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Experimental Study on Behaviour of Concrete Using Different Techniques

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***Abstract*---Excessive fatigue deterioration is usually experienced when reinforced concrete structural elements are subjected to loading. This underscore the desire to strengthen as well as improve the fatigue performance and extend the fatigue life of RC structural components particularly beams. During the few decades, due to rapid growth of population, past backlog and slow rate of construction strengthening of concrete structural elements by (steel fibers, rubber aggregate, eggshell powder) has become a widely used technique where high strength is needed for carrying heavy loads or repairing is done due to fatigue cracking, failure modes and corrosion.**

There is a need to develop appropriate techniques of construction, which are economical and affordable. Towards this end, Reinforced concrete structures construction technique has been developed. The cement concrte cubes & cylinders of Mix 40 grade were casted in which cement is partially replaced with eggshell powder as 5%.10%,15% by weight of cement. Coarse aggregate are replaced with rubber tube by 5%,10%,15% & concrete volume is replaced with 0.5%,1.0%,1.5% of steel fibre. The testing was done using "COMPRESSION TESTING MACHINE" to know the Compressive Strength & Split tensile Strength of RC structures at curing ages 7,14 & 28 days.

Key words — CTM, Behaviour of Concrete, fatigue deterioration

I.INTRODUCTION

I.I Egg shell Powder

Egg shell contains 93.7% of $caco_3$, 4.2% organic matter, 1.3% $mgco_3$, 0.8% of $ca_3(po_4)_2$. Egg shell contains almost same properties as that of lime stone. Limestone powder substitution for cement sense in concretes saving money and energy and reducing carbon dioxide emissions. However, as limestone is a natural mineral resource, quarrying and consequent prolonged use of again leads to problems associated with environment and sustainable development. Furthermore, lime production involves energy intensive process and consumes water. Therefore, identifying analogous material from waste and using the same in concrete production could be a wise idea.

Calcium rich egg shell is a poultry waste with chemical composition nearly same as that of limestone. Use of eggshell waste instead of natural lime to replace cement in concrete can have benefits like minimizing use of cement, conserving natural lime and utilizing waste material.

I.II Rubber Tube

Similarly, Discarded vehicle tubes are one of the important solid
waste challenges to handle & disposal needing more useful applications than just becoming a material for landfilling. Due to the rapid depletion of available sites for waste disposal, many countries discourage the disposal of waste tube rubber in landfills and encourage in the construction sector to use these waste materials in concrete in place of fine or coarse aggregate.

I.III Steel fibre

Again the effect of aspect ratio (60) of steel fiber on mechanical properties of high strength concrete are addressed in this paper.. Mechanical properties of high strength concrete investigated by varying positions of steel fiber in concrete cubes and cylinders. Percentage of steel fiber by volume was 0.5%, 1.0% and 1.5%. A series of 12 specimens (9cubes and 9 cylindres) of aspect ratio 60
For 7, 14 & 28 days of curing were cast.. Experimental findings addressed that as volume of fiber increases, there will be increase in compressive strength. Steel fiber reinforced concrete can be used for construction of pavement, industrial floors, bridge deck slabs satisfactorily.Fibres used in concrete to show cracking, Plasic shrinkage & drying shrinkage.It reduces Permebility of Concrete thus reduces bleeding of water. For same aspect ratio it was found that compressive strength increases in both positions of steel fiber.

II. MATERIALS AND MIX DESIGN

Sand passing through IS sieve 4.75 mm and retaining on IS sieve 150 micron is used in the investigation. The sample shall be brought to an air dry condition before weighting

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and sieving. This may be achieved either by drying at room temperature or by heating at a temperature of 100 to 110 ^{0}C. The air dried sample was weighed. It was sieved with a sieves arranged in descending order of the openings of the sieve. Sieve should clean before use (IS 2386: Part-I 1963). In this experimental programme crushed aggregates were used. For this study 20 mm coarse aggregates were used. The physical properties of coarse aggregate like specific gravity, impact value, bulk density, gradation and fineness modulus are tested in accordance with IS 2386. Steel fibres with properties as shown in Table 1 used for steel fibre reinforced concrete having aspect ratio 60. It is hooked end in shape and circular in cross section as shown in **Figure 1**.

