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An Experimental Investigation On Concrete Reinforced With Eggshell And Fish Bone Powder As Partial Cement Replacements

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Abstract
In order to conserve natural resources and economize energy, weight reduction has been the main focus of machine parts manufacturers in the present scenario. Weight reduction can be achieved primarily by the introduction of better material, design optimization and better manufacturing processes. The egg shell powder composite is one of the potential items for weight reduction of about 20% - 30%. The introduction of egg shell powder composite materials was made it possible to reduce the weight without any reduction on load carrying capacity, more elastic strain energy storage capacity and high strength to weight ratio as compared with those of steel. The use of organic waste in concrete is increasingly becoming implemented in design codes. Fibres are known to have an influence on the cracking process and thereby on the material toughness.
However when fibres are used in beams, which include a relatively small amount of conventional flexural reinforcement, their effect can be localized in a limited part of the concrete. Such localization may lead to a reduction of ductility rather than to its increase, as observed in a study of high strength concrete beams, with and without fibres. This project presents structural tests with normal strength fibre reinforced concrete with reinforcement ratios that varied between 0 to 30%. The results will show the effects of compression strength of the cube.
Keywords: Egg Shell, Elastic Strain Energy, Organic Waste, Flexural Reinforcement, Compression Strength.

I. INTRODUCTION

1.1 INTRODUCTION TO COMPOSITE MATERIAL

According to the literature, by the beginning of the next century the wood will be scarce for the whole world. This situation has led to the development of alternative material. Among various synthetic materials that have been explored and advocated, plastics claim a major share as wood substitutes. Plastics are used for almost everything from the articles of daily use to the components of complicated engineering structures and heavy industrial applications.
Hardware item like door and window frames, flushing cisterns, overhead water storage tanks and water fitting are commercially available and are finding acceptance in the building industry. Plastics are used to manufacture various sanitary wares, which include wash basins, bathtubs, sinks, shower cabins, washing racks and others. Plastic pipes are widely used in the installation of various industrial purposes, water supply etc.
However, during the last decade, the study of filled plastic composites has simulated immense interest in meeting the future shortage of plastic materials. In fact, synthetic fibers such as nylon, rayon, aramid, glass, polyester and carbon are extensively used for the reinforcement of plastics. Nevertheless, these materials are expensive and are non-renewable resources. Because of the uncertainties prevailing in the supply and price of petroleum-based products, there is every need to use the naturally occurring alternatives.

1.2 SCOPE OF THE PROJECT

The subject gives a brief look on the suitability of egg shell powder composite material and their advantages. Efforts have been made to reduce the cost of egg shell powder composite material to that of steel material. The achievement of weight reduction with adequate improvement of mechanical properties has made egg shell powder composite a very replacement material for convectional steel. Material and manufacturing process are selected upon on the cost and strength factor. The design method is selected on the basis of mass production. From the comparative study, it is seen that the egg shell powder composite concrete material are higher and more economical than conventional material.

1.3 NEED OF THE PROJECT

Concrete is very strong in compression but weak in tension. As a Concrete is a relatively brittle material, when subjected to normal stresses and impact loads. The tensile strength of concrete is less due to widening of micro-cracks existing in concrete subjected to tensile stress. Due to presence of fibre, the micro-cracks are arrested. Egg shell and fish bone fibre reinforced concrete is superior than ordinary concrete in strength, durability and many other aspects.

1.4 NECESSITY OF FIBRE IN CONCRETE

- It increases the tensile strength of the concrete.
- It reduces the air voids and water voids the inherent porosity of gel.
- It increases the durability of the concrete.
- Fibres have excellent resistance to creep. Therefore, the orientation and volume of fibres have a significant influence on the creep performance of rebars/tendons.

1.5 OBJECTIVES

- To Study the background of the egg shell powder composite concrete based on the literature survey
- Collection of data about characteristics and properties of egg shell powder fiber
- Theoretical study of fabrication of egg shell powder concrete
- Fabrication of egg shell powder fiber reinforce egg shell powder concrete cubes
- Analysis of various properties
- Result and data presentation
- Report preparation

II. MIX DESIGN

The final mix proportions of M-20 grade of concrete become:-

Water	Cement	FA	CA
180.42	360	584	1223.8
0.50	1.00	1.62	3.40

TABLE 2.1 Details of concrete Mix Proportions for (M20) Grade of Concrete for powder slag.

