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Study of RC Beams Reinforced With CEM-FIL Anti-Crack HD Glass Fiber

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Abstract

Concrete is used more than any other manmade material in the world due to its high compressive strength, long service life and low cost. However, concrete has inherent disadvantages of low tensile strength, low coefficient of thermal expansion and crack resistance. The introduction of glass fibers significantly improves its flexural strength. The objective of this investigation is to reinforce the RC beams with CEM-FIL Anti-Crack HD glass fiber, to enhance the tensile properties of concrete beams cost effectively. The experimental study indicated that the beams reinforced with CEM-FIL Anti-Crack HD glass fibers increases the ultimate flexural load compared with the ordinary RC beams without affecting its workability and compressive strength.

Keywords: CEM-FIL Anti-Crack HD glass fiber, Flexural behaviour, Ultimate load

Introduction

Glass fiber has used over 30 years in several construction elements, mainly non constructional ones, like facade panels, piping for sanitation, decorative non recoverable form work and other products. Glass fiber reinforced concrete (GFRC) consists of high strength, alkali resistant glass fiber embedded in a concrete matrix. The effect of the fibers in this matrix leads to an increase in the tension and impact strength of the material. Fiber glass is a lightweight, extremely strong, and robust material. Although its bulk strength and weight properties are also very favorable when compared to metals, it can be easily formed using moulding processes. It is widely accepted within the concrete industry that traditional concrete mixes are prone to plastic shrinkage during the setting phase and this can often lead to cracking. The addition of relatively small amounts of fiber reinforcement can effectively reduce this problem by controlling this early age plastic shrinkage cracking. It also avoids the need for using light steel mesh for crack control with its attendant disadvantages of handling and positioning. Fiber reinforced concrete is easy and cost effective and it also enables to produce a hardened concrete which has improved surface quality, greater impact resistance, increased durability. Anti crack fibers are alkali resistant glass fibers, especially developed for the reinforcement of cementitious mortars and concrete mixes. They can be easily introduced into a conventional concrete mix giving millions of dispersed fibers per cubic meter of concrete, providing a highly uniform and effective reinforcement.

Methodology

In the present research, RC beams of size 150mm width, 200mm depth and 1250mm length and RC beams with 1% CEM-FIL Anti-Crack HD-10mm glass fiber of concrete were casted using M25 mix. The specifications of these fibers are presented in Table 1 and glass fibers are shown in Fig 1. The beams were designed for flexural failure with 2#12mm bars as the bottom longitudinal reinforcement and 2#8mm bars as the top longitudinal reinforcement. Two legged 8mm stirrups were provided as shear reinforcement at spacing of 130 mm from the supports. Test setup has shown in Fig 2.

Beams were casted with design mix ratio of 1:1.45:2.68 with w/c ratio 0.45. The experiment is carried out for RC beams with 1% of CEM-FIL Anti-Crack HD glass fiber and is compared to the control beams. Specimen after casting is shown in Fig 3. The beams were tested under two point loading test after 28 days water curing.

Physical Properties	Recommended Values by the Supplier
Specific gravity	2.68
Elastic Modulus (Gpa)	72
Tensile Strength (Mpa)	1700
Length (mm)	12
Filament Diameter (μ)	14

Table 1: Physical Properties of Glass Fiber

Fig 1: Glass Fiber

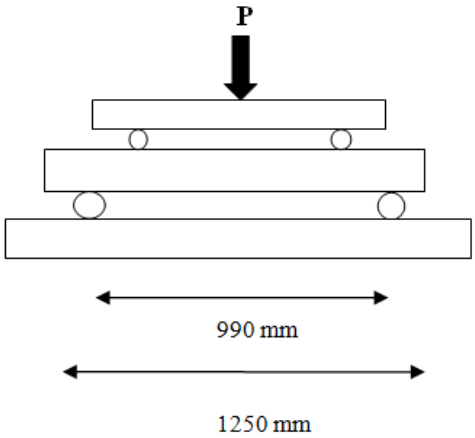

Fig 2: Schematic Setup for Testing

Fig 3: Specimen after casting

Results

The modes of failure of RC beams and beams reinforced with CEM-FIL Anti-Crack HD glass fiber are shown in Fig 4 and Fig 5 respectively.