A high strength concrete was prepared with steel fibre to obtain cube compressive strength higher than 60 N/mm2 after 28 days. ACI method was used to prepare high strength concrete mixture . The mixture were prepared with proper selection of cement, fine aggregate, coarse aggregate, W/C ratio and admixture. Ordinary Portland cement of 53 grade confirming IS 4031:1988 used for experimental work.

Table 1.Steel Fiber Properties

Type	Lengt (mm)	Diameter (mm)	Aspect ratio	Tensile Strength (MPa)	Young's Modulus (GPa)
Dramix	30	0.2	60	1000	210

Ordinary Portland cement of 53 grade confirming IS 4031:1988 used for experimental work.
The proportion of different ingredients are shown in Table 2.

Table 2.Mix Proportion
The total quantities of materials for 1 m^3

Components	**Mixtures**
Cement(Kg/M^3)	447
Coarse Aggregate(Kg/ M^3)	1014.23
Fine Aggregates(Kg /M^3)	797
Water(lit/M^3)	197
W/c ratio	0.44

MIX PROPORTION:
C : F.A : C.A
1 : 1.78 :2.27

Amount of materials used in our project work as per **cubes(150mm*150mm*150mm)** & **cylinders(h=100mm& dia.=200mm)** used:

Components	Wt. of components for M40 grade					
	Cube	cyl.	Cube	cyl.	Cube	cyl.
Steel fibre (% by volume of concrete in kg)	60SF0.5		60SF1.0		60SF1.5	
	0.1	0.063	0.3	0.123	0.4	0.186
Rubber tube (% by wt. of coarse agg in kg.)	RT 5.0		RT10.0		RT15.0	
	0.6	0.28	1.2	0.84	1.8	0.56
Egg Shell Powder (% by wt. of cement in kg)	ESP5.0		ESP10.0		ESP15.0	
	0.264	0.1	0.53	0.3	0.79	0.44

Another materials used in this project was egg shell powder. Broken egg shell was collected from local sources.it is then washed in normal water,it is made dry for 7 days at an temperature of 20-30^{0}c. then it is crushed well in mixture to obtain its powder form, then it is sieved through 90 µm. Materials passed through it was selected for the project. All this steps & processing of egg shell is shown in **Fig.2**

Rubber used is well shredded & it is made to cut less than 20mm which is used as replacement of coarse aggregate & then it is sieved thorugh standard IS Sieve size commonly used for sieving of coarse aggregate. A high strength rubberized concrete is prepared to obtain a compressive strength of 30MPa when cube is casted. **Fig 3.**. Shows the sieving & cutting of rubber tube.

Fig 1. Steel Fibres along with mixing.

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Fig2.Processing of eggshell waste(i)washing (ii)Air drying (iii) grinding & sieving (iv) Mixing.

III. TEST PROCEDURE

a. Workability test :

For steel fibre

Workability is the amount of energy to overcome Friction while compacting.It is the measure of lubrication required for handling the concrete without segregation. The result of workability is shown in below **table 3.**

It was observed that as the percentage of fibre increases the workability reduces.

Workability Test:

Mixtures	Controlled Concrete	60 SF0.5	60SF1.0	60SF1.5
Slump in mm	55	50	40	35

Fig 3. Shows cutting & sieving of rubber.

a. Compressive strength studies:

Compressive strength was done on Compression Testing Machine(CTM) of capacity 2000KN. A rate of loading was 2.5KN/s was applied as Per IS; 156-1959. The Test was done on 150mm cube specimens at 14 & 28 days for all the materials used.

b. Split Tensile Strength:

Split Tensile strength test for cylinders of 100*200 mm size was conducted in accordance with ASTM C496.

The split tensile test was conducted in same machine on which Compressive strength was performed.

IV. RESULT & DISCUSSION

Fig 4. Shows Casting , curing , Compressive strength test & split tensile test.

