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Experimental Study on Steel Fiber Reinforced Concrete with Partial Replacement of Cement by Flyash

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Abstract: Many research has been currently going to modify and improve the concrete properties by the addition of different types of materials. The aim of this project is to study the behavior of M35 grade of concrete with w/c of 0.45 and to determine the compressive strength of concrete when cement is replaced by fly ash with addition of steel fiber. Three different replacement levels namely 10%, 20%, and 30% of fly ash and steel fiber substitutes in concrete was 0.5%, 1.0%, 1.5% respectively. The Cubes and Cylinders are prepared for Compressive Strength and Split-Tensile Strength on the 7th day, 14th day and 28th day of curing. The concreting is done with and without the addition of steel fiber and fly ash. Slump cone test is performed on fresh concrete. Finally, we compare the conventional concrete with steel fiber reinforcement concrete to determine the increment of compressive strength.

Index Terms - **Concrete, Coarse aggregate, Fine aggregate, Water, Steel Fiber, Fly Ash, Compressive Strength, Split-Tensile Strength.**

I. INTRODUCTION

Concrete is mostly using material now a days but it is giving only less strength. So High performance concrete (HPC) has gained worldwide popularity in the present situations since 1990. In practice, high performance concrete, are generally characterized by high cement factors and very low W/C difficult to obtained proper workability, and to retain the workability for sufficiently for long period of time with such concrete mixes. Why because high quantity of water dosage reducing agents (HRWR) and then become a compulsory, with this it is giving cohesive, sticky nature and it becomes very difficult to place and compact.

The above problems shows that there is a probably a correct dosage of water content for high HRWR dosage.Its become not only necessary but also helpless and undesirable, and even harmful from a durability point .

II. LITERATURE REVIEW

i. Ahmad shah, Er. Sonia (2022) They have carried an experimental investigation on the M20 grade concrete with the mix design 1:1.48:2.74 and with the W/C ratio 0.48. In their investigation they obtained the maximum strength at the replacement of 10% of the fly ash and 1.5% of steel fibers for 28 days for compression. And for split-tensile the strength was achieved at 10% fly ash and 1% of the steel fibers. The fly ash addition helps to increases the workability.

ii. K. Srinivasa Rao et al. (2020) Proved that the optimum dosage of fly ash replacement 20%. They have performed experimental investigation on HSC (High Strength Concrete) the maximum strength was achieved at 20% of fly ash and 1.2% of steel fibers at 28 days. The crimped steel fibers are used with the aspect ratio 50mm. The fly ash based concrete will resists the acid attacks.

iii. Savita, Shwetha (2018) They proved that the addition of the steel fibers will reduce the workability of the concrete. They performed an experimental investigation on the fiber reinforced concrete. The maximum strength was achieved at 0.3% of the steel fibers for compressive strength, for split-tensile and flexural strength it was found to be 0.2% of steel fibers for 7 and 28 days of M25 grade concrete.

III. EXPERIMENTAL STUDY

MATERIALS: Cement: The cement used in this experimental investigation is Portland Pozzolanic Cement of 53 grade confirming to IS:1489 (part:1): 1991.

Fine aggregate: In the present investigations fine aggregate is natural sand obtained from near river is used

Coarse aggregate: The coarse Aggregateused in this experimental investigation is crushed granite of 12.5 mm maximum size, which was obtained from the nearby crusher facility.

Water: To mix concrete, potable tap water that complied with IS: 456 - 2000 standards and had a pH value of 7.0±1 was available in the lab.

Fly Ash: The fly ash (Class F) used in this investigation was obtained from S.I.E.L. located at Muthukuru, SPSR Nellore, Andhra Pradesh

Steel Fibers: Steel fiber is a metal reinforcement. Steel fibers which we are used in this project are very less in length, round in shape, , diameter from 0.25 to 0.75mm and aspect ratio from 20 to 100 which are dispersed with concrete at the time of mixing process.

Different tests are conducted for all the materials used for concrete composition. Physical tests were conducted on Cement of OPC 53 grade, Flyash and Steel fiber according to IS 4031 (Part 5) – 1988. We tested Fine aggregate as well as coarse aggregates physically to exhibit their properties.