Fig 4: Failure of control beam

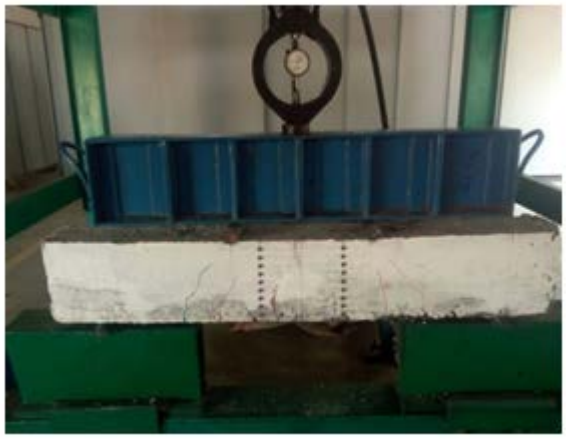

Fig 5: Failure of Beam with 1% of GF

The failure modes were found to be flexural for both the beams. It was also observed that the initiation of CEM-FIL Anti-Crack HD glass fiber increases the first crack load and ultimate load carrying capacity of the beams.

Discussion

The ultimate loading carrying capacity of RC beams was obtained as 146.626 kN. The ultimate load carrying capacity of RC beams with CEM-FIL Anti-Crack HD glass fiber was obtained as 220.249 kN, which is higher than that of control beam.

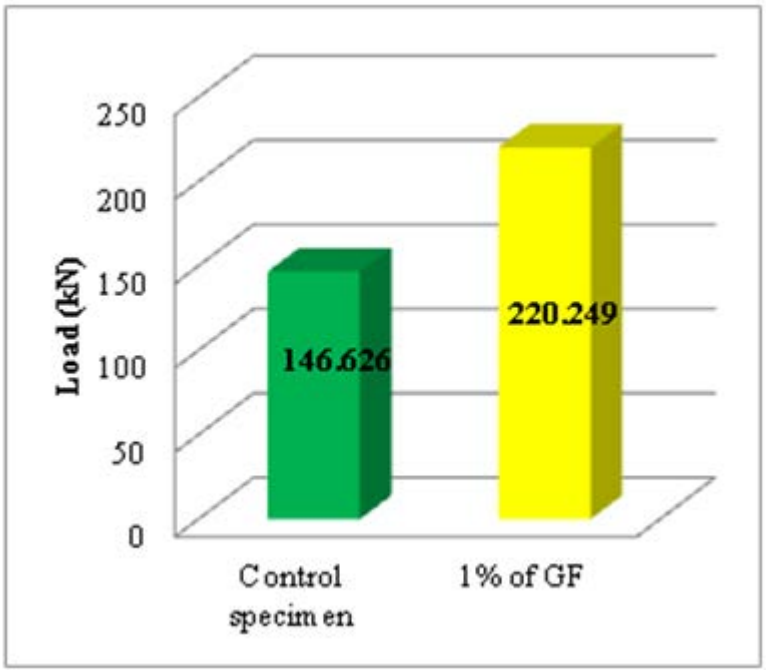

Fig 6: Ultimate Load Carrying Capacity

Conclusions

The research work included the testing of reinforced concrete beams, each having a span of 1250 mm and reinforced with CEM-FIL Anti-Crack HD glass fiber. Based on the research, the following conclusions may be drawn

a) The RC beams reinforced with glass fiber increases the load carrying capacity by 50% when compared to control beams.
b) A reduction in bleeding improves the surface integrity of concrete, improves its homogeneity and reduces the probability of cracks.
c) Compared with ordinary RC beams with a similar steel reinforcement ratio, the beams with GF also have good ductility, smaller crack width and crack spacing, but have significant increases in the yield load and ultimate load capacity.
d) A combination of GF and steel bar in the reinforced concrete flexural members is quite effective in delaying the development of cracks, offers corrosion resistance and improves the flexural bearing capacity of the components economically.

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