Experimental Investigations of Basalt Fibres Induced Concrete in Comparison to Conventional Concrete

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***Abstract*- The present experimental study investigates the inclusion of basalt fibres in conventional concrete to increase its compressive, flexural and tensile strength. So far the researchers have studied on different type of fibres available like steel, glass, polypropylene fibres, jute fibres so on. But the research on basalt fibres are seldom and there is needed to investigate the behaviour of basalt fibres in concrete. The present study is based on the addition of chopped basalt fibres of 6 mm at 0.5%, 1.0%, 1.5 % in normal water. The experimental investigation proves that the inclusion of basalt fibres shows the increase in max. till 1 % of all the strength properties like compressive strength, flexural strengths and tensile strengths etc. The inclusion of basalt fibres acts as the crack arresting agents in the concrete and from the literature it shows that basalt fibres in low cost composites for civil infrastructure provide good mechanical properties at lower cost. Inclusion of fibres is an effective technique to enhance the performance of concrete.**

***Index terms*- Basalt fiber, Cement, Coarse aggregate, Fine aggregate and Water**

I.INTRODUCTION

Basalt fibre is an inorganic material produced from volcanic rock called Basalt. The production of basalt fibres does not create any environmental waste and it is non-toxic in use. Basalt fibre is a unique construction material with high tensile strength, good thermal endurance, and stable in all aggressive environments. It is believed that Basalt fibre reinforced concrete (BFRC) will revolutionize the construction industry because it is cheaper, greener, lighter, and eliminates the problem of corrosion of reinforcement bars and corrosion led damages in the concrete structures. Two types of chopped Basalt fibres are available and these are bundled fibres and filaments. Concrete containing hydraulic cement, water, aggregate, and randomly dispersed fibres is called fibre reinforced concrete (FRC). Different types of commercially available fibres used in concrete and examples of these fibres are steel fibres, glass fibres, polypropylene fibres, carbon fibres, and basalt fibres. The addition of randomly spaced discontinuous fibres helps in arresting the propagation of the micro-cracks and macro-cracks. Randomly dispersed fibres in concrete help in reducing the crack width thus, reduces the permeability of concrete. In addition to crack control, fibres also improve the mechanical properties of plain concrete such as fracture resistance, resistance to impact, and resistance to dynamic loads. Fibres are added to enhance the ductility, increase the tensile and flexural strength of the material and to decrease crack widths and retard their propagation. Comprehensive research over the years on fibres has shown that fibre reinforcement has actually sufficient strength and ductility to be used as a complete replacement to conventional reinforcement in some types of concrete structures, such as foundations, walls and slabs on grades. In beams and suspended slabs, fibres are used in combination with conventional reinforcement which increase both the load bearing capacity and the stiffness of the structure.

II. EXPERIMENTAL MATERIAL

A. Basalt

The basalt fibers provided by Arrow Technical Textiles Pvt. Ltd. Kandivalli, Mumbai. Basalt Fibre Properties are 15 m diameter and 6 mm. length, 2650 kg/m3, 0.0038 thermal conductivity and tensile strength 4800 Mpa.

B. Cement
Cement is an extremely ground material having adhesive and cohesive properties which provide a binding medium for the discrete ingredients. The processes used for manufacture of cement can be classified as dry and wet. The cement commonly used is Portland cement, it is also defined as hydraulic cement, i.e. a cement which hardens when it comes with water due to chemical reaction but there by forming a water resistant product. Portland cement is obtained when argillaceous and calcareous materials are grounded to fine powder and mixed in definite proportion and fused at high temperature. When blast furnace slag is also used as one of the ingredients than the cement obtained is called Portland slag cement (PCC). Portland slag cement (PCC) – 53 grade (ultratech Cement) was used for the experimental programme.

C. Fine Aggregate
Aggregates are generally obtained from natural deposits of sand and gravel, or from quarries by cutting rocks. The least expensive among them are the regular sand and rock which have been lessened to present size by characteristic specialists, for example, water, wind and snow and so on. The stream stores are the most well-known and are of good quality. The second most regularly used source of aggregates is the quarried rock which is reduced to size by crushing. The size of aggregates used in concrete range from few centimetres or more, down to a couple of microns. Fine aggregates is the aggregate most of which passes through a 4.75mm IS sieve and contains just that much coarser material as allowed by the IS details. The fine aggregate used for the experimental programme was obtained from river bed of Koel. The fine aggregate procured from Nareshwar, Bharuch, Gujarat. Passed through 4.75 mm sieve and had a specific gravity of 2.68. The sand belonged to zone III as per IS standards. Clean river sand passing through 4.75 mm sieve was used as fine aggregates. The specific gravity of sand was 2.68 and grading zone of sand was zone 3 as per IS. Angular stones were used as coarse aggregates maximum size 20mm and specific gravity 2.72. Concrete was mixed and cured by ordinary water or tap water.

D. Coarse Aggregate
The aggregates the vast majority of which are held on 4.75mm IS sieve and contains just that a lot of fine material as is allowed by the code specifications are termed as coarse aggregates. The coarse aggregates may be crushed gravel or stone obtained by the crushing of gravel or hard stone; uncrushed gravel or stone resulting from natural disintegration of rock and partially crushed gravel or stone obtained as a product of the blending of the naturally disintegrated and crushed aggregates. In our case crushed stone was used with a nominal maximum size of 20 mm and specific gravity of 2.78.

E. Water
Water is the one most essential element of cement. Water assumes the vital part of hydration of concrete which frames the coupling lattice in which the dormant totals are held in suspension medium until the grid has solidified, furthermore it serves as the lubricant between the fine and coarse aggregates and makes concrete workable.

