EXPERIMENTAL STUDY ON MECHANICAL PROPERTIES OF STEEL FIBRE

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ABSTRACT

In the present study has described the study of conventional concrete using steel fibres as addition in the concrete mix. The results show that a steel fibre increases the durability of concrete and also increases the weight of concrete. In most cases, high rise buildings have been affected during earthquakes due to the higher unit weight of concrete therefore, its application is important. The use of addition in the steel fibres has great impact on developing countries as it permits design flexibility and substantial saving in the cost of construction.

Keyword: - *Steel Fibre, Compressive Strength, Slump Test, Workability, coarse & Fine Aggregate etc.*

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1. INTRODUCTION

Ecological and socioeconomic concerns have been of great concern in the production of new products and the recycling of waste water than by over the last several decades. Power plants emit solid waste such as that are environmentally harmful. Removal of them is a big issue presently. It occupies a wide stretch of approximately and has several potential consequences as well.Pond ash is a waste that is produced around solar energy from ash ponds. These micrometers earth components, Pond ash consists mainly of sulphur, metals or steel. With 75,000 acres of valuable land under the protection of abandoned rain water, the present rate of production of nuclear waste in India has crossed around 130 million tonnes per year.The present rate of ash use is approximately 35 percent, contributing to a much growing ponding region for ash storage and associated environmental impacts.On the other hand, the building of roads and road overpasses, earthen dams, abutments, or other retaining frameworks in india that need a huge number of natural soil or collates is used and a huge amount of fertile soil or natural aggregates have been soaked to fulfill this request.Because of industrial development and the shortage of organic soils availability, scientists believed that the use of heavy metals from power plants would be a substitute for soil profile, reducing the scarcity of soil profile and thus addressing environmental problems due to the deposition of by-products.Even so, pond ash usage has not gained traction leading to a shortage of adequate awareness or due to inadequate study

2. MATERIAL

2.1 CEMENT

The concrete took was 43 grade (Ultratech cement) OPC of uniform quality, adhering to IS 8112-1989. Tests were carried out for basic inertia, normal accuracy, initial and final setting period, or CS of 28 days.The results are shown in Table 3.1. All the results are within the standard limits.

Figure-1 Cement (OPC 43 Grade)

2.2 FINE AGGREGATES

Locally consolidated is the FA (river sand- Badarpur) utilized in the research investigation. In the lab, concrete mix of the FA was performed in accordance with IS 383-1970, and the findings are reported in Table 3.2.The taken sample confirms to grading Zone II (IS 383-1970, Table 4, Clause 4.3).The Fineness modulus (F.M.) of fine aggregate is 2.46; therefore it is fine sand. The grading results and physical properties of fine aggregates are shown in Table 3.3 and 3.4. Every outcomes are within the quality restrictions.

2.3 COARSE AGGREGATE

Normal weight CA of normal dimension 20 mm, informing to IS 383-1970, was utilized throughout the experimental study. The gradation of coarse aggregate by sieve analysis and physical properties of coarse aggregate is shown in Table 3.5 respectively. Every outcomes are within the quality restrictions .

Characteristics	Value
Colour	Grey
Shape	Angular
Maximum Size	20 mm
Specific Gravity	2.68
Fineness modulus	6.656

Table-1: **Properties of Aggregates**

2.4 Steel Fibres:

Cold drawing welding rod with low thermal conductivity (C) or steel wire (SS 302/ SS 304) are made of metal fibres. As per the building project, steel fibres are made in various kinds: hooked, undulated or smooth. Such fibres are utilised for reinforced concrete in building.For on-ground surfaces and sidewalks, fiber-reinforced concrete mix is often used, but could be regarded alone or with arm rebar’s for a broad variety of development components (beams, pillars, foundations and so on). Cold drawing welding rod with low thermal conductivity (C) or steel wire (SS 302/ SS 304) are made of metal fibres. As per the building project, steel fibres are made in various kinds: hooked, undulated or smooth. Such fibres are utilised for reinforced concrete in building.For on-ground surfaces and sidewalks, fiber-reinforced concrete mix is often used, but could be regarded alone or with arm rebar’s for a broad variety of development components (beams, pillars, foundations and so on).

