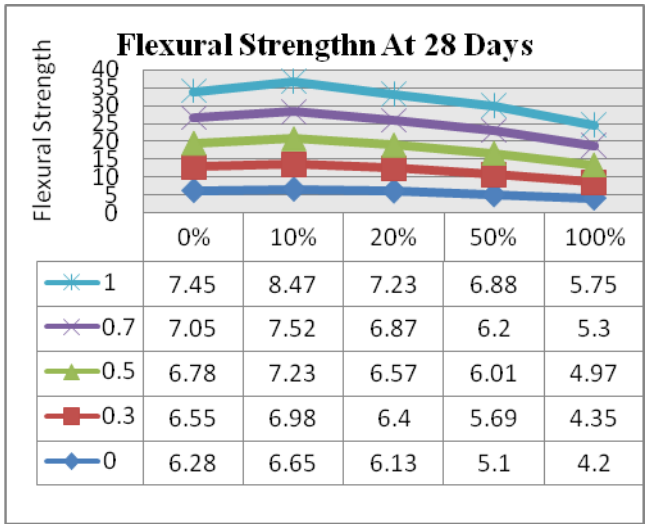
	0%	10%	20%	50%	100%
1	3.8	4.2	3.53	3.4	2.6
0.7	3.47	3.98	3.32	3.01	2.42
0.5	3.33	3.85	3.2	2.89	2.26
0.3	3.28	3.67	3.06	2.76	2.06
0	2.72	3.4	2.52	2.12	1.87

Chart -4: Split tensile Strength at 28 days



	0%	10%	20%	50%	100%
1	6.93	7.15	6.62	6.13	5.32
0.7	6.87	7.01	6.5	5.92	4.96
0.5	6.4	6.56	6.2	5.83	4.77
0.3	6.22	6.45	6.18	5.35	4.21
0	5.4	5.55	5.03	4.45	3.85

Chart -5: Flexural Strength at 7 days



	0%	10%	20%	50%	100%
1	7.45	8.47	7.23	6.88	5.75
0.7	7.05	7.52	6.87	6.2	5.3
0.5	6.78	7.23	6.57	6.01	4.97
0.3	6.55	6.98	6.4	5.69	4.35
0	6.28	6.65	6.13	5.1	4.2

Chart -6: Flexural Strength at 28 days

7. CONCLUSIONS

[1] The compressive strength and flexural strength of concrete increases with bottom ash & Glass fiber content. It is true up to 10% replacement if we replace cement by more than 10% strength starts reducing. Therefore it is always preferable to use bottom ash & glass fiber with 10% replacement of cement and it gives us better result.

[2] Also it was found from the failure pattern of the specimens, that the formation of cracks is more in the case of concrete without fibres than the glass fibre reinforced concrete.

[3] The ductility characteristics had improved with the addition of glass fibres. The failure of fibre concrete is gradual as compared to brittle failure of plain concrete.

[4] In this study bottom ash is a hazardous material used as a replacement for fine aggregate to bring down the pollution. The reduction in strength and stiffness of concrete due to bottom ash is overcome by adding glass fibres to the mix.

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