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Research Article

Effect of Basalt Fiber and Polypropylene Fiber on Hybrid Fiber Reinforced Concrete

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Abstract

The main objective of this research paper was to investigate the performances of M25 grade of concrete mix using hybrid fiber reinforced concrete such as basalt fiber reinforced concrete (BFRC) & polypropylene fiber (PP) on the normal mix & hybrid fiber mix having trial mix proportions 1:1.85:3.45with water cement ratio is 0.42 to study the behavior of hybrid fiber on the compressive strength, flexural strength, spilt tensile strength. the result obtained from test has been compared & analyzed with normal concrete mix prepared with (0.0% fibers). The relationship is established between compressive strength , workability, flexural strength, split tensile strength can be represented by graphically & mathematically. Research data was clearly shows that variation in fiber percentages shows decreases the compressive strength & split tensile strength of concrete.

Keywords: *basalt fibers, polypropylene fibers, spilt tensile strength, compaction factor, workability, concrete mix, hybrid fiber.*

1. Introduction

Concrete is most widely used as construction materials, in high-rise building, towers, airports, residential & commercial building to increases the properties of concrete by addition of fiber in concrete mix design to improve the flexural strength, compressive strength & durability of concrete. The strength & durability of concrete can be increased by addition of hybrid fiber in concrete like basalt & polypropylene fiber of various percentages in concrete. Basalt is natural material available in volcanic rocks. It is mainly used in crushed rock form, in construction of roadways, highways, construction industries .These rocks can be melt up to temperature range of (1300°c - 1700°c) and spin it into fine fibers. Basalt fiber can be used as continuous fiber &it can also be used in combination with other reinforcement (basalt / carbon fibers). Basalt fiber can be used thermal & sound insulation purpose.(e.g. Basalt wool) pipes, bars, mesh, structural plasties ,concrete reinforcing construction works. basalt has good thermal, electrical & sound insulating properties, it can also replace asbestos in almost all its application furthermore, the fiber diameter (comparable with E-glass fibers) can be controlled in order to prevent flexural cracks Concrete beams. its good electrical insulating properties (10 times better than E- glass fibers) on the other hand structural basalt composite components such as, pipes & roads are made from unidirectional basalt reinforcement. Basalt fibers rods has specific strength is 9.6 times greater than steel rod high resistance to aggressive media & high electrical insulating properties.

2. Material Specification

2.1 Cement

The fresh cement is used for research work having grade of cement is 43grade (OPC) all properties of cement are tested by conforming IS -12269-1987.

Table 1 Properties of cement

Sr.no.	Description of materials	Properties
1	Specific gravity	3.15
2	Initial setting time	90min.
3	Final setting time	180 min
4	Standard consistency	33%

2.2. Water: Portable water can used for mixing of concrete work.

2.3. Fine Aggregate: Locally available sand passing through 4.75 mm IS sieve is used

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Table 2 Properties of Fine Aggregate

Sr.no.	Description of materials	Properties
1	Specific gravity	2.805
2	Fineness modulus	4.44
3	Loose bulk density kg/m^3	2500
4	Compacted bulk density kg/m^3	2890
5	Water absorption %	0.46

2.4. Coarse aggregate: As per Ref. IS Code conforming 20MSA coarse aggregate retained on 4.75 sieve crushed coarse aggregate available from local sources has been used.

Table 3.Properties of Coarse Aggregate

Sr.no.	Description of materials	Properties
1	Specific gravity	2.696
2	Fineness modulus	7.950
3	Loose bulk density kg/m^3	1290
4	Compacted bulk density kg/m^3	1584
5	Water absorption %	1.343

2.5.Basalt fiber: Basalt fibers is available in chopped form & procured from Mutakagiri enterprises. Pvt.Ltd Mumbai. Basalt fiber (solidified volcanic lava) is known for its resistance to high temperature .strength& durability. Basalt fiber is extruded from molten basalt rock at diameter generally in between 13-20 µm BFRP fibers products are available in various forms such as bars, mesh, cages, spirals ,fabric & chopped fibers, it used as reinforcement in concrete structures.

