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Flexural Behaviour of Steel Fiber Reinforced GEO-Polymer Concrete

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ABSTRACT

Concrete is the most used development fabric from historic days. It used to be anticipated that the manufacturing of cement would be accelerated from about from 1.5 billion lots in 1995 to 2.2 billion lots in 2020. But 2018 china the usage of 2.37 billion lots individually. India is the 2nd biggest producer of cement in the world. Cement enterprise is anticipated to attain 550 – 600 million lots per annum at 2025. The cement manufacturing contributes almost 8% of worlds world warming due to emission of greenhouse gases, such as CO2, to the atmosphere. Hence, it is indispensable to discover a replacement cloth for cement. The technological know-how Geo-polymer concrete determined as choice for this problem. In this existing research, cement is changed with Fly Ash and GGBS in distinct percentages with steel fibers. The research exhibit that the load carrying capability of most of the gpc combine was once in the most instances extra than that of traditional normal Portland cement concrete mix. The clean and hardened homes of geo-polymer concrete had been observed with and except metal fiber.

The mechanical traits of all the examined mixes are to be more suitable with the aid of the GGBS content, in each undeniable and metal fiber strengthened geo-polymer concrete. A comparative evaluation has been carried out for regular traditional concrete to that of the metal fiber strengthened geo-polymer concrete below ambient curing in relation to compressive, break up tensile, flexural strengths. As the fiber content material normally will increase compressive, cut up tensile and flexural strengths are proportionally increased.

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1. INTRODUCTION

Ordinary Portland cement is one of the most essential binding substances in phrases of extent produced. Since it is manufactured at a very excessive temperature, it consumes lot of energy. Besides big quantity of power consumption, it emits dangerous gases, which pollute the atmosphere. The manufacturing of each and every ton of Portland cement contributes about one ton of CO2 in the atmosphere. Small quantities of NO2 and CH4 gases are additionally emitted. Apart from strength consumption and emission of detrimental gases, calcium hydroxide, one of the hydration products, acquired in the course of the hydration of cement, is a nuisance for development industry. This influences the sturdiness homes of cement based totally materials.

The time period geo-polymer used to be first coined through chemistry professor Davidov its in 1978 to describe a household of mineral binders with chemical composition to comparable that of zeolites however with an amorphous microstructure. Geo-polymer concrete does no longer require any water for matrix bonding. Instead, the alkaline answer reacts with Silicon and Aluminum existing in the fly ash. Geo-polymer was once synthesized by means of mixing alumina silicate-reactive cloth with strong alkali solutions, such as sodium hydroxide (NaOH), potassium hydroxide (KOH), sodium silicate or potassium silicate.

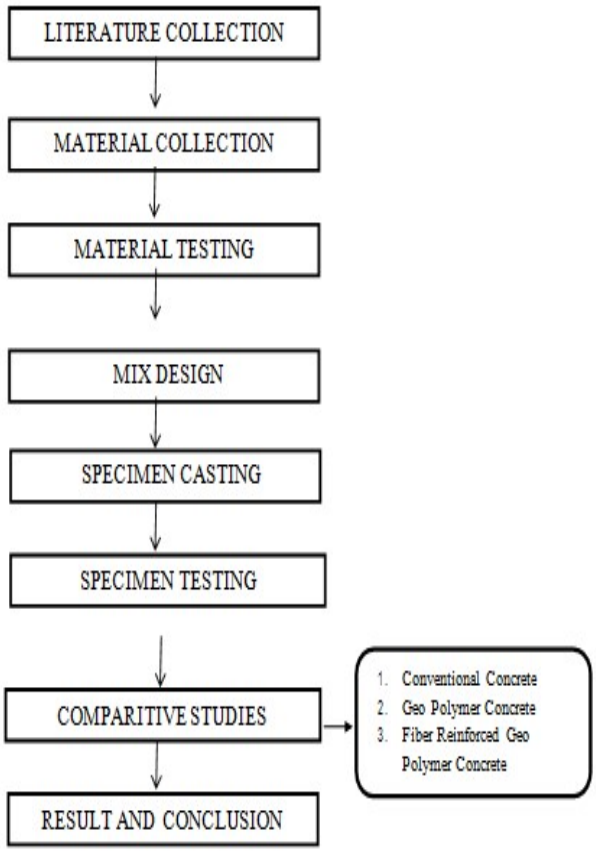
The impact of classification F fly ash (FA) and floor granulated blast furnace slag (GGBS) on the mechanical residences of geo-polymer concrete (GPC) at distinctive substitute stages are made to gain