SN	Slag (%)	W/C Ratio	Mix Proportion (Kg/M³)				
			Cement	slag	Sand	Agg.	Water
1	0	0.5	360	0	584	1224	180.42
2	10	0.5	324	36	584	1224	180.42
3	20	0.5	288	72	584	1224	180.42
4	30	0.5	252	108	584	1224	180.42
5	40	0.5	216	144	584	1224	180.42

TABLE 2.2 Mix Proportions for (M20) Grade for steel fiber

S N	S F (%)	W/C Ratio	Mix Proportion (Kg/M³)				
			Cement	S f	Sand	Agg.	Water
1	0	0.5	360	0	584	1224	180.42
2	0.5	0.5	358.2	1.8	584	1224	180.42
3	1.0	0.5	356.4	3.6	584	1224	180.42
4	1.5	0.5	354.6	5.4	584	1224	180.42
5	2.0	0.5	352.8	7.2	584	1224	180.42

S N	Slag+S F(%)	W/C Ratio	Mix Proportion (Kg/M³)				
			Cement	Slag+S f	Sand	Agg.	Water
1	0	0.5	360	0	584	1224	180.42
2	20 + 1	0.5	284.40	72+3.6	584	1224	180.42

III. EXPERIMENTAL RESULTS

3.1 COMPRESSIVE STRENGTH TEST RESULTS

For each concrete mix, the compressive strength is determined on three 150 × 150 × 150 mm cubes at 7, 14 and 28 days of curing.

Following tables 4.1,4.2 & 4.3give the compressive strength test results of control concrete and ERC concrete produced with 5, 10, 15, & 20 percentages of ERC.

Table 3.1 Compressive Strength of ERC Concrete for 7 Days

Mix Designation	Curing period	Failure load (KN)	Compressive strength (N/mm^2)	Avg Compressiv e strength (N/mm^2)
	7 days	640	28.44	29.03
		680	30.22	
		640	28.44	
M1	7 days	510	22.66	21.7
		475	21.11	
		480	21.33	
M2	7 days	260	11.55	13.55
		385	17.11	
		270	12	
	7 days	320	14.22	11.77
		260	11.55	
		215	9.55	
M4	7 days	280	12.44	10.81
		240	10.66	
		210	9.33	

Table 3.2 Compressive Strength of ERC Concrete For 14days

Mix Designation	Curing period	Failure load (kN)	ompressive strength (N/mm^2)	Avg Compressiv e strength (N/mm^2)
M0	14 days	790	35.11	35.03
		795	35.33	
		780	34.66	
M1	14 days	580	25.77	24.95
		575	25.55	
		530	23.55	
M2	14 days	330	14.66	19.44
		480	21.33	
		500	22.33	
M3	14 days	390	17.33	18.07
		420	18.66	

		410	18.22	
M4	14 days	300	13.33	14.66
		365	16.22	
		325	14.44	

Table 3.3 Compressive Strength Of ERC Concrete For 28 days

Mix Designation	Curing period	Failure load (KN)	Compressiv e strength (N/mm^2)	Avg Compressive strength (N/mm^2)
M0	28 days	980	43.55	44.58
		1020	45.33	
		1010	44.88	
M1	28 days	770	34.22	36.88
		900	40.00	
		820	36.44	
M2	28 days	690	30.66	29.18
		620	27.55	
		660	29.33	
M3	28 days	470	20.88	20.07
		455	20.22	
		430	19.11	
M4	28 days	320	14.22	14.59
		340	15.11	
		325	14.44	

OVERALL RESULTS OF COMPRESSIVE STRENGTH

Following table gives the overall results of compressive strength of ERC concrete produced with different percentages of ERC. The variation of compressive strength is depicted in the form of graph as shown in figure 4.4

Table 3.4 Overall Results of Compressive Strength

Mix designation	Compressive strength (N/mm^2)		
	7 days curing	14 days curing	28 days curing
M0	29.03	35.03	44.58
M1	21.70	24.95	36.88
M2	13.55	19.44	29.18
M3	11.77	18.07	20.07
M4	10.81	14.66	14.59

