FIBER REINFORCED MORTAR

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Abstract:

Mortar serves as a covering material for structural elements, protection for masonry and a design material for aesthetics. This research uses polypropylene fibres as a reinforcing material in the mortar medium. The polypropylene fibres are incorporated into the mortars of various combinations of cement and fine aggregates. The compression strength of these mortar mixes are determined to know the best suitable combination and optimum fibre dosage to serve the requirement. These mortars can be used in repair and rehabilitation works. Fiber reinforced mortars will provide additional strength for weak structural elements, can also resist cracks. It can be effectively used as a retrofitting material.

Keywords: Mortar, Polypropylene fibres, fine aggregate, Retrofitting.

Introduction

Mortar is a multipurpose construction element which is composed of cement and fine aggregates, which gains strength when hydrated [1]. Aggregates are used in cement composites to avoid shrinkage and to reduce the cost of production [2]. Fibres are used as along with building materials to enhance the volume stability since ancient times. Fibres will resist cracking and enhance tensile strength and also increase the life span [3]. Fiber reinforced composites has gained global importance as it improves toughness and post cracking performance of mortar matrix. Dosage of fibres, dimensions of fibres, elasticity values of mortar matrix and fibers are the prime parameters which decides the behavior of fibre reinforced mortar [4]. Mortars incorporated with hemp fibers depicted best results with 2-3% dosage and 12mm length [5]. Mortar being a homogenous mixture of cement, fine aggregates and water, will aid to bind the masonry units, plastering, designing element and even for flooring and other applications such as filler material, repair and retrofitting material. It serves both structural and non-structural purposes [6]

This research focus on the influence of polypropylene fibers in cement mortar.

Materials and methodology

Cement, M-sand, water and polypropyelene fibers were used as raw materials to prepare the cement mortar. Mortar prepared consisted the combination of cement and fine aggregates at 1:2, 1:3 and 1:4 proportions in which the fibers were incorporated at 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9 and 1% by weight of cement. The compressive strength of mortar was determined at 28 days to find its suitability in various civil engineering applications.

Materials:

Cement: 53 grade OPC cement was used for this study and its characteristics are represented in Table 1. It satisfied the requirements specified in IS 12269-2013 [7].

Characteristics	**Results**
Specific Gravity	3.11
Standard Consistency (%)	32
Initial setting time (minutes)	45
Final Setting time (minutes)	420
Fineness (% Passing)	99

Table 1: Characteristics of cement

Fine aggregates: Manufactured – Sand [M-sand] is used as fine aggregate to prepare mortar at various proportions. The characteristics of M-sand are represented in Table 2. It was investigated as per IS-383: 1970 [8].

Properties	**M-Sand**
Specific Gravity	2.69
Water Absorption (%)	3.2

Zone	II
Bulk Density (kg/m^3)	1440

Table 3: Characteristics of fine aggregates

Polypropylene fibers:
Commercially available polypropylene fibers of triangular shape was used for this study. Fibers were white in colour, 12mm in length and 3µm diameter with an aspect ratio about 40.

Water: Portable water abiding by IS-456:2000 [9] was used for casting and curing of mortar.

Methodology
Mortar was prepared using 53 grade cement and fine aggregates as per IS: 2250-1995 [10]. Mortar of various proportions such as 1:2, 1:3 and 1:4 were prepared using mortar mixer. A constant water content of about 15% by weight of cement was used to observe the variation in compressive strength with various dosages of fibers for different proportions.
The mortar cubes of 7.06 X 7.06 X 7.06cm was prepared by filling in 3 layers with 25 numbers of compaction tamping for each layer in the moulds. After 24 hours of casting, specimens were demoulded and subjected to water curing. The cubes specimens were subjected to compression test according to IS 4031 (Part 6)- 1988 [11].

Results and discussion
The mortar specimens of various combinations and proportions are tested for compressive strength and explained as follows.
The influence of polypropylene fibers on compressive strength of 1:2 mortar is depicted in figure 1. With the increase in fiber dosage levels, strength reduced. However, even at 0.9% fibers, strength of mortar was around 10 MPa which was sufficient for majority of mortar applications. But the mix was harsh with increased fiber dosage and these may not find its suitability for masonry mortars.