From the preliminary tests conducted to concrete composition fresh concrete property tests were conducted and also to find the capability of concrete to counterattack by crushing force, compression strength test and split tensile test was carried out for casted cube specimens with Flyash and steel fiber.

IV. CONCRETING PROCESS

Concrete is most usable material in construction industry it's been required to its quality. Concrete is largely produced than all other materials. Normal concrete possesses a low tensile strength. In this project we used a materials like cement, fine aggregate, coarse aggregate, steel fibers, fly ash and water which are used to make concrete. A concrete mix made with fly ash as a partial replacement of cement M35 grade concrete with the ratios of 10% replacement , 20%replacement and 30%replacement and steel fibers with ratios of 0.5%, 1% and 2%. All the materials are weighted as per mix proportion of 1:1.38:2.37, and studied at different ages, namely 7days , 14days and 28days. This experimental investigation is determined for cube and cylinder.



V. RESULTS AND DISCUSSION

5.1 Results of Preliminary Tests for Concrete composition

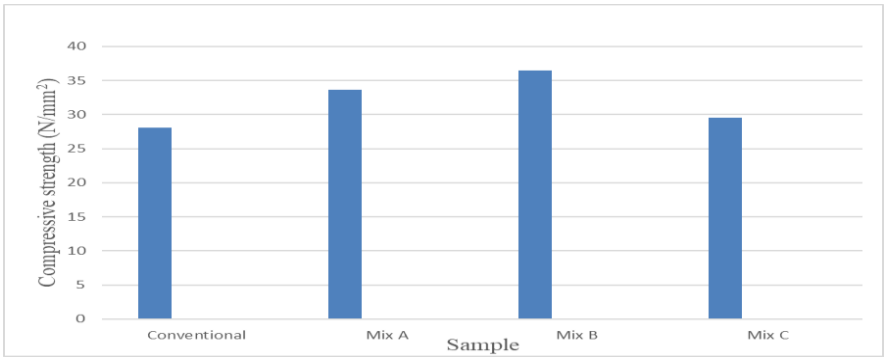
TEST	RESULT
Fineness of cement	5%
Normal consistency of cement	31%
Initial setting time	50 min
Final setting time	450 min
Specific gravity of cement	3.15
Specific gravity of fine aggregate	2.71
Specific gravity of coarse aggregate	2.63
Fly ash	2.4

Table 5.1: Test Results

Table 5.1 displayed mean, different tests conducted on cement, fine aggregate, coarse aggregate, fly ash and steel fiber. Specific gravity test conducted for cement is similar to be tested for fly ash with specific gravity bottle according to IS2720- Part3. Fine aggregate Specific gravity and coarse aggregates Specific gravity was conducted according to IS 2386 Part3 -1963.

Sl.no	Sample	fly ash %	Percentage of steel fibers	Compressive strength (N/mm^2)
1	Conventional mix	0	0	28.08
2	Mix A	10	0.5	33.6
3	Mix B	20	1.0	36.44
4	Mix C	30	1.5	29.55

Table-5.2 Compressive strength test for 7 days of curing

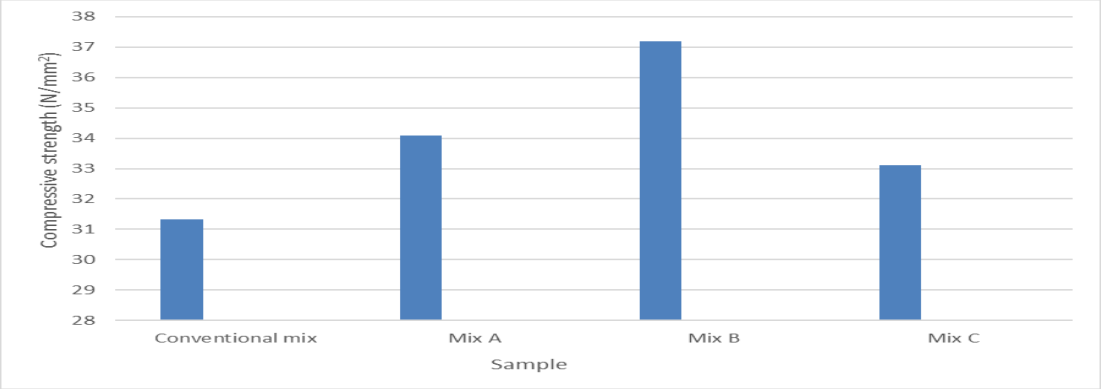


Graph-5.1 Compressive strength after 7 days of curing

From Table 5.2 and graph 5.1 displayed mean, compressive strength is increased gradually from conventional concrete to mix A and mix A to mix B and decreased from mix B to mix C.

