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An Investigation on Durability and Ductility of Concrete using Fly Ash and Fibre Glass

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ABSTRACT

Concrete enterprise is dealing with the environmental impact, via the emission of CO2 while cement manufacturing. Cement partly replaced with pozzolanic waste fabric like fly ash reduces the freeing of CO2. Fly ash is made of thermal energy plants. Due to the usage of glass fibers to standard concrete has a big compressive strength and flexural Strength. This research work deals the look at of different grades (M30, M40) of GFRC by means of partial substitute of cement with fly ash. In keeping with mix proportions, standard sizes of specimens are casted that allows you to locate the durability properties, ductility and flexural power? Durability properties are performed with the aid of checking out the specimens for sulphate and acid assaults. Whereas ductility and flexural energy is received from pressure-pressure curves. And acquired results are as compared to traditional concrete. Its miles been determined from this research is that, ductility, sturdiness and flexural electricity is higher for GFRC than traditional concrete.

Keywords: *Glass fiber, fly ash, compressive strength, stress-strain curve, flexural strength.*

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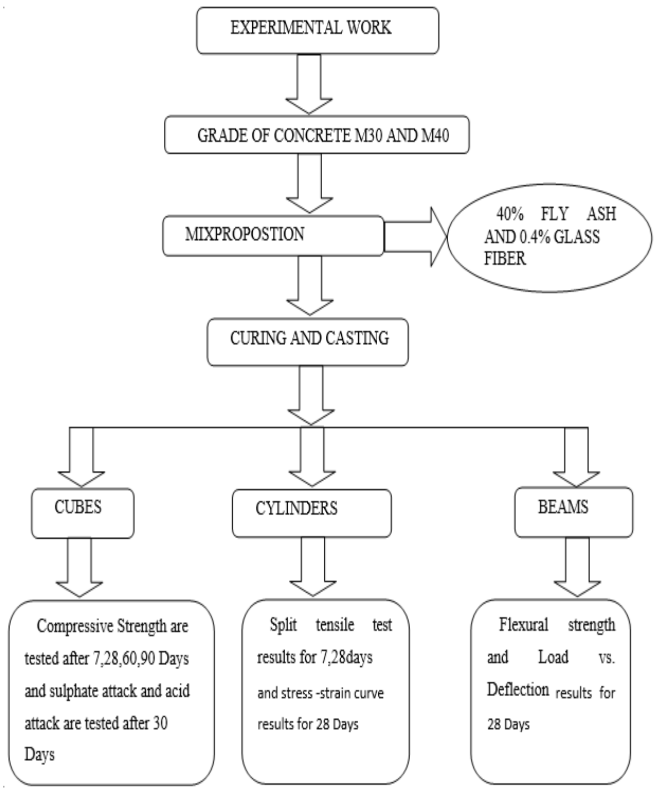
I. INTRODUCTION

Slags OPC 53 grade S cement is manufactured as per specification laid down by ministry of railways under IRST40: 1985. It is a very finely ground cement with is high C3S content designed to develop high early strength required for manufacture of concrete sleeper for Indian Railway. Cementations materials such as mortars and concretes are utilized for the development of construction material because they are durable, low-cost and have an adequate compressive strength and stiffness for structural use. It cannot be directly used to the structures due to its low ductility and less tensile strength. Fibers prevent micro cracks from widening. The components become ductile and tough due to addition of fibers. Conventional concrete cracks easily. When concrete is reinforced with randomly dispersed fibers, we get favorable behavior for repeated loads. For the fixing of proper reinforcement, it is very difficult for the odd shape of structures, it is not commence in the case of fiber reinforced concrete and the progress of work can be achieved at much faster rate. Generally fly ash has higher impact on the environment because of presence of heavy metals like mercury, cadmium, boron. Our paper deals with effective use of fly ash as a construction material which can be replace up to 40%by weight of cement.

Due to this the reinforcement or fibers are utilized in the process of concreting. For the thin members the fiber reinforced concrete are used to gain the tensile strength. The pozzolanic material having essential with the siliceous and aluminous materials as which reacts with calcium hydroxide in the presence of water at ordinary temperature and liberated in the process of hydration to form compounds as like as possessing cementitious properties. Fly ash is waste material, generated in the thermal power station, when powdered coal is used as fuel. The PPC (Portland Pozzolana Cement) products have the high resistance and with the less heat of hydration to attack the aggressive water than the OPC (Ordinary Portland Cement. In India there is apprehension in the mindsof the user to use the Portland pozzolana cement for structural work.

II. Methodology



III. Materials Used

Cement: In this experimental work, standard Portland Cement (OPC) of grade-53 was used. Cement is the most important binding material of cement conforming to IS 12699: 1999 is used in this project work.