Fig -2 : Steel Fibres

3. MIX DESIGN

A concrete mix of M30 has been designed as per the procedure given in IS: 10262-2009. Test data for materials:

Grade designation = M30

Type of Cement = OPC 43 grade confirming to IS: 8112-1989 Specific gravity of cement: 3.15

Specific gravity of coarse aggregate (CA) = 2.68 Specific gravity of FA = 2.65

Sieve analysis of coarse aggregate: Conforming to IS: 383-1970 (Clause 4.1 and 4.2, Table 2)

Sieve analysis of fine aggregate: Conforming to Zone II of IS: 383-1970 (Clause 4.3, Table 4)

4. EXPRIMENTAL PROCESS

4.1 CASTING OF TEST SPECIMENS

After mixing the ingredients (as per mix proportion), the castings were placed on the vibratory chart. The cement was then mixed in 3 levels into the moulds (correctly lubricated). To prevent syrup scouring, every layer was compressed tightly with a tamping rod. Eventually, since loading up the castings up to the full, both samples were pulsed on the plate vibrator.For 7 sec, the chart was pulsed and for all samples as well as all moulds it was kept steady.The upper surfaces were then finished smooth with the help of trowel, after concreting and compaction. The sequence of casting of the test specimens has been shown in Figure 3.7. The moulds were left undisturbed in the laboratory at room temperature for a period of 24 hours. Table 3.8 shows the ingredients used in four mixes (M1, M2, M3, M4and M5) and the number of cubes casted in each mix. In total 45 cubes were casted for the experimental study.

Fig -3: Casting of concrete cubes

4.3 TESTS ON HARDENED CONCRETE SPECIMEN

Testing of hardened concrete plays a very crucial role in controlling and confirming the quality of concrete works. This will help to know the strength and integrity of the sample. In the currently examination, materialcharacteristicslike unit weight, quality of concrete and compressive strength by destructive were determined as per relevant Indian standards

4.3.1 Destructive Test on Hardened Concrete

At the average of 7, 14 and 28 days of healing, overall, the hardened cube specimens were experimented for CS with a CTM conforming to IS 516-1959. Instantly after withdrawal from the bath, the cylinders were examined in damp conditions.The sample was put on the CTS testing framework (Figure 4.1) so that the load was formed on the surface besides the upper side as set. The force was improved and enhanced steadily till the specimen's resistance to the improving load broke down and no higher load was maintained It found that the average load implemented to the failure. Given the compressive power, the ultimate force imposed is separated by its cross sectional region. 3 samples were taken every day on average (7, 14 and 28 days) or the findings were reported.

Fig -4: Testing of Concrete Cubes

The compressive strength test result and percentage reduction in compressive strength for multiple concrete combines is organized in Table 4.2, after curing period of 7, 14 and 28days. The value ranges from 33.51 to 36.56 for concrete mix M1 to M5 respectively for 28 days of curing. Figure 4.2-4.7 clearly shows that 7, 14 & 28 compressive strength increased gradually as percentage of steel fibers1 is increased. It was observed that the increment of compressive strength of concrete specimen at 28 days was found to be 5.97%, 9.64% 11.9% and 15.4% for M2, M3, M4 and M5 respectively. The enhancement in CS is because of the adding of steel fibers with different percentages of steel fibers dosage. Thus, with the increase in percentage of steel fibers as added in the design mix there is improvement in CS or unit weight of cubes also.

