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Experimental Study on Polypropylene Fiber Reinforced Concrete Beams

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Abstract: ***In the following experiment, the study of influence of polypropylene fibers in reinforced High Performance concrete (HPC) beams was done. The dimensions of beam specimen were 200*300*2100mm. The beam was tested after 28 days of curing and was subjected to two point loading under the loading frame. The parameters studied were load-deflection curve flexural toughness, energy absorption capacity. The flexural toughness factor for HPC and PFRC was $9.55x10^{-3}$ and $11.79x10^{-3}$.***
Key Words: High Performance concrete (HPC), Polypropylene fiber reinforced concrete (PFRC), Load Deflection, Flexural strength, energy absorption capacity

I. INTRODUCTION

Concrete is the most broadly utilized development material in world. It is outstanding that customary cement outlined based on compressive quality does not meet numerous practical necessities, for example, impermeability, protection from ice, warm breaking sufficiently.

There are a few demerits of concrete such as the tensile strength of concrete is relatively low when compared to other binding material, the ductility of concrete is less and it contains some soluble salts leading to efflorescence.

The flexural strength can be defined as the stress in a material just before it yields in a flexural test. The transverse bending test is most frequently employed, in which a specimen having either a circular or rectangular cross-section is bent until fracture or yielding using a three point flexural test technique. The flexural strength represents the highest stress experienced within the material at its moment of yield.

The application of these can be widely used in the repair and rehabilitation of old damaged concrete, for the preparation of steel bridge and ship decks surfaces, for the concrete structure that is more subjected to large doses of de-icing salts, for the cementing ceramic tiles to concrete.

A. Literature Review

1) In this paper has formulated a simplified mix design procedure for HPC by combining BIS and ACI code methods of mix design and available literature on HPC. He tested HPC mixes experimentally for compression, split tension, flexure and workability. The performances of the design mixes obtained were very good and the results were reported

2) Worked on High Performance Concrete (HPC). The usage of mineral admixtures in the concrete not only enhanced its strength properties but also durability. The 7 days and 28 days cube compressive strength ratio of HPC obtained was 0.84 to 0.9.

3) Worked on HPC to generalize the results of study on silica fume based high-performance concrete. They made attempt to compare, the 7 days and 28 days compressive strength, splitting tensile strength and flexural strength of concrete by using silica fume with the normal concrete of M60 grade with maintaining the water cement ratio 0.3.

4) studied on blending of a large amount of waste materials such as fly ash, micro silica, rice husk ash (RHA),GGBS, etc. which has been done in large extents in the manufacture of High Performance Concrete (HPC). They observed that Quaternary mix gives better early strength, requires less quantity of super plasticizers & cement and thus contributes to sustainable development

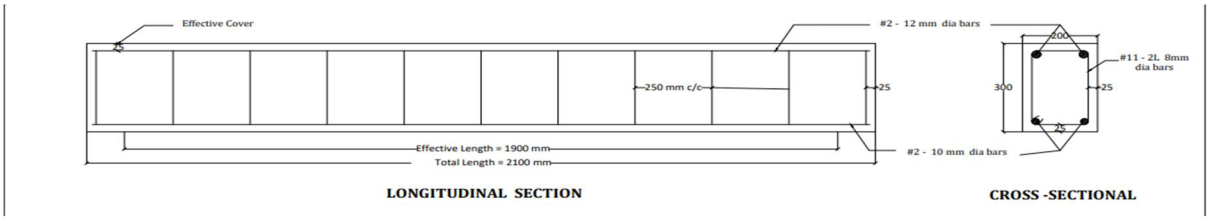
5) in their study, to replace the constituent materials by mineral admixtures, chemical admixtures and additives also, they proposed to use high performance concrete. Also High Performance concrete specimens with fiber and without fiber were cast and the strength tests were observed.

B. Test Programme

1) *Beam specification:* The rectangular beam was casted of size 200X300X2100mm and the reinforcement was provided with 2no's. 16mm diameter tension bars, 2 no's. 10mm diameter compression bars and 2-legged stirrups of 8mm diameter with 250mm c-c spacing.

