Table 2: Compressive Strength of mixes with varying molarity

Molarity	Compressive strength (N/mm^2)
10M	27.55
12M	28.17
14M	26.86

Table 3: Mix Designation

Designation	Fly ash (%)	GGBS (%)	Steel Fibre (%)
GPC	50	50	0
SFRGPC1	50	50	0.1
SFRGPC2	50	50	0.25
SFRGPC3	50	50	0.50
SFRGPC4	50	50	0.75

Table 4: Quantities Of Ingredients Used For Mix Proportions

Particulars	**Quantity (kg/m^3)**
Flyash	550
GGBS	200
Fine aggregate	550
Coarse aggregate	1250
NaOH	16
Na_2SiO_3	95
Water	50

3.2 Specimen Details

Cubes of size 150mm x150mm x 150mm for compressive strength test, cylinders of 150mm diameter and 300 mm and height for splitting tensile strength and beams of size 500mmx100mmx100mm

Table 5: Specimen Details

Mix Designation	Cube	Cylinder	Beam
GPC	6	3	3
SFRGPC1	6	3	3
FRGPC2	6	3	3
SFRGPC3	6	3	3
SFRGPC4	6	3	3
TOTAL	**30**	**18**	**18**

3.3Fresh Properties of concrete

3.3.1Compacting Factor Test

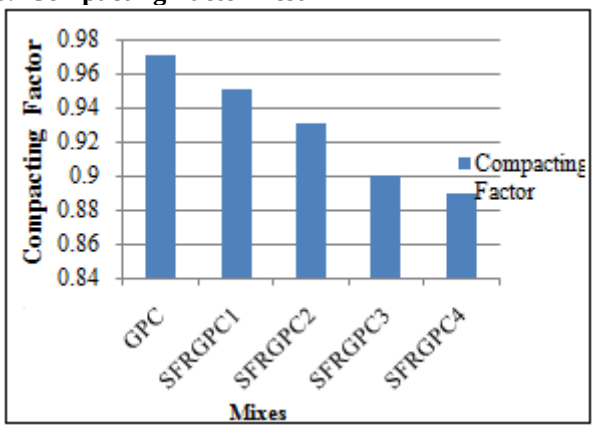

Figure 3: Compactig Factor

3.4 Hardened Properties Of Concrete

3.4.1 Cube compressive strength

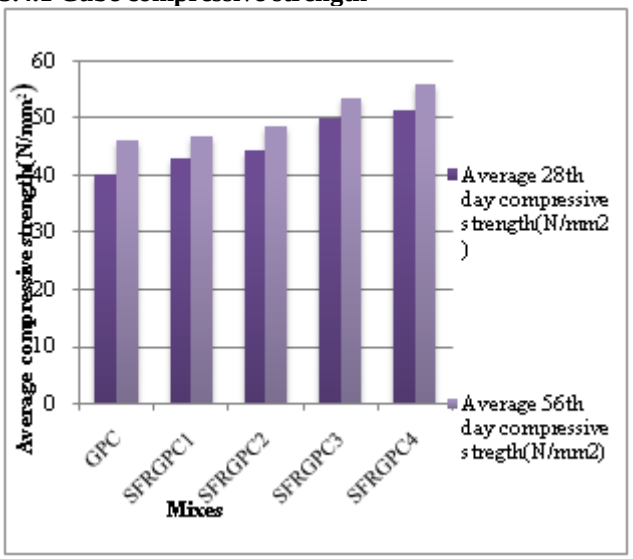

Fig 4 Cube compressive strength

3.4.2 Splitting tensile strength

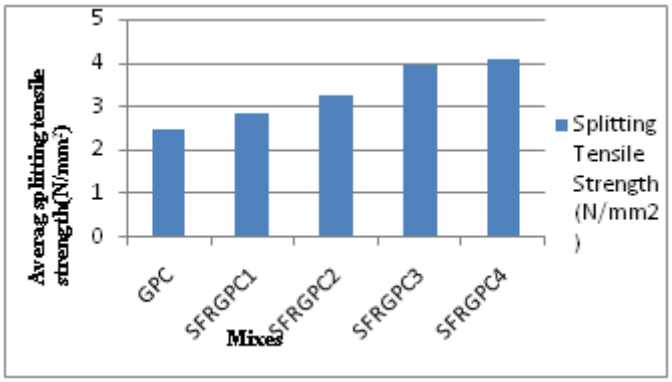

Figure 5: Splitting tensile strength

3.4.3 Flexural strength

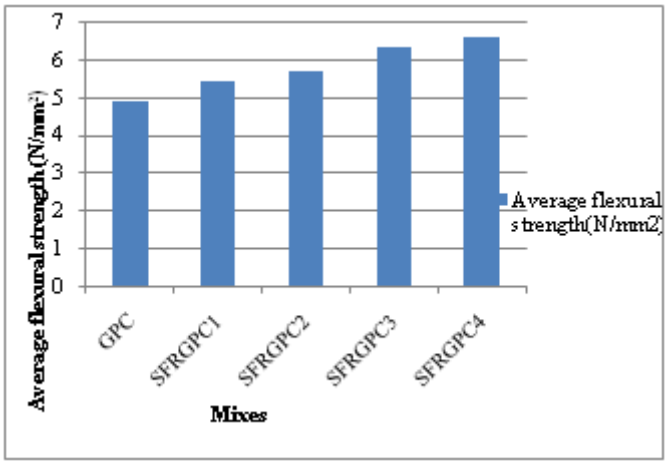

Figure 6: Flexural strength

From this the optimum is choosen as SFRGPC3 ie, Optimum fibres taken as 0.5% as further increase resulted in poor workability. In this optimum mix polypropylene fibre is added at varying percentages of steel fibre from 10 to 40 with the optimum steel fibre kept constant.

4. Mix Design for Hybrid Fibre Reinforced Geopolymer Concrete (HFRGPC)

Hybrid fibre reinforced geopolymer concrete (HFRGPC) was obtained by adding optimum steel polypropylene fibre in different proportions of steel fibre as 10 to 40%, on to GPC. Crimped steel fibres having diameter 0.50 mm and length 25 mm (aspect ratio 50) and polypropylene fibres of 12 mm length were used.

4.1 Specimen Details

