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An Analytical Study of Hybrid Fibre Reinforced Concrete

Mohammed Osama, Hemant Sood
PG Scholar, Construction Technology and Management, NITTTR, Chandigarh, India
Professor, Department of Civil Engineering, NITTTR, Chandigarh, India

Abstract: ***The Concrete possesses high compressive strength but exhibits low tensile strength and brittle failure characteristics. Hybrid Fibre Reinforced Concrete (HFRC) offers an effective solution by combining two different fibres to enhance strength, ductility, and durability. This study investigates the mechanical and durability properties of M40 grade HFRC incorporating galvanized steel fibres and glass fibres in varying proportions. Six concrete mixes were prepared with a total fibre content of 3% by weight of cement. The combinations investigated were S0G0, S3G0, S2G1, S1.5G1.5, S1G2, and S0G3. Experimental investigations included compressive strength, flexural strength, ultrasonic pulse velocity (UPV), permeability, dynamic modulus of elasticity, and dynamic Poisson's ratio. Results indicate that hybridization of steel and glass fibres significantly improves the mechanical performance and durability of concrete. The optimum performance was observed in the S2G1 and S1.5G1.5 mixes, which exhibited enhanced compressive strength, flexural strength, reduced permeability, and superior crack resistance. The study demonstrates the effectiveness of hybrid fibre systems for high-performance concrete applications.***
Keywords: Hybrid Fibre Reinforced Concrete, Steel Fibre, Glass Fibre, Compressive Strength, Flexural Strength

I. INTRODUCTION

A composite fibre reinforced concrete enhances the compressive stress, strain and flexure andsplittensilestrengthofconcrete. Fibersarealsoactingascrackarrestorandreducethepropagation of cracks in concrete. Hybrid Fiber Reinforced Concrete (HFRC) is formed from acombination of different types of fibers, which differ in material properties, remain bondedtogether when added in concrete and retain their individuality and properties. The function ofsteel fiber to enhance the strength of concrete infiber reinforced concrete under compressionand flexural strength and glass fibre reduce the brittleness also act as a crack arrestor. So thecombination of two different nature of fiber shows better prospect for hybridization. HFRC cansustain large degree of deformation. For comparative evaluation of performance, six differenttypes of sample and 9 different types of specimens for each sample will be prepared and testedunder UPV, compression and flexural strength. M40 grade concrete will be prepared, among sixsamples first sample S0C0 is prepared with without fibre and others samples are made with thefraction of steel is 3%, 2%, 1.5%, 1%, & 0% and respectively glass fibre in the same sample is0%, 1%,1.5%, 2%, & 3%. Combined fraction of fibre in concrete is kept 3% by the weight ofcement.Herethe numbers showsthefraction offibrein percentagebythe weight ofcement.

II. LITERATURE SURVEY

1) The reviewed literature indicates that the incorporation of fibers significantly improves the mechanical and durability properties of concrete. Various researchers have investigated the effects of steel fibers, polypropylene fibers, plastic fibers, natural fibers, and hybrid fiber systems on concrete performance.
2) Studies by G. Ruby Selina and Geethanjali (2014), Rajarajeshwari Vibhuti et al. (2013), and Patodi and Kulkarni (2012) demonstrated that hybrid fiber reinforced concrete provides superior compressive, tensile, and flexural strength compared to single-fiber concrete. The combination of different fibers effectively delays crack propagation and enhances structural integrity.
3) Research conducted by Vasudev and Vishnuram (2013), Shahidan (2009), Nataraja (2002), Dwarakanath and Nagaraj (1991), and Otter and Naaman (1988) revealed that steel fibers significantly improve compressive strength, tensile strength, toughness, and crack resistance. Most studies reported optimum performance at fiber contents ranging from 0.5% to 1.0%, beyond which strength gains tend to diminish.
4) Investigations by Nibudey and Nagarnaik (2013) and Andiç (2014) showed that plastic and synthetic fibers improve strength characteristics and durability while contributing to sustainable construction practices. Natural fibers such as coconut fibers were found to enhance toughness, tensile strength, and energyabsorptioncapacity, although excessive fiber content may reduce workability and compressive strength.

