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Study on Structural Behavior of Glass Fiber Reinforced Concrete

L. Senthil Nathan
Department of Harbour and Ocean Engineering, AMET University, Chennai, India

Abstract: Glass fiber reinforced concrete is a recently innovated in the field of civil engineering construction. This product has advantage of being light weight and thereby reducing the overall cost of construction, ultimately bringing economy in construction. Steel reinforcement is easily corroded and structural deformation may appear then the alternative materials and rehabilitation techniques. So, researchers all over the world are attempting to develop high-performance concrete using glass fibers and other admixtures in the concrete up to certain extent. Now a day's different types of fibers are used in modern civil construction like glass, carbon, agamid, and poly-propylene provide vast improvements in tensile strength of concrete.

Key words: Glass fibre, reinforced concrete, structural behaviour, tensile, civil, India

INTRODUCTION

To study the power of glass fiber concrete and conventional concrete. To carry out the comparative study of glass fiber concrete and traditional concrete strength. The primary objective of this work is to increase the strength of concrete by using glass fiber (Table 1). Studies on glass fiber reinforced concrete composites power is illustrated by Swami *et al.* (2010). Glass fiber is a heat resistance material thus it prevents the formation of cracks study of glass fiber reinforced concrete and glass fiber reinforced concrete and its properties are explained by Deo (2015) and Harle and Meghe (2014). With the increase in construction activities, there is the heavy demand on concrete and consequently on its ingredient like aggregate also (Table 2). However, our objective of the project is to study and compare the strength behavior of concrete using glass fiber. This study review understanding to predict soil (Rajaraman *et al.*, 2015), the degradation of calcium from water using microorganism is said by Bhandari and Tajne (2014).

Table 1: Physical properties of glass fiber

Physical properties of glass fiber	Values
Specific gravity	2.68
Elastic modulus (GPa)	72
Tensile strength (MPa)	1700
Diameter (μ)	14
Length (mm)	12
Number of fiber (million/kg)	235

Table 2: Chemical properties of glass fiber

Compounds	Weight in e-Glass (%)	wt. in basalt (%)
SiO_2	52-56	51.6-57.5
Al_2O_3	12-16	16.9-18.2
CaO	16-25	5.2-7.8
MgO	0-5	1.3-3.7
B_2O_3	5-10	-
Na_2O	0.8	2.5-6.4
K_2O	0.2-0.8	0.8-4.5
Fe_2O_3	≤0.3	4.0-9.5

Behavior

Mix design for M20 concrete:

- Grade designation = M-20
- Type of cement = OPC-53 grade
- Brand of cement = bhavya
- Fine aggregate = Zone-II

Sp. gravity:

- Cement = 3.15
- Fine aggregate = 2.54
- Coarse aggregate (20 mm) = 2.71
- Minimum Cement (as per code) = 400 kg/m^3
- Maximum water cement ratio (as per code) = 0.45
- Cement = 400 kg/m^3
- Water = 180 kg/m^3
- Fine aggregate = 582 kg/m^3
- Coarse aggregate 20 mm = 1256 kg/m^3
- Water: cement: FA:CA = 0.45:1:1.45:3.14

MATERIALS AND METHODS

The different diaries were gathered and considered on the glass fiber in concrete by various materials. As per these diaries the procedure of the investigation and the technique for the experimentation and the distinctive tests directed in those diaries were considered and learned. On the premise of the investigations of the diaries gathered for the examination the exploratory philosophy for the venture was pick.

As indicated by the approach taken after for the venture, the materials were gathered for the analysis, the preparatory tests were directed to the materials to know the properties for example, particular gravity, fineness modulus and the water retention. In light of these properties the plan blend was done to know the amount of the materials required for the M20 grade concrete.

The examples with the three distinct rates of including glass fiber for example, 1.5, 1.8 and 2.0% alongside the control examples. The compressive, split and flexural quality of the examples were tried.

RESULTS AND DISCUSSION

The concrete was prepared for the M20 grade concrete with adding of glass fiber with various percentages of 0, 1.5, 1.8 and 2.0%. The specimens were cast tested. The results are presented below (Fig. 1 and 2).

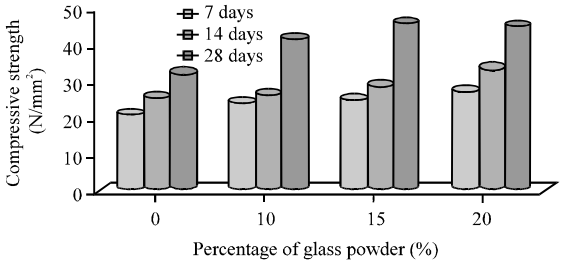

Fig. 1: Compressive strength of cubes; test result of cubes for compression

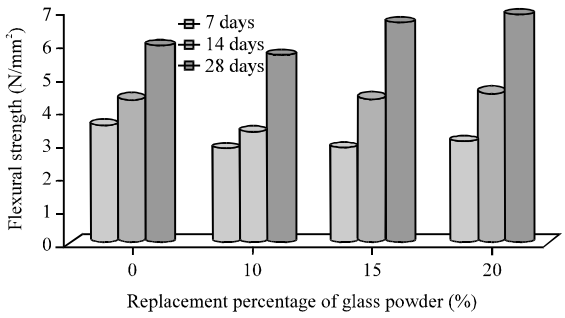

Fig. 2: Flexural strength of beams; test result of beam for flexural strength

Table 3: Test results cubes for compressive strength

	Average flexural strength (N/mm²)			
		Glass fibre concrete		
Curing days	0 (%)	1.5 (%)	1.8 (%)	2.0 (%)
7	20.44	23.72	24.86	27.30
14	24.77	25.90	28.32	32.97
28	31.61	40.67	44.47	44.59

Table 4: Test results beam for flexural strength

	Average flexural strength (N/mm²)			
		Glass fibre concrete		
Curing days	0 (%)	1.5 (%)	1.8 (%)	2.0 (%)
7	3.46	2.78	2.85	3.05
14	4.28	3.29	4.32	4.52
28	5.86	5.61	6.53	6.81

About 20% achieves the maximum flexural strength for partial replacement of fine aggregate with crumb rubber is found to be greater than the conventional concrete. It reached maximum compressive strength when there is the partial replacement of fine aggregate with crumb rubber (20%). So, the maximum percentage of replacement of glass fiber is 20% (Table 3 and 4).

CONCLUSION

The expansion of glass filaments into the solid blend possibly enhances the compressive quality at 28 days. It is seen from the trial results and its examination, that the compressive quality of cement, flexural quality of concrete, part elasticity of solid increments with expansion of percentage of glass strands. The 2.0% expansion of glass strands into the solid shows better outcome in mechanical properties and solidness. Despite the fact that the underlying expense is high the general cost is extraordinarily lessened in light of the great properties of fiber strengthened cement. The glass fiber fortified cement indicated very nearly 20-25% expansion in compressive quality, flexural and split elasticity as contrasted and 28 days compressive quality of plain concrete. While to enhance the toughness from the part of corrosive assaults on concrete the utilization of AR glass strands had indicated great outcome. In this way, the GFRC can be utilized for impact opposing structures, dams, water powered structures.

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