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COMPARATIVE STUDY ON COMPRESSIVE STRENGTH OF NORMAL CONCRETE AND COCONUT SHELL CONCRETE USING STEEL FIBRE

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ABSTRACT

In plain cement concrete the tensile properties is to be improved. The addition of steel fibres improves the resistance of conventionally reinforced concrete members towards cracking, deflection and other serviceability conditions. In addition, the replacement of coarse aggregates with coconut shell is one of the economical enhance Programme. Compressive strength for both conventional and coconut shell concrete targeted to M25 grade. The cubes were cast and tested for compressive strength to find the optimization of percentage of steel fibre. In this study steel fibres are added from 0.5 % to 2.0 % by volume fraction. From the test results, the optimized percentage of steel fibre for both conventional concrete and coconut shell concrete have been found as 1.0 % and 1.5 % respectively.

Keywords: coconut shell, bundled hook steel fibres, compressive strength, volume fraction, coconut shell concrete, conventional concrete.

I. INTRODUCTION

Concrete is one of the important activities in construction industry. The Plain cement concrete is the combination of Ordinary Portland cement, Fine aggregate, Coarse aggregate, water. In this coarse aggregate increases the self weight of the concrete to maximum extent while compare to other components in concrete. Now days the cost of the construction materials is more due to maximum demand in the usage of available resources and it results in scarcity of materials. So the study is mainly towards the alternative material for coarse aggregate and also to reduce its self weight. The Light weight concrete is preferred by the construction industry to eliminate the unwanted dead load in the building.

In this study Coconut shell is used as main component while preparing light weight concrete. This usage may also reduce the generated solid waste from the environment simultaneously. The surface texture of coconut shell is smooth on side and rough on other side. The bulk density of coconut shell is found to be 500 kg/m^3, so coconut shell will produce light weight concrete of bulk density around 2000 kg/m^3. The usage of this material may definitely reduce the self weight of structural members, Infill in structures. The usage of Steel fibres in addition to plain cement concrete may improve mechanical properties, fatigue and pull out resistance of concrete.

2. MATERIALS

2.1 Ordinary Portland Cement (OPC)

Cement is the most important constituent in concrete. The study result says concrete in OPC gives a compressive strength of 8MPa in 24 hours. Generally use of high grade cements offer many advantages for making stronger concrete. Although they are little costlier than low grade cement, they offer 10-20% savings in cement consumption and also they offer many other hidden benefits. As higher grade cements have become so popular but 53grade cement is almost used in the market. The emission of large amount of CO_2 gas during the manufacture of OPC and environmental pollution reduces the production of OPC widely all over the world. The process of setting is exothermic is the main disadvantage. For research activities we can prefer OPC as they possess exact composition of raw cement The properties of cement like Consistency, initial setting time, final setting time and specific gravity were studied and the obtained results were as shown below

Table-1. Properties of ordinary portland cement.

Test	Result	As per IS 4031-1998
Consistency	51	_
Initial setting time	90 min	Not less than 30 min.
Final setting time	5 hours	Not more than 600 min.
Specific gravity	3.05	_

2.2 Aggregates

The aggregates suitable for plain concrete are suitable for coconut shell concrete also. The aggregate are normally divided into two categories, namely, fine and coarse.

2.3 Fine aggregate

The fine aggregates should consist of smooth rounded particles, to reduce the water demand. The fine aggregate having fine modulus of 3.0 or greater is recommended. The fine aggregate to be used should be free from slit and clay. The fine aggregates are sieved using 2.36 mm sieve the particles retained in 2.36mm sieve are used in the concrete to reduce the porosity.

2.4 Coarse aggregate

The Coarse aggregate should satisfy both strength and rheological consideration. The aggregate may be a crushed rock or natural gravel. The aggregate to be used to be free from the deposition of slit or clay because it will reduce cement aggregate bond strength. The uniform size of the aggregates may also improve the performance of the concrete. The stone of size 12.5mm are used in the concrete. The coarse aggregate increases the impact strength and compressive strength of concrete. The tested results of Fine aggregate and Coarse aggregate are given in Tables 2 and 3 respectively.

Table-2. Properties of fine aggregate.

Test	Result	As per IS383-1970
Fineness modulus	5.2	5 to 7
Specific gravity	2.9	2.6

Table-3. Properties of coarse aggregate.

