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AN EXPERIMENTAL STUDY ON THE STRENGTH BEHAVIOUR OF COCONUT SHELL CONCRETE WITH ADDITION OF STEEL FIBRE

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ABSTRACT:

Concrete is the majorly used material in the construction field, in which the materials like Cement, Aggregates and sand are used in prescribed ratios. The aggregates among these elements is the heaviest material which would increase the dead weight of the concrete which will make the job tougher in lifting the concrete for major heights. Getting into our project we use coconut shell which has similar mechanical properties as of aggregates to make the concrete lighter in weight and as we know that coconut shell wouldn't be as strong as aggregates, so we use steel fiber as the reinforcements to reduce the ability of cracks and hence there will be an increase in the toughness of the concrete. In this research work coconut shell has been replaced with coarse aggregate in volumes and added steel fiber of 0.25%, 0.5%, 0.75% and 1% ratio of concrete to match the strength and crack opposing properties of the concrete. At 1% of addition of steel fiber there is a large development in the strength of concrete than that of the other percentages of addition. This would enable us to develop a light weight concrete with greater strength. Along with mechanical strength and toughness parameters.

Keywords: Lightweight Concrete, Economically low concrete, Coconut shell concrete, Crack resistance, Steel fiber, Mechanical parameters.

INTRODUCTION:

Concrete is the material which is vastly used in the world especially for the construction industry compared to the other industries as there is a major growth and requirement in the infrastructure development[1]. The experiments conducted on waste materials like rubber, coconut shell, blast furnace slag, waste water etc., out of these materials coconut shell has fulfilled the most of the required properties of aggregates to replace in concrete[2]. When there is usage of wastes in production of concrete, there is a high advantage of enabling the production of greebconcrete which would result in reduction of Carbondioxide(CO_2) emmison[7]. Vastly producing countries of coconut are mentioned in the table below. In which eight largest producers are from the asia pacific region among the first ten leading coconut shell producing countries[3]. There are numerous tests conducted by researchers on using coconut shell as a replacement for coarse aggregate which gave the results as coconut shell is meeting the minimum acceptable strength for structural concrete and also suggested that this mix would reduce a huge cost reduction about 48%.[Gunasekhar sir 2011]. Steel fibres will be helpful in amplyfing the tensile strength and also the ductility of the concrete. The percentage of Steel fibre addition must be within 0.5%-1.5% as it might reduce the workability of the mix when it become excess.[5] In many developed countries lightweight concrete would reduce the sizes of the structural members which brought a drastic change in developing and constructing high rise structures[6].

MATERIALS:

CEMENT:

Cement is the major component in the manufacturing of concrete which will help in bonding all the materials used in the concrete manufacturing. The major element in the cement is lime which will helps in strength gaining.

Table.1: Properties of cement

S.No	Description	Values
1.	Specific Gravity	3.12
2.	Normal Consistency	30
3.	Setting Time	31 minutes

COCONUT SHELL:

Coconut shell here is the substituting material for the coarse aggregate which results in reducing the weight of the concrete. Coconut shells were fetched and piled up from the nearby restaurants. The shells were in the size of 12mm sieve passing and 10mm sieve retained. The test values are represented in the following table.

Table.2: *Test Values of Coconut Shell [9]*

S.No	Description	Values
1.	Maximum Size of Shell	12.5mm
2.	Water Absorption rate	26%
3.	Fineness Modulus	6.5
4.	Specific Gravity	1.3
5.	Thickness of Coconut Shell	1.9-8mm
6.	Crushing Value	2.78%

Fig.1: Coconut Shell used for the research

STEEL FIBER:

Steel fiber is a metal reinforcing material used to increase the resistance against the cracks and it also increases the firmness of the material. Steel fiber used in this research is crumbled type of size 30mm length and 0.5mm dia. The properties of steel fiber are listed in the below table.