Basalt fiber properties: basalt fibers reinforced concrete has good characteristics such as, volume stability, good workability, good stability ,excellent thermal resistance ,anti -seepage, crack resistance & impact resistance.

2.6. Polypropelene fibers (PP): The fibrillated polypropelyne fibers are procured from Tashi Pvt. Ltd.Nagpur.

3. Experimental Procedure

3.1 Mix design: The mix properties for normal mix are 1:1.85:3.45 with water cement ratio 0.42 by referring the revised IS Code 10262-2009 mix design concrete.

3.2. Batching, Mixing& Casting: Cement, fine aggregate, coarse aggregate & water measured & throully mixed with fibers. and concrete mixes is casted with 0.0%of fibers, hybrid basalt & Polypropylene fiber varying percentages are added in concrete .0.35%B & 0.15% PP,0.4B & 0.1%PP &0.5B % & 0.5PP% ,& 0.7B %&0.3%PP,& 0.8B % & 0.2%PP .Vibration was given to the cube moulds using table vibrator .The top surface of specimen can be leveled & finishing with the help of trowel after 24hrs. specimen were demoulded &were shifted to curing tank, where in they were allowed to cured for 7 days & 28 days ,entire specimen was tested in material testing laboratory of Walchand institute of technology, Solapur.

4. Experimental Results

4.1. Fresh Concrete: The fresh concrete properties slump, compaction factor & Density are shown in table 4.

Table 4 Concrete mix proportions & Properties of fresh & Hardened Concrete

Mix Type (B.F.%&P.P.%)	Slump (mm)	Compaction Factor	Fresh Density (kg/m3)
A0 (0.0%&00%)	65	0.91	2503.23
A1 (0.35%&15%)	65	0.91	2540.88
A2 (0.4%&0.1%)	70	0.92	2409.22
A3 (0.5%&0.5%)	65	0.91	2585.33
A4 (0.7%&0.3%)	65	0.85	2536.79
A5 (0.8%&0.2%)	55	0.89	2589.91

Table 5 Result of Compressive Strength of M25 grade of concrete at 7 days& 28 days

Mix Type (B.F.%&P.P.%)	Compressive Strength(N/mm^2)	
	7 Days	28 Days
A0 (0.0%&00%)	28.733	31.856
A1 (0.35%&15%)	21.989	26.637
A2 (0.4%&0.1%)	18.878	26.408
A3 (0.5%&0.5%)	24.281	26.082
A4 (0.7%&0.3%)	22.254	27.042
A5 (0.8%&0.2%)	14.656	27.560

