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Effect of Fibres on the Compressive Strength of Hollow Concrete Blocks

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ABSTRACT

Concrete is the most often utilised material in building. Cementitious material improvement is critical since it is the most versatile material used in building. The two key established drawbacks of ordinary concrete are destructive behaviour combining brittle failure and inadequate tensile strength. The purpose of this paper is to investigate the impact of adding various types of fibres to hollow concrete blocks. Polypropylene, steel, glass, nylon, and coconut fibres were employed in various proportions in the current work. The inquiry program's major goal is to determine the optimal fibre content as well as the impact of fibre addition on the compressive strength of hollow concrete blocks. After that, the compressive strength of the hollow concrete block samples was measured. The hollow concrete block samples were tested for compressive strength after 28 days of curing period and a notable increase in compressive strength is observed for all the percentage addition of fibres when compared with the hollow concrete block without fibres.

KEYWORDS: *Fibre Reinforced Concrete, Synthetic fibres, Natural fibre, Compressive Strength and Hollow Concrete Block*

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1. INTRODUCTION

The qualities of concrete, such as poor tensile strength and low strain capacity, which result in low crack resistance, can be increased to some extent by incorporating various types of fibres into the mix. Fibre Reinforced Concrete (FRC) is a concrete that has been designed to improve the above-mentioned qualities (Banthia & Sheng 1996) [3]. The major goal of incorporating fibres into concrete is to increase strength in areas such as compressive, tensile, impact resistance (Bairagi & Modhera 2001), toughness, and flexural, as well as to limit the development of cracks in the material.

Internal microcrack propagation leads to concrete's low tensile strength, resulting in brittleness. As a result, structural fissures form in concrete even before it is loaded, due to drying shrinkage and other causes. Internal fractures develop and open up owing to stress when the load is applied, resulting in the production of further cracks, which causes inelastic deformation in concrete. Small uniformly scattered and randomly oriented fibres act as crack arrestors and improve the characteristics of concrete when injected into it.

Metal, synthetic, natural, and other forms of fibres come in a variety of sizes and shapes.

The qualities of the binding matrix, as well as the interaction of the fibres placed in the concrete, determine the behaviour of fibre reinforced concrete. As a result, different sorts of fibres are added to the concrete, causing it to behave differently. The length, diameter, and form of the fibre, as well as the type of material, have an impact on the FRC's behaviour. Geometry and fibre type are two of the most important criteria in FRC (Buratti et al. 2011; Wang et al. 2012) [6,29]. The length, diameter, and proportion of fibres in concrete have an impact on their dispersal.

As a result, while choosing the type of fibre for FRC, selective judgement is essential. Steel fibres give concrete a better flexural tensile strength and resistance to cracking and impact when it comes to volume shrinkage. Steel Fibre Reinforced Concrete has been the subject of a lot of research in the past. This method was most widely utilised for industrial pavements (Sorelli et al. 2006) [27], where significant control of shrinkage cracking is required for precast roof elements (Fererara & Meda 2006) [9], as well as tunnel linings (Bernard 2002)

Natural fibre is the most cost-effective and environmentally friendly type of fibre that may be utilised in concrete with the least amount of environmental impact. This allows for improvements in flexural characteristics, impact resistance, and fracture toughness, among other mechanical qualities. Coconut fibre is one of many natural fibres used in this investigation. Researchers recently discovered that adding coconut fibres to concrete can increase the qualities of FRC. When compared to other natural fibres, coconut fibres produced from the husk of the coconut may withstand up to 6% strain (Lad et al. 2017) [15]. Because of their great affinity for water and retentive nature, coconut fibres impair workability (Lumingkewas et al. 2017).

The majority of fibre reinforced concrete research indicates that only one fibre is put to the mix at a time. In addition, the binding mix varies between investigations. As a result, there is no way to compare the results. The purpose of this research is to investigate the effect of several types of fibres on the compressive strength of hollow concrete blocks, including Polypropylene, Steel, Glass, Nylon, and Coconut Fibres. The same binding matrix is utilised for all of the samples in order to compare the results.

