

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

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## Effect of Glass Fibre on Concrete

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**ABSTRACT:** Accelerated aging tests are being conducted on more than 20 types of glass fiber-reinforced polymer (GFRP) reinforcing bars, which are produced from different combinations of constituent materials, manufacturing parameters, sizes and shapes, and surface coatings. The specimens are being subjected to various sustained tensile loading 22 to 68% of ultimate strength in three types of alkaline environments: NaOH, simulated pore-water solution, and embedded in concrete. Time to rupture or residual strength, as applicable, have been determined. Additionally, stress corrosion mechanisms were evaluated by various microstructural analyses. The results showed clearly that alkaline ions and moisture could penetrate or diffuse through the resin or through cracks and voids to the interphases and the fibers. For GFRP bars embedded in moist concrete under various sustained stress levels, three types of stress corrosion mechanisms have been identified: stress dominated, crack propagation dominated, and diffusion dominated.

**KEYWORDS:** Glass Fibres, Ductility, Compressive Strength, Split Tensile Strength, Flexural Strength

### I. INTRODUCTION

The concrete without any fibres will develop the cracks due to plastic shrinkage, drying shrinkage and other reasons of changes in volume of concrete. The development of these micro cracks causes elastic deformation of concrete. Plain concrete is a brittle material and having the values of modulus of rupture and strain capacity is low. In order to meet the required values of flexural strength and enhances the strain capacity of the plain concrete, the fibres are being used in normal concrete. The addition of fibres in the plain concrete will control the cracking due shrinkage and also reduce the bleeding of water. The addition of glass fibres in plain concrete shows higher flexural strength than plain concrete. Environmental and economic considerations played a great role in the increase in use of mineral admixtures. Cement with fly ash reduces the permeability of concrete and dense calcium silicate hydrate (C-S-H). A preliminary test program has been carried out to study the mechanical characteristics of glass fibre reinforced concrete with the percentage of glass fiber 0 to 0.1. Conventional concrete can be considered as a composite material in which the sand and aggregate are the dispersed particles in a multiphase matrix of cement paste. Concrete differs from most structural composites in that its strength is not greater than that of its components. The reason for this is that the interface between the components is the weak link in the composite and plays a major role in determining a number of properties of concrete. Usually, the aggregates are stiffer and stronger than the paste, and the non-linearity of the concrete stress-strain response is caused by the interaction between the paste and the aggregate.

The concept of using fibres to improve the characteristics of matrix is as old and well established as adding straw or horsehair to mud bricks. The fibres reinforced matrix can continue to carry a considerable amount of load after cracking has occurred. The principal role of fibres is to bridge cracks and resist their formation. The advantage of adding fibres into a matrix include enhancement of compressive strength, tensile strength, flexural toughness, shear strength, durability and resistance to impact. The physical properties of composites depend on the type and the dosage of the added fibers. The first research on glass fibers in the early 1960s used conventional borosilicate glass (E-glass) and soda-lime-silica glass fibers (A-glass). The test results showed that alkali reactivity between the E-glass fiber and the cement-paste reduced the strength of the concrete. Continued research resulted in alkali-resistant glass fibers (AR-glass), that improved long-term durability, but sources of other strength-loss trends were observed. Alkali reactivity and

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cement hydration are the basis for the following two widely held theories explaining strength and ductility loss, particularly in exterior glass fiber concrete. Alkali attack on glass-fiber surfaces reduces fiber tensile strength and, subsequently, lowers compressive strength. Ongoing cement hydration causes calcium hydroxide particle penetration of fiber bundles, thereby increasing fiber-to-matrix bond strength and embrittlement, the latter lowers tensile strength by inhibiting fiber pull out.

## II. RELATED WORK

### CEMENT

The most common cement currently used in construction is opc 53 grade. This type of cement is typically used in construction and is readily available from a variety of sources. The typical fineness of cement ranges from 350 to 500 m<sup>2</sup>/kg for opc 53 grade cement. Selection of the type of cement will depend on the overall requirements for the concrete, such as strength, durability etc.

### FINE AGGREGATE(SAND)

All type of sands are suitable for Fiber reinforced concrete. Either crushed or rounded sands can be used. Siliceous or calcareous sands can be used. The amount of fines less than 0.125 mm is to be considered as powder and is very important for the theology of the Fiber reinforced concrete.

### COARSE AGGREGATE

All types of aggregates are suitable. The normal maximum size is generally 16 – 20 mm. However particle size up to 40 mm more have been used in Fiber reinforced concrete.

