IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Vol.-6, Issue-5, May 2018 E-ISSN: 2347-2693

Experimental Investigation Study on Flexural Behaviour of Basalt Fiber Reinforced Concrete Beam with Steel Fibers

P. Hareesh [1*], S.Pravin Kumar[2]

[1]Department of Structural Engineering, PRIST University, Thanjavur, India
[2]Department of Structural Engineering, PRIST University, Thanjavur, India

*Corresponding Author: hareeshaah@gmail.com
Available online at: www.ijcseonline.org

Accepted: 15/May/2018, Published: 31/May/2018

Abstract— Basalt Fiber-Reinforced Polymer (BFRP) bars are rising as an important choice as inside reinforcement for concrete structures, especially when erosion protection or electromagnetic straightforwardness is looked for. BFRP has been effectively utilizing as a part of the fortifying of the segments and beams. It additionally been executed as reinforcement in the beam and got the satisfactory flexural quality which is progressively the steel Basalt composite bars are made by using basalt filaments and a pitch epoxy folio. They are non-destructive, comprise of 80% strands and have a tensile quality three times that of the steel bar typically utilized as a part of building development. Wherever consumption issues exist, basalt fiber composite bars can possibly supplant steel in reinforced concrete. Contrasted with FRP bar as they are utilized for little sum in building industry the basalt bar are less expensive and have better strength under extraordinary conditions. It is presumed that basalt bars are of awesome enthusiasm for the building business and can be utilized for instance in connect decks, seaward structure and in component structures.

Keywords— Basalt, Fibre, Polymer, Steel, Concrete, Fibre Cincrete, Reinforced Concrete.

I. INTRODUCTION

Basalt (solidified volcanic lava) is known for its protection from high temperatures, quality and solidness. Basalt fiber is expelled from liquid basalt shake at widths by and large between 13 to 20μm. Basalt fiber items are accessible in business amounts from different sources including from China. Basalt shake can be utilized to make basalt bars as well as basalt textures, cleaved basalt fiber strands, ceaseless basalt fiber wires and basalt work. A portion of the potential uses of these basalt composites are: plastic polymer support, soil fortifying, spans and roadways, modern floors, warmth and sound protection for private and mechanical structures, shot verification vests and retrofitting and recovery of structures. Basalt fiber-reinforced polymer (BFRP) bars are the most current sort of FRP fortification utilized as a part of structural building. Notwithstanding great mechanical properties, basalt has a high compound and warm steadiness, great warm, protecting, electrical and sound properties, Due to great protecting properties, basalt is effectively utilized for flame insurance. Basalt composite bars are made by using basalt strands and a pitch epoxy cover. They are non-destructive, comprise of 80% filaments and have a rigidity three times that of the steel bar regularly utilized as a part of building development. Wherever consumption issues exist, basalt fiber composite bars can possibly supplant steel in reinforced cement. As of now there are numerous FRP bar fabricating organizations which advertise their items. The greater part of these bars are made of E-glass fiber and thermosetting sap. However FRP bars need adequate strength under extraordinary conditions. These bars are expensive and are likewise non-impervious to antacids. Basalt bars don't have these detriments and can be viably utilized as a part of different applications, for example, interstate hindrances, seaward structures, and extension decks. Moreover, basalt strands have 10 times better electrical attributes - protecting than glass filaments. Basalt strands are additionally essentially preferable synthetically safe over glass filaments, especially in a firmly soluble condition (e.g., with funnels made of basalt composite destructive fluids and gases can be transported. Basalt FRP bars are a phenomenal option as the fortification of extension braces because of limiting the heaviness of the section having fantastic protection from erosion impacts, decreasing repairs and a critical increment in ease of use. It was found from the examination that the basalt bars had three times higher rigidity contrasted with the steel bars. Basalt fiber rebar is extreme, more grounded and has a higher rigidity. Substantially higher rigidity than steel or fiber glass rebar of a similar distance across. BFRP is well finished twice as solid in pressure to avoid solid splitting BFRP is feeble in flexural and they have diversion contrasted with steel rebar. Points of interest of the basalt bar are that its weight is 33% of the heaviness of steel and the warm extension coefficient is near that of cement. The high mechanical execution/value proportion of basalt fiber composite bar, joined with consumption protection from basic assault, are further purposes behind supplanting steel in concrete with basalt fiber composite bars.