III. METHODOLOGY

Tests for compressive, tensile and flexural strengths.

Figure 1. Demoulding the specimens

Figure 2. Test for Compression Strength

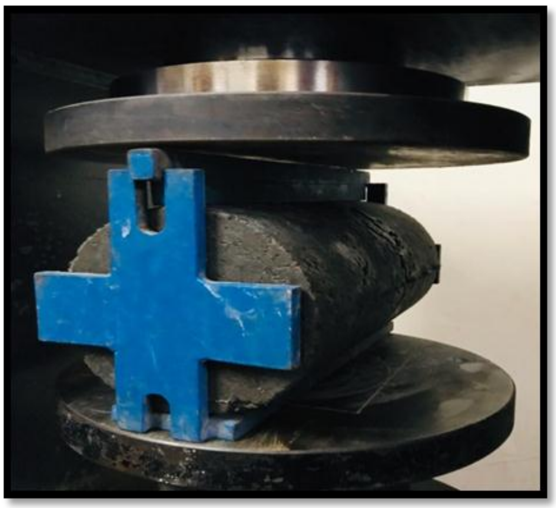


Figure 3. Placing of Cylinder for Testing

Figure 4.Placing of Beam for Testing

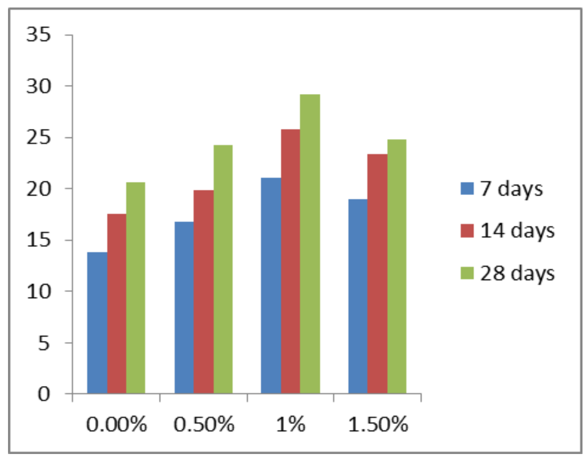
IV. RESULTS

A. Compressive strength

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 until the resistance of specimen to increasing load breaks down. Maximum load taken by specimen was recorded and failure was noted. Results are shown in table no. 1

Table 1. Compressive test results

% of Fibers	Compressive strength results (Mpa)		
	7 Days	14 Days	28 Days
0.0%	13.881	17.507	20.656
0.5%	16.779	19.870	24.233
1%	21.074	25.790	29.179
1.5%	18.958	23.388	24.840

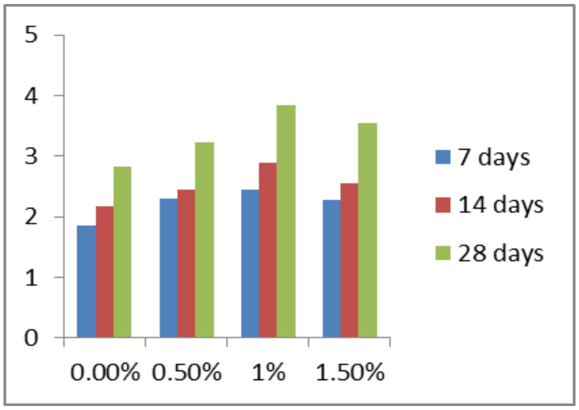


B. Tensile strength

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 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 2. Tensile test results

% of Fibers	Tensile strength results (Mpa)		
	7 days	14 days	28days
0.0%	1.850	2.174	2.835
0.5%	2.300	2.441	3.225
1%	2.451	2.885	3.851
1.5%	2.276	2.562	3.543

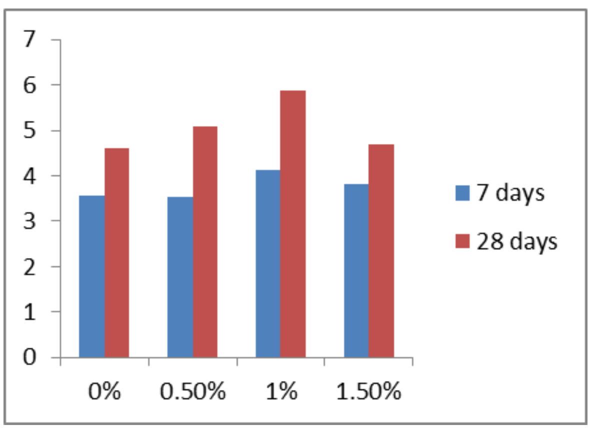


C. Flexural strength

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 until failure occurs. Results are noted carefully. Results are shown in table no. 3

Table 3. Flexural test results

% of Fibers	Flexural strength results (Mpa)	
	7 days	28 Days
0.0%	3.559	4.599
0.5%	3.546	5.089
1%	4.131	5.862
1.5 %	3.811	4.701



V. CONCLUSION

The conclusions presented here are based on the results obtained from this research. Hence, the results will be different for different concrete mix proportions and different water cement ratios. After we conducted our tests there was improvement in strength like (compressive, split tensile and flexural). The optimum fibre length and dosage for basalt bundled fibres which provided the best performance (compressive and split tensile and flexural strength). The optimum percentage fibre which we used provided the best performance compare to conventional concrete of M20 grade. According to research paper which we have studied, shows that after a percentage the strength of concrete will decrease with further addition of basalt fiber in mix design.

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