Experimental Behaviour of Steel Fibre Reinforced Concrete by using EGG Shell Powder as a Partial Replacement for Cement

Mr. T. Ramasamy[1] Mr. K. Mohan Raj[2]
[1]Assistant Professor [2]P.G Student
[1,2]Department of Civil Engineering
[1,2]Mahendra Engineering College, India

Abstract— In this Project the strength improvement of conventional M25 concrete is experimented. The mix design as per IS 10262-2009. The strength improvement is done by partial replacement of ESP and steel fibre. The optimum value of ESP replacement is found from the previous experimental results. The abundant quantity of egg shell and its composition is found to be a suitable replacement for cement. The testing is done as per Indian standards and curing process is done under normal water conditions. The results obtained are favourable as the strength improvement is compressive strength(53.4%) and split tensile strength (20.2%).

Keywords: ESP, Steel Fibre, EGG Shell Powder, Reinforced Concrete

I. INTRODUCTION

In this chapter it is a general introduction about the special type of fibre reinforced conventional concrete is discussed. This a conventional type of concrete which is used for increasing the strength and durability of concrete. These type of concretes are specially designed some new advanced high strength structures for their daily life. This concrete can be easily used manufactured and it has a high load carrying capacity and durability.

II. MATERIAL PROPERTIES

A. *Materials Used*

- Cement
- Fine Aggregate
- Coarse Aggregate
- Egg Shell Powder (ESP)
- Steel Fibre
- Water

Fig. 1: Egg Shell

Chemical Component	% content (OPC)
CaO	63
SiO2	20
Al2O3	6
Fe2O3	3
MgO	1.5
Alkalies(K2O, Na2O)	1
SO3	2

Table 1: Chemical composition of cement

Fig. 2: Egg shell powder

CHEMICAL NAME	% by weight of the sample
CaO	84.1
Al2O3	0.06
SiO2	0.10
Fe2O3	2.65
Cr2O3	6.4
Mno	6.63

Table 2: Chemical Composition of Egg Shell Powder

Appearance	Hooked end
Length	35mm
Diameter	0.45mm
Aspect ratio	77.77
Tensile strength	1100 Mpa

Table 3: Physical properties of steel fiber

Fig. 3: Steel Fiber

MATERIAL	WEIGHT (Kg/m3)
CEMENT	450
FINE AGGREGATE	635.15

COARSE AGGREGATE	1069.18
WATER	214.03

Table 4: Mix Proportions for Fibre Reinforced Egg Shell Concrete

Fig. 4: Concrete Mix With 10% ESP as Partial Replacement for Cement

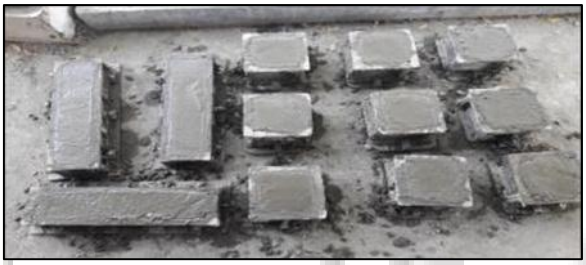

Fig. 5: Concrete Mix With 10% ESP as Partial Replacement for Cement and an Additive of 1% Steel Fiber

Fig. 6: Curing Of Specimen

III. TESTS RESULTS

Mix ID			Compressive Strength of Cube (N/mm2)	
At 7 days	At 14 days		At 28 days	% Increase with ControlMix
CM	15.23	22.56	26.34	-
M1	17.6	26.10	35.05	33.07
M2	29.83	32.5	40.4	53.40

Table 5: Compressive Strength of Cube

Mix ID		Split Tensile Strength of Cylinder (N/mm2)
At 7 days	At 28 days	% Increase with Control Mix
CM	1.54	2.70	-
M2	2.64	3.25	20.40

Table 6: Split Tensile Strength of Cylinder

Fig. 6: Cylinder after Failure

Mix ID		Flexural Strength of Prism (N/mm2)
At 28 days		% Increase withControl Mix
CM	2.65	-
M2	4.14	56.23