Fine Aggregate: Locally available river sand belonging to zone II of IS 383-1970 was used for the projectwork.

Coarse Aggregate: The coarse aggregate can be formed by the crushing of granite. And having with the maximum size of 20mm and 12.5mmwas found according to the norms of Indianstandards.

Water: Water is the most important additive to form a molded mix in a concrete. the fresh water available in laboratory are used for concreting mixing and curing both glass fiber reinforced concrete mixes M30 and M40 grades are used in water.

Superplasticizer: Super-plasticizers are high range water reducers that are used to make the mix workable at lower water-to-binder ratios.To increase the workability of the glass fiber reinforced concrete mixes, the high range of water reducing proxy MYK PC-20 has been used in this present work.

Fly Ash: Fly ash is a by-product of combustion of pulverized coal in thermal power plants. It is removed by the dust collection system as a fine particle residue from the combustion of gases before they are discharged into the atmosphere. Fly ash particles are typically spherical, ranging in diameter from less than 1µm up to 150µm, the majority being less than 45µm. More than 85 percent of most fly ashes comprise of chemical compounds and glasses formed from the elements like silicon, aluminum, iron, calcium, and magnesium.

Glassfiber: Alkali resistance glass fibers are used in project work. Glass fiber is chemically inorganic fiber and obtained from molten glass of Specific composition. Glass fiber is made up of natural materials such that its produces substances of ecologically pure and not harmful to the community. Glass fiber made up from 200-400mm individual filaments. It is not possible to mix fibers more than 3%. Glass fibers have excellent electronic heat and insulation capacities.

Acids: To check the sulphate attack resistance, the specimen is placed in acidic solutions such as H_2SO_4, $MgSO_4$ with 5% of concentration in water.

IV. Results and Discussion

A. Compressive Strength Test for M30 grade:

concrete mix	compressive strength			
	7days	28days	60 days	90 days
M30	28.22	46.70	48.81	51.9
M 30 fly ash with Glass Fiber	30.28	51.11	54.45	56.6

Table 1: Control Mix and Composite Mix for M30 Grade

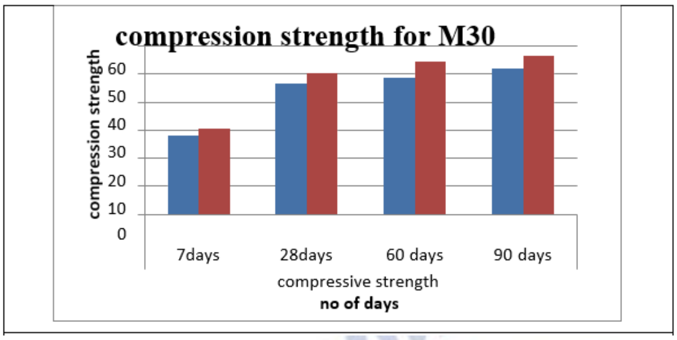


Figure 2: Compressive strength M30 grade plane and fly ash and glass fiber

Compressive Strength Test for M40 grade:

concrete mix	compressive strength			
	7days	28days	60 days	90 days
M 40	36.67	54.66	55.55	60.2
M 40 fly ash with Glass Fiber	40.25	56.53	60.5	65.3

Table 2: Control Mix and Composite Mix for M40 Grade

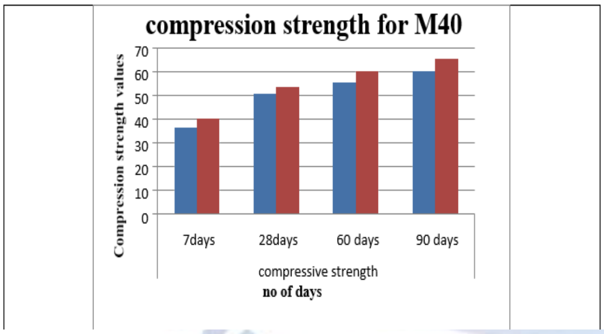


Figure 3: Compressive strength M40 grade plane and fly ash and glass fiber

Split Tensile Strength for M30 grade:

concrete mix	Split Tensile strength	
	7days	28days
M 30 Plain	2.82	3.25
M 30 fly ash with Glass Fiber	3.4	3.50