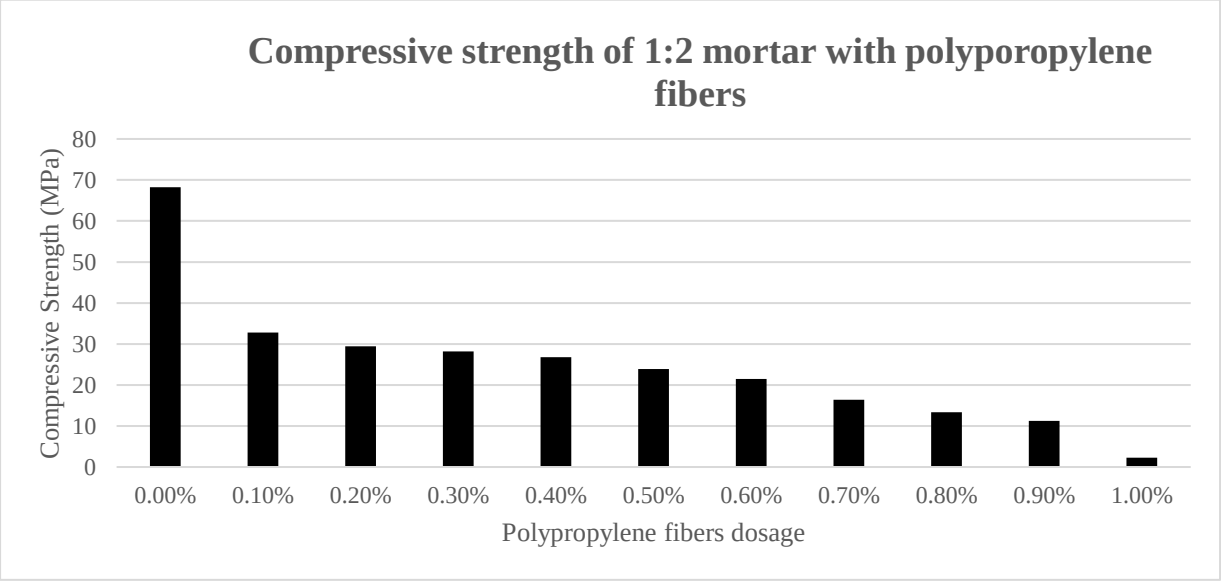

Figure 1: Variation of compressive strength of 1:2 mortar at various incorporation

levels of polypropylene fibers

The impact of polypropylene fibers on compressive strength of 1:3 mortar is depicted in figure 2. With the increase in dosage, strength decreased. However, when compared with 1:2 mortar, 1:3 mortar exhibited higher compressive strength.