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Several researchers also observed that increasing fiber volume fraction and aspect ratio generally improves strength properties up to an optimum level, after which performance may decline due to poor workability and fiber clustering. Hybridization of fibers was consistently reported to provide better crack control, ductility, and long-term durability.

Research Gap

In the previous research mostly experiment was done with single fibre reinforced concrete andsome beneficial outcome was appeared. Each fibre has different property by which they canenhance the quality of concrete. Some fibres have less modulus of elasticity than cement matrixsuch as nylon, coir, sisal etc. On other hand some fibres have more modulus of elasticity thancement matrix like steel asbestos, glass etc. So the ideas are to blend two different natures offibres and added to concrete mix then observe the results. It is expected to improve the followingpropertyof concrete byhybridization offibreinconcrete.

- Enhancingcompressive &flexurestrength.
- Reducethebrittlenessof concrete.
- Utilizethefibreasacrack arrestor.

III. OBJECTIVE OF THE WORK

1) Tofindout effectoncompressiveandflexuralstrength of M40 grade concrete byvariationinpercentageof isolated fibres.
2) To evaluate the compressive and flexural strength of HFRC (M40 GRADE CONCRETE) using predetermined combination of composite fibres.

IV. METHODOLOGY

Thefollowingmaterialsareused forthe preparationofhybrid fiberreinforcedconcrete.

1) PortlandPozzolanacement(PPC)
2) Fineaggregate(FA)
3) Coarseaggregate(CA)
4) GalvanizedSteelfiber(GSF)
5) GlassFibre(GF)

Various tests were conducted on cement, fine aggregate, coarse aggregate.

Preparation of mix design of M40 grade concrete. 6Cubes and 3 beamswerecasted withcontrol mix using natural aggregate.

First sample S0C0 is prepared with without fibre and others samples are made with thefraction of steel is 3%, 2%, 1.5%, 1%, & 0% and respectively glass fibre in the same sample is0%, 1%,1.5%, 2%, & 3%. Workabilitytests,compressivestrength,tensilestrength of concrete were conducted.

V. MATERIAL TEST

Table-1:MaterialTestingResults

Test	Material	Equipmentused	Values obtained
Specific gravity	PPC	Density Bottle	2.984
Initial setting time	PPC	Vicat apparatus	80 mins
Final setting time	PPC	Vicat apparatus	498 mins
Specific gravity	Fineaggregate	Pycnometer	2.62
Specific gravity	Coarse aggregate	Pycnometer	2.8
Water absorption	Coarse aggregate	Oven Dry Method	0.7 %
Workability	M340 Concrete	Slumpcone apparatus	100mm

VI. MIX DESIGN

Table-2:M40MixProportioning

Cement(Kg/m3)	450
Fineaggregate(Kg/m3)	617.6
Coarseaggregate(Kg/m3)	1197.88
Water(li/m3)	183.06
Watercementratio	0.4

Mixratio1:1.37:2.60:0.37

VII. EXPERIMENTAL INVESTIGATION

A. Test Procedure

For concretetestspecimensconsistof150x150x150mmcubes and beams of 100x100x500mm . Compressive strength was obtain on the basis of concrete cube specimen tested at 7 and 28 and for flexure strength beams specimens were tested at 28 day.

B. Test on fresh concrete

On fresh concrete, workability testapply to check the affects of concrete strengthanddurabilityaswellasthe appearanceof thefinishedproduct. For easily placed and well compacted in homogeneously without bleeding and segregation concreteis to be well workable. In this work the workability of concrete is measured by slump test.

