Fiber Reinforcement to Increase the Strength of Concrete using Fly Ash

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Abstract: In this paper that we have prepared, Hybrid fibre reinforced concrete being a irrelatively new construction material is considered as ia special type of fibre reinforced concrete. Laboratory iand field experiments have shown HFRC to be a unique construction material possessing high compressive, flexural and tensile strength. Because of it's higher strength and ductility, the composite has excellent potential for structural application in serve +service situations where conventional concrete do not perform satisfactorily.
Keywords: - Fly Ash, Concrete, Fibre, Strength.

1 INTRODUCTION

When the coal is burnt in the power plant it turns into a fine powder and this is produced in the power plant which we call as fly ash. It contains aluminum and silicious products, which when mixed with water takes the form of cement. In this calculation it can equal Portland cement so we can say when it is mixed with water. Whenever it is added to the concrete mix, it imparts strength and can help to improve it. Fibre Reinforced Concrete :- The concrete contains fine or fine and coarse aggregates prepared with hydraulic pressure, provide brittleness while applying tensile load. The mechanical properties of concrete can be improved as reinforcement with randomly oriented short discrete fibers that prevent the propagation of cracks or prevent propagation. Its performance obviously depends on how the fiber is found, such as the fiber geometry, concentration, orientation, and distribution of the fiber.
Some applications of fly ash and Fiber reinforce

Fly Ash
We can say that it is friendly with an environment. Use as an admixture and produce high strength It uses as prime material in many cement products like bricks, concrete blocks etc. Its use in wide range in pcc or Portland cement concrete pavements
Fiber reinforce
It is used in place of steel in concrete blocks. They are nonhazardous and renewable. We can use natural fibers like bamboo, jute, coconut husk, elephant grass etc.

Types of Fly Ash

- Class – C
- Class - F

Type of Fibre:-

- Good adhesion within the matrix.
- Adaptable elasticity modulus (sometimes higher than that of the matrix)
- Compatibility with the binder, which should not be attacked or destroyed in the long term.

Being sufficiently short, fine and flexible to permit mixing, transporting and placing.

2 Results and discussions

Table 2 Compressive Strength (56 days)

MIX	Fibre Mix Proportion by Volume (%)		Fibre vol. fraction (%	56 Days Compressive Strength (MPa)			
	SF	PPF		S1	S2	S3	Average
MX 1	0	0	0	43.6	44.1	44.3	44.2
MX 2	0	100	0.75	39.1	39.8	38.2	39.03
MX 3	25	75	0.75	41.5	43.6	43.1	42.7
MX 4	50	50	0.75	49.6	50.1	49.6	49.7
MX 5	75	25	0.75	51.5	56.9	51.4	53.5
MX 6	100	0	0.75	45.4	50.2	46.6	47.4

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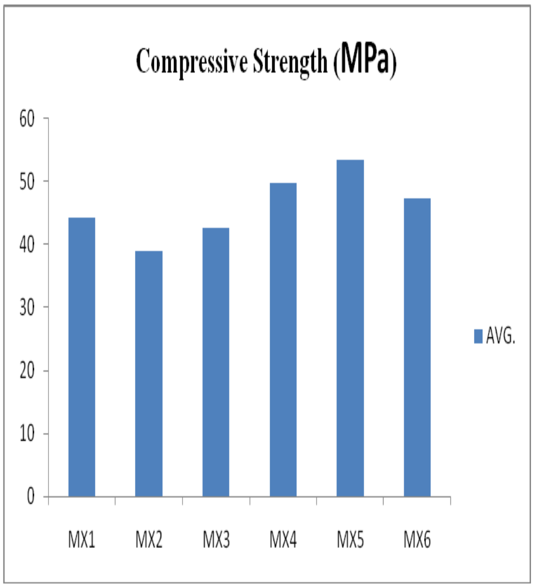

Fig 2 Compressive Strength (56 days)