Table.3: Specifications of Steel Fiber

S.No	Description	Values
1.	Length	30mm
2.	Diameter	0.5mm
3.	Density	7780 Kg/m^3
4.	Tensile Strength	1000N/mm^2

RESULTS AND DISCUSSIONS:

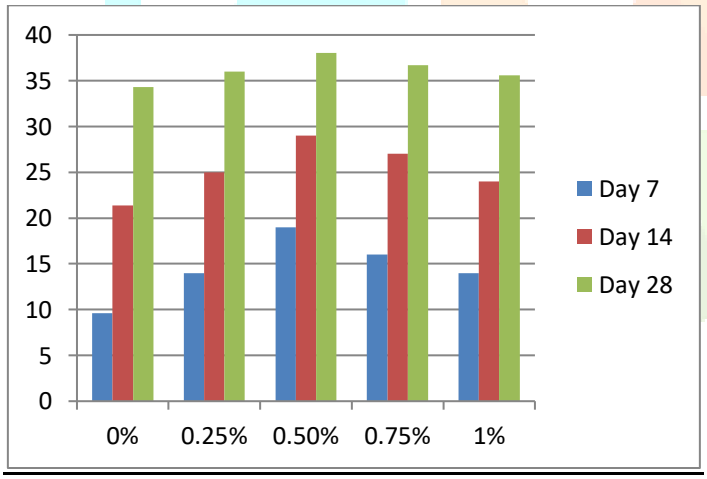
COMPRESSION TEST:

Compressive strength is the ability to resist from the compressive loads applied on a material. In this research the specimens used for compression test are cubes of 100mm x 100mm x 100 mm sizes, with a curing durations of 7days, 14days and 28 days.

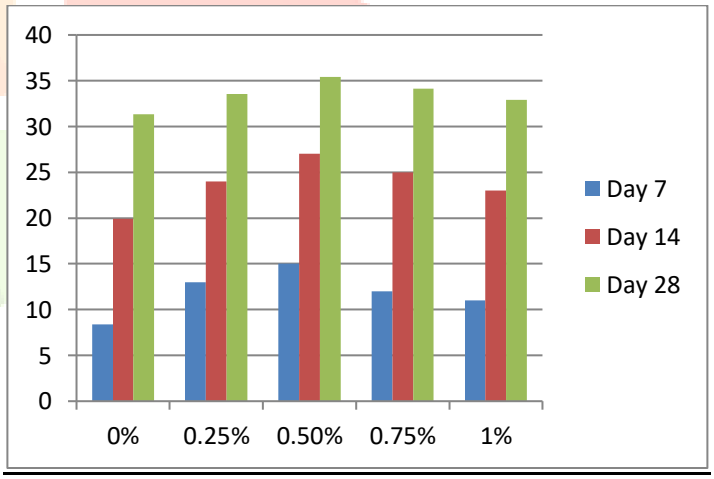
Table.4: Compression Test Results

COMPRESSION TEST(N/mm^2)				
Mix	**Replacement of coconut shell**	**Day 7**	**Day 14**	**Day 28**
CC	0%	9.6	21.36	34.28
	0.25%	14.	25.	35.994
	0.5%	19.	29.	38.0508
	0.75%	16.	27.	36.6796
	1%	14.	24.	35.6172
Mix	**Replacement of coconut shell**	**Day 7**	**Day 14**	**Day 28**
CSC	0%	8.36	19.94	31.34
	0.25%	13.	24.	33.5338
	0.5%	15.	27.	35.4142
	0.75%	12.	25.	34.1606
	1%	11.	23.	32.907

COMPRESSIVE STRENGTH



Compression Test Results of CC



Compression Test Results of CSC

Fig.2: Compression Test Results in graph representation

From the above figures, at 0.5% addition of steel fiber for both the CC and CSC the results obtained are with the highest compressive strength when compared to the regular CC and CSC. It doesn't mean that the remaining percentage of additions are the failure ones, as per the mix grade all the percentage additions has reached target mean strength.