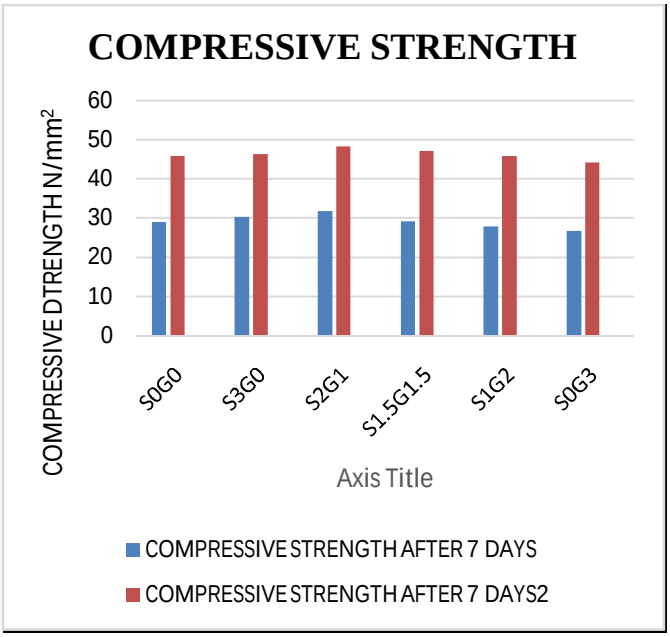
C. Testonhardened concrete

To ensure the design strength of hardened concrete various test is to be done and quality of concrete construction is achieved. It includes compressive strength test,flexuraltensilestrengthtest,strengthtest and modulus of elasticity

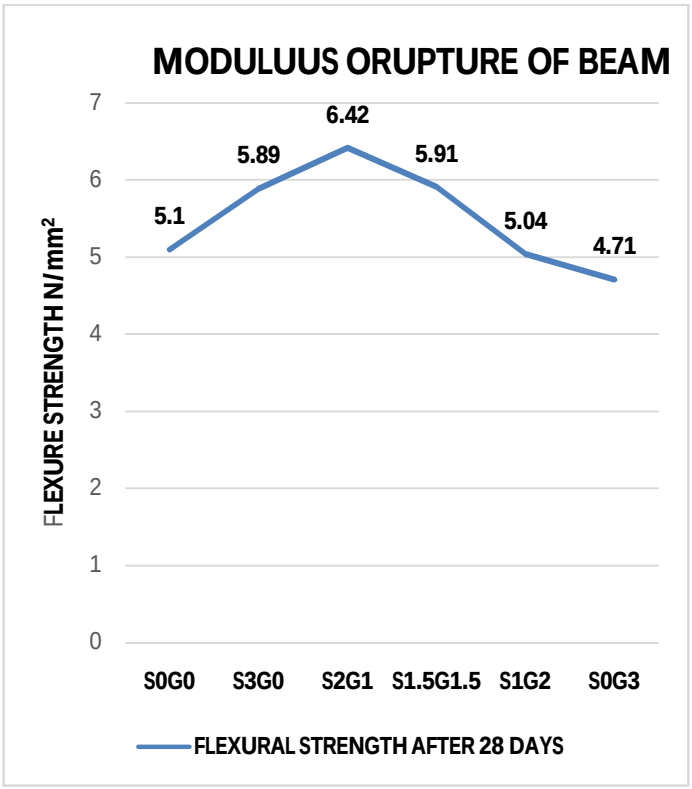
VIII. EXPERIMENTAL RESULTS AND DISCUSSION

Table-3: Mean Compressive Strength test and flexural strength result

Sample	Specification	Mean Compressivestrength (N/mm^2)		Mean Flexure Strength (after 28 days) (N/mm^2)
		7 days	28 days	
Sample I	S0G0	28.95	45.82	5.10
Sample II	S3G0	30.27	46.36	5.89
Sample III	S2G1	31.75	48.32	6.42
Sample IV	S1.5G1.5	29.26	47.08	5.91
SampleV	S1G2	27.93	45.85	5.04
SampleVI	S0G3	26.70	44.15	4.71

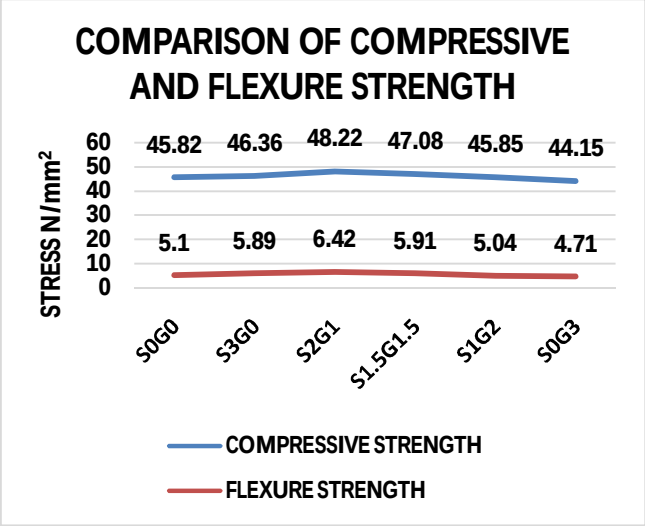


Flexural strength of concrete beam has calculated at the age of 28 days of curing shown in below table. It is represented in the form of modulus of rupture. Flexural strength of a beam is found maximum in sample III which contains 2.0% steel and 1.0% glass fibre. There is 18.91% increment as compare to non-fibrous concrete beam. It is analyze from the result the flexural strength decreases by increasing the glass fibre.



