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Experimental Study on Strength Properties of Glass Fibre Reinforced Concrete

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Abstract:

Glass-fibre reinforced concrete (GRC) is a material made of a cementatious matrix composed of cement, sand, water and admixtures, in which short length glass fibres are dispersed. It has been widely used in the construction industry for non-structural elements, like façade panels, piping and channels. GRC offers many advantages, such as being lightweight, fire resistance, good appearance and strength. In this study trial tests for concrete with glass fibre and without glass fibre are conducted to indicate the differences in compressive strength and flexural strength by using cubes of varying grades.

INTRODUCTION:

Normal concrete which is strong in compressive strength possesses a very low tensile strength, limited ductility and little resistance to cracking. The low resistance to tensile crack propagation in turn results in low fracture toughness, limited resistance to impact and explosive loading. Internal micro cracks are inherently present in the concrete due to drying, shrinkage and poor tensile strength, eventually leading to brittle fracture of concrete. Hence fibers are added to concrete to overcome these disadvantages.The modern development of fiber reinforced concrete (FRC) started in the early sixties. Addition of fibers to concrete makes it a homogeneous and isotropic material.

MECHANICAL PROPERTIES OF FRC:

Addition of fibers to concrete influences its mechanical properties which significantly depend on the type and percentage of fiber. Fibers with end anchorage and high aspect ratio were found to have improved effectiveness. Modulus of elasticity of FRC increases slightly with an increase in the fibers content. It was found that for each 1 percent increase in fiber content by volume there is an increase of 3 percent in the modulus of elasticity.

The flexural strength was reported [2 to be increased by 2.5 times using 4 percent fibers. For FRC, toughness is about 10 to 40 times that of plain concrete.The presence of 3 percent fiber by volume was reported to increase the splitting tensile strength of mortar about 2.5 times that of the unreinforced one. The use of fibers in reinforced concrete flexure members increases ductility, tensile strength, moment capacity, and stiffness. The fibers improve crack control and preserve post cracking structural integrity of members.Addition of fibers increases shear capacity of reinforced concrete beams up to 100 percent. Addition of randomly distributed fibers increases shear-friction strength, the first crack strength, and ultimate strength.

Fig Glass Fiber

GLASS FIBERS REINFORCED CONCRETE (GFRC):

Glass fiber reinforced concrete is the term applied to products manufactured using cement/aggregate slurry thoroughly mixed with alkali-resistant (AR) glass fiber reinforcement.

TYPES OF FIBERS:

The fiberss can be broadly classified into two groups
1)Low modulus, high elongation fiberss
2)High Strength, high modulus fiberss

LOW MODULUS, HIGH ELONGATION FIBERSS:

Nylon, polypropylene, plastic are some of the low modulus high elongation fiberss which are capable of large energy absorption characteristics. They do not lead to strength improvement but impart toughness, resistance to impact and explosive loading.Ex: rayon, aramid etc.

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1.2.2 HIGH STRENGTH, HIGH MODULUS FIBERSS:

High Strength, high modulus fibers are Glass, Carbon and Steel. These fibers impart primary characteristics of strength and stiffness to composite and varying degrees of dynamic properties.

Fibers Material	TensileStrengthN/mm^2	Young's Modulus (10^3N/mm^2)	Specific Gravity
Steel	275-2758	200	7.86
Glass	1034-3792	69	2.5
Asbestos	551-965	89-138	3.2
Nylon	758-827	4.31	1.1
Polypropylene	551-758	3.45	0.90

EFFECT OF FIBERSS IN CONCRETE:

Adding steel fibers to the concrete will reduce the slump. It is important therefore to increase the slump of the concrete with super plasticizer to above the level required for placing the concrete prior to adding the fibers. The amount by which the slump should be increased will depend up the type of fibers used and the dosage rate.The main difference between dewatered and non-dewatered GRC is the difference in density which has two effects. Firstly although the fiber content by weight is the same, the higher density of the dewatered board gives a higher fiber volume fraction giving higher strengths. Secondly the dewatered board has better compaction.

MIXING:

Mixing of fibers reinforced concrete needs careful general the difficulty of mixing the materials uniformly. Increase in the aspect ratio, volume percentage and size and quantity of coarse aggregate intensify the difficulties and balling tendency. Steel fibers content in excess of 2% by volume and aspect ratio of more than 100 are difficult to mix.

Grade of concrete	Cement (kg)	Fine aggregate (kg)	Coarse aggregate (kg)	Water (ltr)	W/C ratio	Glass fibers
M30	399	705	1080	191.58	0.48	0.5%(195 Gms)
M30	399	705	1080	191.58	0.48	1%(390Gms)
M30	399	705	1080	191.58	0.48	1.5%(585 Gms)

RESULT AND DISCUSSION:

Grade of concrete	No of days	Compression strength of concrete
		Without GF
M30	3	22
M30	7	28
M30	21	36
M30	28	39

Grade of concrete	No of days	Compression strength of concrete with GF (0.5%)	Compression strength of concrete with GF (1%)	Compression strength of concrete with GF (1.5%)
M30	3	24	26.2	24.6
M30	7	30	32.7	21.6
M30	21	38	42.6	41.5
M30	28	42	44.7	43.2

CONCLUSION:

Under the limitation of the experimental work, the following conclusions are made

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GLASS FIBER MIXES WITH ASPECT RATIO 55

Maximum increase in compressive strength obtained at 44.7N/mm2 at 1% glass fiber.

GLASS FIBER MIXES WITH ASPECT RATIO 65

Maximum increase in compressive strength obtained at 46.8N/mm2 at 1% glass fiber.

GLASS FIBER MIXES WITH ASPECT RATIO 75

Maximum increase in compressive strength obtained at 37.6N/mm2 at 1% glass fiber.

From the above result shows the concrete with glass fiber got more strength compare with nominal concrete mix at certain point of glass fiber mix into the concrete the strength was gradually going to decrees.

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