# EXPERIMENTIAL INVESTIGATION OF GLASS FIBRE REINFORCED GEO POLYMER CONCRETE

Mr.R.Balamurugan[(1)]
[(1)] Assistant professor,Civil Engineering
Bharathiyar college of Engineering and technology
karaikal,puducherry,India

Mr.R.Balachandran[(2)] , Mrs.S.Kalaiyarasi[(3)]
Mr.Sathish Kumar.P[(4)] , Mr.Saravanan.R[(5)]
[(2) (3) (4) (5)] Final year Civil Engineering
Bharathiyar college of Engineering and technology
karaikal,puducherry,India

*Abstract*—Concrete is a tough and strength material but it is porous material also which interacts with the surrounding environment. The durability of the concrete depends on largely on movement of water and gas enters and moves through it. To produce the quality concrete in certain conditions, We have to add the glass fibres in the ratio of 1%,2%,3% by volume of concrete. To determine the mechanical properties of glass fibre geo polymer concrete (GGPC), which contains fly ash, alkaline liquid and glass fibres. Alkaline liquid to fly ash ratio was fixed as 0.35% by volume of cement. To increase the strength of concrete as quality wise, we are adding glass fibres and geo polymer in to the concrete. Concrete mixes were produced, tested and compared in terms of strength with the conventional concrete. These tests were carried out to evaluate the compression strength, flexural strength and split tensile strength at the 7 days and 21 days. There will be a increase in strength when glass added to concrete as 1%, 2%, 3% and alkaline liquid and to decrease the curing period of the concrete. Glass Fibre reinforced Geo polymer concrete to improve structural strength.Reduce crack widths and control the crack width tightly, thus improving durability.Increase resistance to plastic shrinkage and curing. The mix design was carried out for M40 grade concrete as per IS 10262-2009

***Keywords-component; glass fibres, geo polymer, Alkaline liquid, compression strength, flexural strength, split tensile strength, Glass Fibre reinforced Geo polymer concrete.***

## *I.* INTRODUCTION

Concrete is the most widely used construction material which has several desirable properties like high compressive strength, stiffness and durability under normal usual environmental factors.Geo polymer concrete (GPC) is a type of inorganic polymer composite, which has recently emerged as a prospective binding material based on novel utilization of engineering material.Geo polymer concrete does not utilize any portland cement in it however the binder is produced by the reaction of an alkaline liquids is rich in silica, alumina. High early strength, low shrinkage, freeze thaw resistance, sulphate resistance and corrosion resistance are the properties of geopolymer concrete.

Geopolymer is a type of amorphous alumino-silicate product that exhibits the ideal properties of rock-forming elements, i.e., hardness, chemical stability and longevity. Glass Fiber Reinforced Concrete (GFRC) is a type of fiber reinforced concrete which are mainly used in exterior building facade panels and as architectural precast concrete.

## II. LITERATURE REVIEW

### Design of Geo polymer Concrete

**1. Prof.MorePratapKishanraoAssistant Professor, Dept. of Civil Engineering, Symbiosis Institute of Technology, Pune, IndiaInternational Journal of Innovative Research in Engineering and TechnologyVolume 2 Issue 5 May 2013**

More PratapKishanrao, 2013 studied the **Design of Geopolymer concrete**. Reducing the greenhouse gas emissions is the need of the hour. Five to eight percent of the world's manmade greenhouse gas emissions are from the Cement industry itself. It is an established fact that the green house gas emissions are reduced by 80% in Geopolymer concrete vis-a-vis the conventional Portland cement manufacturing, as it does not involve carbonate burns etc. Thus Geopolymer based Concrete is highly environment friendly and the same time it can be made a high-performance concrete.

A mixture of fly ash and ground granulated blast furnace slag in equal proportions is used as binding/cementacious material in complete replacement of conventional Portland cement to prepare geopolymer concrete mixes.The parameter studied includes compressive strength and weight loss after expose to elevated temperature. Further, it is also established that high temperature curing is not required in all cases of GPC, as sunlight curing can used at least in tropical countries for Geopolymer concrete mixes.

## 2. Glass Fiber Reinforced Concrete & Its Properties

ShrikantHarle, Prof. Ram Meghe,Department of Civil Engineering,College of Engineering, Amravati (M.S.)International Journal of Engineering and Computer Science ISSN:2319-7242Volume 2 Issue 12 Dec, 2013 Page No: 3544-3547

ShrikantHarle, and Prof. Ram Meghe, 2013 studied the**Glass Fiber Reinforced Concrete & Its Properties.**Glass fiber reinforced concrete (GFRC) is a recent introduction in the field of civil engineering.Steel reinforcement corrosion and structural deterioration in reinforced concrete structures are common and prompted many researchers to seek alternative materials and rehabilitation techniques.To develop high performance concrete using glass fibers and other admixtures in the concrete up to certain extent.

It can also be concluded that Flexural strength and split tensile strength almost 15 to 20 % increase in strength as compared to 0% glass fiber. Also the percentage increase of compressive strength of glass fiber concrete Mixes compared with 28 days compressive strength is found to be 20 to25 %.