Concrete Mix Designation	Days	Compressive Strength	Avg. Compressive Strength	Effect on compressive strength (%)
M-1 (Conventional)	7	22.16	22.30	0
		22.26		
		22.49		
	14	25.73	24.57	0
		25.45		
		22.54		
	28	31.92	31.62	0
		31.16		
		31.78		

M-2	**7**	**23.95**	**23.87**	**7.04**
		23.62		
		24.05		
	14	**26.13**	**26.45**	**7.65**
		26.34		
		26.89		
	28	**33.12**	**33.51**	**5.97**
		33.65		
		33.76		
M-3	**7**	**24.78**	**25.32**	**13.54**
		25.72		
		25.46		
	14	**26.92**	**27.50**	**11.92**
		27.54		
		28.05		
	28	**35.02**	**34.67**	**9.64**
		34.97		
		34.01		
M-4	**7**	**26.16**	**26.06**	**19.28**
		25.96		
		26.08		
	14	**27.76**	**28.06**	**14.20**
		28.98		
		27.45		
	28	**35.12**	**35.40**	**11.9**
		35.76		
		35.34		

M-5	7	28.76	28.36	27.17
		28.34		
		27.98		
	14	29.36	29.76	21.12
		29.87		
		30.05		
	28	35.78	36.50	15.4
		36.98		
		36.76		

4.3.2 Unit weight of Concrete:

Sr. No.	Concrete Mix	Weight (Kg)
1.	M1	8.26
2.	M2	8.31
3.	M3	8.35
4.	M4	8.39
5.	M5	8.43

Table-2: Unit weight of Concrete:

