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A REVIEW ON " USE OF GLASS FIBERS IN CONCRETE "

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ABSTRACT:

Concrete is one such basic component in which constant up gradation has always been implemented in order to improve its properties by adding different admixtures or additives. Glass Fiber is one such material which could be added in concrete to change its properties and strength. In order to improve these properties, and attempt has been made to study the effect of addition of glass fibers in OPC and PPC concrete. In the present experimental investigation glass fibers in different percentage has been studied for the effect on mechanical properties of concrete by carrying compressive strength test, flexural strength test and splitting tensile strength test. Results show that proper addition of GLASS FIBER in concrete can improve the mechanical properties, especially the flexural strength. Experiments were performed to check the performance of use concrete grades when mixed with Glass Fiber in different proportions. Tests were carried out for 0.45, 0.50 and 0.55 w/c ratio.

KEYWORDS: Woven Roving Glass Fiber, OPC Cement, PPC Cement, compressive strength, tensile strength, flexure strength.

1. INTRODUCTION:

Concrete is a composite construction material composed primarily of aggregate, cement and water. The aggregate is generally coarse gravel or crushed rocks such as limestone, or granite, along with a fine aggregate such as sand. The cement, commonly Portland cement serve as a binder for the aggregate. Plain cement concrete has relatively high compressive strength but possesses a very low tensile strength, limited ductility and durability. It has been recognized that the addition of small closely spaced and uniform dispersed glass fibers concrete improve its static and dynamic properties. This type of concrete is known as Glass Fiber Reinforced Concrete. It consists of mixtures of cement, mortar and Glass fiber to overcome the above stated disadvantages of plain concrete. Experimental investigations show that addition of glass fibers increase the initial and final compressive strength, tensile and flexural strength. It should be noted that glass fibers may not improve the durability aspect of concrete. Concrete is good in compression but fails to achieve suitable tensile strength. Under loading condition in a tension zone due to low tensile strength tension cracks are observed on surface of member. Water infiltrated to this tension cracks accelerates process of reinforcement corrosion occurs and thus decreases yield strength of member. To save member from ill-environmental effects. In order to achieve the ductility of concrete without increasing % of tensile reinforcement.

Fiber Reinforced Concrete

Fiber-reinforced concrete (FRC) is concrete containing fibrous material, which increases its structural integrity. Fibers include steel fibers, glass fibers, synthetic fibers and natural fibers. Within these different fibers that character of fiber-reinforced concrete changes with varying concretes, fiber materials, geometries, distribution, orientation and densities. Fibers are usually used in concrete to control cracking due to both plastic shrinkage and drying shrinkage. Some types of fibers produce greater impact, abrasion and shatter resistance in concrete. Generally, fibers do not increase the flexural strength of concrete, and so cannot replace moment resisting or structural steel reinforcement. Various types of Glass fiber which are in the below section are:

P-Glass O-Glass E-glass

Figure 1- Types of glass fibers

2. USE OF GLASS FIBERS IN CONCRETE

2.1. Fresh concrete properties: -

2.1.1. Slump Test: -

References [1]. For fiber glass percentages of 0.2, 0.25, 0.3 by volume, the workability is found to be nearly 0.88 by compaction factor. For 0.5 percent it is 0.85 compared to 0.9 compaction factor for plain concrete mixes. The w/c ratio taken is 0.5. Higher percentages of fiber beyond 0.5 percent and up to 1.5 percent require super plasticizer. At 2 percent fiber content balling has occurred and mix was not in a workable condition with a W/C ratio of 0.5. The replacement of Steel fiber with Glass fiber by 0, 25, 50 and 100 percentages from total fiber content of 0.5, 0.75, and 1.0 by volume, the workability was affected marginally.

References [4]. where the 1.0 wt.% brucite fibers is the best quantity for workability The effects of the dosage of grade S brucite fibers to the workability of the concrete at the conditions of W/C = 0.5 and 1# water reducer. The result shows that the slump and the cohesiveness of the concrete decrease with the dosage increase of brucite fibers. From the workability of the concrete, the best quantity of brucite fibers should be around 1.0 wt.% of the concrete where the cohesiveness and the water-retention capacity are good, and there is not much loss in the slump.

References [5]. The performance of woven rowing glass fibers based concrete with a constant proportion of fly ash is investigated in this study. The woven type glass fibers are added in various percentages. It is expected that the results obtained from the experiments will help to arrive at the optimum percentage of woven glass fiber which should be used at site to gain all strength as well as workability and durability when 25% fly ash has been replaced for cement.

2.2. Hardened Concrete Properties: -

2.2.1. Compressive strength: -

References [1]. It is observed that with increase in fiber percentage, the compressive strength also increases with age. At the age of 7 days with 1.5 percentage fiber the compressive strength is 16.36 percent in excess over the strength of reference mix and for 28 days it is 17.49 percent in excess of reference mix. As the percentage replacement of steel fiber by glass fiber is increased, the compressive strength decreases.

References [3]. The addition of polypropylene fibers at a maximum dosage (0.1% by weight of the cement) as recommended by the manufacturer was found to reduce the compressive strength of the concrete. The strength of polymer modified fiber reinforced concrete in Phase I (65 MPa concrete beam series was found to be about 65% of the strength of corresponding ordinary concrete. The cracking strength of the beams was observed to be varying with the compressive strength of the concrete.

