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Study of Concrete Behaviour with Addition of Basalt Fibers

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Abstract:- The research paper focus on "Study of Concrete Behavior with the Addition of Basalt Fibers", works were carried out on experimental investigation of basalt fiber concrete. The present paper focus on the comparison of the compressive strength, tensile strength, flexural strength of plain concrete and concrete using basalt fibers of M30 grade concrete. Various types of fibers such as steel, carbon, polypropylene, glass are used to improve the tensile and flexural strength of concrete. Based on the laboratory experiments on basalt fiber concrete, cubes, beams and cylindrical specimens have been casted with different proportions of 0%, 0.5%, 1.0%, 1.5%, and 2.0% to the weight of the cement. The results obtained shows a considerable increase in the compressive strength, tensile strength, flexural strength of basalt fiber concrete at 28 days to that of the plain concrete.

Keywords:- *Basalt fibers, compressive strength, tensile strength, flexural strength.*

I. INTRODUCTION

The most common construction material used around the world is concrete which is man-made. As we aware of that concrete is good in compression but weak in tension. In order to increase the tensile strength of the concrete, various types of fibers are added to the concrete mix. Of these various fibers, we focus on one of the recent advancement known as basalt fibers to increase the tensile strength of concrete and also it acts as the great crack resistance.

A. Basalt fiber: (History)

The first patent revealing the technique of producing basalt fiber was given to a French scientist and subsequently the research was started in the USSR. Basalt fibers are originated from basalt rock which is of igneous rock type. Basalt fiber is made by rapid cooling of basalt rock which contains 50-60 % of SiO_2. It has certain unique properties when compared to that of the various other fibers in terms of tensile strength, elastic modulus, percentage of elongation.

II. EXPERIMENTAL PROGRAM

A. Materials used

In this paper, various materials their properties, tests conducted and results are discussed. This section also explains the mix proportions.

B. Cement

The cement acts as the binding material in the concrete to bind the aggregates and sand to form a homogenous mix. In this paper, ordinary Portland cement of 53 grade confining to IS: 12269-2013 was used for casting of the specimen.

C. Fine aggregates

Aggregates are the major ingredients of concrete which constitute about 70-75% of the total volume. In this paper, locally available sand confining to zone III as per IS:383-1970 was used for casting of the specimens.

D. Coarse aggregates

In this paper, crushed stone aggregates of 20mm & 16mm(base course) are used confining to IS: 383-1970.

E. Water

Water in the concrete mix, distributes the cement evenly & reacts with cement which results in calcium silicate hydrate gel formally known as CSH gel. Potable water was used for casting concrete specimens confining to IS:456-2000 was used in this research.

F. Basalt fibers

Chopped basalt fibers of length 12mm was used in this research.

Tests results conducted on materials

S.No	Test	Cement	Fine Aggregates	Coarse Aggregates
1.	fineness	5%	-	-
2.	Specific Gravity	3.14	2.64	2.7
3.	Water Absorption	-	1%	0.8%

G. Mix Design

Concrete mix of M30 grade is designed to test the compressive, tensile & flexural strength of the specimens with cement content of 350 kg/mm^3, fine aggregates of 650 kg/mm^3 and coarse aggregates of 1233 kg/mm^3 having a water cement ratio of 0.45.

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Mix Design Ratio – 1:1.85:3.52

III. TESTING METHODS

A. Compressive Strength

As per IS:4031-1988 part 6, the compressive strength is the capacity of the materials to withstand the load which reduces its size. Generally cube specimens of dimensions 150x150x150 mm are used to determine the compressive strength.

$$compressive\ strength = \frac{\text{ultimate compressive load}}{\text{area of cross section}}$$

B. Split tensile strength

As per IS:5816-1970, the tensile strength is defined as the load under which cracks will develop. The cylindrical specimens of dimensions 150x300 mm are used to determine the tensile strength of the concrete.

$$tensile\ strength = \frac{2P}{3.14xdxl}$$

Where,

P = failure load of the specimen.

d = Diameter of the specimen.

L = length of the specimen.

C. Flexural Strength

As per IS:516-1959, flexural strength is the ability of the material to resist the deformation under the applied load. Prism specimen of dimensions 100x100x500 mm were used to determine the flexural strength of the concrete.

$$flexural\ strength = \frac{3xPxl}{2xbxdxd}$$

Where,

P = failure load of the specimen.

l = length of the specimen.

b = breadth of the specimen.

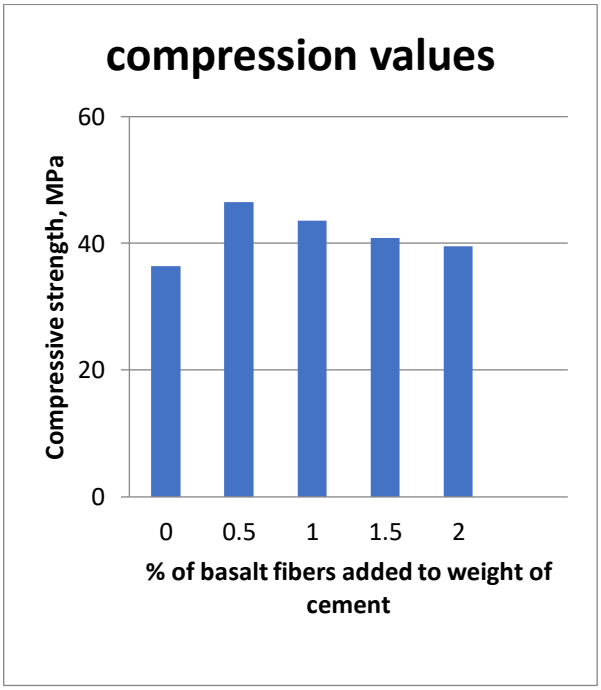
d = depth of the specimen.