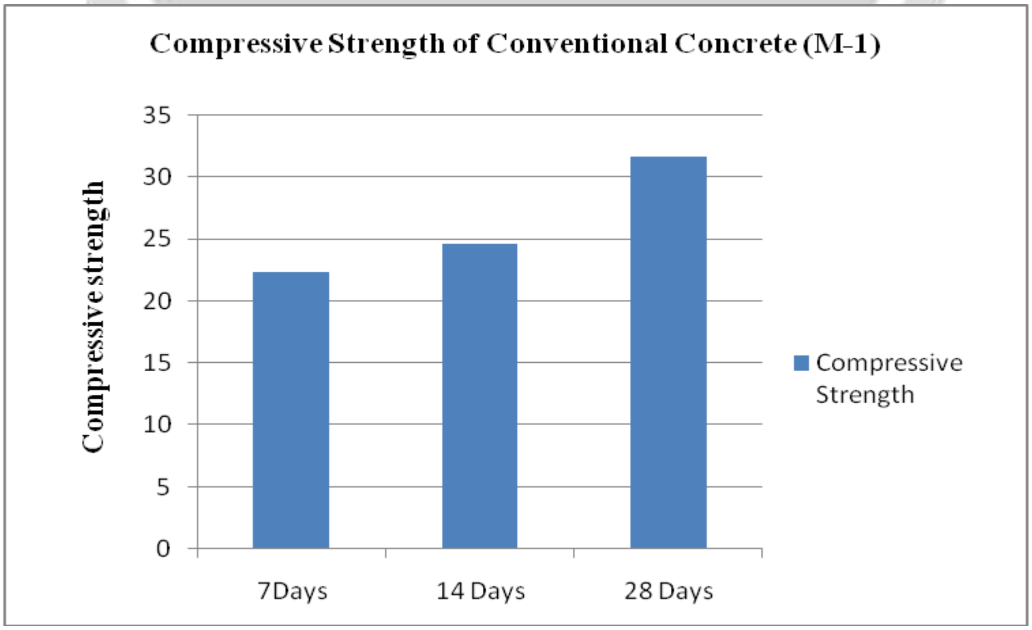

Fig -5: Compressive strength results of M-1 mix

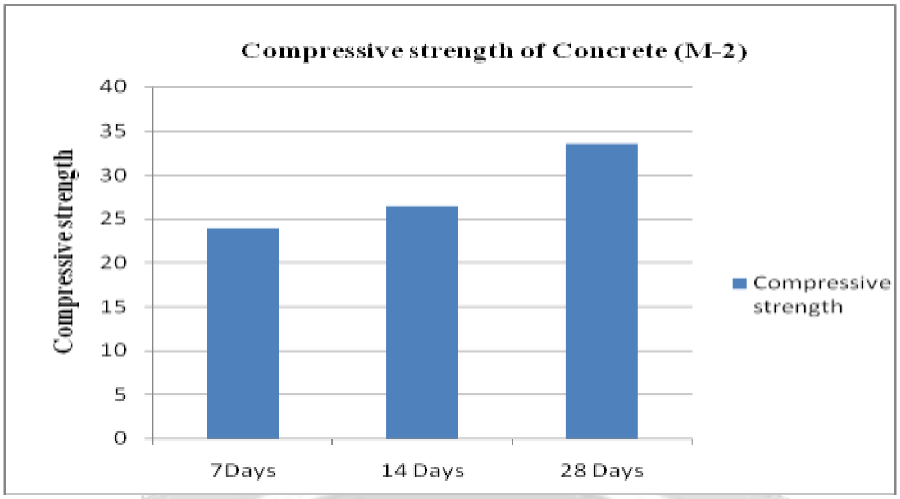

Fig -6: Compressive strength results of M-2 mix

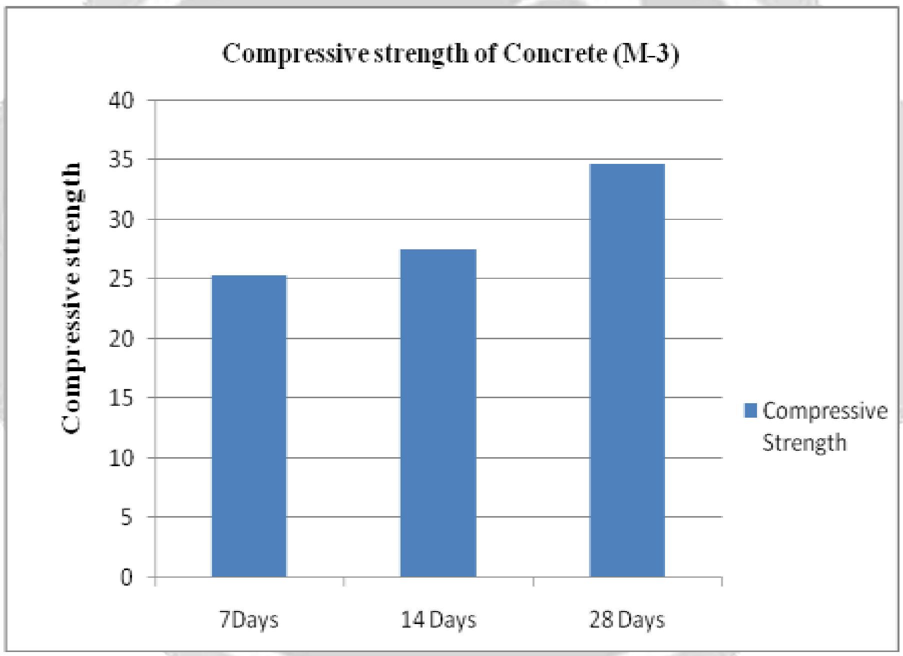

Fig -7: Compressive strength results of M-3 mix

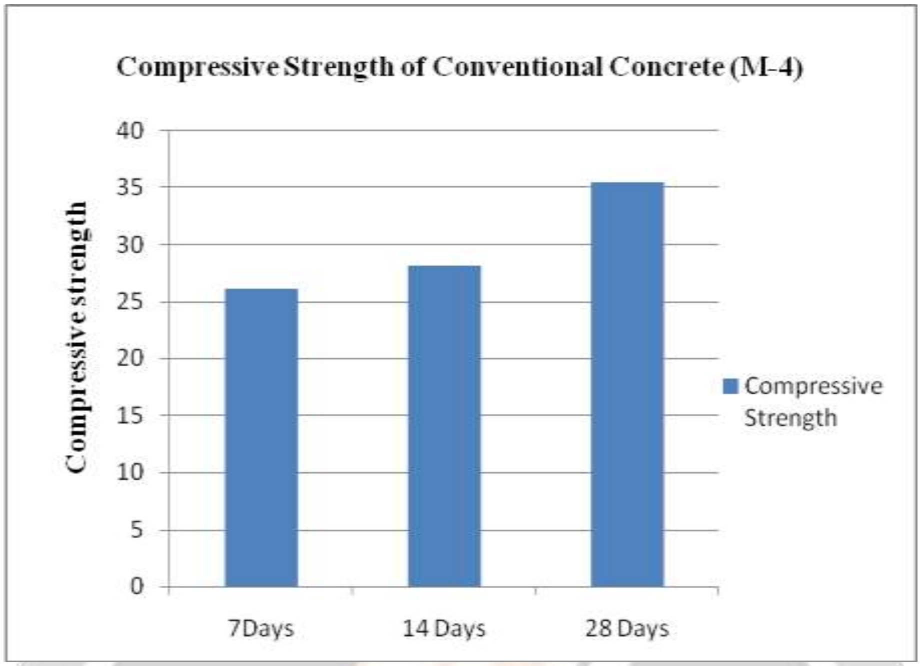

Fig -8: Compressive strength results of M-4 mix

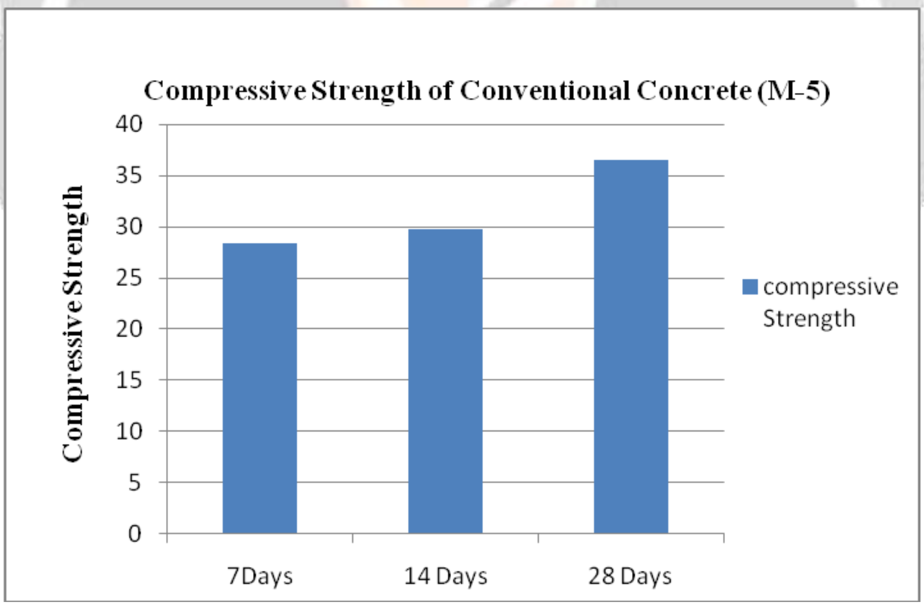

Fig -9: Compressive strength results of M-5 mix

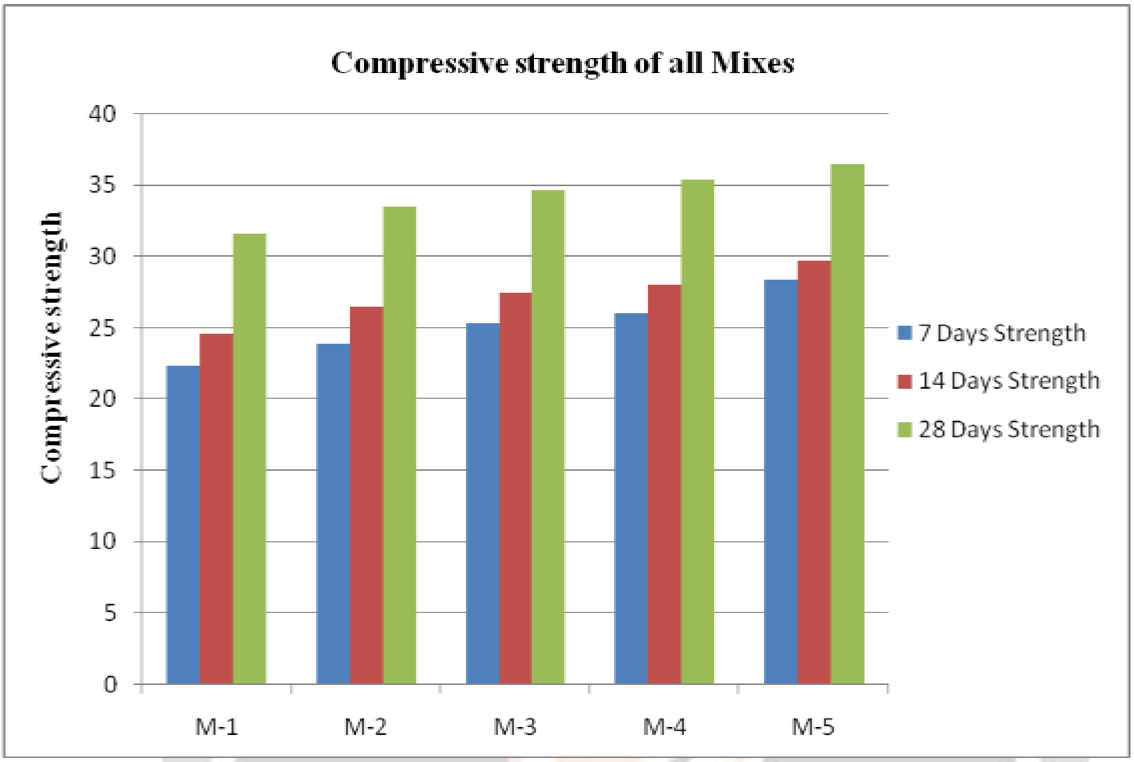

Fig -10: Compressive strength results of all the mixes

4. CONCLUSIONS

Recent developments in the material and construction technology have led to the significant changes resulting in improved performance, wider and more economical use. Concrete which is of utmost importance to the construction industry has also undergone rapid and phenomenal development in the past few years. As a results, steel fibres have emerged as the concrete which serves both economic, environmental