References [4], Brucite fibers can generally increase the compressive and flexural strengths, especially the latter. This is accordance with the test result of brucite- fiber reinforced cement mortar. When the brucite fiber was added, the strengths were increased at first, and then went down. As the brucite dosage reached 1.5 wt.%, the compressive strengths of both 7d and 28d got almost to that of unreinforced ones, and so did the flexural strength of 7d. The only exception is the 28d's flexural strength that was about 24% higher than the original one. The optimum dosage is about 0.5 wt.%, where the compressive and flexural strengths were increased by about 13% and 41% for 28d, and about 10% and 38% for 7d.

References [5]. Compressive strength is increasing than the 28 days compressive strength. It is observe that 0.5 gives more strength compare to 0.45 w/c.0.2 % glass fiber gives superior strength compare to other mix. As Glass fiber based concrete has an advantage of very high initial compressive strength, it can be added to fly ash based concrete to conquer its disadvantage. In acid curing, compressive strength is decreasing compare to normal curing compressive strength. In this test 0.45 w/c ratio gives higher strength than 0.5 w/c ratio. 0.2 % VF gives higher strength result in both w/c ratios.

References [6]. Compressive strength increases with increasing percentage of glass fibers. It can be observed that 28 days compressive strength is increased by 8.81% with addition of 0.03% of glass fiber compared to normal M-20 concrete. It can be observed that 28 days' compressive strength is increased by 11.15% with addition of 0.06% of glass fiber compared to normal M-20 concrete. Also it can be observed that 28 days compressive strength is increased by 23.44% with addition of 0.1percentage of glass fiber compared to normal M-20 concrete. Concern with percentage of addition of glass fibers are gives better results by addition 0.1 %.

2.2.2. Flexural strength: -

References [1]. It is observed that with increase in fiber percentage, the flexural strength also increases with age. At the age of 7 days with 1.5 percentage fiber the flexural strength is 84.21 percent in excess over the strength of reference mix and for 28 days it is 45.56 percent in excess over the strength of reference mix. The variation of flexural strength at 28 days with various percentages of glass fiber of 0, 25, 50, 100 percent by volume used as replacement for steel fiber in total fiber content of 0, 0.5, 0.75. 1.0 percentages were studied and results for typical 0.75 total fiber content are presented in Table. It is observed that as the percentage of total fiber content is increased, the flexural strength also increases. As the percentage replacement of steel fiber by glass fiber is increased and steel fiber percentage is decreased, the flexural strength goes on decreasing.

References [6]. Flexural strength increases with increasing percentage of glass fibers. It can be observed that 28 days' flexural strength is increased by 7.27%with addition of 0.03% of glass fiber compared to normal M-20 concrete (Table 2). It can be observed that 28 days flexural strength is increased by 9.27%with addition of 0.06% of glass fiber compared to normal M-20 concrete. Also it can be observed that 28 days flexural strength is increased by 19.31% with addition of 0.1% of glass fiber compared to normal M-20 concrete.

2.2.3. Splitting tensile strength: -

References [1]. It is observed that with increase in fiber percentage, the split tensile strength also increases with age. At the age of 7 days with 1.5 percentage fiber the split tensile strength is 44.48 percent in excess over strength of reference mix and for 28 days it is 65.45 percent in excess. The variation of split tensile strength at the end of 28 days with various percentages of glass fibers of 0, 25, 50 and 100 percentages by volume used as replacement of Steel fibers in total fiber content of 0, 0.5, 0.75 and 1.0 percentages were studied and results for typical 0.75 total fiber content are presented in Table 6. It is observed that as the percentage of total dual fiber content (steel fiber and glass fiber) is increased, the split tensile strength also increases. It is also observed that as the percentage replacement of steel fiber by glass fiber is increased and steel fiber percentage decreases, the split tensile strength goes on decreasing.

References [6]. It can be observed that 28 days Splitting tensile strength is increased by 2.8% with addition of 0.03% of glass fiber compared to normal M-20 concrete. It can be observed that 28 days Splitting tensile strength is increased by 12.73%with addition of 0.06% of glass fiber compared to normal M-20 concrete. Also it can be observed that 28 days Splitting tensile strength is increased by 42.23%with addition of 0.1% of glass fiber compared to normal M-20 concrete. Concern with percentage of addition of glass fibers are gives better results by addition 0.1 %.

3. OBSERVATION AND REMARKS: -

- The addition of glass fibers into the concrete mixture marginally improves the compressive strength at 28 days.
- Experimental results and its analysis, that the compressive strength of concrete, flexural strength of concrete, splitting tensile strength of concrete increases with addition of Percentage of glass fibers.
- The 0.1% addition of glass fibers into the concrete shows better result in mechanical properties and durability.
- Addition of glass fiber decreases the workability of concrete.
- Glass fiber based concrete gives more strength than conventional concrete.
- Proper addition of brucite fibers can increase the compressive, flexural, and impact strengths as well as sulfate corrosion resistance of the concrete, especially the flexural strength.
- Higher percentages of Glass fibers from 1.0 percentage affect the workability of concrete, and may require the use of super plasticizers (workability agents) to maintain the workability.

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