the most reliable share . The polymerization procedure was once accelerated in the greater temperature than ambient. Fly ash-based geo-polymer concrete cured in ambient temperature achieves decrease energy in the early days as in contrast to warmth cured samples however in ambient curing the compressive energy will increase as the age of concrete will increase from 7 days to 28 days .

1.1 Objectives

- Study of the impact of the usage of Ground Granulated Blast Furnace Slag and Fly Ash in concrete and its benefits.
- For checking the impact of substitute of cements with the aid of the usage of Ground Granulated Blast Furnace Slag and Fly Ash and robust alkali options such as potassium hydroxide (KOH), sodium hydroxide (NaOH).
- To learn about the conduct of metal fiber in geo polymer concrete.
- An strategy in the direction of the use of choice substances as concrete admixture.
- To minimize the CO2 emission and the environmental air pollution from the manufacture of cement.

2. METHODOLOGY



3. MATERIALS STUDIES

3.1 CEMENT

Table 3.1 Chemical composition of Cement

Chemical composition	Percentage
Silicon Dioxide (SiO2)	22.40
Aluminum Oxide (Al2O3)	5.20
Iron Oxide (Fe2O3)	3.80
Magnesium Oxide (MgO)	1.70
Calcium Oxide (CaO)	61.60
Ignescent Material	1.40

Fig. 3.1 OPC-43 grade

Fig. 3.2 Fly ash

3.2 GGBS

Fig.3.3 GGBS

Ground-granulated blast-furnace slag (GGBS or GGBFS) is bought by way of quenching molten iron slag (a derivative of iron and steel-making) from a blastfurnace in water or steam, to produce a glassy, granular product that is then dried and floor into a pleasant powder.

The chemical composition of a slag varies drastically relying on the composition of the uncooked substances in the iron manufacturing process. Silicate and aluminates impurities from the ore and coke are mixed in the blast furnace with a flux which lowers the viscosity of the slag. In the case of pig iron manufacturing the flux consists in the main of a combination of limestone and forsteriteor in some casesdolomite.

3.3 STEEL FIBER

Steel fibers combined into the concrete can grant an choice to the provision of traditional metal bars or welded material in some applications. The idea has been in existence for many years (the first patent was once utilized for in 1874) and it has been used in a restricted vary of applications: amongst the first primary makes use of used to be the patching of bomb craters in runways all through World War II. However, it used to be throughout the Seventies that business use of this fabric started out to accumulate momentum, especially in Europe, Japan and the USA.

Fig.4.4 Steel Fiber

4. PRELIMINARY STUDIES

4.1 Cement Properties

S.No	Description	Values
1	Specific gravity	3.15
2	Fineness(%)	0.2
3	Initial setting time (minutes)	30
4	Final setting time (hours)	5

Table 4.1 Cement Properties

4.2 Fine and Coarse Aggregate properties

S. No	Description	Fine Aggregate Values	Coarse Aggregate Values
1	Specific gravity	2.7	2.85
2	Fineness (%)	5.5	6.12
3	Water absorption (%)	1.72	0.51

Table 4.2 Fine and Coarse Aggregate properties

4.3 Ground Granulated Blast furnace Slag (GGBS)properties

S.No	Description	Values
1	Specific gravity	2.9
2	Fineness(m^2/kg)	350
3	Bulk density(kg/m3)	1200
4	Calcium oxide	40
5	Silica	35
6	Alumina	13
7	magnesia	8