### GLASS FIBERS

Glass has been the predominant fiber for many civil engineering applications because of an economical balance of cost and specific strength properties. Glass fibers are commercially available in E-glass formulation (for electrical grade), the most widely used general-purpose form of composite reinforcement, and other formulations for high strength (S-2@ glass), improved acid resistance (ECR glass), and alkali resistance (AR glass).

### GLASS FIBERS PROPERTIES

- Density-2.6T/m<sup>3</sup>
- Elastic Modulus – 73GPa
- Tensile strength – 1700MPa
- Filament diameter - 14μ
- Specific Gravity – 2.6
- Length – 12mm
- Aspect ratio -857.1
- Sp. Surface area – 105m<sup>2</sup>/kg
- No. of fibers – 220millions per Kg

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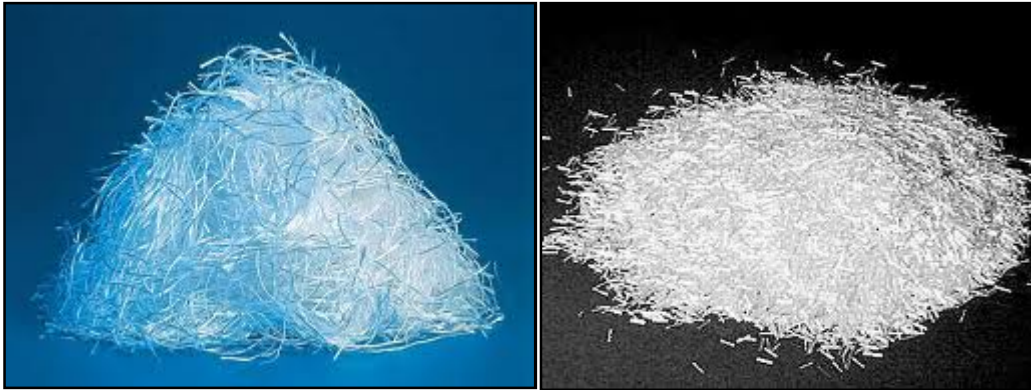


Fig:- Glass Fiber

### TEST SPECIMEN:

Test specimens consisting of 150×150×150 mm cubes for Compressive strength, 150mmΦ, 300mm length cylinders for split tensile strength and 150×150×700 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.

The following table gives result of compressive strength for M20 grade of concrete mix with different % of glass fibers in 7 days, 14 days and 28 days.

Mix (M-20)	Comp. Strength 7 Days	Comp. Strength 14 Days	Comp. Strength 28 Days
Normal	15.44	19.78	24.37
1.5% GF	16.80	21.53	26.81
2% GF	13.54	16.32	19.39
2.5% GF	12.36	15.66	17.34

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

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The following table gives result of flexural strength for M20 grade of concrete mix with different % of glass fibers in 7 days, 14 days and 28 days.

Mix (M-20)	Comp. Strength 7 Days	Comp. Strength 14 Days	Comp. Strength 28 Days
Normal	2.36	2.71	3.05
1.5% GF	3.15	3.82	4.74
2% GF	3.52	4.56	5.21
2.5% GF	4.91	5.29	5.77

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

The following table gives result of split tensile strength for M20 grade of concrete mix with different % of glass fibers in 7 days, 14 days and 28 days.

Mix (M-20)	Comp. Strength 7 Days	Comp. Strength 14 Days	Comp. Strength 28 Days
Normal	3.2	3.74	4.62
1.5% GF	3.76	4.96	6.53
2% GF	4.21	5.61	7.15
2.5% GF	4.59	5.87	7.32

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

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## III. EXPERIMENTAL RESULTS

### 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 17.34 to 24.37 N/mm<sup>2</sup> for M20.

### 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 fiber. These values are observed to be varied from 3.05 to 5.77 N/mm<sup>2</sup> for M20.

### Split tensile strength of ordinary concrete and varying percentage glass fiber concrete mixes

Table-3 gives 28 days Split tensile strength for different grades of concrete mixes with different % of glass fiber and the values are observed to be varied from 4.62 to 7.32 N/mm<sup>2</sup> for M20.

## IV. CONCLUSION

By using glass fiber more than its optimum percentages compressive strength is decreased due to crack development and presence of voids addition of 2% glass fiber in concrete increase compressive strength of concrete about 15%.desired strength is not achieved in 2.5 % and 3 % mix proportion of gf conventional concrete gives better strength for particular proportions (2.5% & 3%) gf used in partial work. some admixtures or materials must be used to increase compressive strength of concrete.

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