

Effect of Glass Fibre on Ordinary Concrete

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ABSTRACT: During the past decades the construction field has experienced a growing interest in the advantages of fibre reinforcement in concrete. Between the different fibres available, e.g. steel, synthetic, glass, and natural fibres, steel fibre is probably the most investigated and most commonly used. Worldwide, a great deal of research is currently being conducted concerning the use of glass fibre as reinforcement in concrete. Less weight facilitates easy and rapid installation and also decreases the load applied on the structure. The light weight and tough material also minimizes the transportation expenditures, permits flexibility in design, and reduces the impact on environment. Superior strength enhances the ability to endure seismic loads. In the present experimental investigation, glass fibres has been used to study the effect on compressive, split tensile and flexural strength on M20 & M25 grades of concrete with varying percentage of glass fibre.

KEYWORDS: GFC, glass fibres, compressive strength, split tensile strength, flexural strength

I. INTRODUCTION

Glass fibre reinforced concrete composites contain high strength glass fibres that are surrounded by a cementitious medium. In this shape, both the fibres and the environment maintain their natural individual chemical characteristics. However, the concrete produced has improved resultant properties that cannot be attained if either of the components is used individually. The glass fibres are the main elements that carry the load, while the enclosed matrix keeps the fibres in the preferred position and direction. The medium facilitates transfer of the load on the fibres, and shields them from the damage due to environment. Glass fibres can be integrated into the matrix either in constant or irregular lengths. The most widespread shape in which glass fibre reinforced composites are used in structural applications is known as laminate. This form is achieved by consolidating fine fibre layers and a matrix into the desired size. The orientation of fibre in each layer, and the stacking sequence of the layers, can be used to produce a range of mechanical properties of the composite materials.

Glass fiber reinforced concrete (GFRC) also called GRC or FRC is a cementitious , composite material, cast in thin shell shapes for use in construction. GFRC can be used wherever a light, strong, weather resistant, attractive and fire retardant material is required. GFRC can be used as wall panels, window surrounds, spandrels, column covers, soffits, cornices, brackets, quoins, railings, pilasters, copings, domes, etc. Landscape and hardscape uses include site furnishings, planters, bollards, urns, tables and fountains. GFRC is used in historical restorations and renovations, for the replication of building ornaments of terra-cotta, carved stone and even wood.

II. MATERIALS AND METHODS

Materials

Cement

OPC- 53 grade available in local market is used in the investigation. The cement used has been tested for various proportions as per IS: 4031-1988 and found to be conforming to various specifications of IS: 12269-1987. The specific gravity was 3.02 and the fineness was 3200 cm²/gm.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 11, November 2014

Coarse aggregate

Crushed angular stone from a local source was used as coarse aggregate.

Fine aggregate

Wainganga River sand was used as fine aggregate. The specific gravity and fineness modulus was 2.55 and 2.93 respectively.

Glass fibre properties

- Density- 2.6T/m^3
- Elastic Modulus – 73GPa
- Tensile strength – 1700MPa
- Filament diameter - 14μ
- Specific Gravity – 2.6
- Length – 12mm
- Aspect ratio -857.1
- Sp. Surface area – $105\text{m}^2/\text{kg}$
- No. of fibres – 220millions per Kg

Test specimens

Test specimens consisting of $150\times 150\times 150$ mm cubes for Compressive strength, $150\text{mm}\Phi$, 300mm length cylinders for split tensile strength and $150\times 150\times 700$ mm beams for flexural strength using different percentage glass fibre for M20 grade of concrete mix were cast and tested as per IS: 516 and 1199.

Table-1. Compressive strength for M20 grade of concrete mix with different % of glass fibre.

Grade of concrete	No. of days	Compressive Strength (N/mm^2)			
		Ordinary concrete	with 0.15% GF	with 0.30% GF	with 0.45% GF
M20	7	20.66	22.07	23.55	25.33
	28	25.66	27.85	29.18	29.33

Table-2. Flexural strength for M20 grade of concrete mix with different % of glass fibre.

Grade of concrete	No. of days	Flexural Strength (N/mm^2)			
		Ordinary concrete	with 0.15% GF	with 0.30% GF	with 0.45% GF
M20	7	2.35	2.54	2.9	3.91
	28	3.05	4.38	4.8	5.21

**International Journal of Innovative Research in Science,
Engineering and Technology**

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Vol. 3, Issue 11, November 2014

Table-3. Split tensile strength for M20 grade of concrete mix with different % of glass fibre.

Grade of concrete	No. of days	Split tensile Strength (N/mm ²)			
		Ordinary concrete	with 0.15% GF	with 0.30% GF	with 0.45% GF
M20	7	3.2	3.44	3.82	4.06
	28	4.62	6.08	6.65	6.74

III. RESULT

Compressive strength of different grades of ordinary concrete and varying percentage glass fibre concrete mixes
Table-1 gives 28 days compressive strength for different grades of concrete mixes with different % of glass fibre and their values are observed to be varied from 35.20 to 41.88 N/mm² for M20 and 39.5 to 45.03 N/mm² for M25.

Flexural strength of ordinary concrete and varying percentage glass fibre concrete mixes
Table-2 gives 28 days Flexural strength for different grades of concrete mixes with different % of glass fibre. These values are observed to be varied from 3.05 to 3.66 N/mm² for M20 and 4.12 to 4.9 N/mm² for M25.

Split tensile strength of ordinary concrete and varying percentage glass fibre concrete mixes
Table-3 gives 28 days Split tensile strength for different grades of concrete mixes with different % of glass fibre and the values are observed to be varied from 3.62 to 4.27 N/mm² for M20 and 4.23 to 5.03 N/mm² for M25.

Variation of compressive strength, split tensile strength and flexural strength of the ordinary concrete and different percentages of glass fibre concrete mixes compared with 28 days strength
The increase in compressive strength for all the grades of concrete mixes at 28 days is observed to be 12 to 18%. The flexural and split tensile strength for all the grades of concrete mixes at 28 days is observed to be 16% to 20%.

VI. CONCLUSION

- a) A reduction in bleeding is observed by addition of glass fibres in the concrete mixes;
- b) The percentage increase of compressive strength of various grades of glass fibre concrete mixes compared with 28 days compressive strength is observed from 12 to 18% and
- c) The percentage increase of flexural and split tensile strength of various grades of glass fibre concrete mixes compared with 28 days is observed from 16 to 20%.

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