Table 4.3 Ground Granulated Blast furnace Slag properties

4.4 Steel Fiber Properties

S.No	Description	Values
1	Specific gravity	7.85
2	Elastic modulus(GPa)	300
3	Length(mm)	30
4	Diameter(mm)	0.5

Table 4.4 Steel Fiber Properties

5. RESULT OF SPECIMENS

5.1Compressive Strength TestResult

S.No	Specimen	Compressive Strength (N/mm^2)
1	Conventional Concrete	26
2	Fly Ash (90%)+GGBS (10%)	33.3
3	Fly Ash (90%)+GGBS (10%)+Steel Fiber (0.25%)	35.85
4	Fly Ash (90%)+GGBS (10%)+Steel Fiber (0.5%)	37.80

Fig.No.5.1 Testing of Cube

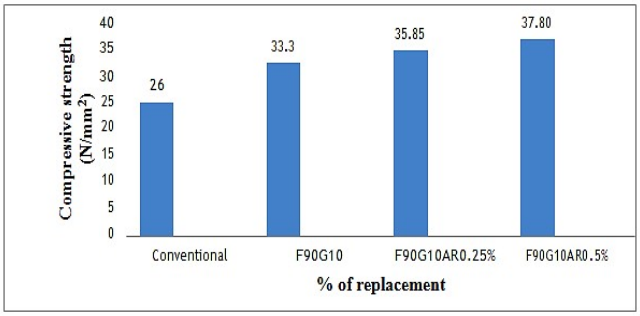


Fig.5.1 Graphical representation of compressive strength test results

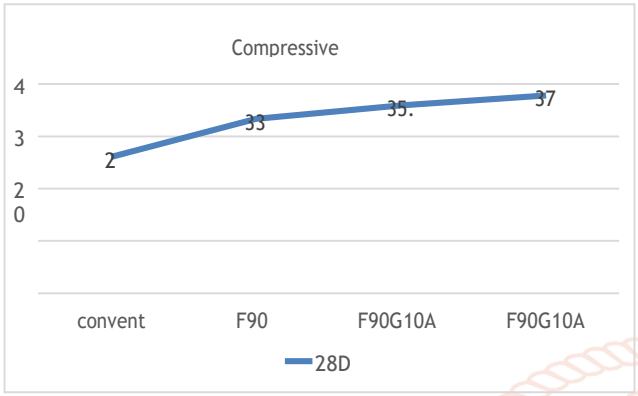


Fig.5.2 Graphical representation of compressive strength test results

5.2 Split Tensile Strength Test Results

Fig.5.3 Testing of Cylinder

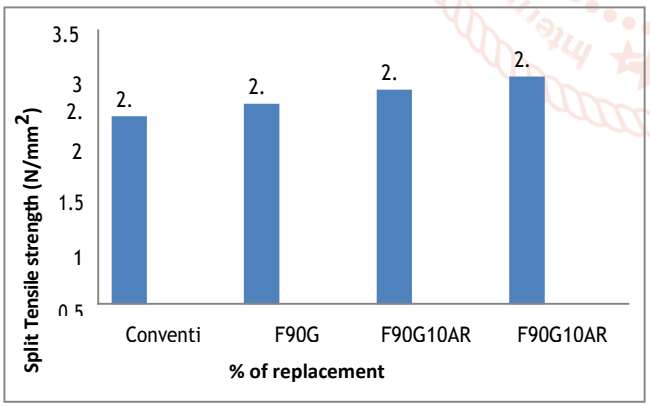


Fig.5.4 Graphical representation of split tensile strength test results

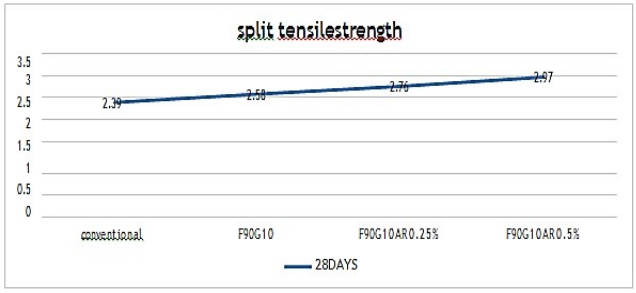


Fig.5.5 Graphical representation of split tensile strength test results

5.3 *Flexural Strength Test Results*

Table 5.2 Flexural Strength test results on concrete prisms

S.No.	Specimen	FlexuralStrength (N/mm^2)
1	Conventional Concrete	3.4
2	Fly Ash (90%)+GGBS (10%)	3.8
3	Fly Ash (90%)+GGBS (10%)+Steel Fiber (0.25%)	4.64