IX. COMPARISON BETWEEN FLEXURAL STRENGTH AND COMPRESSIVE STRENGTH

The relation between flexural strength and compressive strength is established. Representation of graph shows straight line relationship between the compression and flexural strength. The sample has lower compressive strength also shows lower flexural strength and increases with the increasing the corresponding value.



X. CONCLUSIONS

The outcomes of experimental results, the 28 days compressive strength of the sample III S2G1 with 2% steel fibre and 1% glass fibre content is found optimum. The compressive strength of S2G1 is found +5.23% greater than sample without fibre S0G0. Inclusion of 1% glass fibre also gives the good result but by increasing the glass fibre more than 1%, decreases the compressive strength and least compressive strength is found at the sample VI which contains maximum 3% glass fibre and 0% steel fibre. Only steel fibre alsogives good result in compression. The sample contains 3% steel fibre has +1.18% greater compressive strength than sample S0G0.

In the case of flexural strength after 28 days, sample III S2G1 contains 2% steel fibre and 1% glass fiber has +25.88% greater flexural strength than sample S0G0. Two other samples, S3G0 & S1.5G1.5also shows the growth in flexural strength as compareto S0G0this increment is +15.5% & +15.88%respectively. But furtherincrement in percentageof glass fibrereducingthe flexural strength of concrete.

XI. SCOPE FOR THE FUTURE WORK

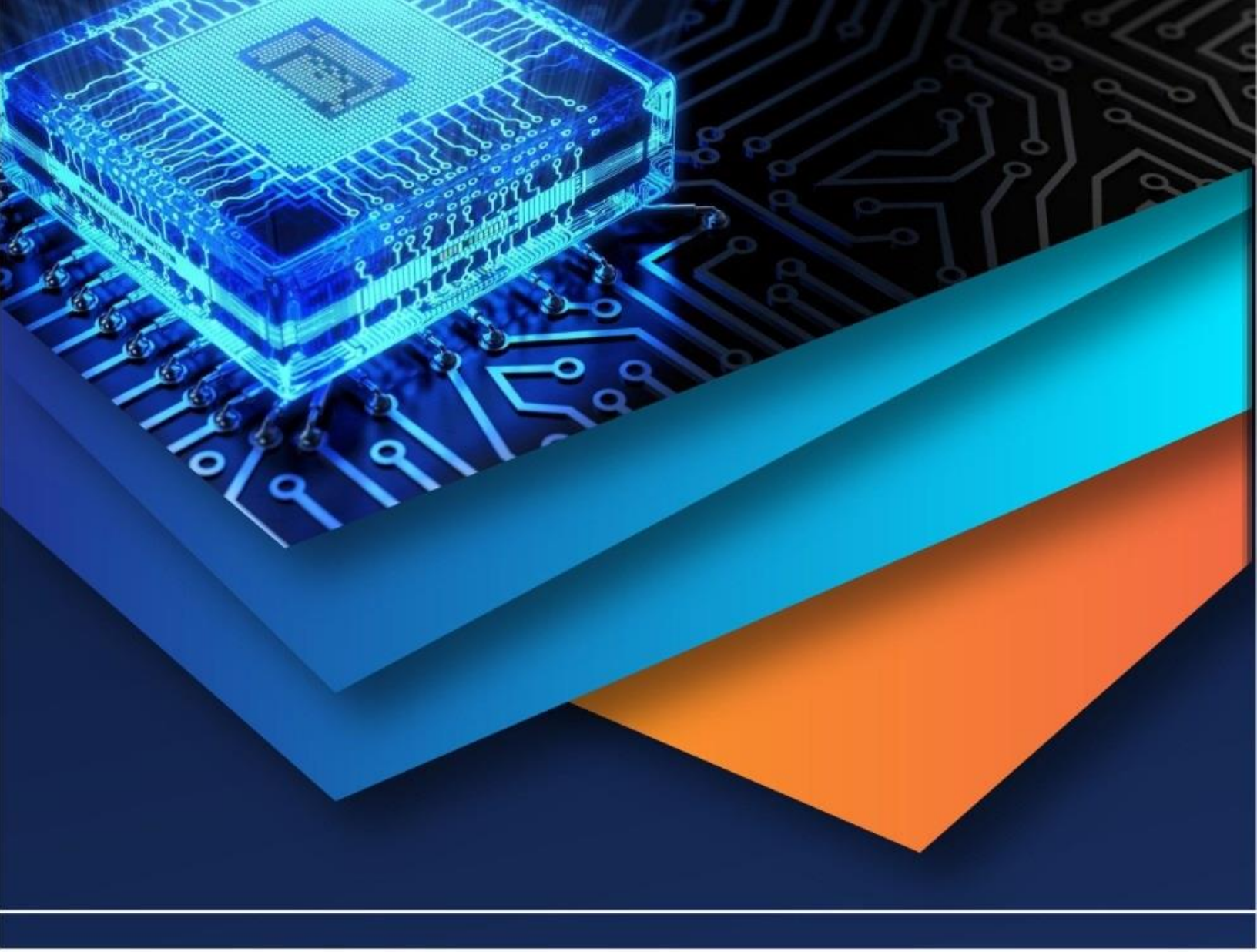
In this research it was studied the how hybrid fibres improve the inbuilt property of concrete by mean of compressive strength and flexural strength. Here five different fractions of fibres were implemented. This work can be proceed by extension of experimental investigation so other properties of harden concrete such as impact resistant, split tensile strength, propagation ofcracks can be investigated.

