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Performance of Basalt Fiber in Concrete

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Abstract: ***The research work was carried out on experimental investigation of basalt concrete. Properties of concrete were checked by testing cubes, cylinder & beams. The specimens were casted using M40 Grade concrete with locally available material. The object of present work was to study effect of different proportion of fibers in the mix design and find out optimum percentage of fibers with maximum strength criteria. The specimens like cubes, cylinder and beam tested for compressive strength, split tensile strength and flexural strength. The experimental results showed that the addition of basalt fiber in concrete enhance the properties of concrete.***

Keywords: Basalt fiber BFC, compressive strength, Flexural strength, split tensile test, Basalt fiber cylinder, fibers concrete

1. Introduction

Basalt rock is formed after cooling of lava on earth crust. Basalt rock is a row material for making basalt fibers. Basalt is naturally hard, dense, dark brown to black colored rock. For making continuous basalt fibers, basalt rock is melt at 1500^0 c temperature. The material does not undergo any toxic reaction with water and air. Also do not have any side effects on human health. Basalt fibers have major qualities like acid resistance, alkali resistance. It is thermally, electrically and sound insulated. It also has crack resistance, corrosion resistance. Hence it can be used successfully in increasing life of construction in various field i.e. housing, railway, highway, bridges, runway and tunnels.

2. Literature Survey

BFRP as a new material in infrastructure engineering as compared to carbon, glass and aramid for strengthening. Matthys S (2005) has tested the confinement of columns by FRP and has reported that basalt fibers show comparatively good properties to glass fibers. The basalt fibers are chemically inert.[3] Aggerwal et al, (2007) have shown that concrete with fly ash as replacement to cement in some amount (0 to 50%) gives better results of mechanical properties of concrete[1]. Singaravadivelan et al (2012) showed that the concrete strength increased by 25% on addition of basalt fiber.[2] This literature survey reveals that fibers are truly corrosive resistance, environment friendly. Basalt fibers have property to resist high impact load and temperature loads. Basalt requires less energy in manufacture and row material is widely available in all over world. Basalt fibers cheaper than other fibers like carbon, steel but their mechanical and physical properties gives impressive results so it becomes a beneficial solution in structural engineering. This paper present efficiency of basalt fiber concrete on cubes, cylinder and beams under compression, flexural and split tensile test.

3. Experimental Program

The program was conducted for understanding effectiveness of adding basalt fibers in concrete, the testing carried out on 24 concrete cubes (150mmX150mmX150mm) for compressive strength, 12 numbers of cylinders (150mmX300mm) was casted for split tensile test and 4 numbers of beams was manufactured for flexural strength. Casting was made in M40 mix design including fly ash 15%. The specimens were cured for 28 days in potable water.

4. Material

1. Cement: OPC of 53 grade cement was used which having specific gravity 3.15. 15% cement was replaced by fly ash.
2. Fine aggregate: crushed sand used as fine aggregate in concrete mix design. The crushed sand was passing through 4.75 mm sieve and retained on 60micron sieve, having specific gravity 2.81 and water absorption 2.88%.
3. Coarse aggregate: maximum size of aggregate was selected for this mix design is 10mm. specific gravity of aggregate was 2.89 and water absorption 1.63%.
4. Fly ash: fly ash manufactured at parali, BEED. Having specific gravity 2.26.
5. Admixture: BASF Rheobuild 821 IA was used for this mix design. 1.2% of admixture to volume of concrete.
6. Basalt fiber: Specific gravity 2.9. Different proportions of fiber were taken for making specimens (0 to 0.75%).
7. Water: Used potable water which satisfying requirements of IS 456: 2000. w/c ratio for this mix design was 0.46.

5. Testing Program

A] Compressive strength Test: IS 516:1959

Compressive strength of concrete was tested with and without basalt fiber. Concrete cubes were casted (150mmX150mmX150mm) and cured for 28 days. Cubes were tested under compressive testing machine. The load was applied by increasing rate of 140kg/cm^2/min. until the resistance of specimen to increasing load breaks down. Maximum load taken by specimen was recorded and failure was noted. Three cubes were tested in each category. Results are shown in table no. 1

Table No. 1

Sr. no.	*Percentage of fiber*	*Compressive strength in MPa after 28th days*
1	0	49.98
2	0.25	63.51
3	0.50	56.64
4	0.75	47.93

B] Split Tensile Strength Test: IS 5816:1999

The cylinder specimen (150mm X300mm) was placed horizontally in the centre part of assembly by using wooden strips. Specimen loaded by equal distribution of load. The load was applied and increased continuously at the rate of 1.2 to 2.4 N/mm^2/min until failure of specimen. Maximum load applied was recorded carefully and observe the condition of the specimen. Results are shown in table no. 2

Table No. 2

Sr. no.	*Percentage of fiber*	*Split tensile Strength in MPa after 28th days*
1	0	4.565
2	0.25	5.700
3	0.50	5.640
4	0.75	5.205

C] Flexure Strength Test: IS 516:1959

The beams were casted for this test having dimension (150mmX150mmX700mm). The specimen was placed in machine for uniform loading. The load was applied to uppermost part of mould along with two loading points. For Appling loads two steel rollers were used in the assembly. Load continuously applied 180kg/min until failure occurs. Results are noted carefully. Results are shown in table no. 3

Table No.3

Sr. no.	*Percentage of fiber*	*Flexural strength in MPa after 28th days*
1	0	4.3
2	0.25	6.3
3	0.50	5.8
4	0.75	5.16

6. Conclusion

This paper shows effectiveness of basalt fiber when it used in varying percentage in concrete. It shows that performance of concrete higher at 0.25% then it gets decreased slowly. Basalt based composites can replace steel material in construction. It shows effective results so it reduces cost of steel in construction. From these results use of basalt fiber in low cost composites for civil infrastructure provide good mechanical properties at lower cost of basalt fiber. Use Basalt fiber in concrete is an effective technique to enhance performance of concrete.

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