The results of the compressive strength test conducted on HFRC containing different combinations of steel and polypropylene fibres are presented in table 4.1 and 4.2 for 28 days and 56 days strength respectively. Strength of plain concrete is also shown in the table for reference. It is observed that with the introduction of 100% polypropylene fibres to the plain concrete, the compressive strength drops to 40.3MPa from 35.06MPa and 44.2 MPa to 39.03 MPa resulting in approximately 10% reduction. That is with the introduction of less quantity of steel fibre content there is considerable reduction in compressive strength properties. However, an increase in the compressive strength of fibrous concrete is observed with the addition of steel fibres to the mix and maximum compressive strength is obtained for concrete containing 75% steel fibres+25% polypropylene fibres. In general, there is an increase in compressive strength varying from 6% to 18% on addition of fibres to concrete and in this investigation also with the optimum fibre combination of 75% steel fibres 25% polypropylene fibres for which the maximum increase in compressive strength of 18% over plain concrete is observed. But with adding 0.75% of fibre instead of 1% there is little increase in compressive strength compared to 1% fibre content in case of 75% steel and 25% olypropylene composition. Further, it can also be seen that the compressive strength of concrete mix containing 50% steel fibres 50% polypropylene fibres is higher than that of concrete mix containing 100% steel fibres. The percentage increase/decrease in compressive strength of HFRC over plain concrete is presented in table 4.1 and 4.2.

2 Split Tensile Strength

Split Tensile Strength test were conducted on total 36 specimen for six different mixes and the results were carried out by taking an average from three test specimen for each mix.

Table 3 Split Tensile Strength (28 days)

MIX	Fibre Mix Proportion by Volume (%)		Fibre Vol. Fraction (%	28 Days Split Tensile Strength (MPa)			
	SF	PPF		S1	S2	S3	Average
MX 1	0	0	0	4.2	4.6	4.4	4.4
MX 2	0	100	0.75	4.9	5.4	5.3	5.2
MX 3	25	75	0.75	6.2	6.9	6.4	6.5
MX 4	50	50	0.75	7.8	8.7	8.5	8.4
MX 5	75	25	0.75	10.1	9.7	9.8	9.8
MX 6	100	0	0.75	11.2	10.5	11.4	11.1

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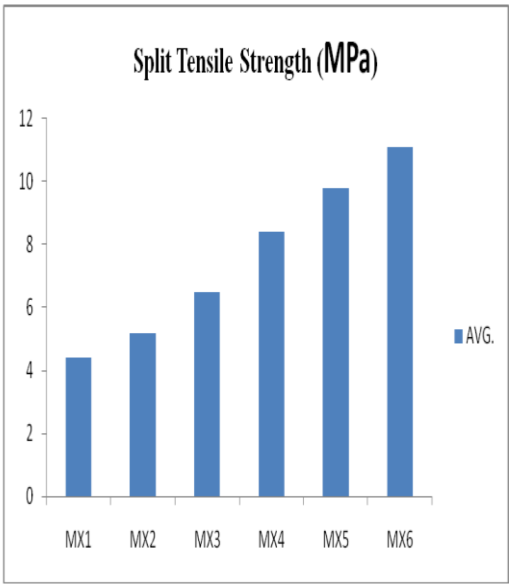

Fig 3 Split Tensile Strength (28 days)

Table 4 Split tensile Strength (56 days)

MIX	Fibre Mix Proportion by Volume (%)		Fibre vol. Fraction (%	56 Days Split Tensile Strength (MPa)			
	SF	PPF		S1	S2	S3	Average
MX 1	0	**0**	**0**	4.5	4.5	4.8	4.5
MX 2	0	100	0.75	5.7	5.7	5.4	5.6
MX 3	25	75	0.75	7.4	6.9	7.5	7.2
MX 4	50	50	0.75	9.2	9.5	8.9	9.2
MX 5	75	25	0.75	10.4	10.6	10.7	10.5
MX 6	100		0.75	11.8	11.6	12.1	11.8