concerns and increase the compressive strength. A steel fibre (S.F.) proves to be a increment in the conventional concrete. The adding of SF in the conventional cement by SF shows has good potential as structural member for economical and durable construction. The following are the observations and conclusions on the basis of experimental results:

On the addition of steel fibers with different percentages in the concrete mixes (0.5 % to 2% of steel by the replace of total weight of material) increases the weight of concrete cubes. The maximum weight of cubes in M-5 mix is 8.43.

- With regard to concrete mix M1, the concrete mix M2, M3 M4 and M-5 demonstrated significant improvement in CS of 7.04 percent, 13.54, 19.28 percent or 14.20 percent at 7 days of curing. The CS (via CTM) of concrete mix M2, M3 and M4 are 23.87 MPa, 25.32, 26.06 MPa and 28.36 MPa respectively, at curing period of 7 days.

- With regard to concrete mix M1, the concrete mix M2, M3 M4 and M-5 recorded an improvement in CS of 7.65 percent, 11.92, 14.20 percent and 21.12 percent at 14 days of curing time.The CS (viaCTM) of concrete mix M2, M3 and M4 are 26.45 MPa, 27.50, 28.06 MPa and 29.76 MPa respectively, at curing period of 14 day.
- CTM (destructive testing method) CS has been observed to enhance with an improvement in the addition of steel fibers in traditional concrete. With regard to concrete mix M1, the concrete mix M2, M3 M4 and M-5 demonstrated significant improvement in CS by 5.97 percent, 9.6, 11.94 percent or 15.4 percent at 28 days of

curing time.The CS (via CTM) of concrete mix M2, M3 and M4 are 33.51 MPa, 34.67, 35.40 MPa and 36.50 MPa respectively, at curing period of 28 day.

- Increment in the compressive strength of all the mixes at 7 days is more faster because as per the results percentage increment in strength is more as comparison to 14 & 28 days for all the mixes of concrete.

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