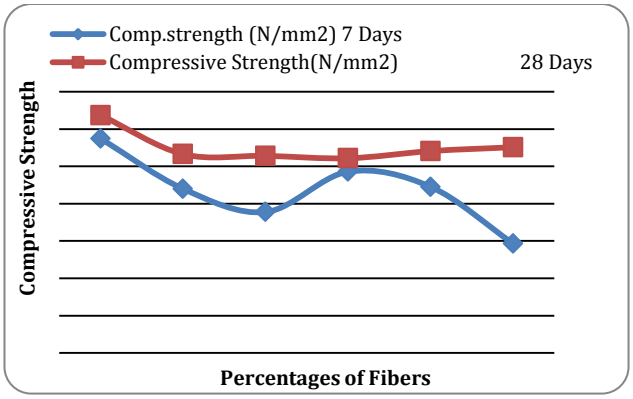

Fig 1 Compressive strength Vs % of fiber

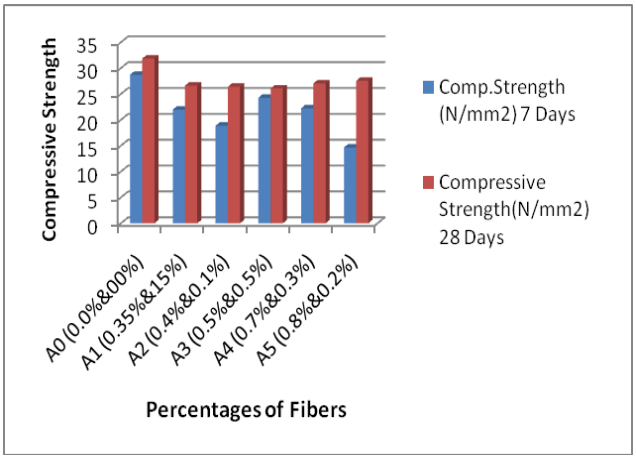

Fig 2 Compressive strength Vs % of fiber

Table 6 Result of Flexural Strength at 28 days

Mix Type (B.F. %&P.P.%)	Flexural Strength(N/mm^2)
	28days
A0 (0.0%&00%)	4.39
A1 (0.35%&15%)	5.185
A2 (0.4%&0.1%)	5.190
A3 (0.5%&0.5%)	4.148
A4 (0.7%&0.3%)	3.525
A5 (0.8%&0.2%)	3.111

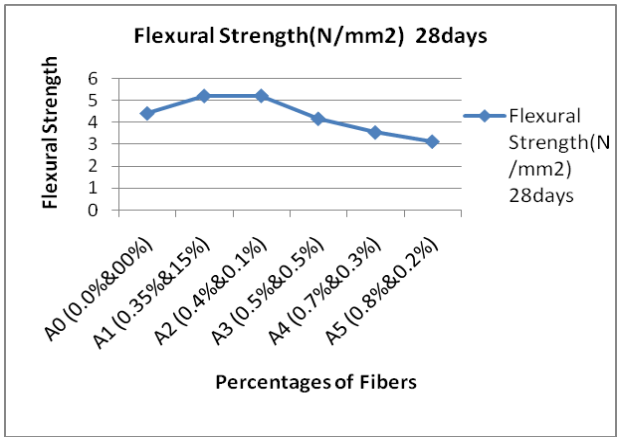

Fig 3 Flexural strength Vs % of fiber

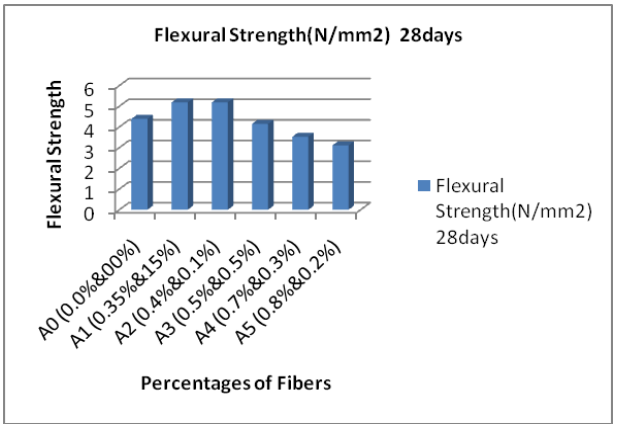

Fig 4 Flexural strength Vs % of fiber

Table 7 Result of Spilt tensile Strength at 28 days

Mix Type (B.F.%&P.P.%)	Spilt tensile Strength(N/mm^2)
	28days
A0 (0.0%&00%)	3.749
A1 (0.35%&15%)	3.318
A2 (0.4%&0.1%)	3.944
A3 (0.5%&0.5%)	2.669
A4 (0.7%&0.3%)	3.705
A5 (0.8%&0.2%)	2.296

