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Experimental behavior of R.C.Beam by the partial replacement of coarse aggregate using cocos nusifera(Coconut Shell)

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Abstract - *The main aim of the project is to encourage the use of these harm free waste products as construction materials in low-cost housing. In conventional constructions, the cost of the materials are high and this has necessitated the use of waste material i.e., coconut shell (cocos nusifera) which is also the light weight material. Hence in this current scenario this experimental study of partial replacement of coarse aggregate finds an effective solution in the reduction of land fill cost and also reduces the environment pollution. In this experimental study the partial replacement of coarse aggregate with 0% to 50% of coconut shell waste collected from the agricultural farms and houses were used along with the admixture. They are mixed at M30 graded concrete and the specimens are casted, cured and tested for its compressive strength & with its result the beams are casted and tested for flexural strength. The parameters will be tested for 28 days curing.*

Key Words:

Coconut shell, Admixture and Concrete Strength Parameters, compression strength, flexural strength.

1.INTRODUCTION

Concrete plays the main role in our construction field. The demand of concrete in both developing and developed countries increases the consumption. The demand for concrete increases environmental degradation and ecological imbalance, etc. The possibility of a complete depletion of aggregate resources has rendered continued use of aggregates for construction unsustainable. Because of this challenge, researchers throughout the world have been investigating ways of replacing aggregates to make construction sustainable and less expensive. wastes generated by industrial and agricultural processes have created disposal and management problems which pose serious challenges to efforts towards environmental conservation, their use contributes to resource conservation, environmental protection and the reduction of construction costs, since waste materials can be obtained at little or no cost, while making significant contribution to the conservation of natural resources and maintenance of ecological balance. The uses of structural grade lightweight concrete reduce considerably the self-load of a structure and permit larger precast units to be handled. Today, it is more difficult to find a natural resource. Use of the waste materials not only helps in getting them utilized in cement, concrete and other construction materials, but also has numerous indirect benefits such as reduction in land fill cost, saving in energy, and protecting environment from possible pollution effect. It is also economical. In the present work, coconut shell as partial replacement for coarse aggregate in concrete is studied.

1.1 MATERIALS USED

Cement: A cement is a binder, a substance that sets and hardens and can bind other materials together. Cements used in construction can be characterized as being either **hydraulic** or **non-hydraulic**, depending upon the ability of the cement to set in the presence of water. The most important uses of cement are as a component in the production of mortar in masonry, and of concrete, a combination of cement and an aggregate to form a strong building material

Sand : The sand is a naturally occurring granular material composed of finely divided rock and mineral particles. It is defined by size, being finer than gravel and coarser than silt. **Sand** can also refer to a textural class of soil or soil type; i.e. a soil containing more than 85% sand-sized particles.

Construction aggregate: simply "aggregate", is a broad category of coarse particulate material used in construction. Aggregates are used as a stable foundation or road/rail base with predictable, uniform properties or as a low-cost extender that binds with more expensive cement or asphalt to form concrete.

Coconut shell aggregate: Coconut shell is the one of the natural waste. Coconut shells are mostly used for making ornament, fancy items, etc. The powdered shell is also used in the industries of plastics, glues, and abrasive materials and it is widely used for the manufacture of insect repellent in the form of mosquito coils and in agarbathis. The purpose of this research work is to develop a concrete with coconut shells as coarse aggregate. The whole entity could be called

coconut shell aggregate concrete (CSC). After the coconut is scraped out, the shell is usually discarded as waste.

1.2 LITERATURE REVIEW

J.P. RIES (2011) studied that Lightweight aggregate (LWA) plays important role in today's move towards sustainable concrete, Lightweight aggregates contributes to sustainable development by lowering transportation requirements, optimizing structural efficiency that results in a reduction in the amount of overall building material being used, conserving energy, Reducing labor demands and increasing the survive life of structural concrete.

AMARNATH YERRMALLA (2012) et al studied the strength of coconut shells(CS) replacement and different and study the transport properties of concrete with CS as coarse aggregate replacement. They concluded that

a. Increase in CS percentage decreased densities of the concrete.

b. With CS percentage increased the 7 days strength gain also increased with corresponding 28 days curing strength.

S.M.SUBASH, P.M.DHUREEN KARTHIK Concrete a composite man-made material is the most widely used building material in the construction industry. It consists of a rationally chosen mixture of binding material such as lime or cement, well graded fine and coarse aggregates, water and admixtures. The matrix is usually 22-34% of the total volume. The project was carried out with various % replacement of coconut shell in place of coarse aggregates.

K.GUNASEKARAN, P.S.KUMAR (2008) The high cost of conventional building material is a major factor affecting housing delivery in India. In developing countries where abundant agricultural and industrial waste are discharged, these wastes are can be used as potential material or replacement material in the construction industry.