## III. MATERIAL COLLECTION & CHARACTERIZATION

### *A. Fly ash*

Generally fly ash quality is assessed on the basis of some of the key parameters like pozzolanic activity, material retained on 45 micron sieve, loss on ignition and other chemical parameters.

### *B. Cement: (OPC)*

The most common cement used is an ordinary Portland cement. The Ordinary Portland Cement of 53 grades conforming to IS: 8112-1989 is being used. Cement (PPC) The most common cement used is Portland pozzolana cement. The Portland pozzolana cement of 53 grades conforming to IS: 1489 (PART-1) 1991 is being used.

### *C. Aggregate*

Aggregates are the important constituents in concrete. They give body to the concrete, reduce shrinkage and effect economy. One of the most important factors for producing workable concrete is a good gradation of aggregates. Good grading implies that a sample fraction of aggregates in required proportion such that the sample contains minimum voids.

### *D. Glass Fibre*

Glass fibres are made of silicon oxide with addition of small amount of other oxides Glass fibres are characteristic for their high strength, good temperature resistance, corrosion resistance & available at low price. In this investigation alkali resistance glass fibres of 12mm length & 14 microns nominal diameter having density of 2680Kg/m3 were used.

### *E. Alkaline liquids*

A combination of Sodium hydroxide solution & Sodium silicate solution was used as alkaline activators for geo polymerization. Sodium hydroxide is available commercially in falkes& pellets form. For this experimental program Sodium hydroxide flakes with 98% purity were dissolved in distilled water to make NaOH solution. Sodium silicate is available commercially in solution form which was used as such. The chemical composition of Sodium silicate is Na2O=16.37%, SiO2=34.35% (total solids= 50.72%.), water=49.28%

## IV. CASTING OF CONVENTIONAL CONCRETE

We casted convention concrete and glass fibre reinforced geopolymer concrete with M40 mix design, we casted cubes of around for conventional concrete of cube size 150 mm x 150mm x 150 mm.

We casted convention concrete and glass fibre reinforced geopolymer concrete with M40 mix design, we casted beams of around for conventional concrete of beam size 100 mm x 100mm x 500 mm.

We casted convention concrete and glass fibre reinforced geopolymer concrete with M40 mix design, we casted cylinders of around for conventional concrete of cylinder size 100 mm dia x 200mm length.

## V. RESULTS AND DISCUSSION

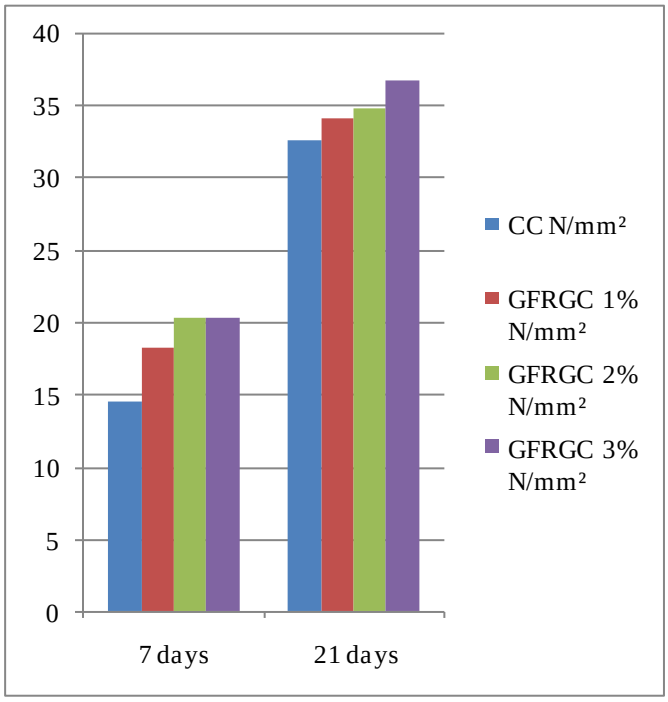
### a) Comparison of Compressive Strength

| Nature of concrete / compressive strength | 7 Days N/mm$^2$ | 21 Days N/mm$^2$ |
|---|---|---|
| Conventional concrete | 14.55 | 32.66 |
| GFRGC 1% | 18.33 | 34.22 |
| GFRGC 2% | 20.33 | 34.88 |
| GFRGC 3% | 20.33 | 36.77 |