Table 7: Flexural Strength of Prism

Fig. 7: Prism after Failure

OPTIMUM MIX - FE					
L/2			L/3		
LOAD	DIVISIONS	DEFLECTION	LOAD	DIVISIONS	DEFLECTION
0	0	0	0	0	0
10	12	0.12	10	12	0.12
20	24	0.24	20	24	0.24
30	34	0.34	30	33	0.33
40	45	0.45	40	45	0.45
50	52	0.52	50	52	0.52
60	63	0.63	60	62	0.62
70	74	0.74	70	73	0.73
80	88	0.88	80	86	0.86
90	121	1.21	90	114	1.14

Table 8: Deflection Values for Optimum Mix -FE

IV. GRAPHS

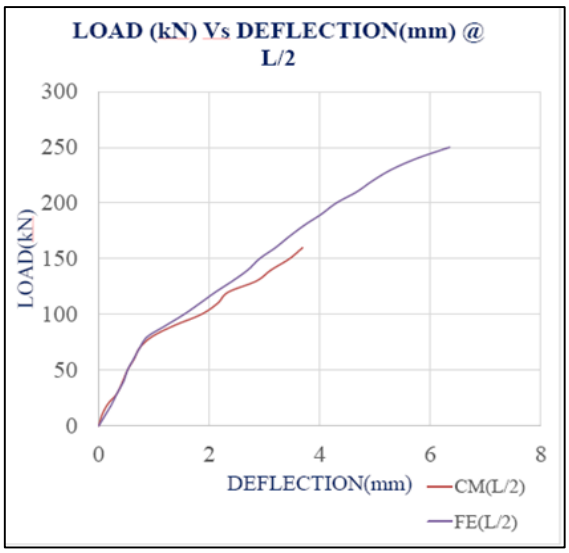

Fig. 8: LOAD (kN) Vs. DEFLECTION (mm) @ L/2

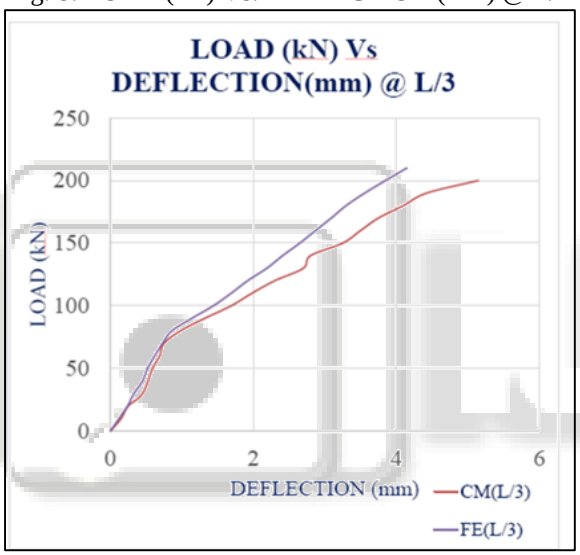

Fig. 9: LOAD (kN) Vs. DEFLECTION (mm) @ L/3

Fig. 10: Beam after Failure

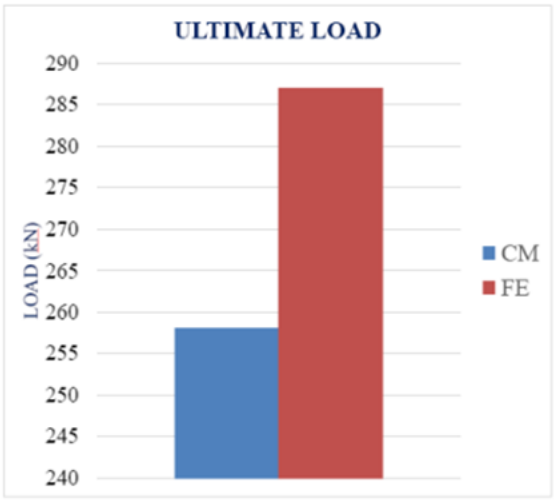

Fig. 11: Ultimate Load (kN**)**

V. CONCLUSION

Based on the experimental study, by using partial replacement of Egg Shell Powder (ESP) for cement by 10%, the results obtained are more favourable as there is an increase in compressive strength (53.40%), split tensile strength (20.40%) and flexural strength (11.24%) than the conventional control mix of M25 grade.

This concrete can be used for any environmental condition and this can have a higher load carrying capacity so it can be adopted for practical applications.

Further this project can further be continued by increasing the percentage replacement of ESP to more than 10% in the ratios of 15%, 20% & 30 % so as to increase its strength and durability of concrete. Through this project it can be concluded that ESP replacement can be effective in improving the performance of the concrete.

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