International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 10 Issue: 03 | Mar 2023 www.irjet.net p-ISSN: 2395-0072

AN EXPERIMENTAL INVESTIGATION 0F STRENGTH PARAMETERS OF GLASS FIBER USING M30 CONCRETE

P. Manikanta[1], K. Kusuma[2], CH. Aadharsh[3], CH. Rajesh[4], K. Tarun[5], D. Ramesh[6]

[1]Assitant professor, Department Of Civil Engineering, Gayatri Vidya Parishad College for Degree and PG Courses(A), Rushikonda, Visakhapatnam, A.P, India.
[2,3,4,5,6]B.Tech , Department Of Civil Engineering, Gayatri Vidya Parishad College for Degree and PG Courses(A), Rushikonda, Visakhapatnam, A.P, India.

Abstract - *Concrete is a major product which is widely used in every construction site and it is being used as per the strength required for the structure. In modern days varieties of admixtures are being used in the concrete for gaining more strength and durability as per the requirement and also to enhance the properties of concrete like compressive strength, split tensile strength etc. There has been a substantial growth in the use of glass fiber in the concrete for enhancing its properties and also for arresting the micro cracks. Hence, the glass fiber is generally being used in the present days structures. In this studies we are making an experimental investigation of strength properties of glass fiber in concrete with different proportions like 0.1%, 0.2%, 0.3% to the weight of cement to determine its effect in its properties like compressive strength, split tensile strength, and flexural strength.*

Key Words: Glass fiber, compressive strength, durability, flexural strength, micro cracks.

1. INTRODUCTION

Reinforced with Fiber Concrete is a composite material with a high tensile strength made of a matrix with a random distribution or dispersion of tiny fibers. Since the cracking strength of concrete is boosted by the uniformly dispersed fibers' presence, and the fibers also serve as crack arresters. When fibers are added to concrete at a given amount, the strain qualities such as crack resistance, ductility, as well as flexure strength and toughness, are all improved. Corrosion is avoided and the characteristics of concrete are improved with alkali resistant glass fiber such as increased tensile strength, improved impact resistance, increased shear strength, and improved water resistance because of its semi-crystalline structure, which is known to break easily under impact. Conventional concrete exhibits the characteristic known as "brittle failure." When subjected to explosive force, this is very risky due to the production of ballistic debris, which may cause serious collateral damage. As GRFC does not undergo brittle failure, this is not the case. Because the glass fibers are randomly distributed and laid out in all directions within the material matrix, they tend to hold the material together. Ballistic debris is drastically minimised with GFRC. In order to determine if glass fiber reinforced concrete manufactured with Ordinary portland cement is suitable for marine and hydraulic constructions, it was decided to conduct an experiment to determine the strength and durability of the material.

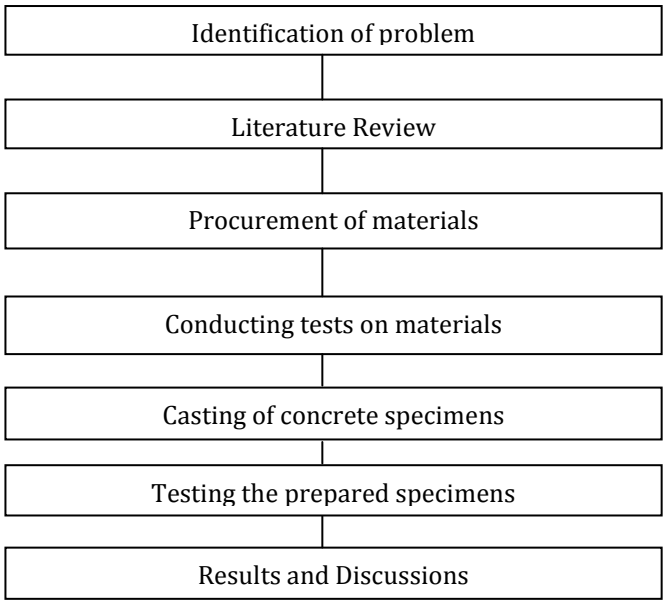
2. OBJECTIVE

The main objective of GFRC is to increase tensile strength in concrete. Glass fiber in the concrete helps in arresting the micro cracks and increases the durability of structure.