Test	Result	As per IS 383-1970
Fineness modulus	2.7	Medium sand
Specific gravity	2.5	2.55

2.5 Steel fibres

Steel fibres are used in concrete in the form volume fraction towards the total volume of concrete. The volume fraction of steel fibres used in concrete may not exceed 2%. The fibres may be bundle hooked, corrugated towards its length and in cross section wise it is round, rectangular, available in many shapes. They are commercially available and they are used mainly in sub structural works in the construction projects. They range of ultimate strength may exceed 2000 MPa. Fibres are available in various aspect ratio and it should be preferred with aspect ratio around to 50 to avoid balling. The properties of steel fibres are listed in the table given below:

Table-4. Properties of the steel fibres.

Property	Bundled Hooked End steel fibres
Length (mm)	60
Diameter (mm)	0.75
Aspect ratio (l/d)	80
Tensile strength (N/mm2)	1225
Elastic modulus (N/mm2)	210000

2.6 Coconut shell

Coconut shell is used as a waste material in replacement of coarse aggregate. Coconut shell is collected freshly from the oil mill; these shells are crushed into small pieces approximately around 10-15mm size. Before crushing the surface of the coconut shell was made smooth by removing the fibres on its upper layer. The thickness of the shell will be maximum of around 8-10mm. This replacement may help us to prepare light weight aggregate and also satisfy the environmental needs by replacing the solid waste materials. The Coconut shell is having high water absorption characteristics while compare to normal coarse aggregate was identified through literature study. The smooth surface on the one side of the coconut shell will improve the workability of concrete. The coconut shell used as the replacements are sieved using 20 mm sieve.

3. EXPERIMENTAL STUDY

3.1 Test procedure

The testing machine may be of any reliable type, of sufficient capacity for the tests and capable of applying the load at the rate specified in 140 kg/sq cm/min. The permissible error shall be not greater than ± 2 percent of the maximum load. Tests shall be made at recognized ages of the test specimens, the most usual being 28 days. The ages shall be calculated from the time of the addition of water to the dry ingredients. At least three specimens, preferably from different batches, shall be made for testing at each selected age.

The specimens casted will be tested for Compressive Strength of cube with replacement and without replacement of coarse aggregate with coconut shell (Cubes 150x150x150mm)

3.2 Test results on compressive strength of conventional concrete

The compressive strength of conventional concrete with addition of steel fibres for various volume fractions of 0.5%, 1.0%, 1.5%, 2.0% for 7days and 28 days curing are listed below:

Table-5. Compressive strength of conventional concrete with volume fraction of Bundled Hook Steel fibre.

Specimen designation	Volume of fraction (%) Steel fibre	Compressive strength attained from 7days curing in (N/mm^2)	Compressive strength attained from 28days curing in (N/mm^2)
CC	-	24.1	29.2
A11	0.5	27.1	33.2
A12	1.0	28.5	36.4
A13	1.5	27.4	34.2
A14	2.0	26.8	32.4

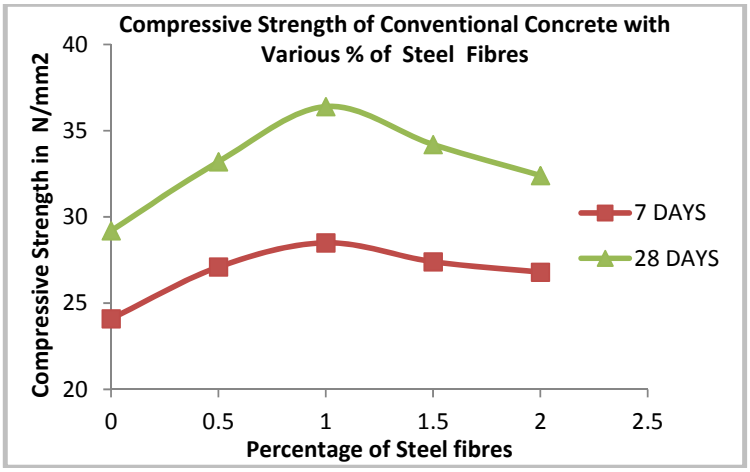

Figure-1. Compressive strength of conventional concrete with various % of steel fibres.

3.3 Test results on compressive strength of coconut shell concrete

The compressive strength of coconut shell concrete with addition of steel fibres for various volume fractions of 0.5%, 1.0%, 1.5%, 2.0% for 7 days and 28 days curing are listed below:

Table-6. Compressive strength of coconut shell concrete with various volume fraction of steel fibre.