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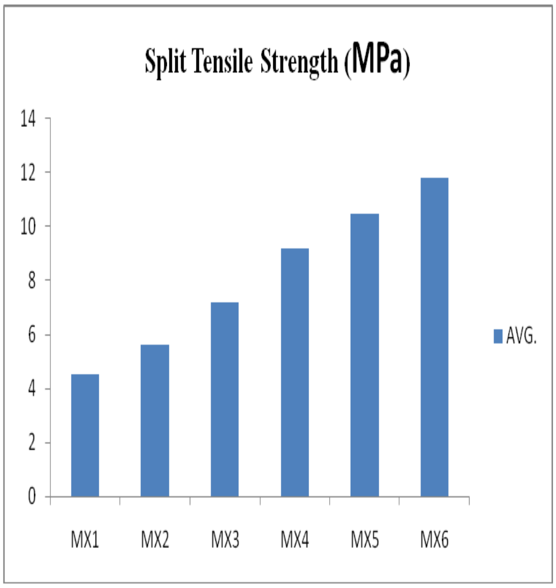

Fig 4 Split Tensile Strength (56 days)

The results of the spilt tensile strength test conducted on HFRC containing different combinations of steel and polypropylene fibres are presented in table 4.3 and 4.4 for 56 days curing strength. The 28 and 56 days spilt tensile strength of plain concrete is also shown in the table for reference. It is observed that with the introduction of 100% polypropylene fibres to the plain concrete, the spilt tensile strength increases from 4.4 MPa to 5.2 MPa and 4.5 MPa to 5.6 MPa resulting in approximately increase of 18%. There is increase in the split tensile strength of fibrous concrete is observed with the addition of steel fibres to the mix and maximum split tensile strength is obtained for concrete containing100% steel fibres. In general, there is an increase in spilt tensile strength varying from 18% to 160% on addition of fibres to concrete and the optimum fibre combination is 100% steel fibres 0% polypropylene fibres for which the maximum increase in spilt tensile strength of 160% over plain concrete is observed. There is no considerable effect of polypropylene fibre on tensile strength. The percentage increase/decrease in spilt tensile strength of HFRC over plain concrete is presented in table 4.3 and 4.4.

3 Flexural Strength

Flexural Strength test were conducted on total 36 specimen for six different mixes and the results were carried out by taking an average from three test specimen for each mix.

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Table 5 Flexural Strength (28 days)

MIX	Fibre Mix Proportion by Volume (%)		Fibre Vol. Fraction (%	28 Days Flexural Strength (MPa)			
	SF	PPF		S1	S2	S3	Average
MX 1	0	0	0	4.3	4.2	4.9	4.4
MX 2	0	100	0.75	3.4	3.5	4.3	3.7
MX 3	25	75	0.75	6.1	6.0	5.8	5.9
MX 4	50	50	0.75	6.6	6.3	6.4	6.4
MX 5	75	25	0.75	7.5	7.3	7.6	7.4
MX 6	100	0	0.75	5.5	5.4	6.5	5.8

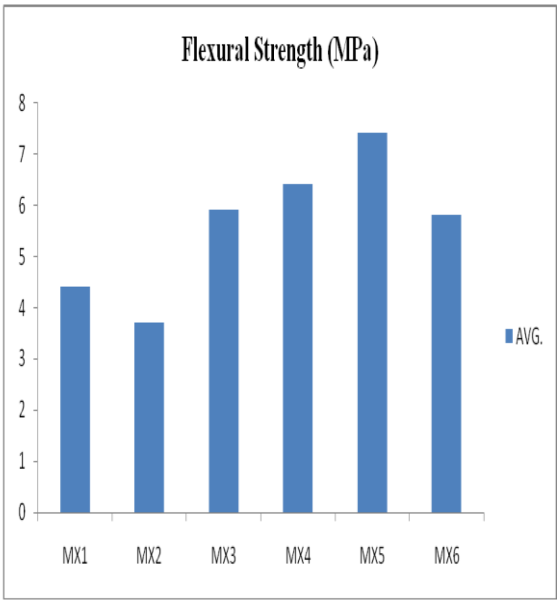

Fig 5 Flexural Strength (28 days)