OBJECTIVE OF THE PROJECT

The Objective of the project is

- To design the beam theoretically
- To calculate the flexural strength of the beam experimentally
- To compare the results theoretically with the obtained experimental results

II. LITERATURE REVIEW

A. Hybrid Fiber Reinforced Concrete Beam- K.Tamilselvan and Dr. N. Balasundaram (March 2017)

The point of this exploratory examination is to think about the flexural conduct of Hybrid fiber reinforced solid shafts (HFRC). In this examination, by including the strands in ordinary cement satisfactory flexibility of cement is guaranteed and shrinkage break is diminished. The conduct of RC bar structures fortified by utilizing hybrid fiber reinforced (HFRC) is examined. Review of M30 according to IS 0262:2009 solid pillars are threw. The steel and Polypropylene (PP) filaments are utilized as a part of various extents with 0.5% of volume of cement. The properties of the crisp solid (workability) is gotten from the Slump test, Compaction factor Test and the solidified cement were finished by Compressive quality, Split elasticity and Flexural quality by including Super plasticizer CONPLAST SP 430 at 0.8% to the aggregate volume. The hybrid strands different extents are 33:67, 50:50 and 67:33 for the volume division is 0.5% of volume of cement were utilized as a part of the solid blends. Absolutely six pillars were threw including control bar example. The test outcomes demonstrate the utilization of Hybrid Fiber reinforced cement enhances flexural conduct of the pillars amid stacking conditions.

B. Basalt Fiber Reinforced Geopolymer Concrete- Anil Ronad et al. (Aug 2016)

Concrete is most utilized development material on the planet. Development industry utilizes a large portion of the regular assets as it incorporates creation of concrete. It is the major contributing component to the CO2 discharges, causing a dangerous atmospheric devation. A substitute to the OPC has been discovered known as Geopolymer concrete. It utilizes modern waste material, for example, fly powder, GGBS, rice husk fiery debris rather than bond along these lines diminishing effects because of concrete generation. In this investigation both fly fiery debris and GGBS are used in influencing Geopolymer to concrete. Soluble arrangement is utilized is contains sodium silicate (103 kg/m3) and Sodium hydroxide(41 kg/m3) in the proportion of 2.5.sodium hydroxide of 10 molarity is utilized. Plain concrete is weaker in strain. Filaments are added to improve the quality to the concrete to meet given serviceability necessities. Basalt fiber is viewed as a promising new material. It has great quality attributes, protection from substance assault, sound protection properties. It has extensive variety of utilizations like soil reinforcing, spans and expressways, mechanical floors. In this investigation different extents of basalt filaments added to the geopolymer concrete and compressive and split tensile quality of the diverse blends were contrasted and the geopolymer concrete without basalt strands. Filaments are added to the geopolymer concrete in the scope of 0.5% to 2.5% at 0.5% augmentations. Flexural quality of various blends were contrasted and reference mix(0% fiber).from the outcomes it is presumed that expansion of basalt strands at an ideal substance to the geopolymer concrete can increment flexural quality.

C. Steel Fibre and Nylon Fibre Reinforced Concrete Beam- Arul Raj C., Baskar K (April 2017)

Execution of Conventional concrete is improved by the extra of filaments in concrete. Including a solitary sort of fiber into concrete has constrained capacities, such a significant number of ebb and flow inquires about are situated to the improvement of hybrid fiber in concrete to acquire better mechanical properties. The fundamental purpose behind steel and nylon fiber utilized as a part of concrete lattice is to enhance post breaking reaction of the concrete and to enhance vitality ingestion limit, malleability and to give split protection and break control. The presentation of concrete is acquired as an answer for create concrete with improved flexural quality. In this investigation inspects the flexural quality of concrete with two unique kinds of fiber, for example, steel fiber and nylon fiber with fiber substance of 0.75% of steel fiber is kept consistent in each blends and 0.50%, 0.75% of nylon fiber was fluctuated in each blends. The tests are to be done with two distinct evaluations of concrete, for example, M25 and M30 review and the outcomes are to be contrasted between traditional concrete with fiber reinforced concrete.

III. EXPERIMENTAL ANALYSIS

A. MATERIAL

1. CEMENT

Cement is characterized as the material with glue and firm properties which make it fit for holding the constituents of concrete into a minimal solid mass. Cement is acquired by pounding the crude materials (calcareous materials like limestone, chalk, marine shell and argillaceous materials containing silica, alumina and iron oxide).The blend is then scorched in an expansive turning furnace at a temperature of 1300C to 1500C. The subsequent item called clinker is cooled and ground to fine powder called cement. In this undertaking, Ordinary Portland Cement (OPC) 53 review is utilized. Tests were directed for cement according to IS8112:1989. The physical properties of cement utilized as a part of the trial work are given in Table 3.1.