3. SCOPE

The present data indicates that there is significant improvement in the strength properties of the concrete by using glass fibers. Further study can be extended to know the mechanical properties of fiber reinforced concrete by adding combination of fibers. We can also study different parameters like frost resistance, fatigue life, drying shrinkage of the concrete with and without fibers.

4. METHODOLOGY



2. EXPERIMENTAL PROGRAMME

2.1 Materials used

2.1.1 Ordinary Portland cement

The cement used in the experimentation was Ordinary Portland cement. The physical properties of tested cement are given in Table.1

Table.1. Physical properties of Ordinary Portland cement

Sl. No.	Properties	Value
1	Fineness	93.5%
2	Specific Gravity	3.15
3	Normal Consistency	27%
4	Setting time Initial Final	 30min 8hrs

2.1.2 Fine Aggregates

Manufactures sand purchased from the supplier was used as fine aggregate. The sand used confirmed to grading zone-2 as per IS: 383-1970 specification.

2.1.3 Coarse Aggregates

The crushed stone aggregate by locally quarry purchased from the supplier. The coarse aggregates used in the experimentation was 20mm and downsize aggregate. The physical and mechanical properties are given in Table.2

Table.2. Physical and mechanical properties of Coarse Aggregate

Properties	Results	Permissible limit
Impact value	10.1%	Should not be more than30%
Crushing value	17.84%	Should not be more than 30%
Specific Gravity	2.68	2.6-2.8

2.1.4 Glass Fibers

The glass fiber used is alkali-resistance glass fiber which has a cut length of 12mm. The constant proportions of 0.1% fibers up to 0.3% are used by weight of cement. Aluminum oxide, calcium oxide, and silicon dioxide are the three primary components needed to create glass. Glasses made from a different combination of those elements and other minerals will change greatly. E-glass is a type of glass that is widely available and has high electrical insulating characteristics.

2.2 MIX PROPORTION

Design of concrete mix needs not only the knowledge of material properties and properties of concrete in plastic condition, it also needs wider knowledge and experience of concreting. Even then the proportion of the materials of concrete found out at the laboratory requires modification and readjustments to suit the field conditions.

Table.3.Mix Proportion for M30

Grade	Cement (kg/m3)	Fine Aggregate (kg/m3)	Coarse Aggregate (kg/m3)	Water (l/m3)	w/c ratio
M30	414	606	1197	186	0.45

2.2.1 Casting of Concrete Specimen

Concrete was prepared by a mix proportions of M30 grade concrete. The different percentage of fibers like 0.1, 0.2, 0.3 were adopted in the experimental programme. Glass fibers were added in the mix by weight of cement. The entire mix was homogeneously mixed with calculated amount of water. The compressive strength test specimens were of dimensions 150 × 150 × 150mm. The split tensile strength

test specimens were of dimensions 150mm diameter × 300mm length. The flexural strength test specimens were of dimensions 100 × 100 × 500mm.These specimens were cast and tested after 3 days, 7 days and 28 days of curing as per IS specification.

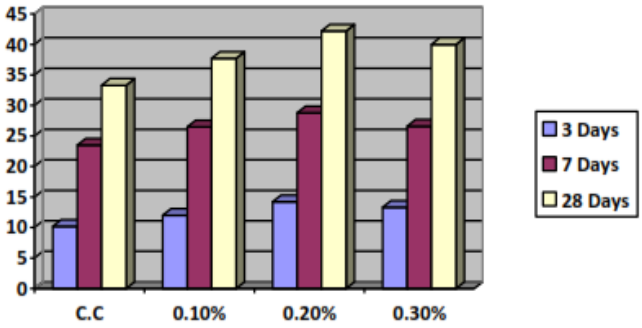
3. RESULTS AND DISCUSSIONS

3.1 Compressive Strength

Using cube samples of M30 Grade concrete, compression strength tests were carried out using a compression testing equipment. The average strength values were evaluated on three samples each batch. As the proportion of glass fiber to cement weight rises up to 0.2%, the compressive strength of GFRC at 3 days, 7 days, and 28 days exhibits an increasing trend. Further observation reveals that after 28 days of curing at M30 0.2% glass fiber, the highest compressive strength is attained.

