ISSN 2063-5346

STUDY ON MECHANICAL PROPERTIES OF GLASS FIBRE REINFORCED CONCRETE BY PARTIALLY REPLACING NON-BIO DEGRADABLE WASTE AS FINE AGGREGATE

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Article History: **Received:** 01.06.2023 **Revised:**07.07.2023 **Accepted:** 25.07.2023

Abstract

We all know that the tensile strength of concrete is less than the compressive strength of concrete The major scope of this research is to study the mechanical properties of GFRC is a fiber-reinforced concrete by the addition of glass fibre to increase the tensile strength and to compromise the need in demand of naturally occurring fine aggregate in construction field by partially replacing the non - bio degradable waste as fine aggregate. Glass fiber-reinforced concrete consists of high tensile strength, Glass fiber is a non-corrosive material and non - Bio degradable waste used here is the purpose to reduce the demand of naturally occurring fine aggregate in construction and to conserve nature. the plastic waste used (PET). The aim of the project is to find the mechanical properties of GFRC with different percentage of chopped glass fiber and by partially replacing the Fine aggregate (PET) Non - Bio degradable waste. This project limited to study on adding glass fibre by varying percentage (1, 0.75, 0.5, 0.25) and by partially replacing the PET waste in fine aggregate with different percentage (0.5, 1.25, 1.5, 5). By casting the specimen with the arrived concrete mix with the above mentioned percentage of glass fibre and PET waste the mechanical properties of concrete was found. The study results that the concrete mix with glass fibre of 0.75% and plastic waste of 1.25% was casted which results high compressive strength, Concrete with glass fibre of 1% and plastic waste of 0.5% was casted and which results high tensile strength. Both the compressive strength and tensile strength of concrete with the comparator mix was resulted the optimum strength. Compressive strength results 66.9Mpa. And the Tensile strength results 72.9Mpa.

Keywords*: PET (Polyethylene Terephthalate), GFRC Glass Fibre Reinforced Concrete, On-Biodegradable (PET) Waste.*

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DOI: 10.48047/ecb/2023.12.Si8.544

1. Introduction

Concrete is a composite material which is composed of Cement, Fine aggregate, Coarse aggregate and water. Concrete has high Compressive Strength, but the Tensile Strength is significantly low. As result without compensating, Concrete would fail from Tensile stresses even when they loaded in Compression. The popularity of the glass-fiber reinforced concrete was grown for the past few years due to its versatility, strength and relative ease of manufacture. GFRC is too thinner which makes it much lighter than the conventional reinforced concrete. The principal factors that are affecting strength properties of GFRC are fiber content, composite density, fiber orientation, fiber length and the type of cure. All these are impacted by the fiber reinforcement. PET waste is The Polyethylene Terephthalate (PET) plastic is generally used thermoplastic polymer in the construction world. According to the polymer nomenclature, PET is known as poly (oxyethylene oxyterephthaloyl) based on its structure. It is well known as Polyester in the textile industries. Is also mixed with glass fibers and carbon to increase the mechanical strength of the material without the addition of those materials also PET remains still very strong and stays light weigh in nature. In general, the concrete is less in tensile strength in that case the fibre like polypropylene fibre, steel fibre, asbestos fibre, carbon fibre, organic fibre, glass etc are used to increase the tensile strength of concrete

2. Materials Method

Cement (OPC 53)

53 Grade OPC provides the high strength and high durability for concrete structures because of its particle size distribution and the perfect crystallized structure. It is used in construction when we need high strength concrete at very low economical cement content. This grade of cement used for specialized works such as prestressed concrete components, precast items such as paving blocks, building blocks etc.

Coarse Aggregate

Coarse aggregate is the portion of the concrete which is made up of the larger stones embedded in the mix. Concrete contains three ingredients; Water, cement, and aggregate. That aggregate is made of fine sand and coarse gravel. Coarse aggregate sizes are larger than 4.75 mm while fine aggregates form the portion below 4.75 mm. A maximum size up to 40 mm is used for coarse aggregate in most structural applications, while for mass concreting purposes such as dams, sizes up to 150 mm may be used.

Fine Aggregate

River sand Sand generally composed of rounded particles and may or may not contain clay or other impurities. It is obtained from the banks and beds of rivers.

Pet Bottle Waste

Polyethylene terephthalate is a highly recyclable plastic resin and a form of polyester. It is a polymer created by the combination of two monomers: modified ethylene glycol and purified terephthalic acid. ... Almost 1.8 billion pounds of PET were recycled in 2015, used to make a variety of products. PET is which stands for polyethylene terephthalate, is a form of polyester (just like the clothing fabric). It is extruded or molded into plastic bottles and containers for packaging foods and beverages, personal care products, and many other consumer products. 1kg = about 25 x one-liter bottles or 50 x 500ml bottles. It takes about 30,000 PET bottles to make one ton of recycled PET. PET flakes are used as the raw material for a range of products that would otherwise be made of polyester. Examples include polyester fibers (a base material to produce clothing, pillows, carpets, etc.), polyester sheets, strapping, or back into PET bottles.

Figure 1: PET Waste

AR Glass Fibre

Alkali Resistant (AR: Alkali Resistant) Glass Fibers are specially designed for concrete construction.