IV. RESULTS & DISCUSSIONS

A. Compressive strength values

The following table represents the compressive strength values of M30 grade of concrete with different proportions of basalt fibers added to the weight of cement for 28 days of curing:

S.No	proportion	Average compressive strength, MPa
1.	0%	36.44
2.	0.5%	46.51
3.	1.0%	43.55
4.	1.5%	39.53
5.	2.0%	39.53



Graph 1: compression values

The following graph represents the compressive strength of the M30 grade of concrete for 28 days of curing tested for 3 cube specimen for each proportion.

B. Tensile Strength Values

The following table represents the tensile strength values of M30 grade of concrete with different proportions of basalt fibers added to the weight of cement for 28 days of curing:

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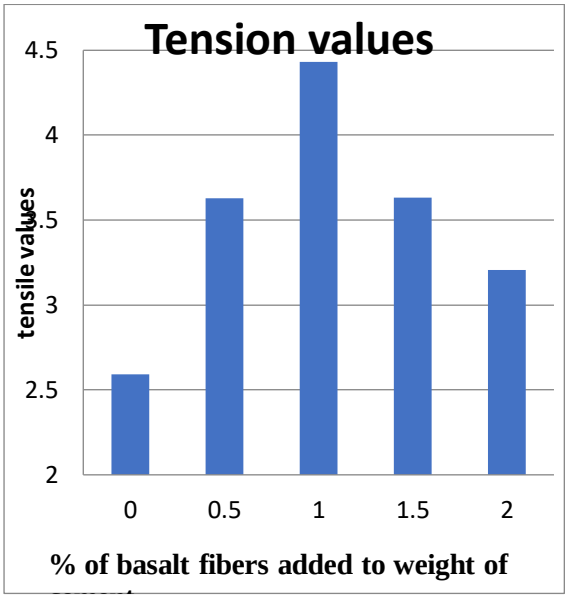
S.No	proportion	Average compressive strength, MPa
1.	0%	2.591
2.	0.5%	3.629
3.	1.0%	4.451
4.	1.5%	3.632
5.	2.0%	3.207



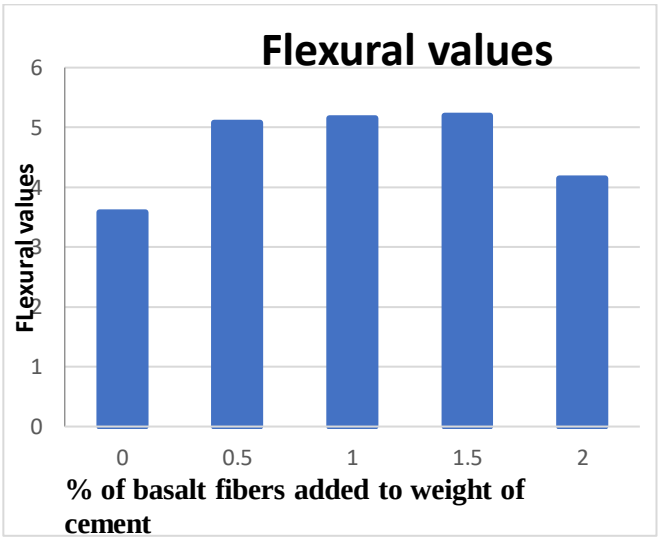
Graph 2: Tension values

The following graph represents the tensile strength of the M30 grade of concrete for 28 days of curing tested for 3 cube specimen for each proportion.

C. Flexural Strength Values

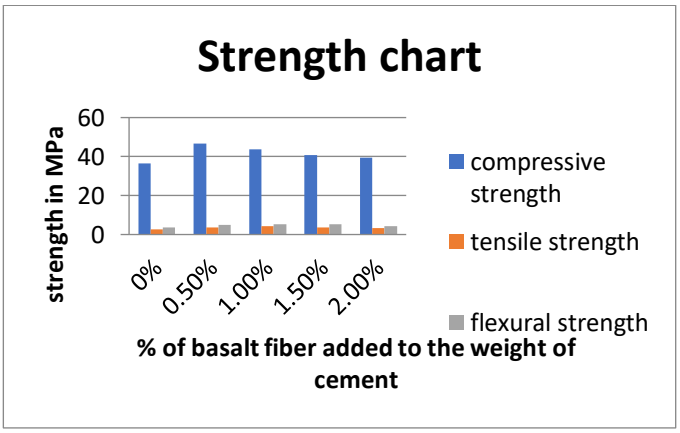
The following table represents the tensile strength values of M30 grade of concrete with different proportions of basalt fibers added to the weight of cement for 28 days of curing:

S.No	proportion	Average compressive strength, MPa
1.	0%	3.575
2.	0.5%	5.075
3.	1.0%	5.15
4.	1.5%	5.20
5.	2.0%	4.15



Graph 3 Flexural values

The following graph represents the flexural strength of the M30 grade of concrete for 28 days of curing tested for 3 cube specimen for each proportion.



Graph 4: Strength Values Comparison

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V. CONCLUSIONS

Based on the test results, the following conclusions are made:

- The percentage increase of compressive strength of basalt fiber concrete compared with plain concrete is 15%.
- The percentage increase of split tensile strength of basalt fiber concrete mix on an average compared with 28 days compressive strength of plain concrete is observed as 69%.
- The flexural strength of basalt fiber concrete is also found have a maximum increment of 70% when compared to that of plain concrete.
- The addition of basalt fibers acts as crack resistors.
- Ductility characteristics increase with inclusion of basalt fibers.

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