Table.4. Average Compressive Strength of M30

Sl. No	Percentage of fiber	Average Compressive strength (N/mm2)		
		M30		
		3days	7 days	28 days
1	C.C	10.2	23.5	33.3
2	0.1	12	26.5	37.7
3	0.2	14.2	28.8	42.2
4	0.3	13.3	26.6	40



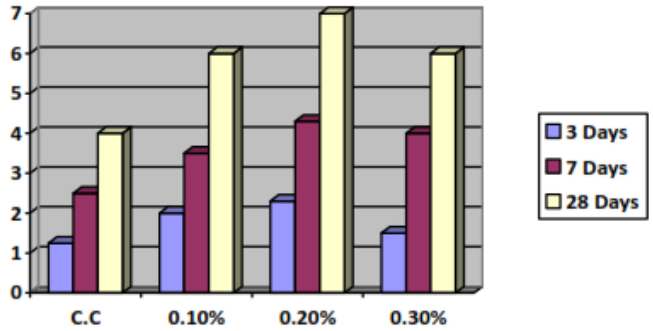
Graph.1. Average Compressive Strength for

3.2 Flexural Strength:

The flexural strength of GFRC increases with increasing percentage of glass fibers. The percentage increase in flexural strength is maximum at 0.2% of glass fiber at 28 days curing of GFRC. The percentage increase in glass fiber from 0.1% to 0.2% has also increased in percentage in flexural strength from 33.3% to 84% compared to the conventional concrete at the level of 3 days of curing. Thus can be observed that addition of glass fiber has significantly increased the flexural strength.

Table.5. Average Flexural Strength of M30

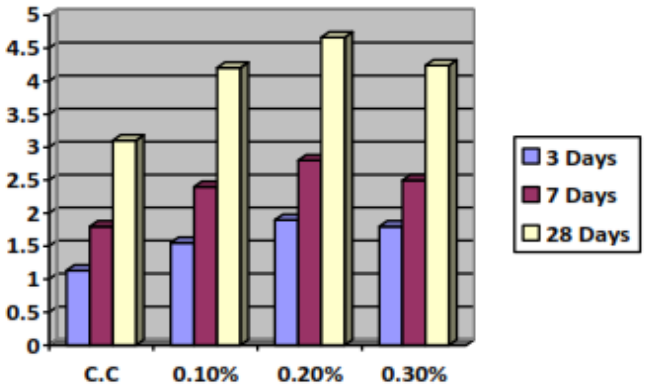
Sl.No	Percentage of fiber	Average Flexural strength (N/mm2)		
		M30		
		3days	7 days	28 days
1	C.C	1.25	2.5	4
2	0.1	2	3.5	6
3	0.2	2.3	4.3	7
4	0.3	1.5	4	6



Graph.2. Average Flexural Strength for

Table.6. Average Tensile Strength of M30

Sl.No	Percentage of fiber	Average Split Tensile strength (N/mm2)		
		M30		
		3days	7 days	28 days
1	C.C	1.13	1.8	3.1
2	0.1	1.55	2.4	4.2
3	0.2	68.14	2.8	4.66
4	0.3	1.8	2.5	4.24



Graph.3. Average Compressive Strength for

3.3 Split-tensile strength:

The split tensile strength of GFRC increases with increasing percentage of glass fibers. The percentage increase in tensile strength is maximum at 0.2% of glass fiber for both 7 days and 28 days curing of GFRC. Thus it can be observed that addition of glass fibers has significantly increased the tensile strength in both 7 days and 28 days curing.

4. CONCLUSION:

In this study, it is concluded that the variety of Glass Fiber Concrete made with Ordinary Portland Cement is an excellent choice for marine and hydraulic structure constructions, as compressive strength, flexural strength and tensile strength increases with increase in percentage of glass fiber with respect to weight of cement. As the tensile strength of this composite rises, less steel reinforcing may be needed, reducing the rate of marine structures deteriorating .As tensile and compressive strength increases with increase in percentage of glass fiber with respect to weight of cement, marine and hydraulic structural elements can be provided with extra concrete cover supported by glass fiber, which makes it hard for elements that cause deterioration to reach the surface of steel reinforcements, preventing corrosion and increasing the life of concrete in these environments.

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