Table 3.1 Physical properties of Cement

S. No.	Physical property	Value obtained
1	Initial Setting Time	36 minutes
2	Final Setting Time	390 minutes
3	Specific Gravity	3.15

2. FINE AGGREGATE

Fine aggregate is added to concrete to help workability to the concrete blend and to avert isolation of the cement glue and coarse aggregates amid its transportation. The aggregate division from estimate 150 micron to 4.75mm is named as fine aggregate. The fine aggregate is spoken to by its zone. In this venture, Natural River sand adjusting to IS 383:1970 is utilized as fine aggregate. The physical properties of fine aggregate utilized as a part of the test work are given in Table 3.2.

Table 3.2 Physical properties of Fine aggregate

S. No.	Physical property	Value obtained
1	Fineness modulus	2.7
2	Grading zone	I
3	Specific Gravity	2.65
4	Moisture Content	0.5%
5	Water Absorption	0.9%

3. COARSE AGGREGATE

The coarse aggregate is utilized fundamentally to provide massiveness to concrete. The aggregate part from measure 4.75 mm to 80 mm is named as coarse aggregate. The coarse aggregate is depicted by its ostensible size. In this undertaking, smashed granular aggregate of 20mm size complying with IS 383:1970 is utilized as coarse aggregate. The physical properties of coarse aggregate utilized as a part of the test work are given in Table 3.3.

Table 3.3 Physical properties of Coarse aggregate

S. No.	Physical property	Value obtained
1	Fineness modulus	7.0
2	Nominal size	20 mm
3	Specific Gravity	2.69
4	Moisture Content	Nil
5	Water Absorption	0.5%

4. WATER

The nature of water is imperative, since debasements in it might meddle with the setting of the cement and it might unfavourably influence the quality of the concrete or cause recoloring of its surface and may likewise prompt erosion of the reinforcement. Water utilized for blending and curing should be spotless and free from harmful measures of oils, acids, antacids, salts, sugar, natural material they might be pernicious to concrete or steel allowable points of confinement.

B. TENSILE PROPERTIES FOR BFRP AND STEEL BAR

1. GENERAL

Tensile properties of bar and steel are tested and calculated by tensile machine.

2. TENSILE PROPERTIES

Length of the bar = 1000mm

Table 3.4 Tensile Properties for BFRP & Steel bar

TYPE	DIAMETER OF BAR	AREA(MM^2)	TENSILE STRENGTH (N/mm^2)	PEAK LOAD (KN)	YOUNGS MODULUS
BFRP	8mm	50.24	684	34.36	48857
STEEL	8mm	50.24	486	24.41	200000

Table 3.5 Tensile Properties for BFRP & Steel bar

TYPE	STRAIN	CHANGE IN LENGTH(mm)	% OF ELONGATION	LOAD AT YEILD POINT	YEILD STRESS(N/mm^2)
BFRP	0.014	14	1.4	28.73	572.172
STEEL	0.0024	2.4	0.24	20.84	415

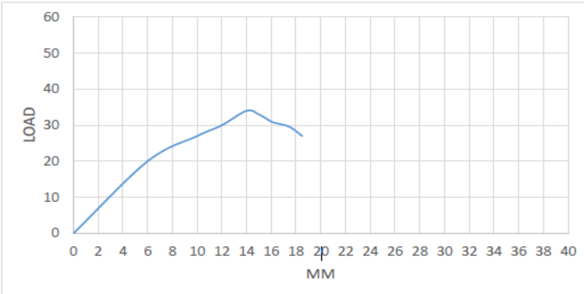

Fig 3.1 Stress & Strain Curve for BFRP bars

C. COMPRESSIVE STRENGTH OF CONCRETE GENERAL

The main aim of this investigation is to study the structural behaviour by conducting compressive strength test on 150mm cube specimen.

1. CONCRETE COMPRESSIVE STRENGTH

Concrete grade of M30and casted and cured for 7, 28 days

Table 3.6 Concrete Compressive Strength

% of STEEL FIBRE	COMPRESSIVE STRENGTH(MPA)		ACTUAL COMPRESSIVE STRENGHT(MPA)
	24.88	31.11	
0.5%	24.93	35.55	33.77
	24.80	34.66	
1%	25.49	39.20	
	25.33	39.28	39.19
	25.55	39.11	

% of STEEL FIBRE	COMPRESSIVE STRENGTH(MPA)		ACTUAL COMPRESSIVE STRENGHT(MPA)
	26.71	42.13	
1%	26.75	42.04	42.08
	26.84	42.08	
1.5%	25.46	35.86	
	25.42	35.91	35.87
	25.37	35.86	