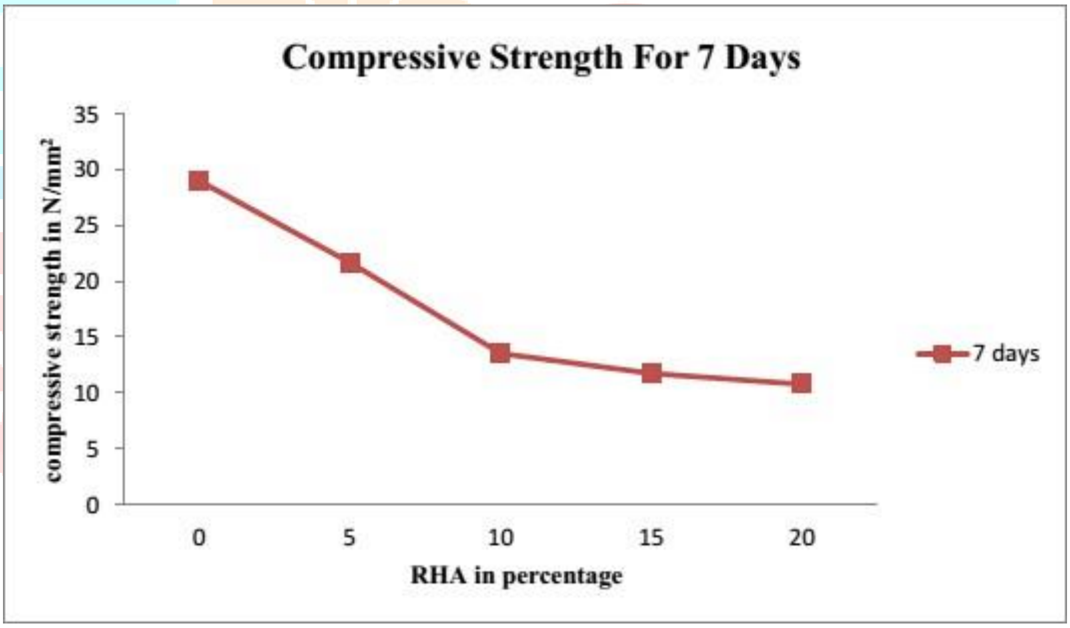
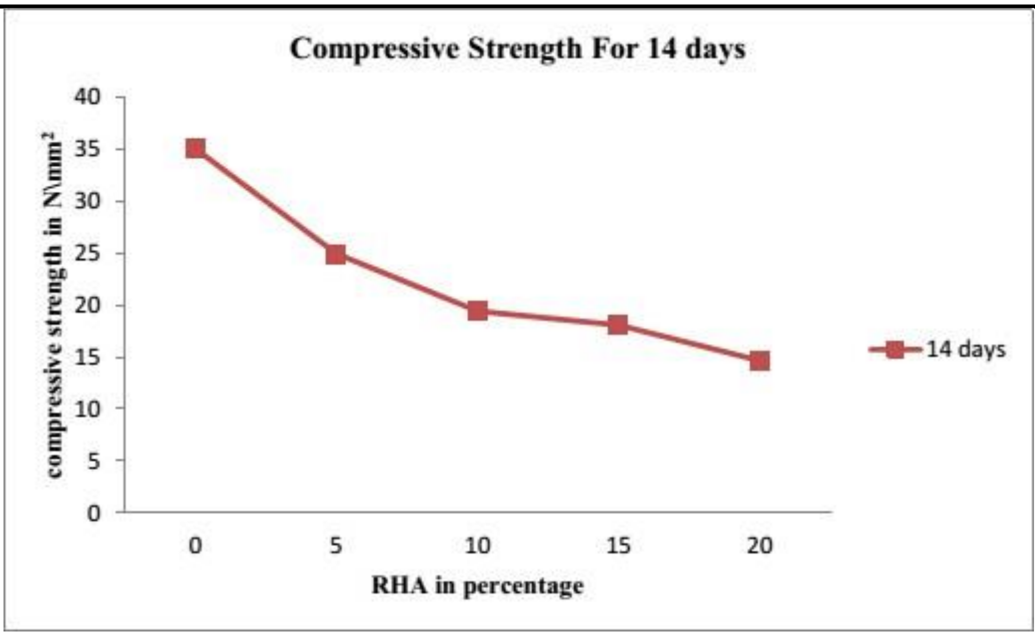
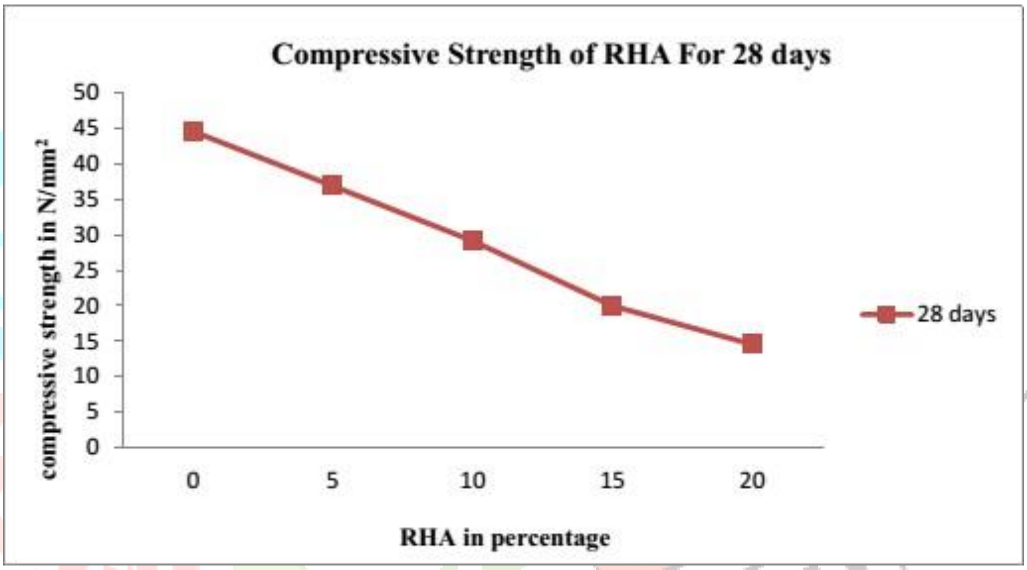