4	Fly Ash (90%)+GGBS (10%)+Steel Fiber (0.5%)	4.9

Fig.5.6 Testing of Prism

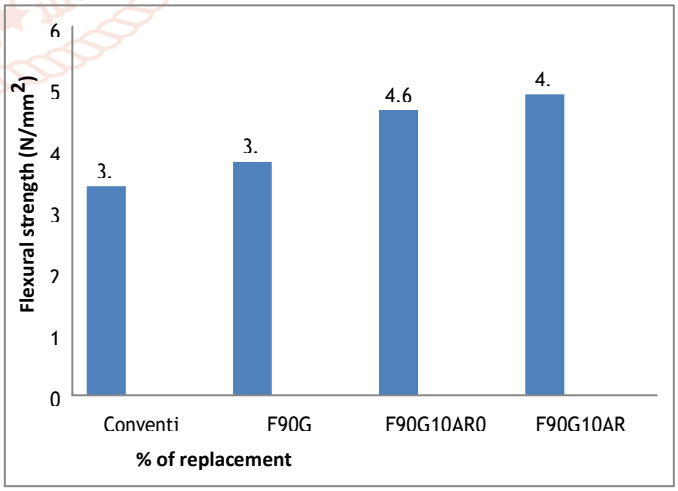


Fig.5.7 Graphical representation of flexural strength test results

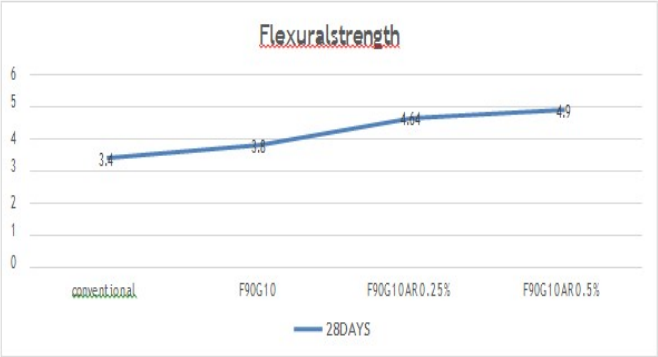


Fig.5.8 Graphical representation of flexural strength test results

6. CONCLUSION

From the Experimental outcomes the following conclusions used to be drawn.

- The use of metal fiber on geo-polymer concrete has produced the most beneficial compressive electricity price and geo-polymer , will decorate the discount of cement utilization in concretes, thereby lowering the environmental air pollution brought about with the aid of the cement manufacture.
- It was once located from the take a look at consequences that the compressive power of fiber strengthened geo-polymer possess higher outcomes than geo-polymer concrete.
- The flexural conduct and cut up tensile electricity of fiber strengthened geo-polymer concrete possess correct ductile in nature than geo-polymer concrete
- The addition of metal fiber offers better effects of compressive value.
- Compared to geo-polymer concrete fiber bolstered geo-polymer concrete yields higher mechanical properties.
- The addition of metal fiber offers higher outcomes of compressive, tensile, flexural values.

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