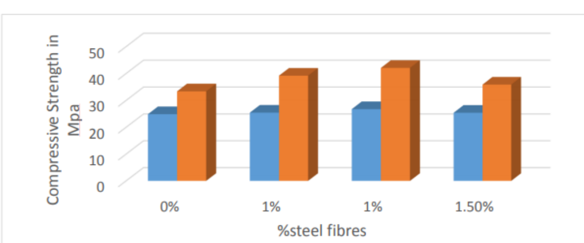

Fig 3.2 compressive strength of concrete and % of steel fibres

2. SPLIT TENSILE TEST FOR STEEL FIBRE

Concrete grade of M30and casted and cured for 7, 28 days

Target mean strength = 0.7 √ fck = 3.83

Table 3.7 Split Tensile Test for Steel Fibre

% OF STEEL FIBRE	SPLIT TENSILE STRENGTH(N/mm^2)7days	SPLITTENSILE STRENGTH(N/mm^2)28days
0	1.71	2.73
0.5	2.085	3.33
1	3.05	4.5
1.5	2.1	3.51

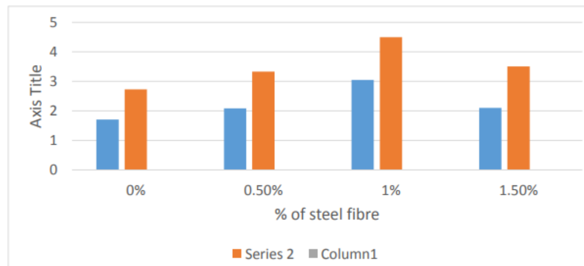

Fig 3.3 Graph of Split Tensile Strength

IV. CONCLUSION

Based on this investigation the following conclusion can be drawn.

- BFRP bar has high tensile strength than steel bar.
- BFRP reinforcement beam shows high deflection compared to steel reinforcement beam
- By addition of 1% steel fibre in BFRP reinforcement beam result shows deflection is reduced and ultimate load where increased compared to BFRP reinforced beam.

REFERENCES

[1] K.Tamilselvan and Dr. N. Balasundaram "Hybrid Fiber Reinforced Concrete Beam", (March 2017).

[2] Anil Ronad Et Al. "Basalt Fiber Reinforced Geopolymer Concrete", (Aug 2016).

[3] Arul Raj C., Baskar K, "Steel Fibre and Nylon Fibre Reinforced Concrete Beam" (April 2017).

[4] Criganz.T .Vad "Basalt Fibre as a Reinforcement of Polymer Composites", (Periodica Polytechnica, Mechanical Engineering Pg 49, (2010).

[5] Ramakrishan, V.Panchalan "A New Construction Material Non Corrosive Basalt Reinforced Concrete", Special Publication 229,253-270

[6] Wiberg .A "Strengthening of Concrete Using Cementious Carbon Fibre Composites", (Poyal Technology, Stockholm, Sweden)

[7] C.B Kukreja and S.Chawla "Flexuaral Characterstic of Steel Fibre Reinforced Concrete) the Indian Concrete Journal Pg 58, 2007.

[8] Bolishetti Chaitanya, S Sunil Pratap Reddy, Muchakurthi Karthik, "An Experimental Investigation on Effect of High Temperatures on Steel", International Journal of Computer Sciences and Engineering, Vol.5, Issue.9, pp.156-163, 2017.

[9] M.C.Nataraja, "Fibre Reinforced Concrete-Behaviour Properties and Application Indian Concrete Journal, Pg 248.

[10] Rana, "Some Studies On Steel Fibre Reinforced Concrete", International Journal of Concrete Technology and Advanced Engineering, Volume 3, Issue 1, January 2013.

[11] ACI Committee 544, "State Of The Art Report on Fiber Reinforced Concrete", ACI Manual of Concrete of Practice, Part 5, Pg 20-23.

[12] Dr.Muhanad Shalall, "Strength and Elasticity of Steel Fiber Reinforced Concrete at High Temperatures Journal of Engineering Development Vol 11, Sep 2008.

[13] Milind V Mohod, "Performance of Steel Fiber Reinforced Concrete", Indian Journal of Engineering and Science, Vol 1, Pg 1-4.

[14] Marek Ubanski "Investigation on Concrete Reinforced with Basalt Rebars as an Effective Alternative of Convential RC Beams" International Journal of Engineering, vol 2, Pg 237.

[15] Subramanian R.V, "Reinforcement of Polymers by Basalt Bar", International Composite News, Pg 1-10.

[16] Maceij Szumigala, "Flexuaral Behaviour of Full Scale Basalt Frp Beams" Expermental and Numerical Studies Scientific and Technical Conference Material Problem in Civil Engineering, Pg 518-525.