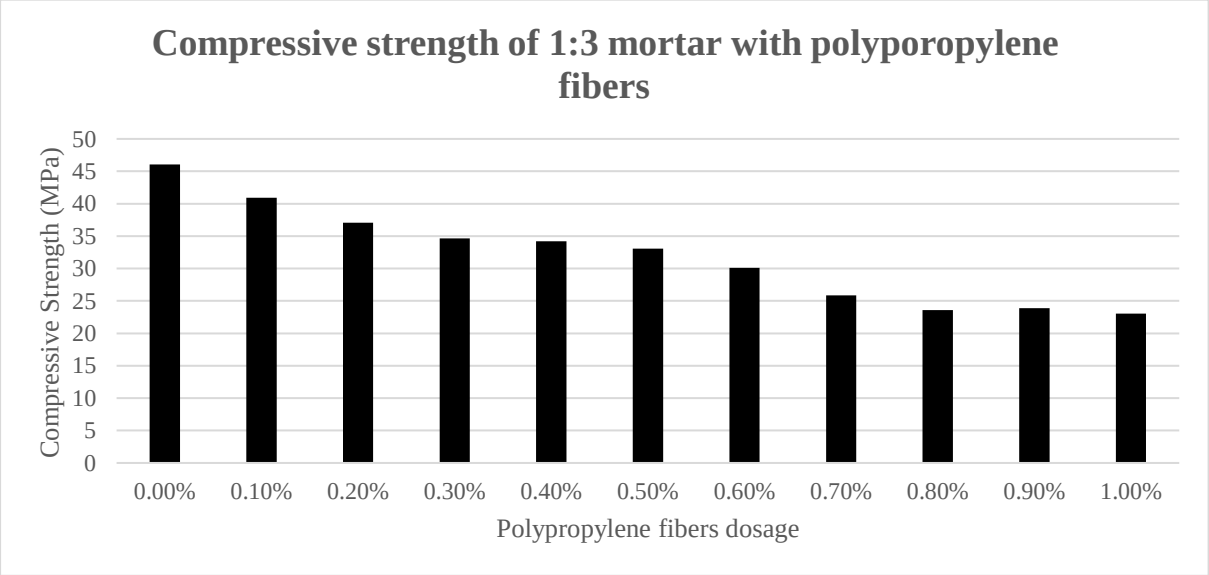

Figure 2: Variation of compressive strength of 1:3 mortar at various incorporation levels of polypropylene fibers

The impact of polypropylene fibers on compressive strength of 1:4 mortar is depicted in figure 3. With the increase in dosage, strength decreased. However, when compared with 1:3 mortar, 1:4 mortar exhibited lesser compressive strength.

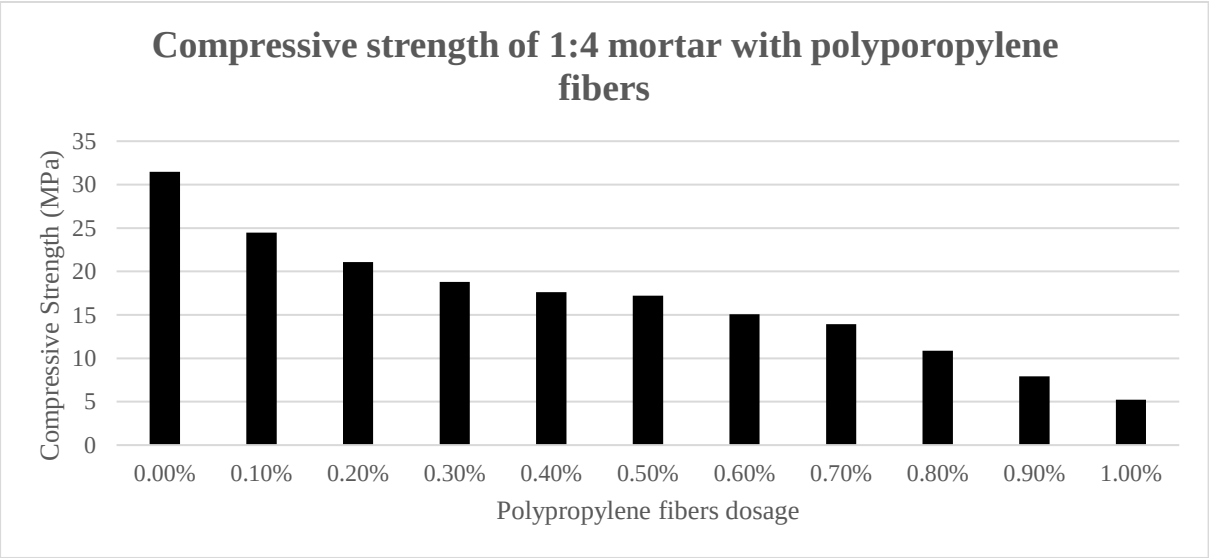

Figure 3: Variation of compressive strength of 1:4 mortar at various incorporation levels of polypropylene fibers

Conclusion

From the experimental studies, following broad conclusions can be drawn;

1. Compressive strength of mortar decreases with increase in fiber content in all proportions.
2. Increase in the fiber content at low water cement ratio, causes balling effect and leads to decrease in strength.
3. Among the considered proportions, 1:3 mortar depicts better results in the presence of fibers.

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