From each mix, 30 cubes of size 150 mm x150 mm x150 mm to determine the compressive strength, 18 cylinders of size 150mm diameter and 300mm height to determine splitting tensile strength and 12 beams of size 500mmx100mmx100mm to determine the flexural strength were also cast in addition to columns.

Table 6: Mix Designations For Different Mixes

Sl. No.	Mix Designation	Mix Details
1	GPC	Control Mix1
2	SFRGPC3	Control Mix2
3	HFRGPC1	0.5% steel fibre and polypropylene fibre in 10% of steel fibre
4	HFRGPC2	0.5% steel fibre and polypropylene fibre in 20% of steel fibre
5	HFRGPC3	0.5% steel fibre and polypropylene fibre in 30% of steel fibre
6	HFRGPC4	0.5% steel fibre and polypropylene fibre in 40% of steel fibre

Table 7: Specimen Details

Mix Designation	Cube	Cylinder	Beam
GPC	6	3	3
SFRGPC3	6	3	3
HFRGPC1	6	6	3
HFRGPC2	6	3	3
HFRGPC3	6	3	3
HFRGPC4	6	3	3
Total	**30**	**18**	**18**

4.2 Tests on specimens

Testing of concrete specimens plays an important role in controlling and confirming the quality of concrete. All the specimens cast were subjected to testing in order to study the effect of replacement of cement with constant amount of flyash and GGBS in the geopolymer concrete at ambient temperature on workability, strength

1. Study on workability
- Compacting factor test

2. Study on strength
- Compressive strength test
- Splitting tensile strength test
- Flexural strength test

5. Results and Discussions

The study on fresh properties of concrete, mechanical properties of concrete are discussed in this chapter.

5.1 Test On Fresh Properties Of Concrete

The values obtained are shown in fig 7. It was found that the value of fresh properties goes on changing with the addition of fibres. As the percentage of polypropylene increases, the fresh properties go on decreasing.

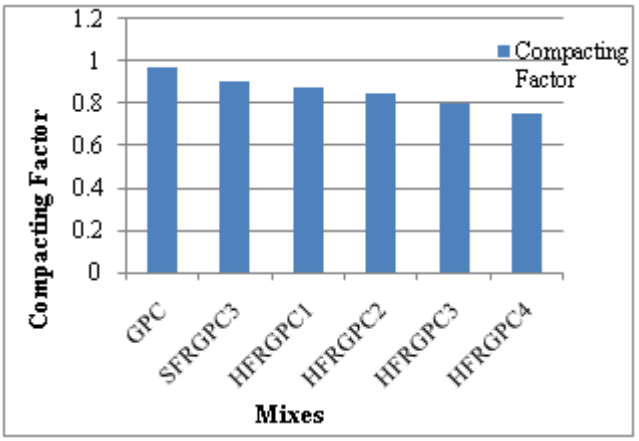

Figure 7: Compacting Factor

5.2 Cube Compressive Strength

Compressive strength of all concrete mixes was determined at 28 and 56 days of curing. Comparing to GPC, HFRGPC2 has showed an increase in strength of 40% at 28 days and 37% at 56 days. Comparing to SFRGPC3, HFRGPC3 has showed an increase in strength of 20% at 28 daysand 24% at 56 days. From the compressive strength test, HFRGPC3 was obtained as the optimum percentage

