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COMPARATIVE STUDY ON EGG SHELL POWDER AS PARTIAL REPLACEMENT WITH CEMENT IN CONCRETE

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ABSTRACT – ***Discarded eggshells is used as substitute for the cement because the shell is composed of Calcium. To determine the viability of utilizing the Egg shells as an alternate to cement, an Egg shell powder is used in different proportions 10%, 20%, 30% and 35% by weight of cement. To discover the fine composition which brings about optimum percentage of strength, Concrete is cast and carries through Compression test and tensile test.***

Keywords: Concrete, Egg Shell Powder, Compressive Strength, Split Tensile Strength, Mix Proportion

I. INTRODUCTION

Experiments have demonstrated that it is conceivable to utilize reused materials to supplant a portion of the combination elements in concrete and delivered an further supportable structure materials. One regular material that can be reused and have the chance of utilization in concrete is utilized egg shell.

Concrete is a man-made structure materials that resembles a stone. Concrete is a composite material made out obviously granular material installed in a hard network of materials that occupies the space among the aggregates and paste them jointly.

Egg shell comprises of a various combined developing layers of, the internal most layer maxillary 3 layers develops on the external most egg film and makes the base on which palisade layer comprise the substantial part of the egg shell. The upper layer is secured by the natural fingernail skin. The egg shell basically comprises of protein, magnesium, carbonate and calcium. In many other countries, it is the accepted practice for egg shell to be dried and used as a source of calcium in animal feeds. The quality of line in egg shell waste influenced greatly by the extent of exposure to sunlight, raw water and harsh weather conditions. It is the fine grained powder with suitable proportion which is sieved to the required size before used with concrete.

The egg shell primarily contains calcium, magnesium, carbonate and protein. In many other countries, it is the accepted practice for egg shell to be dried and used as a source of calcium in animal feeds. The quality of line in egg shell waste influenced greatly by the extent of exposure to sunlight, raw water and harsh weather conditions. It is the fine grained powder with suitable proportion which is sieved to the required size before used with concrete.

II. OBJECTIVES OF PROPOSED PROJECT

To determine the compressive strength and tensile strength of specimen and to conduct the basic material testing of coarse aggregate, check the workability of egg shell powder mixture in fresh concrete.

III. METHODOLOGY

The test was carried out at the civil engineering laboratory of M.I.T, Thandavpura. The main objectives of this investigation are an attempt to compare the strength parameter like Compressive strength and split tensile strength of normally cured M_{20} Grade of concrete mix and also comparing properties of the replaced concrete with harden state. Test results are compared with conventional concrete and that of concrete in which cement is partially replaced by Egg Shell Powder.

A. *MATERIALS USED*

Ordinary Portland cement (OPC) 0f 53grade, Coarse Aggregate, Fine Aggregate, Water and Egg Shell Powder.

TABLE I

Chemical Composition of Cement (OPC 53grade)

SL. NO	Oxide Contents	Percentage (%)
1	CaO	50.7
2	SiO_2	0.09
3	Al_2O_3	0.03
4	MgO	0.01
5	Fe_2O_3	0.02
6	Na_2O	0.19
7	P_2O_5	0.24
8	SrO	0.13
9	NiO	0.001
10	SO_3	0.57
11	Cl	0.219

TABLE II

Physical properties of Cement (OPC 53grade)

Sl No	Description	Test Values
1	Specific Gravity	0.820
2	Standard Consistency	28%
3	Initial Setting Time	40min
4	Final Setting Time	350min
5	Compressive Strength	
6	Fineness Modulus	3.2

TABLE III

Physical properties of Aggregates

Sl No	Description	Coarse Aggregate	Fine Aggregate
1	Specific Gravity	2.71	2.65
2	Fineness Modulus	3.70	2.6
3	Water Absorption	0.39%	0.50%
4	Impact Test	32.77%	
5	Crushing Test	32.04%	

TABLE IV

Chemical Composition of Egg Shell

SL.NO	Oxide Contents	Percentage (%)
1	CaO	60 – 67
2	SiO_2	17 – 25
3	Al_2O_3	3.0 – 8.0
4	Fe_2O_3	0.5 – 6.0
5	MgO	0.1 – 4.0
6	K_2O, Na_2O	0.4 – 1.3
7	SO_3	1.3 – 3.0

B. *MIX PROPORTION*

The mix proportion are designed as per IS 10262:2009[12][13][14] for M_{20} Grade of concrete exposed to severe environmental condition. The mix proportion was done for replacement of Cement with Egg Shell at various percentages i.e.., 0%, 5%, 10%, 15%, 20%, 25% and 30% respectively. The mix proportion is as follows.