MAJID ALI (JUNE 2010) The versatility of coconut fibres and its applications in different branches of engineering, particularly in civil engineering as a construction material. Coconut fibre is one of the natural fibres abundantly available in tropical regions, and is extracted from the husk of coconut fruit. Coconut fibre is extracted from the outer shell of a coconut. The common name, scientific name and plant family of coconut fibre is Coir, Cocosnucifera and Arecaceae (Palm), respectively.

2. METHODOLOGY

The following steps were adopted to do the process in sequence:

1. Collection of samples and testing their properties
2. Mix design calculations
3. Design of beam
4. Casting of specimens
5. Curing of specimens for 28 days strength
6. Analysis & result calculation

2.1 MIX DESIGN FOR M30

Mixing Sequence Used

- Workability of concrete
  a. Compacting factor test = 0.90
- Specific gravity test
  a. Cement = 3.21
  b. Fine aggregate = 2.62
  c. Coarse aggregate = 2.72
- Sieve analysis test
  a. Fine aggregate = conforming zone (as per IS 2386-3)
- Water absorption test
  a. Water absorption of fine aggregate = 2.2
  b. Water absorption of coarse aggregate = 0.3

Requirement of Concrete Mix Design

The basic requirement of concrete materials we have required at mix proportion based given materials. If the project concrete mix ratio is M30 grade of concrete. So the mix proportion is 1:1.53:2.76 to be followed. After mixing the concrete, it is to be under gone for the tests for workability, etc.,

Testing of Fresh Concrete

Compaction factor test

Compaction factor test is a test to measure the workability of concrete and is useful for concrete of very low workability. This test works on the principle of determining the degree of compaction achieved by a standard amount of work done by allowing the concrete of fall through a certain height. The degree of compaction called the compaction factor is measured by the density ratio i.e., the ratio of the density actually achieved in the test to the density of the same concrete being fully compacted. This test is carried out as per specifications of IS: 1199-1959.

Cube Compressive strength of the Coconut Shell Concrete

In this report, the hard concrete test (compression test) for the various replacement of coconut shell was taken and its report were noted. Totally 15 cubes were casted and tested. Compressive strength = crushing load/resisting area of cross section

$$= W/A$$

Details of the R.C.Beam

In this experimental set up, four beams were to be casted and tested which is of 1.5m long. One is conventional concrete beam, the other three were coconut shell concrete beam. The beam was designed as under reinforced section to carry on a minimum ultimate load of 125KN. The beam consists of three 12mm diameter bars at the bottom & two 10mm diameter bars at the top. 8mm diameter bars are used as stirrups to hold the reinforcements and to act as shear reinforcements.

Casting & Curing of Specimens

The beam moulds were prepared to cast the beams. The moulds then were cleaned and oiled before casting. Then the concrete is mixed in the above mentioned ratio using the laboratory type mixer machine or manually. The replacement percentage of CSA instead of Coarse aggregate must be in proper to get the clear results. The mixed concrete is then placed in the mould and compacted using the tamping rod. After 24 hours the specimen is demoulded and is cured for 28 days. Then the beam is dried in air for 12 hours after curing before the testing.

Testing of specimens

The beams were cured for 28 days to achieve the approximate flexural strength and they are tested using the loading frame of 500KN. The beams are tested as simply supported beam. Its tested strength were recorded.

3. RESULT AND DISCUSSION
FLEXURAL STRENGTH TEST RESULT:

From the result obtained from the compressive strength test, the beam is to be casted & tested. The beams to be casted is with the dimension 230mm wide and 150mm deep with the cover of 15mm.The diameter of the bar used is 12mm as tensile bars and 10mm as compressive bars. 6mm stirrups is used to hold the bars in its position. There were four beams casted. One is conventional concrete beam and the other was 25% replacement of coconut shell concrete beams. Then the beam is casted and tested using the loading frame of 500KN.The result obtained from the 28 days cured beams is as follows:

Table -1: Flexural strength of CSC beams

s.no	**25% replacement of CS aggregates in beams**
	Load(KN)
B1.	90
B2.	89
B3.	91
Average of the three beams	**90**

3. CONCLUSIONS

Thus the properties tests of the material have been conducted and reported in the above chapters. Then the further researches have been conducted with the waste Coconut Shell as the replacement for the coarse aggregate with the various proportions.

The compressive strength is calculated for all the proportions of the sample. From that strength we can conclude the optimum replacement level of coarse aggregate. In this research the replacement percentage is up to 50% with the conventional coarse aggregate. The compressive strength of the CSC is 37.7N/mm^2 by replacing 25% of coarse aggregate.

Then the beam is casted and tested for the above compressive strength and the result obtained is 90KN.From this results, we undoubtfully adopt this for small housing and office buildings.

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