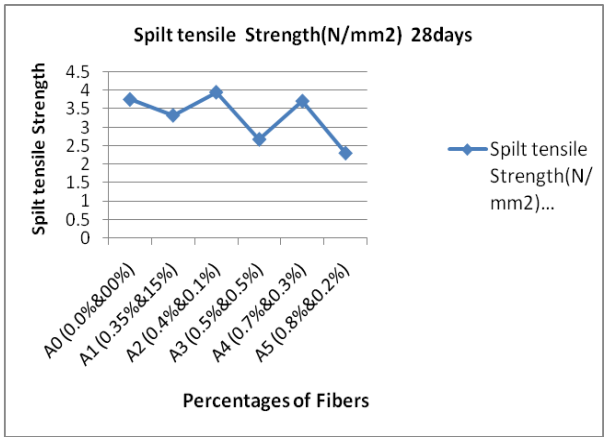

Fig 5 Spilt tensile Strength Vs % of fiber

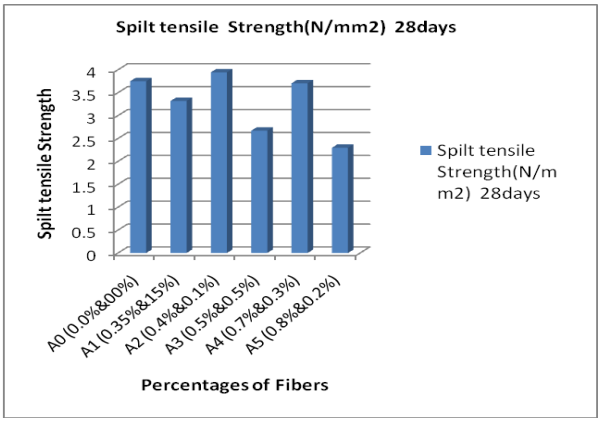

Fig 6 Spilt tensile Strength Vs % of fiber

5. Conclusion

1) Higher density mixes gives higher compaction factor& lower slump i.e.A5 mix.
2) Lower density mixes gives lower compaction factor & higher slump.i.e.A2 mix.
3) Addition of 0.5% Fibers results is marginal increase in Compressive & Flexural Strength of Concrete.
4) Addition of hybrid basalt fiber & Polypropylene fibers results reduction in compressive & Split tensile strength. The flexural strength is improved for 0.5% fiber & decreased for 1% fiber this may be because of fibrillated nature of basalt & polypropylene fiber which affect the homogeneity of concrete & hydration process of cement particle.

5) 1% of total fibers does not prove feasible addition inn case of basalt & polypropylene fibers.

Reference

Gore ketan, Prof.Suhasini M.Kulkarni (2012),The Performance Of Basalt Fibre In High Strength Concrete ,*JIKRCE* 2(2) ,117-124.

Cengin Duran atis ,Okan Karahan (2007)Properties Of Steel Fiber Reinforced Fly Ash Concrete, *ELSEVIER* ,23,392-399.

M.V. Krishna Rao , N.R Dakhshina Murthy & V.Santhosh kumara (2011) ,Behaviour Of Polypropylene Fibre Reinforced Fly Ash Concrete Deep Beams In Flexure And Shear ,*AJCEB&H,12(2),143-144.*

A.Alavi Nia , M. Hedayatiana, M. Nili , V. Afrough Sabet (2012) An Experimental And Numerical Study On How Steel And Polypropylene Fibers Affect The Impact Resistance In Fiber-Reinforced Concrete ,*IJIE ,46,62-7*

Ilker BekirTopc U, Mehmet Canbaz Effect of different fibers on the mechanical properties of concrete containing fly ash (2007), *ELSEVIER*, 21,1486-149

Elba Helen George, B. Bhuvaneshwari, G. S. Palani,P. EapenSakaria, Nagesh R. Iyer Effect of Basalt Fibre on Mechanical Properties of Concrete Containing Fly Ash and Metakaolin (July 2014), *international conference, Kerala,India,* pp. 444-451.

G.L.Sheldon Forming fiber from basalt rock: A literature review (1977),21(1),pp.18-24.