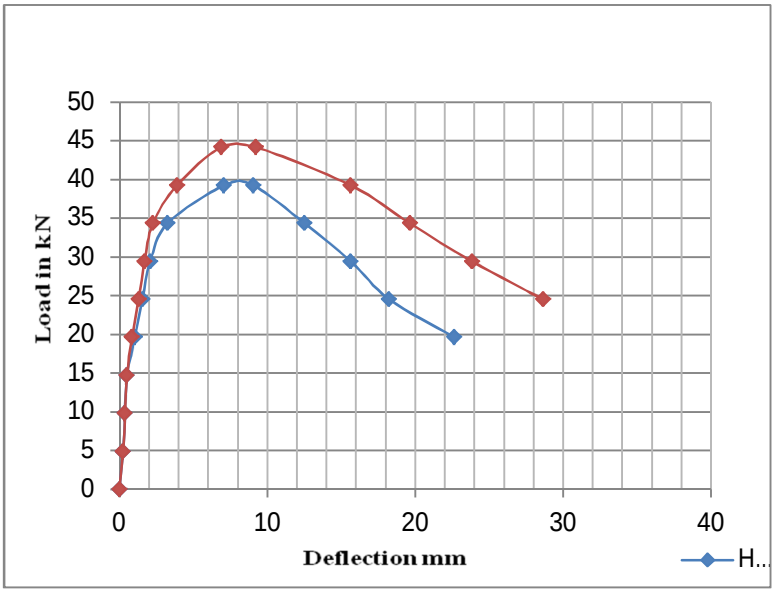
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The beam casted was being tested under the loading frame for testing of flexure.



III. TEST RESULTS

A. *Load deflection curve*



HPC PFRC

LOAD (kN)	DEFLECTION (mm)
0	0
4.905	0.25
9.81	0.38
14.715	0.51
19.62	1.05
24.525	1.55
29.43	2.08
34.335	3.26
39.24	7.08
39.24	9.05
34.335	12.52
29.43	15.65
24.525	18.25
19.62	22.65

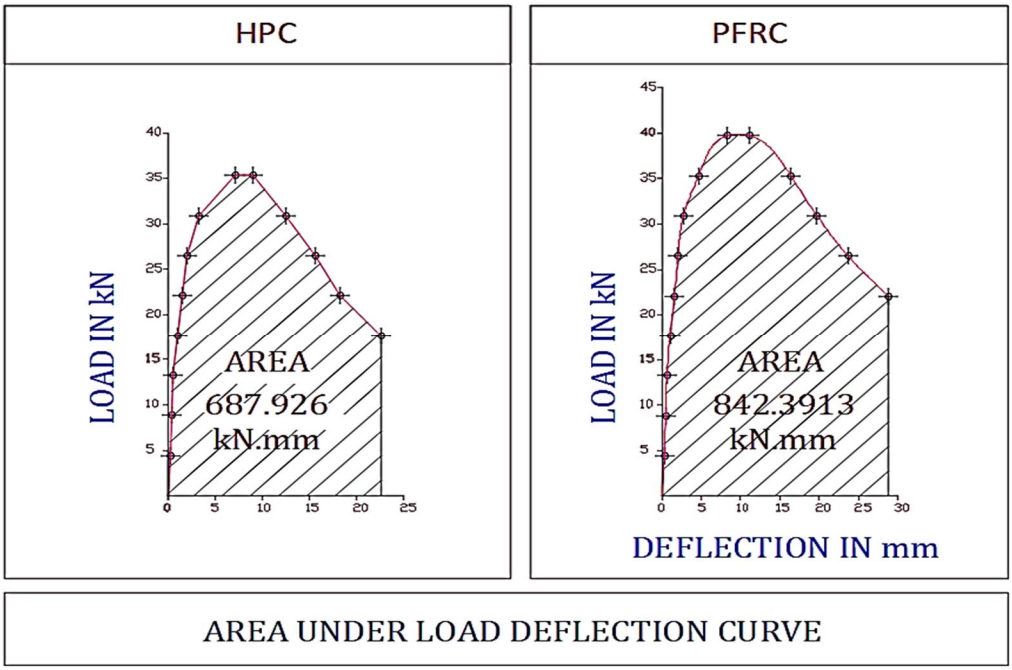
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LOAD (kN)	DEFLECTION (mm)
0	0
4.905	0.25
9.81	0.38
14.715	0.51
19.62	0.85
24.525	1.3
29.43	1.7
34.335	2.26
39.24	3.89
44.145	6.88
44.145	9.25
39.24	15.64
34.335	19.64
29.43	23.84
24.525	28.66

B. Flexural Toughness Factor

Flexural Toughness Factor (*Ft*)

$$FT = \frac{Area\ under\ the\ load\ deflection\ X\ effective\ length}{\frac{L}{250} X\ b\ X\ h^2}$$



The flexural toughness factor for High Performance Concrete was found to be 9.5545 X 10^{-3} and that of Fiber reinforced High Performance Concrete was found to be 11.79x10^{-3}. There was an appreciable increase in the flexural toughness factor by the addition of fiber in HPC.