Specimen designation	Volume of fraction (%) Steel fibre	Compressive strength attained from 7days curing in (N/mm^2)	Compressive strength attained from 28days curing in (N/mm^2)
CC	-	19.2	23.2
A11	0.5	19.6	26.5
A12	1.0	22.9	26.9
A13	1.5	23.8	28.7
A14	2.0	21.5	25.14

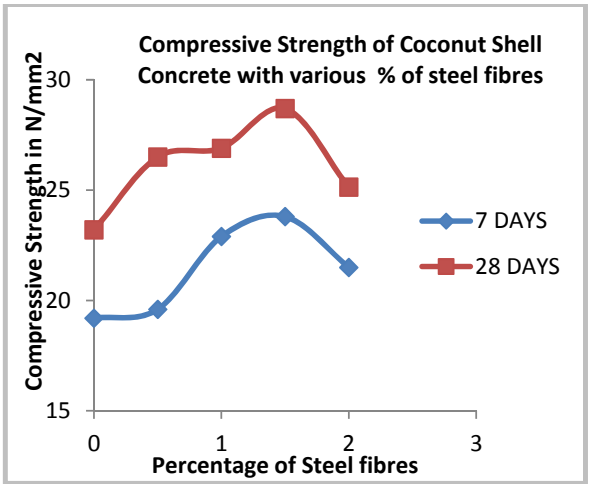

Figure-2. Compressive strength of coconut Shell concrete with various % of steel fibres.

The maximum compressive strength of Control concrete for 7 days and 28 days are found to be with various volume fraction of steel fibre are 28.5 N/mm^2 and 36.4 N/mm^2 respectively.

The maximum compressive strength of Coconut Shell concrete for 7days and 28 days are found to be with various volume fraction of steel fibre are 23.8 N/mm^2 and 28.7 N/mm^2 respectively.

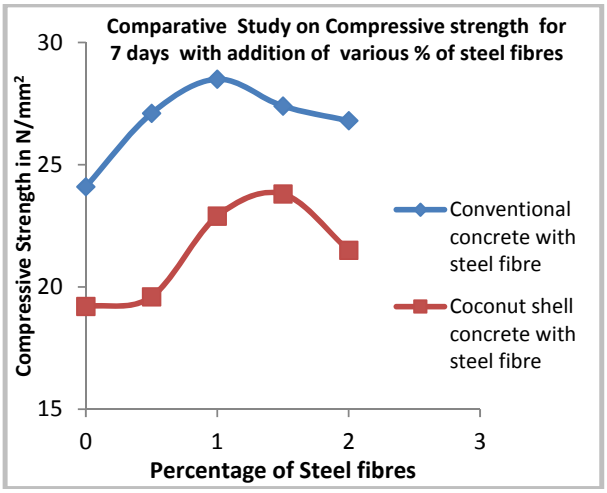

Figure-3. Comparative study on compressive strength for 7 days with various % of steel fibres.

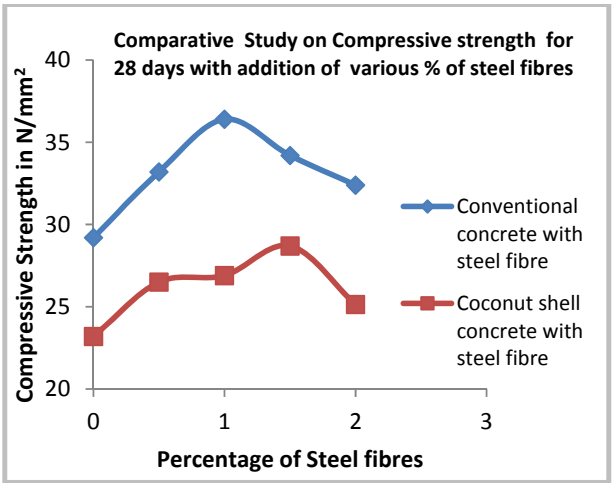

Figure-4. Comparative study on compressive strength for 28 days with various % of steel fibres.

4. CONCLUSION

The following conclusions were drawn based on the test results arrived from the compressive strength of cube are given below:

- The volume fraction of 1.0% of steel fibre on Control concrete shows a considerable increase in compressive strength for 7 days and 28 days are 28.5 N/mm^2 and 36.4 N/mm2 respectively.
- The volume fraction of 1.5% of steel fibre on Coconut shell concrete shows a considerable increase in compressive strength for 7 days and 28 days are 23.8 N/mm2 and 28.7 N/mm2 respectively.
- The study gives a clear idea that coconut shell can be definitely used as an aggregate replacement in light weight concrete
- The comparative study shows only a considerable difference in compressive strength of concrete through addition of steel fibre in volume fraction

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