SPLIT TENSILE

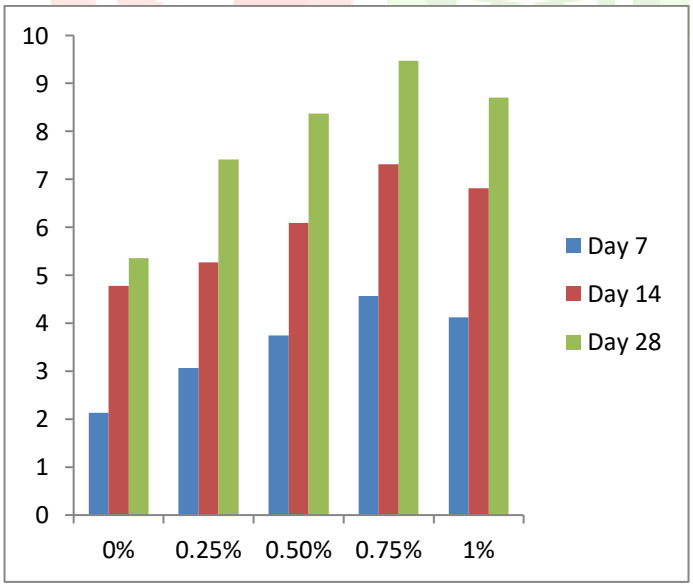
Split Tensile Strength of the concrete is the ability to resist the forces applied on the specimen to split into two pieces. In this research the cylinders of sizes 100mm x 200mm were used in testing the specimen.

Fig.3: Specimen Break-Split Tensile Test

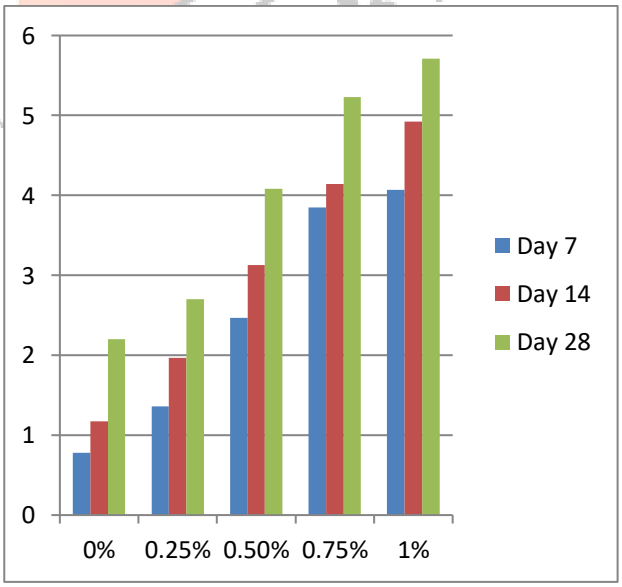
Table.5: Split Tensile Test Results

SPLIT TENSILE TEST(N/mm^2)				
Mix	**Replacement of coconut shell**	**Day 7**	**Day 14**	**Day 28**
CC	0%	2.13	4.774	5.36
	0.25%	3.07	5.27	7.42
	0.5%	3.74	6.09	8.37
	0.75%	4.57	7.32	9.47
	1%	4.12	6.82	8.71
Mix	**Replacement of coconut shell**	**Day 7**	**Day 14**	**Day 28**
CSC	0%	0.78	1.17	2.20
	0.25%	1.36	1.97	2.70
	0.5%	2.47	3.13	4.08
	0.75%	3.85	4.14	5.23
	1%	4.07	4.92	5.71

SPLIT TENSILE STRENGTH



Split Tensile Test Results of CC



Split Tensile Test Results of CSC

Fig.4: Split Tensile Test Results in graph representation

The above figures shows that the highest tensile strength of CC is at 0.75% of addition of steel fiber where as the CSC has shown the highest tensile strength at 1% of addition of steel fiber.