They contain alkaline zirconium silicates. They are effective to prevent concrete cracking. This adds strength and flexibility to concrete. They are also used for asbestos changes. They have alkali strength and strength. It is very difficult to dissolve in water. Not affected by pH changes. They are easily added to stainless steel and concrete mixtures. Intensive Magnesium and Calcium added fibers. Ideal for applications with high acidic strength and mechanical strength. Alkali Resistant (AR: Alkali Resistant) Glass Fibers are specially designed for concrete construction. They contain alkaline zirconium silicates. They are effective to prevent concrete cracking. This adds strength and flexibility to concrete. They are also used for asbestos changes. They have alkali strength and strength. It is very difficult to dissolve in water. Not affected by pH changes. They are easily added to stainless steel and concrete mixtures. Intensive Magnesium and Calcium added fibers. Ideal for applications with high acidic strength and mechanical strength. Glass fibers of 10mm to 50mm length and few microns in a diameter can added up by 5% weight and mixed with cement and water. add a little quantity of lubricating admixtures, the resulting mix will cast into the mould. In some processes, the roving can be chopped and mixed with slurry of suitable consistency on a mold for production.

Figure 2: AR Glass Fibre

Table 1: Mix Proportion

Cement	Fine Aggregate	Coarse Aggregate	Water
394 kg/m3	678 kg/m3	1130.9 kg/m3	197 liter
1	1.72	2.87	0.5

Compressive Strength Test

Compressive strength test is the maximum compressive stress under a gradually applied load on a solid material which can sustain without fracture on it. The compressive strength is defined as

$$CS = F / A$$

Where the compressive strength is equal to the force applied at the point of failure divided by cross sectional area. Compressive strength test must be performed with the equal opposing forces applied on the test material.

Figure 4: Casted Specimen for the Compressive Strength Test

Tensile Strength Test

Tensile strength is what the ability of material to withstand pulling force and it refers to the breaking strength of material when applying a force that has the capable of breaking of the material simultaneously, constant rate of extension/load. It is measured in units of force per cross-sectional area. Tensile strength is what the amount of stress which is handled by a material before it breaks. tensile strength is the capacity of material to tension that is caused by mechanical loads applied to the material.

Figure 5: Casted Specimen for the Tensile Strength Test

3. Result and Discussion

Compressive Strength Test

From the above tested and obtained results the study says that the addition of Alkali resisting glass fibre makes the concrete more efficient than the conventional mix by adding the fibre in (0,1,0.75,0.25,0.5) different percentages and partially replacing the plastic waste instead of sand Here the maximum compressive strength attained at 0.75% of adding glass fibre with 1.25% of plastic waste with the derived concrete mix

Table 2: Compressive Strength Test

Mix No	Glass Fibre (%)	Plastic Waste (%)	Compressive Strength In (M Pa)
1	0	0	63.3
2	1	0.5	63.9
3	0.75	1.25	67.6

4	0.5	1.5	65.3
5	0.25	5	64.9

Tensile Strength Test

The study says that the addition of Alkali resisting glass fibre makes the concrete more efficient than the conventional mix by adding the fibre in (0,1,0.75,0.25,0.5) different percentages and partially replacing the plastic waste instead of sand. Here the maximum tensile strength was attained at 1% of glass fibre with 0.5% of plastic waste. By adding the plastic waste, the bond in concrete was dynamically started reduced.

Table 3: Tensile Strength Test

Si No	Glass Fibre (%)	Plastic Waste (%)	Tensile Strength In (M Pa)
1	0	0	63.3
2	1	0.5	74.9
3	0.75	1.25	70.1
4	0.5	1.5	67.4
5	0.25	5	60.1

4. Conclusion

This chapter shows that the ideas obtained from the previously published journals and the changes what we decide to do. From the conventional mix we know the amount of materials required for the designed project. The testing of materials and the quality of materials are obtained to attain the designed strength. The specimens are made for the required shape by using the mould for the testing of specimens in the machine. The mix design is calculated and the grade of concrete are choosing which is economical. Batching work are done for all shape of the specimen to reduce the losing of concrete. The weighing should be made for all material before casting. The casting and demoulding are done after one day. Curing for the specimen is done for 28days to attain the maximum strength. Testing for the specimen and the strength of the conventional concrete are obtained after curing. This shows that the normal M25 grade of concrete strength after curing of 28days. By comparing the strength of the specimen which we decided to made with the conventional and using glass fibre and plastic waste shows that GFRC service life is higher than the traditional concrete due to controlling of micro cracks propagation , corrosion (especially AR- Glass fibre) and less permeability .GFRC is light weight and is about 50-70% lighter than the traditional concrete .The fibre content greater than 0.25% resulted slight increase in compressive strength of 67.6 M Pa at 0.75% inclusion .In comparison the compressive strength of plain concrete was 63.4 M Pa. Split tensile strength of GFRC was increased slightly after inclusion 0.25 % of Glass fiber . After dosage of 0.50% there no increase in split tensile strength. The maximum increase in compressive strength was attained at the inclusion of 0.75% of GFRC and 1.25% of PET waste, increase in percentage of PET naturally reduces the bond in concrete and the workability is good in 1% - 1.5% of PET

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