2. DETAILS OF EXPERIMENTS

2.1. Materials used

2.1.1. Cement

The study employed locally available 53 grade Ordinary Portland Cement (OPC) with the brand name Chettinad and a specific gravity of 3.13. The beginning and final setting timeframes were 50 and 170 minutes, respectively, with a standard consistency of 32 percent. In a normal mortar that has been cured for 28 days, the compressive strength is 54 MPa. IS 12269 – 1987 confirms the physical qualities.

2.1.2. Fine Aggregate

Quarry sand which is available passing through 4.75mm IS sieve as per IS: 383-1987. The physical properties of the fine aggregates are shown in Table 2.

Sl. No	Properties	Values
1	Specific gravity	2.62
2	Bulk density	1560 kg/m^3
3	Grading	Zone II

2.1.3. Water

Clean potable tap water available in the laboratory, which satisfies drinking standards, was used for the preparation of specimens and for the curing of specimens.

2.1.4. Super Plasticizer

High range water reducing admixtures (Super plasticizers) are the chemical admixtures used in the present work and this requires well- dispersed particle suspension. In the current study, Glenium was used as super plasticizer.

Fibres Table 4 shows the different types of fibres and the fibre ratios used for preparing the concrete samples.

2.2. Mix Design

The process of selecting materials such as cement, aggregates, and water, as well as establishing their relative proportions, is known as concrete mix design. The primary goal of concrete mix design is to produce a concrete with the appropriate strength, durability, and workability for the least amount of money. The design of concrete mix has been carried out. The final mix proportion (cohesive) listed in Table was used in the current study.

Figure 1 Specimen cast

3. DISCUSSIONS BASED ON THE TEST RESULT

The variations of compressive strength of the blocks with various percentage of polypropylene fibre content are shown in figure 2.

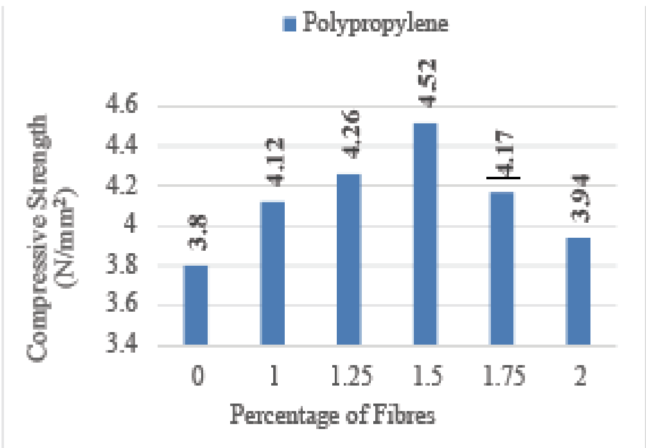

Figure 2 Variation of Compressive strength of Hollow Concrete Block with various Percentage of Polypropylene Fibres

The compressive strength of the hollow concrete block with polypropylene fibre is shown to rise up to 1.5 percent fibre content before decreasing. After a 28-day curing time, the compressive strength of the hollow concrete block was found to be 4.12N/mm2 for 1% of fibres, 4.26N/mm2 for 1.25 percent of fibres, 4.52N/mm2 for 1.5 percent of fibres, 4.17N/mm2 for 1.75 percent of fibres, and 3.94 N/mm2 for 2.0 percent of fibres. When compared to a hollow concrete block without fibres, the optimum proportion of polypropylene is 1.5 percent, and the percentage improvement in strength is 19.0 percent. There is a reduction in droop as the fibre content rises, especially over 1.5 percent. The compressive strength of the controlled hollow concrete block was found to be 3.8N/mm2.

