Evaluation of Flexural Properties of Geopolymer Concrete Beam With Polypropylene Fibre.

ABSTRACT
The main objective of this study is to investigate the impact of polypropylene fiber on the mechanical flexural behavior of GPC. Polypropylene fibre with varying percentages (0.25%, 0.5%, & 1%) is adopted in this study. The addition of fibres changes its brittle behavior to ductile with significant improvement in flexural, compressive strength. For curing, temperature was fixed at room temperature for 24 hours. The concrete specimens were tested for mechanical properties of concrete namely cube compressive strength, flexural strength, & other tests were conducted for cement, chemical admixture, coarse aggregate & fine aggregate. In this project we try to overcome the problem like cost of concreting and shear crack development. The specimen shall be tested by four point loading in flexural test machine.

Keywords
Fly ash, alkaline activator, Polypropylene fibre.

1. INTRODUCTION
Geopolymer is the world’s most versatile, durable and reliable construction material. Large quantities of Portland cement are required for Geopolymer. The consumption of Ordinary Portland Cement (OPC) causes pollution to the environment due to the emission of CO2. Geopolymer Concrete was introduced to reduce environmental pollution that causes by production of Portland cement.
In 1978, Professor Joseph Davidovits introduced the development of mineral binders with an amorphous structure, named geopolymers. Davidovits (1988; 1994) proposed that an alkaline liquid could be used to react with the silicon (Si) and the aluminum (Al) in a source material of geological origin or in by-product materials such as fly ash and rice husk ash to produce binders.

1.2 Geopolymer
Geopolymer is an inorganic alumino-silicate polymer synthesized from predominantly silicon and aluminium materials of geological origin or by-product materials such as fly ash. Geopolymer-based materials are environmentally friendly, and need only moderate energy to produce. They can be made using industrial by-products, such as fly ash, as the source material. In geopolymer Concrete, the geopolymer paste serves to bind the coarse and fine aggregates, and any un-reacted material. Geopolymer Concrete can be utilized to manufacture precast Concrete structural and nonstructural elements, to make Geopolymer pavements, to immobilize toxic wastes, and to produce Geopolymer products that are resistant to heat and aggressive environments.

1.3 Material used in Geopolymer
Casting the ferrocement beam and ferrocement beam having partial replacement of aggregate with cork and rubber powder. The beam having a size of 150*150*1200mm and testing it for flexure with the help of suitable equipment’s. The purpose of this investigation is to make a structure vibration free by using anti-vibration materials. Finally compare the result of ferrocement beam with ferrocement beam having partial replacement of aggregate with cork and rubber powder.

- Fly ash- Fly ash is the waste material produced in blast furnace. Components of fly ash are amorphous composition (60%), quartz (20%), mullite (17%), maghemite (1.7%) and hematite (.9%). Fly ash is commonly used as a substitute for OPC in Geopolymer and the addition of it provides; Fly ash consists of spherical particles which improve the workability of the fresh OPC Concrete. This enables one to reduce the amount of water in the mix which reduces the amount of bleeding of OPC Geopolymer. Improves mechanical properties such as compressive strength, due to the water reduction and ensures a higher reactivity and better “packing” of particles.
- Alkaline activator- According to Prof. J. Davidovits the alkaline liquid should be made prior to one day before mixing because at the time of mixing of Na2SiO3 with NaOH solution it generates a huge amount of heat and the polymerization takes place by reacting with one another, which will act as a binder in the geopolymer Concrete.
- Aggregate- Coarse aggregates & Fine Aggregate used in case of cement Geopolymer can be used in case of Geopolymer Concrete (GPC) also where the coarse aggregate should conform to IS-383-1970.

To perform strength comparison between cork and rubber used in concrete.

1.4 Objective
- To study the flexural strength of Geopolymer beam.
- To achieve flexural strength by using artificial polypropylene fiber.
• By using carbon nano tube for curing of FRGPC beam to avoid effect of temperature variation.
• Comparative study of A.F. in Geopolymer with conventional Concrete.
• To achieve economy by use of optimum percentage of FA and GGBS in Geopolymer.

1.5 Advantages

• Geopolymer concrete has low carbon emission.
• Sustainable construction is the one of best advantage of geopolymer concrete.
• It has longer service life
• Because of low CO2 emission it reduce global warming potential
• It can be reuse so reduction of virgin materials usage
• For binder like NaOH & Na2SiO3 we can use recycled industrial waste
• GPC uses fly ash i.e waste from thermal industry so it is cost saving.

1.6 Research Gap

• Till not much research was carried out in the field of using A.S.F
• Carbon nano tube in geopolymer concrete beam curing is not much done.
• Use of cold steel fibre is not much done in beam.
• Optimum percentage of FA and GGBS has not been encountered.
• Cost of concreting is more.
• flexural strength increase, there is large variation in elasticity of concrete due to this shear crack are developed

2. METHODOLOGY

2.1 Material Collection:-
Fly Ash:-
Fly ash used in the GPC from the thermal power plant eklahare

Fine Aggregate:-
Natural river sand used as fine aggregate.

Coarse aggregate:-
Crushed stone of size 20 mm were used as coarse aggregate.

Water:-
Fresh or portable water used to hydrate the fly ash in the mixture.

Alkaline activator:-
Sodium silicate (Na2SiO3) & Sodium Hydroxside (NaOH) as binder in geopolymer Concrete.