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Materials	Percentage	Compressive strength of concrete=Load/Area In MPa						Split tensile strength =2P/∏DL In MPa					
		@7 Days		@ 14 Days		@28 Days		@7Days		@ 14 Days		@28 Days	
		Load (kN)	Strength (MPa)	Load (kN)	Strength (MPa)	Load (kN)	Strength (MPa)	Load (kN)	Strength (MPa)	Load (kN)	Strength (MPa)	Load (kN)	Strength (MPa)
EGG SHELL POWDER	5%	585	26	832	37	945	42	98	3.15	128	4.1	138	4.4
	10%	765	34	877	39	1012	45	104	3.3	138	4.4	150	4.8
	15%	720	32	855	38	968	43	100	3.2	131	4.2	141	4.5
RUBBER TUBE	5%	495	22	720	32	855	38	37	1.2	72	2.3	100	3.2
	10%	607	27	765	34	900	40	47	1.5	78	2.5	113	3.6
	15%	563	25	698	31	810	36	43	1.4	87	2.8	103	3.3
STEEL FIBRE	0.5%	855	38	945	42	1102	49	131	4.2	147	4.7	175	5.6
	1.0%	866	38.5	990	44	1147	51	138	4.4	150	4.8	179	5.7
	1.5%	922	41	1012	45	1192	53	282	4.5	163	5.2	185	5.9

LINEAR REGRESSION ANALYSIS:

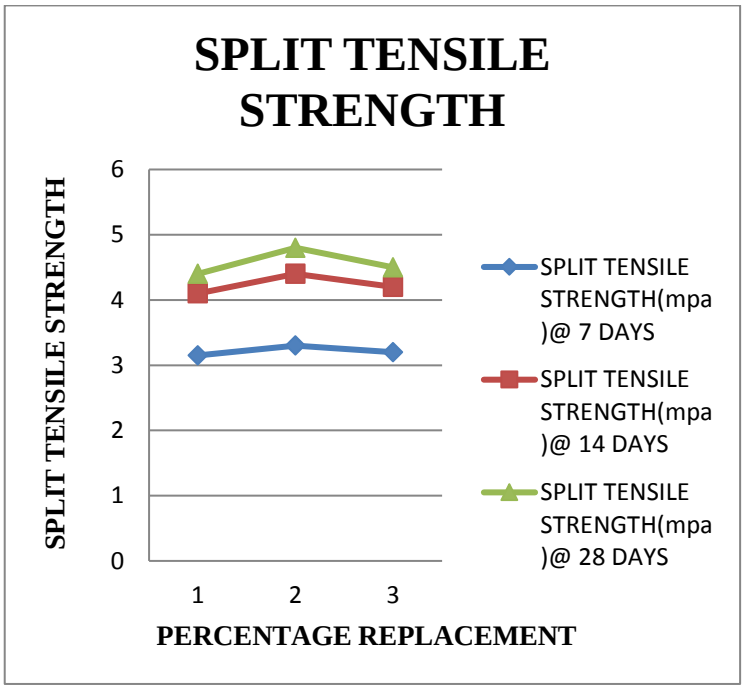

Figure : Change in Split tensile strength with different ESP replacement

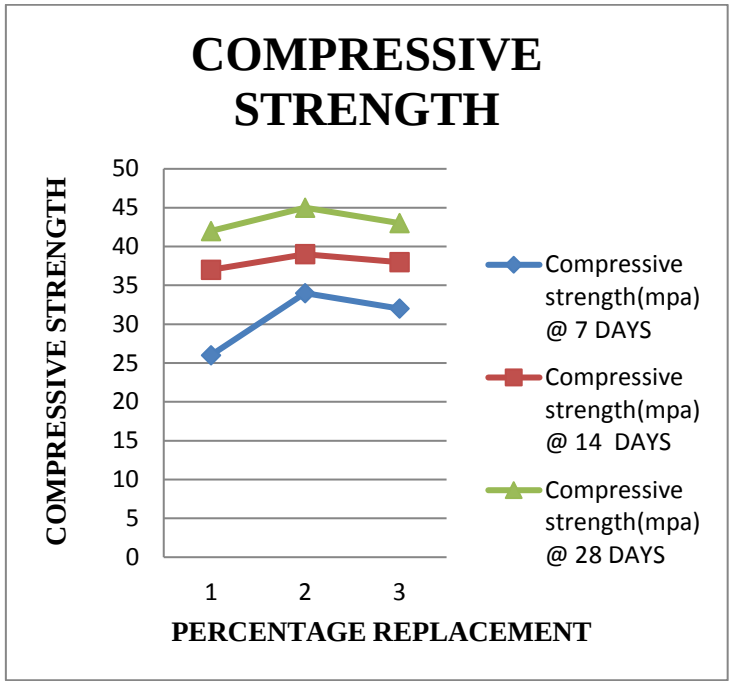

Figure: Varition in Compressive strength with different ESP replacement

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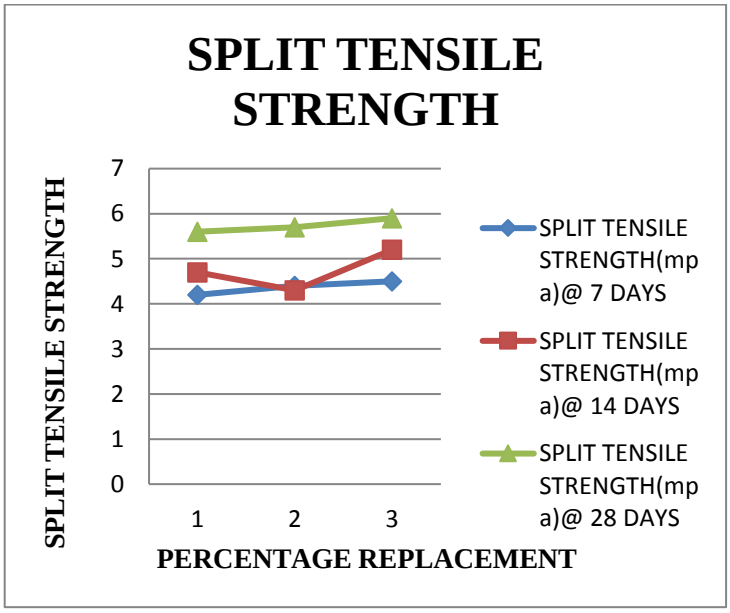

Figure : Change in Split tensile strength with different steel fibre percentage

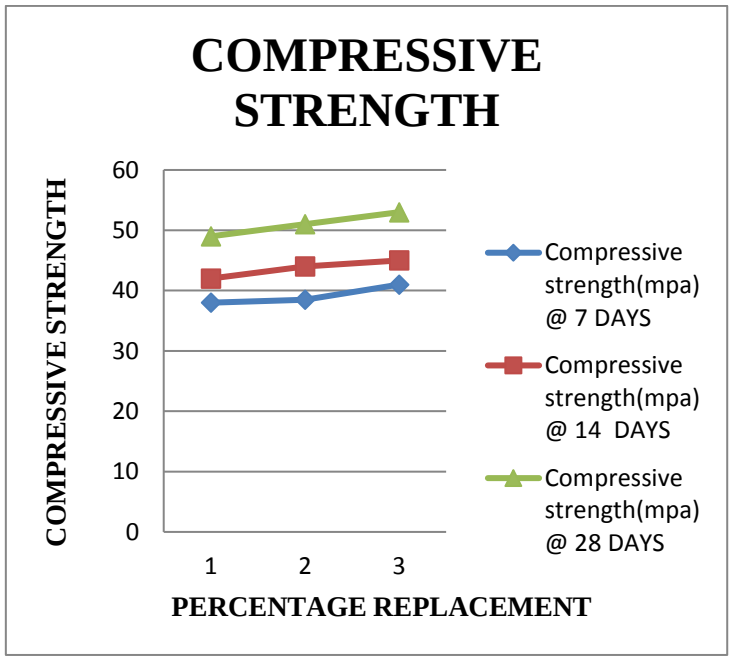

Figure : variation in Compressive strength with different steel fibre percentage.