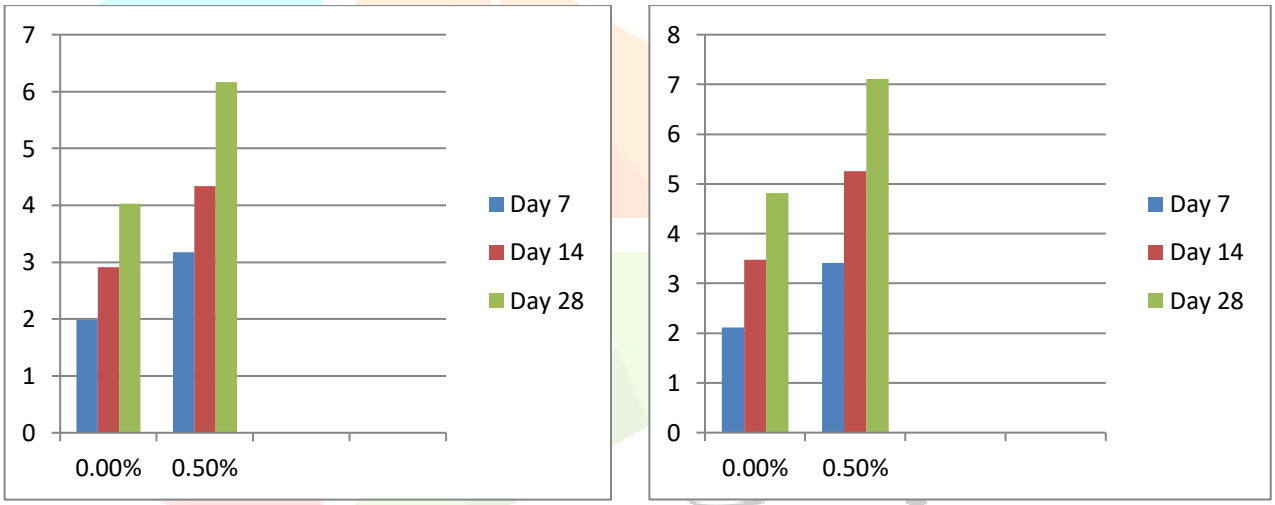
FLEXURE STRENGTH TEST:

The Flexure Strength is one of the most vital characteristic of the concrete which has to be kept in mind. This property shows the ability to resist from the bending, the main objective of this test is to identify the initiation of the cracks in the concrete members. As steel fibers has been proved as the top notch reinforcement ingredient in controlling the cracks by increasing the strength in concrete.

Table.6: Flexure Strength Test Results

FLEXURE TEST(N/mm^2)				
Mix	**Replacement of coconut shell**	**Day 7**	**Day 14**	**Day 28**
CC	0.1%	2.12	3.48	4.82
	0.5%	3.41	5.26	7.11
Mix	**Replacement of coconut shell**	**Day 7**	**Day 14**	**Day 28**
CSC	0.1%	1.98	2.91	4.03
	0.5%	3.17	4.34	6.17

FLEXURE STRENGTH



Flexure Test Results of CC Flexure Test Results of CSC

Fig.5: Flexure Test Results in graph representation

From the above figures a 0.5% of addition of steel fiber for both CC and CSC has given the higher flexure resistance than that of the normal member.

CONCLUSION

The concrete in this research has the following possible conclusions:

1. Coconut shell concrete as light weight concrete materials has better compressive strength.
2. With the use of steel fiber in coconut shell concrete has given possible crack resistance and restricted the initiation of crack from minor to major.
3. This coconut shell concrete with addition of steel fibers can be a commendable material in the construction industry.
4. The use of Coconut Shell Concrete would make the task easier in constructing high raise buildings as it is light in weight.
5. This light weight concrete can be used for all the various construction requirements like flooring, slab, columns and roofs.

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