2.2 EXPERIMENTAL PROGRAM AND TESTING OF MATERIALS

2.1.1 Test on Fly Ash
To know the quality of coarse material present in cement sample. As per IS 269-1976, the fineness of cement should not exceed 10% by weight in case of OPC, and should not exceed 5% for rapid hardening cement. Fineness of fly ash = 3%

2.1.2 Test on Coarse Aggregate
To know the toughness of aggregate.
It should not exceed 30% for wearing surface and 45% for other Geopolymer work.
Impact value = 10.38%

2.1.3 Crushing Value
To find resistance offered by aggregate against gradually applied load. It should not exceed 30% for wearing surface & 45% for other Geopolymer work.
Crushing value = 3.17%

2.2.4 Experimental Procedure
The experimental procedure of concrete units consists of:
• Mixing of ingredients of concrete
• Placing of concrete
• Compaction of concrete
• Finishing of concrete
• Curing
• Testing

The Following mentioned two procedures are very important and having risk in handling chemicals.

Mixing Of Ingredients of Concrete:- Dissolve 520gm of NaOH pellets in one liter of distilled water to produce a 13M concentration of NaOH solution. The Sodium hydroxide solution is prepared 24 hours before use in the concrete mix because the temperature of the solution rises after pellets of NaOH dissolved in water. Hence it is important to cool the solution at room temperature, and then it can be used. Thus prepared the sodium hydroxide solution is mixed along with sodium silicate solution to obtain decided AAS. Then for about three minutes solid constituents of geopolymer concrete mix i.e. fly ash, fine & coarse aggregates, are dry mixed. AAS then thoroughly applied for four minutes to dry mix to achieve a homogeneous mix.

Placing of concrete:- Prior to pouring of concrete in the moulds, the inner surfaces of the moulds were coated with a thin film of oil to prevent the concrete from adhering to the mould. All the moulds were filled with concrete in 3 layers.

Casting Schedule
3. Test Results

3.1 Compressive Strength Test
Reference- IS:516 – 1959
Material- Concrete cubes size 150 mm x 150 mm x 150 mm
Apparatus- compression testing machine

<table>
<thead>
<tr>
<th>Mixture id</th>
<th>No of test specimens to be casted</th>
</tr>
</thead>
<tbody>
<tr>
<td>(% of PD)</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>0.25</td>
<td>3</td>
</tr>
<tr>
<td>0.5</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

3.2 Splitting

<table>
<thead>
<tr>
<th>Mixture id</th>
<th>No of test specimens to be casted</th>
</tr>
</thead>
<tbody>
<tr>
<td>(% of PD)</td>
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<td>0</td>
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</tr>
<tr>
<td>0.25</td>
<td>3</td>
</tr>
<tr>
<td>0.5</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

3.3 Splitting Tensile Strength Test
Material- Concrete cylinders of 150 mm diameter and 300 mm height
Apparatus- Universal Testing Machine

Table No 1 Universal Testing Machine

<table>
<thead>
<tr>
<th>% OF PPF</th>
<th>Splitting tensile strength (N/mm²)</th>
<th>Avg. strength</th>
<th>% change in strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cube 1</td>
<td>3.61</td>
<td>4.66</td>
<td>3.87</td>
</tr>
<tr>
<td>Cube 2</td>
<td>4.10</td>
<td>3.39</td>
<td>4.22</td>
</tr>
<tr>
<td>Cube 3</td>
<td>4.19</td>
<td>4.31</td>
<td>3.92</td>
</tr>
<tr>
<td>1</td>
<td>4.34</td>
<td>4.24</td>
<td>4.91</td>
</tr>
</tbody>
</table>

From the results it is observed that, the compressive strength is increased due to the increased in PP fibre percentage.1. The addition of a low fraction of polypropylene into geopolymers delayed the initial and final setting of the geopolymer matrixes. Because of this compressive strength values are low at initial stages. However, a further increase in polypropylene content reduced the initial setting time so that compressive strength increases.

The Split tensile strength test results of GPC cylinders with the various proportion of PP fibers at 28th days are given in Table 10. From the test results, it is observed that Split tensile strength of GPC is gradually increasing as the addition of PP fiber. Polypropylene fiber influences the initial and final setting time of the geopolymers. So that initial tensile strength values are low. Further increase in polypropylene fiber up to some extent decreases settling time and increases the tensile strength.
3.4 Flexural Strength Test

Table 2 Flexural Strength Test

<table>
<thead>
<tr>
<th>% OF PPF</th>
<th>Flexural strength test (N/mm²)</th>
<th>Avg. strength</th>
<th>% change in strength</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cube1</td>
<td>Cube 2</td>
<td>Cube 3</td>
</tr>
<tr>
<td></td>
<td>0.25</td>
<td>6.42</td>
<td>6.24</td>
</tr>
<tr>
<td>0.5</td>
<td>6.33</td>
<td>6.87</td>
<td>6.9</td>
</tr>
<tr>
<td>1</td>
<td>7.88</td>
<td>7.19</td>
<td>7.98</td>
</tr>
</tbody>
</table>

The results of Flexural strength test are show that the increased in percentage of polypropylene fiber increase the flexural strength.

CONCLUSION

After studying several test result of different specimen ranging in PP fibre content from 0% to 1% the following conclusions are deduced:

- Geopolymer concrete with PP fibre is best alternative to conventional cement concrete.
- The addition of Polypropylene Fibre into the geopolymer concrete increase the flexural strength as increase in percentage of PP fiber.
- It also increase the compressive as well as split tensile strength of geopolymer concrete.
- The flexural strength of FRGPC increased by 26.52 % for 1% of addition of PP fibre as compred to Conventional GPC.
- Fly ash based geopolymer concrete reinforced with fly ash can substitute the conventional concrete for the precast products where curing conditions can be maintained.

REFERENCES