The compressive strength of the hollow concrete block with steel fibres increases until it reaches 3% fibre content, beyond which it decreases. At 28 days, the compressive strength of the hollow concrete block was 4.27 N/mm2 for 2.5 percent of fibres, 4.81 N/mm2 for 2.75 percent of fibres, 5.22 N/mm2 for 3 percent of fibres, 4.62N/mm2 for 3.25 percent of fibres, and 4.04 N/mm 2 for 3.5 percent of fibres. When compared to a hollow concrete block without fibres, the optimum proportion of steel fibres is found to be 3%, and the percentage improvement in strength is found to be 37%. There is a reduction in slump when the fibre content is increased, especially when it exceeds 3%. The compressive strength of the controlled hollow concrete block was found to be 3.8N/mm2.

CONCLUSIONS

The following conclusions are drawn based on the experimental investigations carried out.

1. Slump is reduced when fibre content increases, particularly beyond 1.5 percent dose in the case of polypropylene, 3 percent in the case of steel fibres, and 1% in the case of glass, nylon, and coconut fibres. As the mixture becomes more fibrous, it becomes more difficult to handle.
2. It is revealed by the compressive strength test on the hollow concrete blocks that the strengths were increased proportionately with the increase in the percentage of Polypropylene, Steel, Glass, Nylon and Coconut fibres with reference to the hollow concrete blocks without fibres.
3. In comparison with other samples of Fibre Reinforced Hollow Concrete Blocks in the present study, maximum compressive strength was exhibited by the samples with 1.5% Polypropylene fibre, 3% Steel fibre and fibre content of 1% in the case of Glass, Nylon and Coconut fibres.
4. The percentage increase in the maximum compressive strength with the addition of fibres (as against the mix without fibres), obtained as per the present study are detailed below:
   - 19% increase in strength was obtained with the addition of 1.5% of Polypropylene fibre.
   - 37% increase in strength was obtained with the addition of 3% of Steel fibre.
   - 16%, 21%, 13% increase in strength was obtained with the addition of 1% of glass fibres, nylon fibres and Coconut fibres respectively.
5. Out of the five different types of fibres used in the current study, the addition of Steel fibres and the Nylon fibres gave the maximum percentage increase in the compressive strength compared to that of the hollow concrete blocks prepared without fibres.

REFERENCES

[1] Akça, K. R., Çakır, Ö. and İpek, M. Properties of polypropylene fiber reinforced concreteusing recycled aggregates. Construction and Building Materials, 98, 2015, pp. 620–630.

[2] Bairagi, N. K. and Modhera, C. D. Shear Strength Reinforced Concrete. ICI Journal, 1(4), 2001, pp. 47–52.

[3] Banthia, N. and Sheng, J. Fracture Toughness of Microfiber Reinforced Cement Composites. Cement and Concrete Composites, 18, 1996, pp. 251–269.

[4] Bayasi, Z. and Zeng, J. Properties of Polypropylene Fibre Reinforced Concrete, ACI Material Journal, 9(6), 1993, pp. 605–610.

[5] Bernard, E. S. Correlations in the behaviour of fibre reinforced shotcrete beam and panel specimens. Materials and Structures/Mat~riaux et Constructions, 35, 2002, pp. 156–164.

[6] Buratti, N., Mazzotti, C. and Savoia, M. Post-cracking behaviour of steel and macrosynthetic fibre-reinforced concretes. Construction and Building Materials, 25, 2011, pp. 2713–2722.

[7] Chaitanya, J. D., Abhilash, G. V. S., Khan, P. K., Manikanta, S. G. and Taraka, R. V. Experimental Studies on Glass Fiber Concrete. American Journal of Engineering Research, 5(5), 2016, pp. 100–104.

[8] Chandramouli, K., Rao, S. P., Pannirselvam, N., Sekhar, S. T. and Sravana, P. Strength Properties of Glass Fibre Concrete. ARPN Journal of Engineering and Applied Sciences, 5(4), 2010, pp. 1–6.