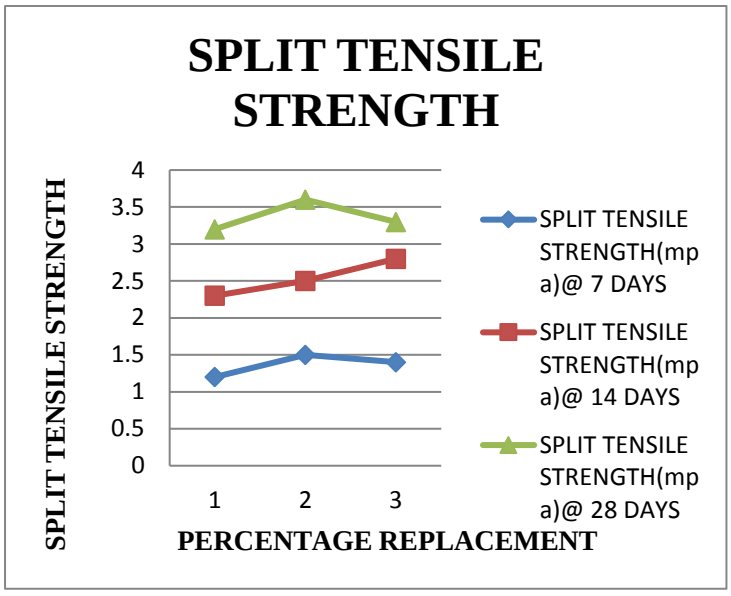

Figure : variation in Split tensile strength with different Rubber repacement

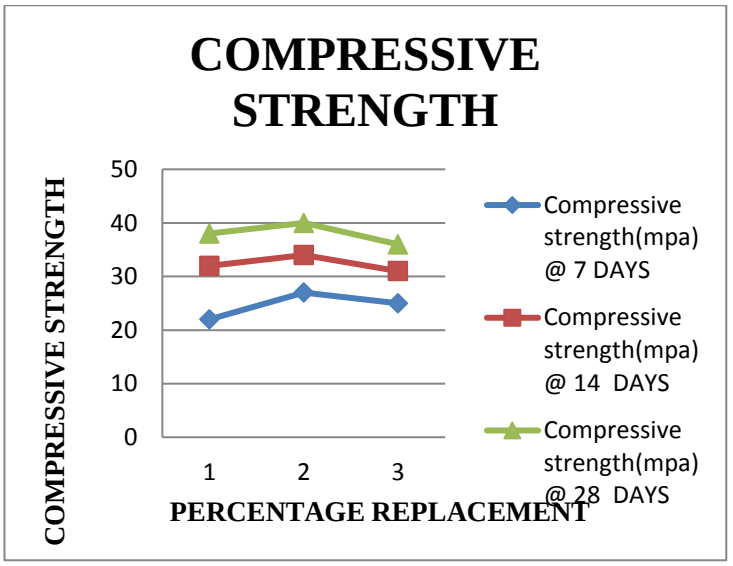

Figure : variation in Compressive strength with different Rubber percentage.

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CONCLUSION:

1. Compressive strength for steel fibre reinforced concrete with aspect ratio 60 increases & split tensile strength too except in case of 1.5% steel fibre. Fibres are used to show cracking before the structure collapse.
2. Fibres in concrete helps in propagation of cracks.
3. Rubber tube used in concrete to show its elastic properties
   Before it undergo failure. Rubber tube with 10% of replacement of coarse aggregate shows greater compressive strength in comparison to 5% &15% used.
4. Compressive strength was higher than control concrte with 5 & 10% ESP replacement @ 7, 14 &28 days of curing. ESP replacement greater than 10% shows less strength.
5. Split tensile strength of ESP concrete were adoptable at upto 10% ESP replacement. However, concrete with 15% ESP had lower split tensile strength.

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