Table 3: Control Mix and Composite Mix for M30 Grade

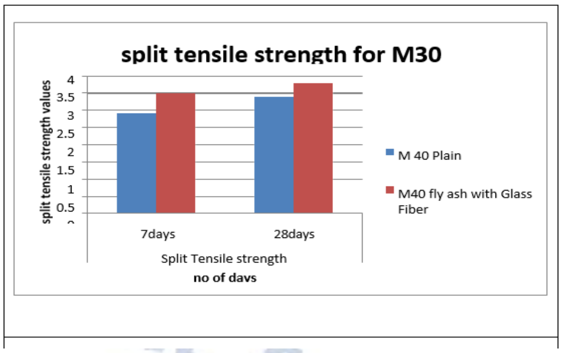


Figure 4: Split strength M30 grade plane and fly ash and glass fiber

Split Tensile Strength for M40 grade:

concrete mix	Split Tensile strength	
	7days	28days
M 40 Plain	2.9	3.40
M40 fly ash with Glass Fiber	3.5	3.62

Table 4: Control Mix and Composite Mix for M40 Grade

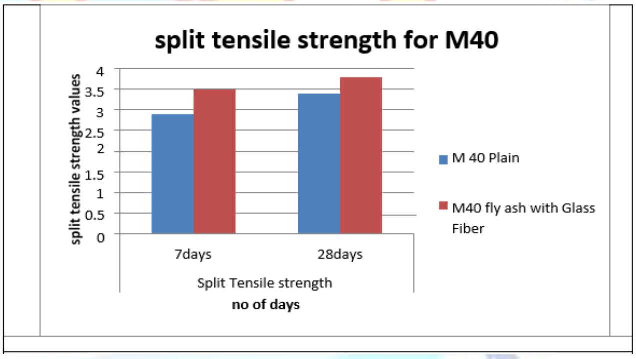


Figure 5: Split Tensile M40 grade plane and fly ash and glass fiber

Stress-Strain Curve on Control Mix:

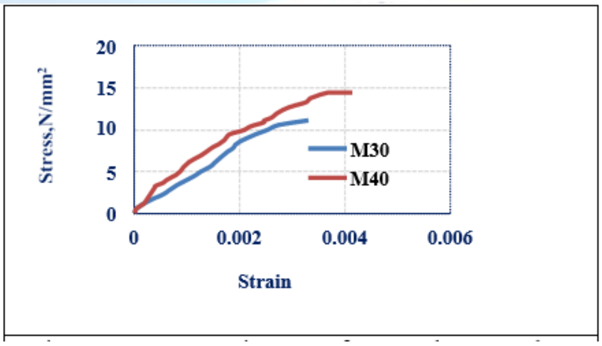


Figure 6: Stress-Strain curve of M30 and M40 grade control mix

Stress-Strain Curve on Composite mix:

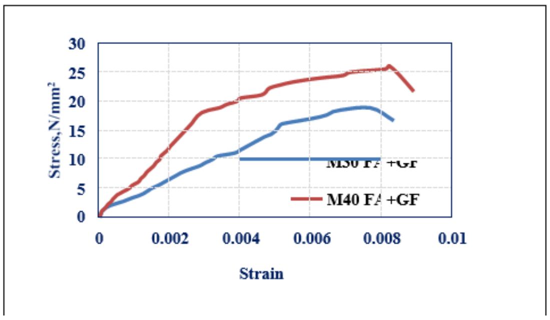


Figure 7: Stress-Strain Curve of M30 and M40 grade composite mix

Flexural Strength Test:

Composite mix:

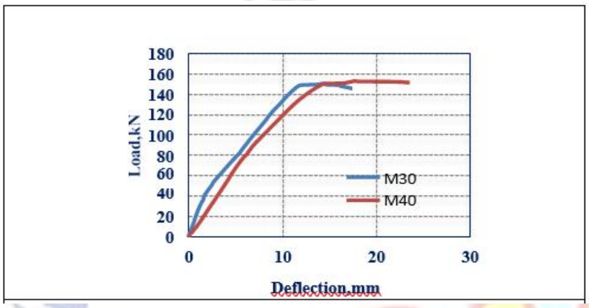


Figure 8: Flexural strength of beam with Composite mix M30 and M40 grade of concrete

Control mix:

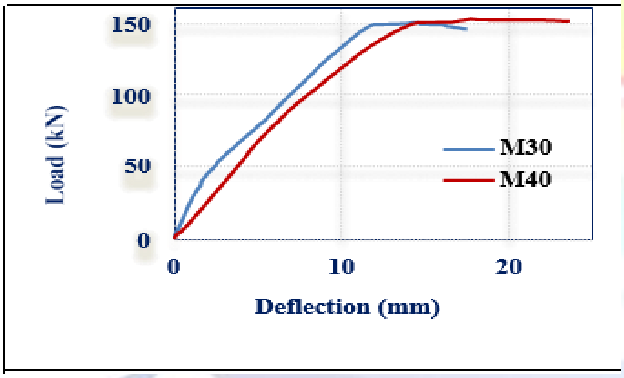


Figure 9: Flexural strength of beam with Control mix M30 and M40 grade of concrete