TABLE V

MIX PROPOTION

Cement	Fine Aggregates	Coarse aggregates	Water
437.77 Kg/cum	699.21 Kg/cum	1114.18 Kg/cum	195 ltr
1	1.6	2.5	0.45

TABLE VI

Mix Combination for Casting of Concrete Specimens

Type of mix	Cement (Kg/m^3)	Fine aggregate (Kg/m^3)	Coarse aggregate (Kg/m^3)	Egg Shell Powder (Kg/m^3)	Water (L/m^3)
CC	437.77	699.21	1114.18	NIL	186
ESP5	415.88	699.21	1114.18	21.89	186
ESP10	393.99	699.21	1114.18	43.78	186
ESP15	372.10	699.21	1114.18	65.67	186
ESP20	350.22	699.21	1114.18	87.55	186
ESP25	328.33	699.21	1114.18	109.44	186
ESP30	306.44	699.21	1114.18	131.33	186

IV. RESULTS and DISCUSSIONS

Concrete cubes of 150mm X 150mm x 150mm has been casted to test compressive strength. Cylindrical prisms of 150mm diameter and 300mm in length are cast to determine the Split tensile Strength according to IS codes : 516 :1959

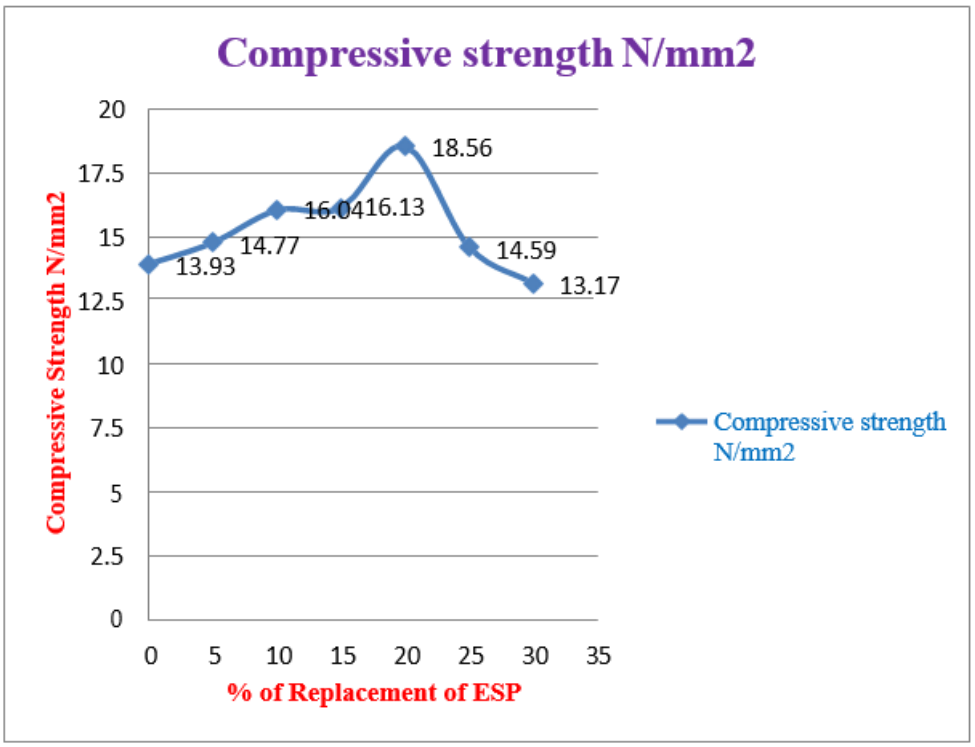

FIG. 1. Average Compressive strength of cubes for 7 days

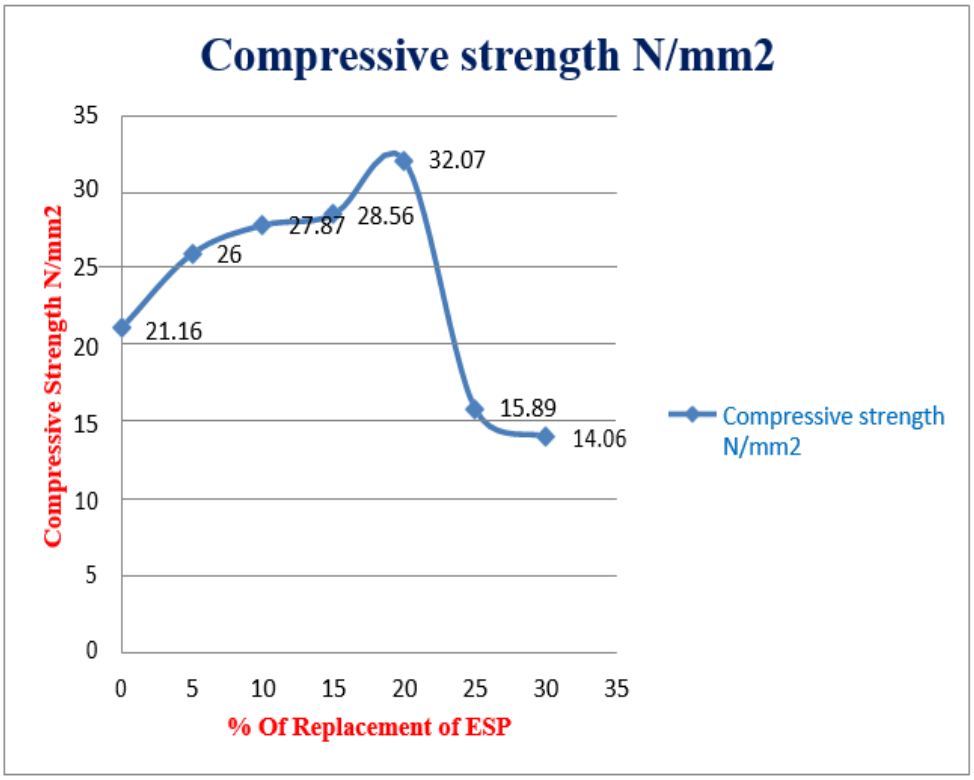

FIG 2: Average Compressive strength of cubes for 7 days

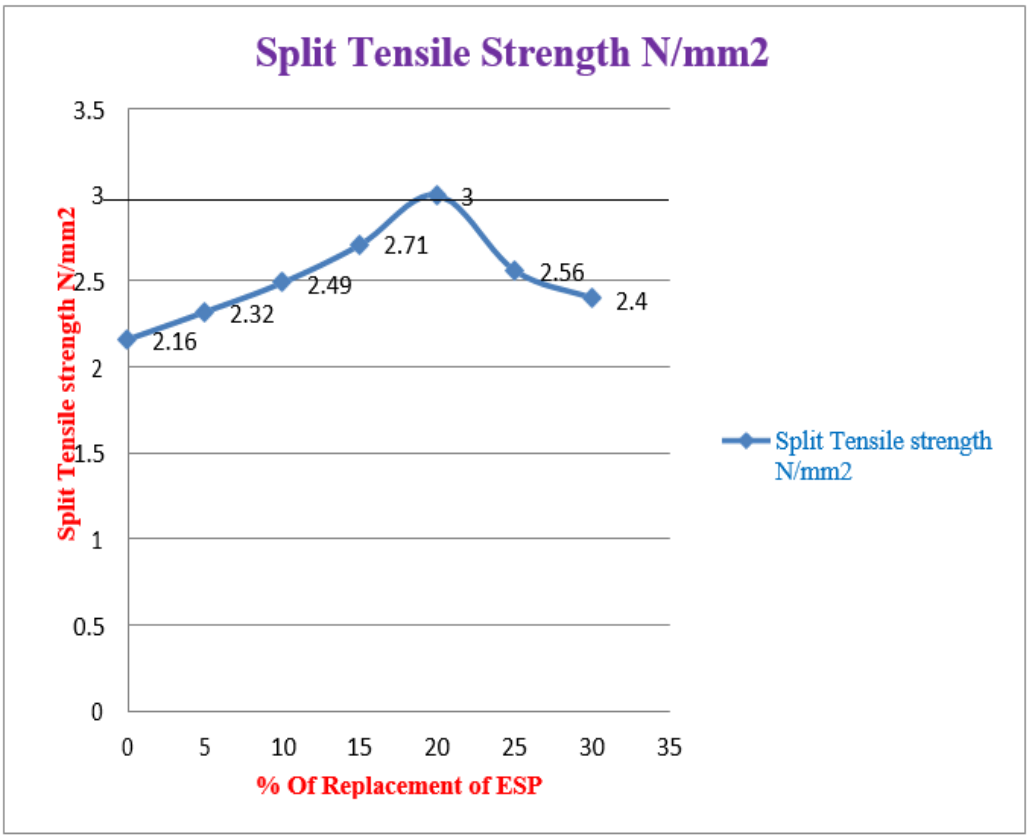

FIG 3: Average Split Tensile strength of cubes for 7 days

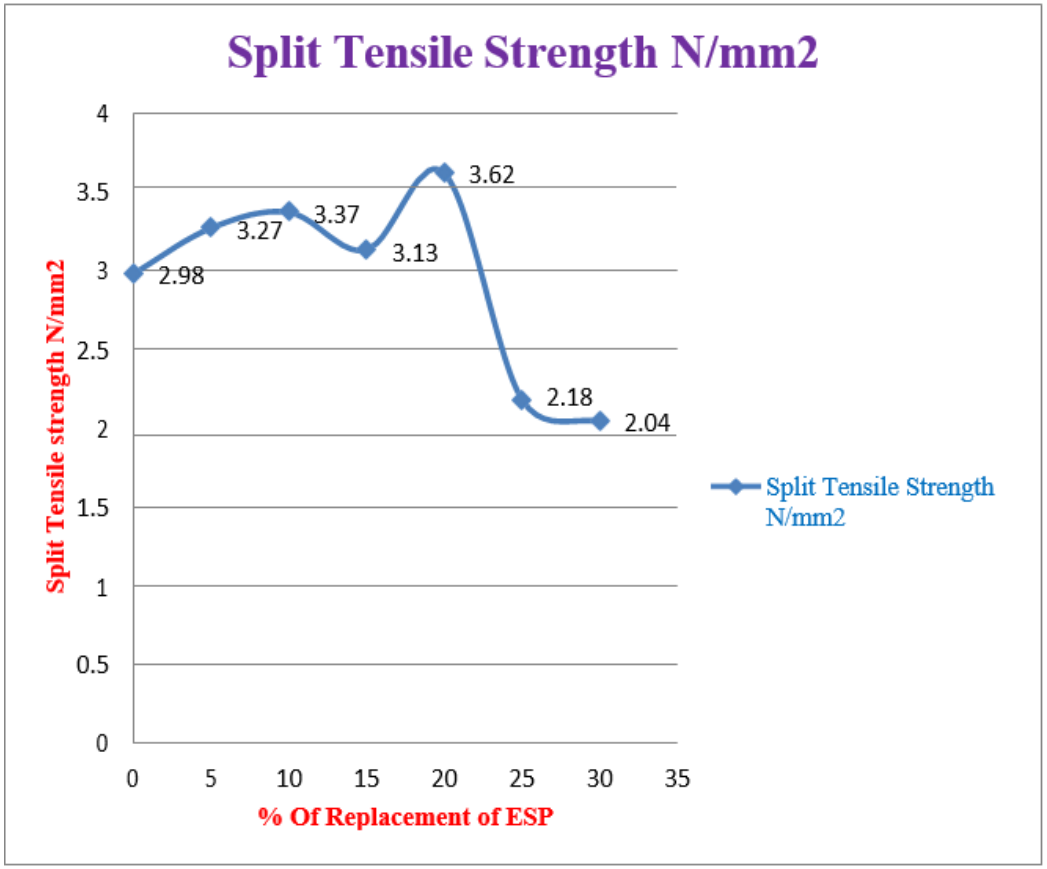

FIG 4: Average Split Tensile strength of cubes for 7 days

V. CONCLUSION

The result which came after carrying out all tests found successful which indicates that eggshell powder can be used as a replacement material for cement in concrete. According to the test performed it is observed that, there is an increment in properties of concrete according to the percentage of egg shell powder by weight of cement in concrete. When M_{20} Concrete with 0%, 5%, 10%, 15%, and 20% of replacement of egg shell powder with cement in concrete is compared with plain cement concrete, it is found that, there is an increase in Compressive Strength and Split Tensile Strength up to 20%.After further increase by 25% and 30% of replacement of egg shell powder with cement in concrete is compared with plain cement concrete it is found that, there is a gradual decrease in the Compressive Strength and Split Tensile Strength. Environmental pollution and natural recourses consumption is reduced by using eggshell powder. The workability of concrete is increased by increasing the amount of eggshell powder.

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