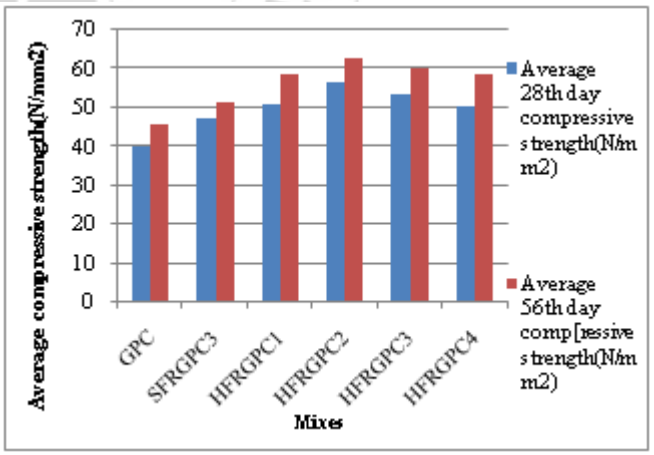

Figure 8: Compressive Strength Of Concrete

5.3 Splitting Tensile Strength

The test results are given in Table 5.3.. Percentage increase in strength of HFRGPC3 was 70% when compared to GPand 7% compared to SFRGPC3

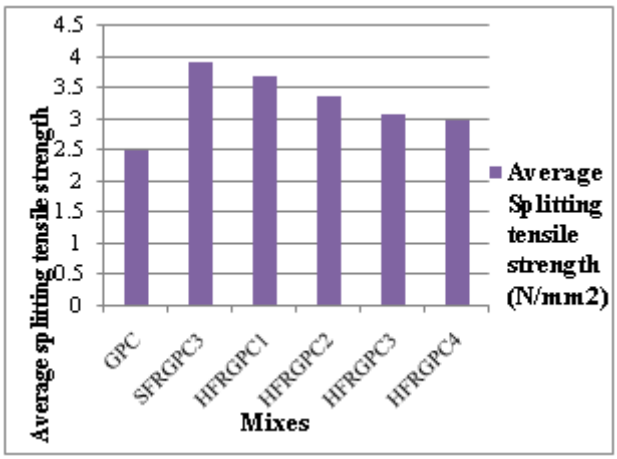

Figure 9: Splitting Tensile Strength

5.3 Flexural Strength

Percentage increase in strength of HFRGPC3 was 42% when compared to GPC and23 % compared to SFRGPC

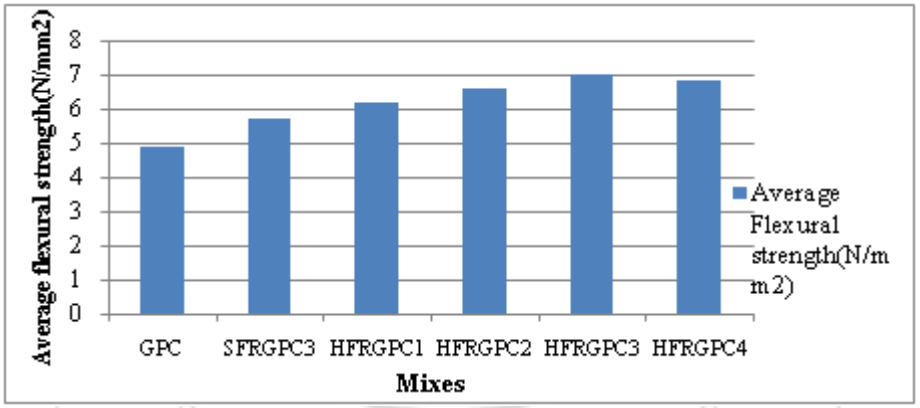

Figure 10: Flexural Strength

6. Conclusions and Scope

6.1 Conclusions

An experimental investigation was carried out to study the effect of steel fibres and polypropylene fibres on the compressive strength, splitting tensile strength and flexural strength are discussed here.

- When fibre is added to concrete, the mix becomes stiff. So the workability is decreased with addition of fibre. The workability can be improved by adding super plasticizer to some extent.
- In the case of SFRGPC mixes, the mix obtained by the addition of steel fibre in 0.5% of total volume was taken as the optimum mix
- Geopolymer technology encourages recycling of waste & finally it will be an important step towards sustainable concrete technology.
- Geopolymer technology not only contribute to the reduction of greenhouse gas emissions but also reduces disposal costs of industrial waste.
- There is an increase in early age compressive strength due to the addition of fibre in concrete. Comparing to GPC, HFRGPC3 has showed an increase in strength of 40% at 28 days and 37% at 56 days. Comparing to SFRGPC3, HFRGPC3 has showed an increase in strength of 20% at 28 days and 24% at 56 days.
- Percentage increase in splitting tensile strength of HFRGPC3 was 70% when compared to GPC and 7% compared to SFRGPC3.
- Percentage increase in flexural strength of HFRGPC3 was 49 % when compared to GPC and 23% compared to SFRGPC3

6.2 Scope

- The work can be extended by varying different parameters like aspect ratio of fibres ,different combination of fibre.
- This study can be extended to find the crack patterns of beam column joint and durability properties of geopolymer concrete

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