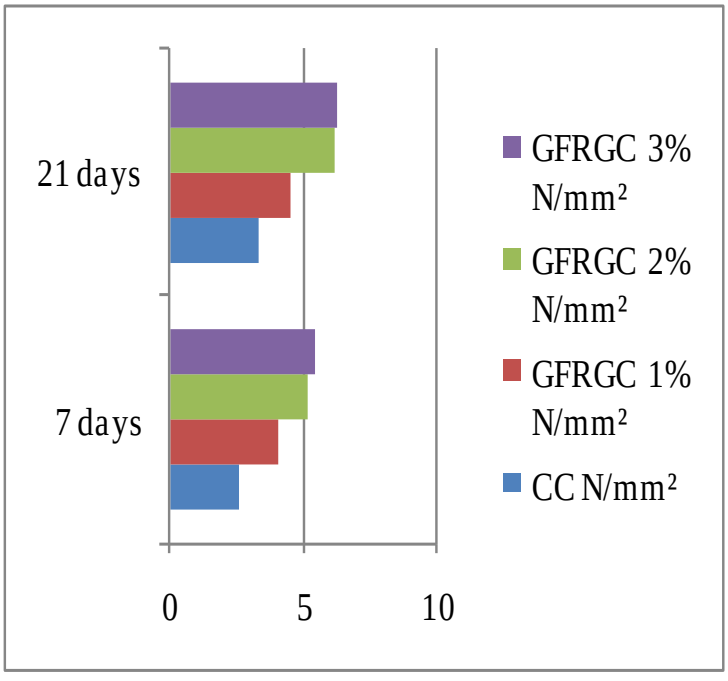
### b) Comparison of Flexural Strength

| Nature of concrete / compressive strength | 7 Days N/mm$^2$ | 21 Days N/mm$^2$ |
|---|---|---|
| Conventional concrete | 2.6 | 3.3 |
| GFRGC 1% | 4.08 | 4.46 |
| GFRGC 2% | 5.16 | 6.13 |
| GFRGC 3% | 5.42 | 6.21 |

**Comparison of Compressive Strength**



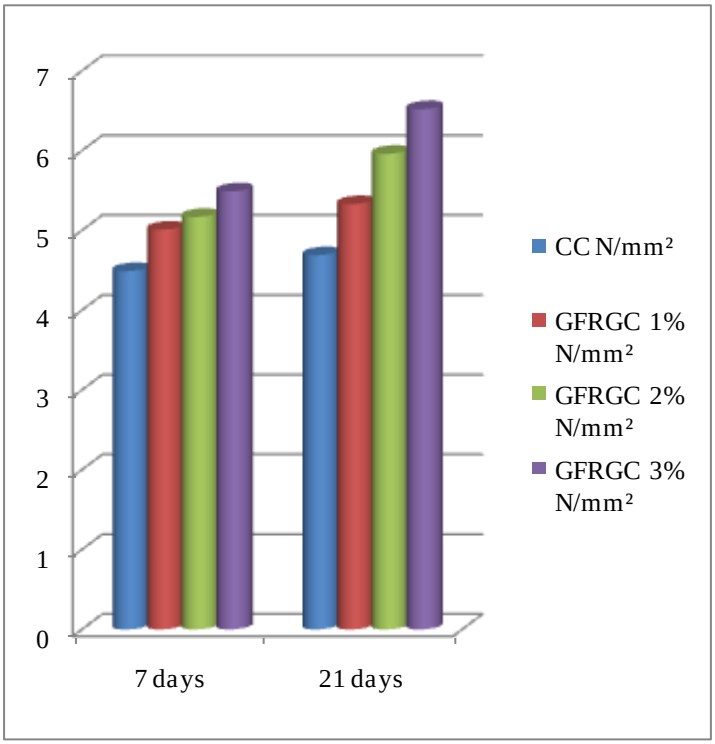

**Comparison of Compressive Strength**



### *c) Comparison of Split Tensile Strength*

| Nature of concrete / compressive strength | **7 Days N/mm$^2$** | **21 Days N/mm$^2$** |
|---|---|---|
| **Conventional concrete** | **3.49** | **4.69** |
| **GFRGC 1%** | **5.01** | **5.33** |
| **GFRGC 2%** | **5.17** | **5.96** |
| **GFRGC 3%** | **5.49** | **6.52** |

### *a) Comparison of Split Tensile Strength*




## *V. CONCLUSION*

From the above results and comparison it can be stated that glass fibers shown good results.Compressive strength, flexural strength and split tensile strength for these glass fibers are more as compared to Conventional concrete.It can also be concluded that Flexural strength and split tensile strength shows almost 40 to 50% increase in strength as compared to 0% glass fibers.The fire resisting properties of Glass fibers are used to build the innovative concrete structures.It can also be concluded that Compression strength shows almost 20 to 30% increase in strength as compared to 0% glass fibers.Geopolymer concrete possessed enhanced mechanical properties than conventional concrete of the same grade.From the above results and comparison following point are observed:

- ✓ The compressive strength is found to be much more for normal concrete with the addition of glass fibers as compared to the geopolymer concrete with the addition of glass fibers.
- ✓ The flexural strength for geopolymer concrete with the addition of glass fibers found to be more as compared to the normal concrete with the addition of glass fibers.
- ✓ Split tensile strength is found to be more for normal concrete with the addition of glass fibers as compared to the geopolymer concrete with the addition of glass fibers.

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AUTHORS PROFILE

1.

(1)

Mr.R.Balamurugan is working as a Assistant professor and HOD in civil engineering at Bharathiyar college of engineering and technology,karaiklal. for the past 3 years.Before that working as a site Engineering in private concern for about 2 years.

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(3)

(4)

(5)

Second ,third and last author is doing final year civil engineering at Bharathiyar college of engineering and technology,karaikal.