Durability Studies with H2SO4 AND MgSO4:

Sulphate attack for M30:

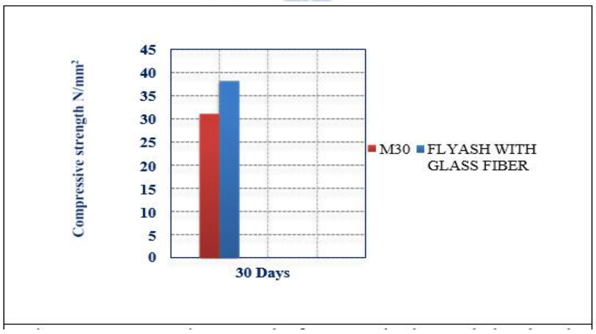


Figure 10: Compressive Strength of M30 Grade plane and Fly ash and Glass fiber with Sulphate Attack

Sulphate attack for M40:

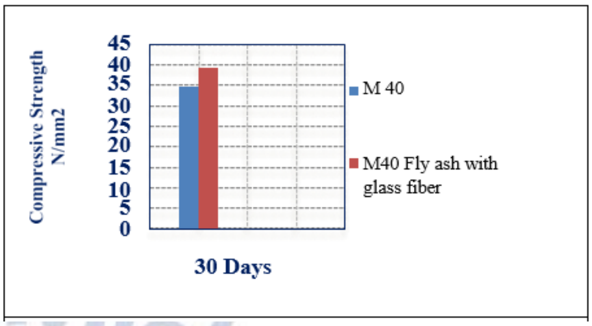


Figure 11: Compressive Strength M40 Grade plane and Fly ash and Glass fiber With Sulphate Attack

Acid attack for M30:

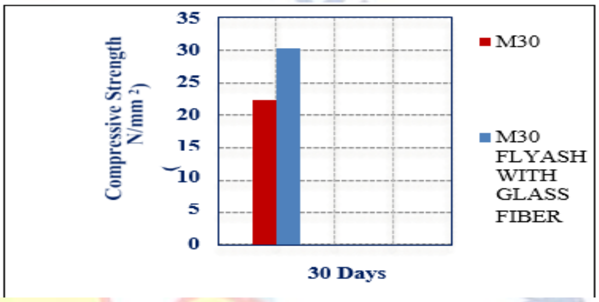


Figure 12: Compressive Strength M30 Grade plane and Fly ash and Glass fiber With Acid Attack

Acid attack for M40:

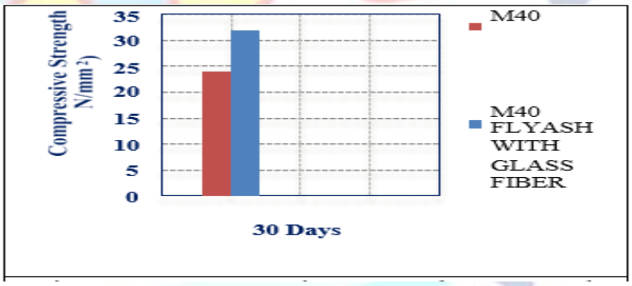


Figure 13: Compressive Strength M40 Grade plane and Fly ash and Glass fiber With Acid Attack

V. Conclusion

The following conclusions were obtained by the addition of glass fiber and fly ash as the replacement of cement.

1. The addition of glass fiber and fly ash has improved the compressive strength, split tensile strength and flexural strength of concrete.

2. The slump value of the concrete mix by adding Fly ash and Glass fiber is 73mm.

3. For the mix of Fly ash (40%), Glass fiber (0.5%) and Cement (60%), there obtained a low workability.

4. The addition of 0.8% of admixture is used to increase its workability.

5. The compressive and Split tensile strength of M30 and M40 conventional concrete were less when compare to composite concrete.

6. When compared with Composite mix, the stress-strain values of Control mix were high. With the replacement of cement with Fly ash and Glass fiber, the load carrying capacity of beam increases.

7. When the cubes of Composite mix (M30 & M40) treated with $MgSO_4$, the compressive strength value increase when compared with the cubes of control mix (M30 & M40) due to Sulphate attack.

8. In case of H_2SO_4, the compressive strength for the composite mix of M30 & M40 was increased when compared with control mix.

9. Flexural Strength for the conventional concrete which is having the ultimate load of 151.7 KN is 24.7 N/mm2.

10. The Flexural Strength for the composite concrete which is having the ultimate load of 154.3 KN is 25.14 N/mm2.

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