After the testing of specimens it is observed in sample S0G0, S3G0, S2G1, the results are improving or stable in the higher fraction of steel fibre with the partial combination of glass upto a limit of 1.0% by the weight of cement. But further increment in glass fibre and decrement in steel fibre adversely affect the strength of specimen. Both the compression and flexural strength reduces for the sample S1G2, S0G3. So the new investigationcan be done for the higher fraction of steel fibre beyond 3% and the fraction of glass is kept limited up to 1.0% by the weight of cement.

REFERENCES

[1] A.Thakur and H. Sood, 'Study of Strength Properties of Hybrid Fiber Sisal/Polypropylene Reinforced Concrete using Ppc', International Journal for Research in Applied Science & Engineering Technology, vol. 5, pp. 1770-1777, 2017.
[2] S. Maqbool and H. Sood, 'Effect of PET Fibers on the Mechanical Properties of Concrete', SSRG International Journal of Civil Engineering, vol. 3, no. 12, pp. 1-6, December 2016.
[3] B.Rajarajeshwari Vibhuti, Radhakrishna, Aravind N (2013)"Mechanical properties of hybrid fibre reinforced Concrete for pavements"
[4] S. C. Patodi, & C. V. Kulkarni (2012) "Performance Evaluation Of Hybrid Fiber Reinforced Concrete Matrix. International Journal of Engineering Research and ApplicationsVol. 2, Issue5, September- October 2012, pp.1856-1863
[5] GSelinaRuby,C.Geethanjali (2014)"Influence ofhybridfiberonreinforced concrete"
[6] R. Vasudev , and B.G.. Vishnuram (2013) Studies on Steel Fibre Reinforced Concrete – A Sustainable Approach.
[7] Mohammad Adnan Farooq, Dr Mohammad Shafi Mir(2013) "Laboratorycharacterization of steel fibre reinforced concrete for varying fibre proportion and aspect ratio" International Journal of Emerging Technology and Advanced Engineering, pp 2250-2459, Volume 3, Issue 2, February 2013

[8] M.Natraj(2002) “FiberreinforcedconcreteTbehaviourpropertiesandApplication”
[9] Shetty,M.S,"ConcreteTechnologyTheoryandPractices",S.Chand&Company,New Delhi.
[10] IS516:1959,“MethodofTestsforStrengthofconcrete”,BureauofIndianStandard, New Delhi.



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