Sl.no	Sample	fly ash %	Percentage of steel fibers	Compressive strength (N/mm^2)
1	Conventional mix	0	0	31.33
2	Mix A	10	0.5	34.08
3	Mix B	20	1.0	37.20
4	Mix C	30	1.5	33.10

Table-5.3 Compressive strength test for 14 days of curing

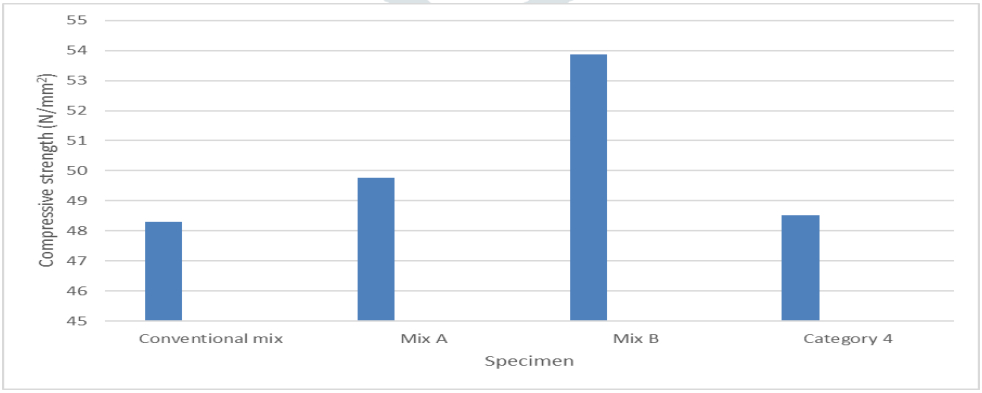


Graph-5.2 Compressive strength for 14 days of curing

From Table 5.3 and graph 5.2 displayed mean, compressive strength is increased gradually from conventional concrete to mix A and mix A to mix B and decreased from mix B to mix C

Sl.no	Specimen	Percentage of fly ash	Percentage of steel fibers	Compressive strength (N/mm^2)
1	Conventional mix	0	0	48.31
2	Mix A	10	0.5	49.77
3	Mix B	20	1.0	53.88
4	Mix C	30	1.5	48.53