Table 6 Flexural Strength (56 days)

MIX	Fibre Mix Proportion by Volume (%)		Fibre vol. Fraction (%	56 Days Flexural Strength (MPa)			
	SF	PPF		S1	S2	S3	Average
MX 1	0	0	0	5.2	4.9	5.5	5.2
MX 2	0	100	0.75	4.2	4.5	5.2	4.6
MX 3	25	75	0.75	6.8	7.2	6.8	6.8
MX 4	50	50	0.75	7.3	7.5	7.6	7.4
MX 5	75	25	0.75	8.4	8.5	8.9	8.6
MX 6	100	0	0.75	6.3	6.8	7.4	6.8

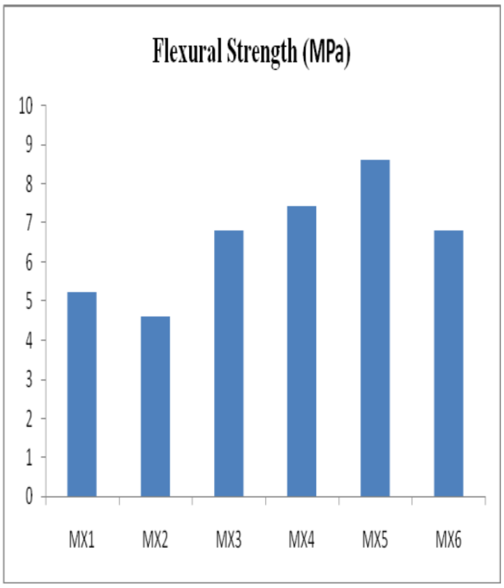

Fig 6 Flexural Strength (56 days)

The flexural strength results for HFRC containing different combinations of steel and polypropylene fibres are presented in Table 4.5 and 4.6. The flexural strength of plain concrete is also listed for reference and comparison in the table. It can be seen that in general, like compressive strength, the flexural strength of concrete containing 100% polypropylene fibres is less than that of the plain concrete. There is a drop of approximately 16% in the flexural strength of concrete containing 100% polypropylene fibres as compared to that of plain concrete. With gradual replacement of polypropylene fibres with steel fibres, an increase in the flexural strength is observed up to a fibre combination of 75% steel fibres 25% polypropylene fibres. With further replacement of polypropylene fibres with steel fibres i.e. for concrete containing 100% steel fibres, a decrease in flexural strength is observed. The increase in flexural strength taken as average of three batches of fibrous concrete containing different combinations of steel and polypropylene fibres varied from 30% to 70%, showing an increase of 34% for HFRC with 25% steel fibres 75% polypropylene fibres; 45% for 50% steel fibres 50% polypropylene fibres; 68% for concrete containing 75% steel fibres 25% polypropylene fibres and 31% for concrete containing 100% steel fibres. Thus the optimum fibre combination for maximum flexural strength is 75% steel fibres 25% polypropylene fibres as obtained in this investigation.

3 CONCLUSION

The maximum compressive strength reaches in the HFRC at 75% steel fibres and 25% polypropylene fibres because of the high elastic modulus of steel fibre and the low elastic modulus of polypropylene fibre work in perfect combination. The spilt tensile strength of fibre percentage with 100% steel fibre shows maximum increase in strength. Improved tensile strength can be achieved by increasing the percentage of steel fibres. The higher number of fibres bridging the diametrical splitting crack, the higher would be the spilt tensile strength.

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