Fig 3.1 Compressive Strength of ERC Concrete For 7 Days





SPILT TENSILE STRENGTH TEST RESULTS

Test has been conducted after 7, 14 and 28 days of curing. Split tensile is conducted on 150 mm diameter and 300 mm length cylinders as per IS 5816-1999.

Following tables 4.5, 4.6 & 4.7 gives the split tensile strength test results of control concrete and ERC concrete produced with 0,5,10, 15, & 20 percentages of ERC.

Table 3.5 Split Tensile Strength of ERC Concrete for 7 Days

Mix Designation	Curing period	Failure load (kN)	Tensile strength (N/mm^2)	Avg Tensile strength (N/mm^2)
M0	7 days	130	1.89	1.93
		140	1.98	
M1	7 days	175	2.47	2.01
		110	1.55	
M2	7 days	110	1.55	1.51
		105	1.48	
M3	7 days	100	1.41	1.30
		85	1.20	
M4	7 days	70	0.99	0.91
		60	0.84	

Table 3.6 Split Tensile Strength of ERC Concrete for 14 days

Mix Designation	Curing period	Failure load (kN)	Tensile strength	Avg Tensile strength
M0	14 days	155	2.19	2.29
		170	2.40	
M1	14 days	180	2.54	2.21
		130	1.89	
M2	14 days	130	1.83	1.79
		125	1.76	
M3	14 days	85	1.20	1.13
		75	1.06	
M4	14 days	135	1.90	1.79
		120	1.69	

Table 3.7 Split Tensile Strength of ERC Concrete for 28 days

Mix Designation	Curing period	ailure load (KN)	Tensile strength	Avg Tensile strength
M0	28 days	210	2.97	3.11
		230	3.25	
M1	28 days	175	2.47	2.43
		170	2.40	
M2	28 days	170	2.47	2.64
		200	2.82	
M3	28 days	120	1.69	1.83
		140	1.98	
M4	28 days	100	1.41	1.58

FLEXURAL STRENGTH TEST RESULTS

Flexural strength also known as modulus of rupture, or bend strength, or transverse rupture strength is a material property, defined as the stress in a material just before it yields in a flexure test.
The specimen shall then be placed in the machine in such a manner that the load shall be applied to the uppermost surface as casting the mould, along two lines spaced
20.0 or 13.3 cm apart. The load shall be applied without shock and increasing continuously at a rate such that the extreme fibre stress increases at approximately 7 kg/cm^2 /mm.

Table 3.8 Flexural Strength of ERC Concrete for 7 Days

Mix Designation	7 Day	14 Day	28 Day
F 05	2.22	4.08	6.68
F 10	1.95	4.32	5.86
F 15	1.81	3.90	5.43
F 20	1.66	3.80	4.98

VI.CONCLUSION

The study on the effect of fibers can still be a promising work as there is always a need to overcome the problem of brittleness of concrete. The following conclusions will be being drawn from the investigation.

1. Density of concrete is more as the percentage of fiber increases.
2. Slump will lose at the higher percentage of fiber & lesser fly ash content.
3. Workability of concrete is improves when fly as percentage increases.
4. The specimen will give good Compressive strength and Flexural strength.
5. The Super-plasticizer is necessary for higher grade to get required slump & workable mix.

In the second phase the concrete cube with variable percentage of fibre reinforcement will be made. Slump test and compressive strength of the specimen will be carried out.

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