Table-5.4 Compressive strength test for 28 days of curing

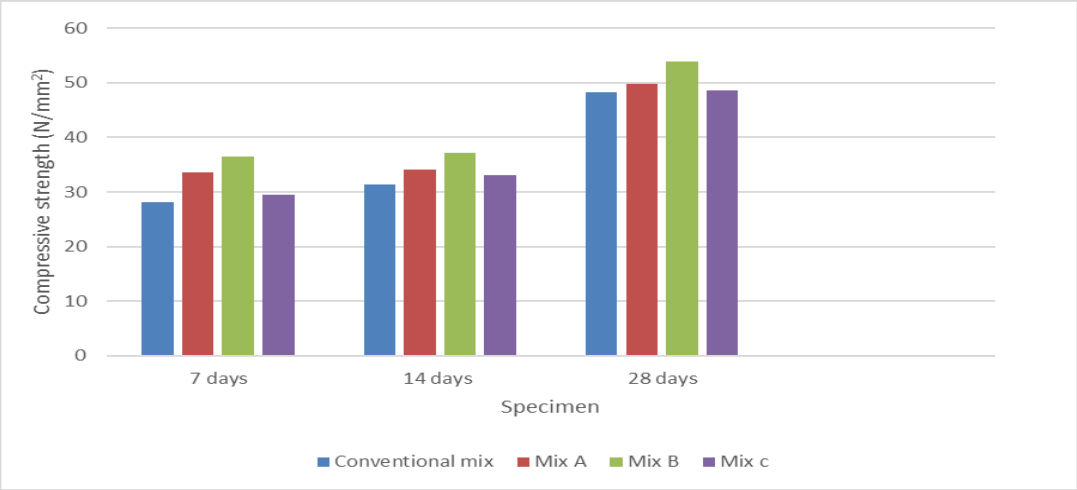


Graph-5.3 Compressive strength for 28 days of curing

From Table 5.4 and graph 5.3 displayed mean, compressive strength is increased gradually from conventional concrete to mix A and mix A to mix B and decreased from mix B to mix C

	Conventional mix	Mix A	Mix B	Mix C
fly ash%	0	10	20	30
Percentage of steel fibers	0	0.5	1.0	1.5
After 7 days curing compressive strength (N/mm^2)	28.08	33.6	36.44	29.55
14 days compressive strength (N/mm^2)	31.33	34.08	37.2	33.10
Compressive strength after 28 days curing (N/mm^2)	48.31	49.77	53.88	48.53

Table-5.5 Compressive strength test for 7, 14 & 28 days of curing

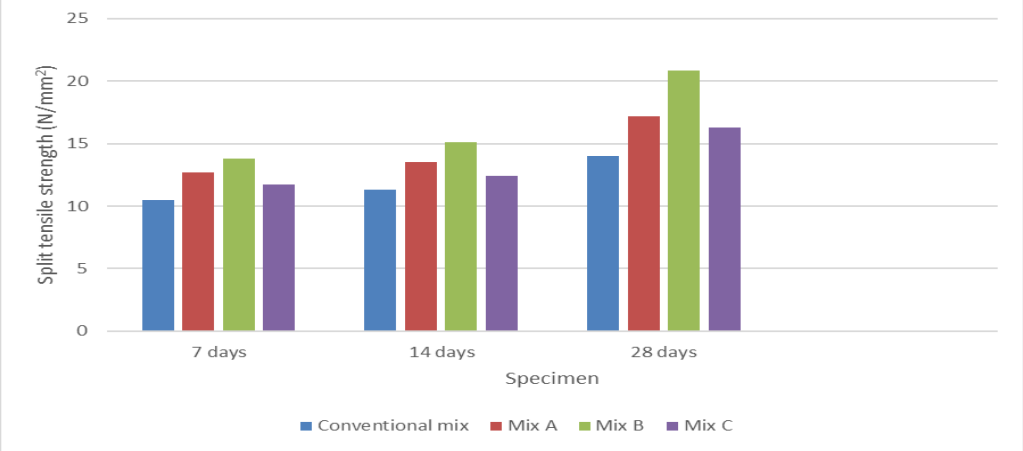


Graph-5.4 Compressive strength for 7, 14 and 28 days of curing

Finally, from Table 5.5 and graph 5.4 displayed mean, compressive strength is increased gradually from conventional concrete to mix A and mix A to mix B and decreased from mix B to mix C

	Conventional mix	Mix A	Mix B	Mix C
fly ash%	0	10	20	30
Percentage of steel fibers	0	0.5	1.0	1.5
7 days split tensile strength (N/mm^2)	10.47	12.73	13.77	11.7
14 days split tensile strength (N/mm^2)	11.30	13.53	15.12	12.42
28 days split tensile strength (N/mm^2)	14.01	17.19	20.85	16.32

Table-5.6 Split tensile strength test after 7, 14 & 28 days of curing



Graph-5.5 Split tensile strength after 7, 14 and 28 days curing

And from Table 5.6 and graph 5.5 displayed mean, split tensile strength is increased gradually from conventional concrete to mix A and mix A to mix B and decreased from mix B to mix C

VI. CONCLUSIONS:

- We observe compressive strength with addition of fly ash and steel fibers to the conventional mix by 20% and 1% gives the maximum compressive strength.
- We observed that less workable of concrete when steel fibers are added to the mix as the slump values are less when compared to conventional mix.
- The mix with high percentage of steel fibers gives high split tensile strength and high compressive strength to the mix.

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