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C. Energy Absorption Capacity

The energy absorption capacity found in the above graph, HPC has an area of 687.92 kN.mm under the load – deflection curve and FRC has an area of 842.39kN.mm under the load – deflection curve. This shows that the fibre reinforced concrete has more absorption capacity over the reference concrete.

IV. FIGURES



V. CONCLUSION

A. Based on the Experimental Results, Following Inferences Are Drawn

1) Comparative bending behavior of high performance concrete and polypropylene fiber reinforced concrete indicated the influence of polypropylene fiber in the enhancement of flexural strength.

2) The load taking capacity of the PFRC increased at the peak deflection compared to HPC. This is due to energy absorption by fiber matrix.

3) Flexural toughness factor for PFRC beam increased by 22.56% compared to HPC beams.

4) From the graph, it is evident that the energy absorption capacity is enhanced to 842.39kN-mm from 687.92kN-mm.

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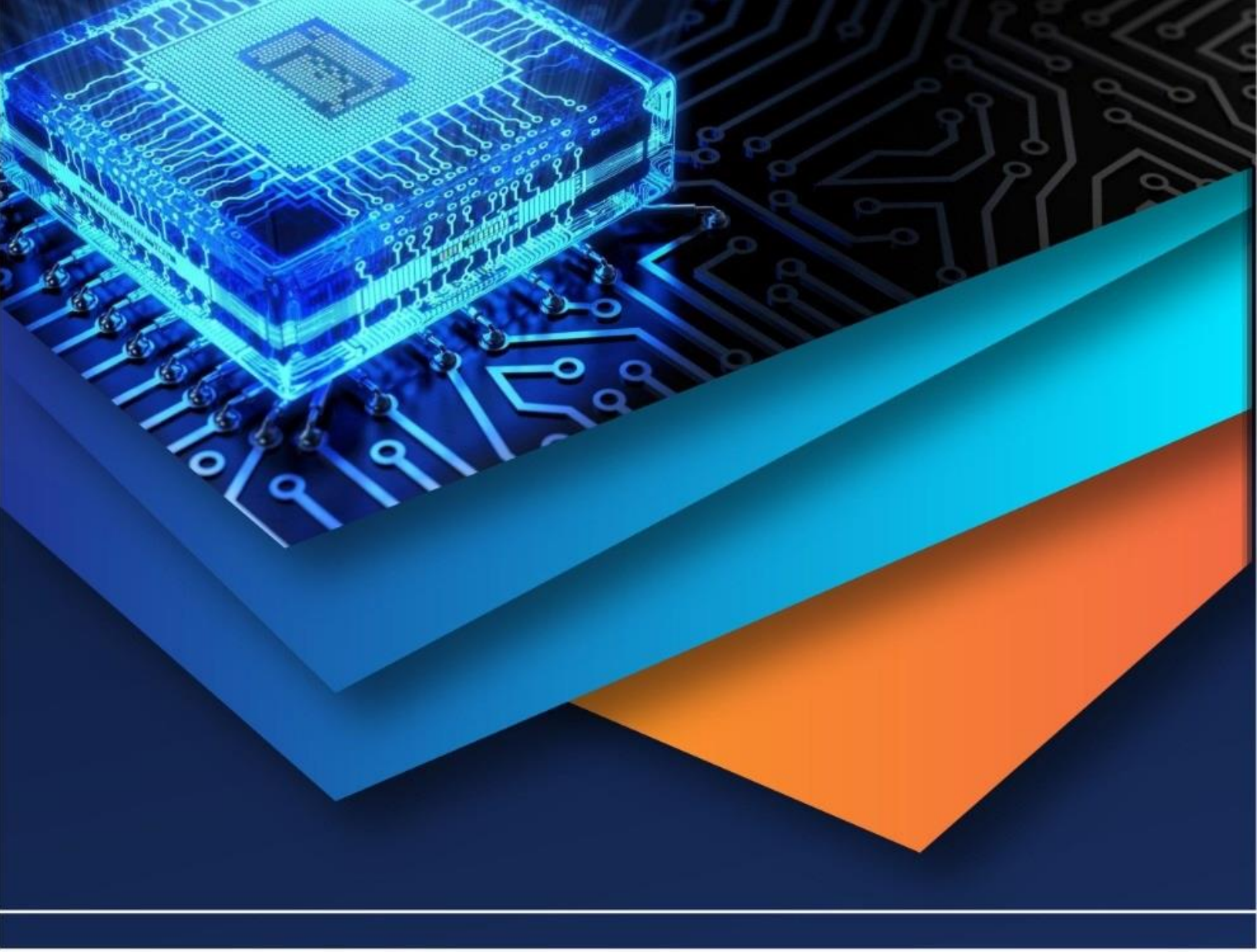
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