International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 06 | June-2018 www.irjet.net p-ISSN: 2395-0072

A Review on Flexural Behaviour of RC Beam with Partial Replacement of Coarse Aggregate by Coconut Shell

Tejaswini Tanaji Shinde[1], M. V. Nagendra[2]

[1] *PG Student,Civil department, Padmabhooshan Vasantraodada Patil Institute of Technology, Sangli, Maharashtra, India*

[2] *Associate Professor,Civil department, Padmabhooshan Vasantraodada Patil Institute of Technology,Sangli, Maharashtra, India*

Abstract - *This review paper covers the study of strength characteristics of concrete with coconut shell. Coconut is grown in more than 93 countries. India is the third largest, having cultivation on an area of about 1.78 million hectors. The properties of coconut shell aggregate concrete are examined and the use of coconut shell aggregate in construction is tested. Experimental studies are conducted on the effect of coconut shell used in proportions of 5%,10%,15%,20% and 25% to replace coarse aggregate in conventional concrete (M20 grade and M30 grade). The tests were carried to determine the compressive and flexural strength using cube and beam specimen respectively. The obtained results are compared with that of conventional mix. Tests are as per the specified procedure of Indian Standard Codes. From study, we find out the optimum percentage for replacement of coarse aggregate by coconut shell and we can encourage the use of these 'seemingly' waste products as construction material in Civil engineering.*

Key Words: Coarse aggregate, coconut shell, compressive strength, flexural strength, conventional concrete.

1. INTRODUCTION

Concrete is the vital civil engineering material. Its manufacturing involves utilization of ingredients like cement, sand, aggregate, water and required admixtures. The coarse aggregate is the main constituent of concrete mix. Demand of construction material is increased due to infrastructural development across the world. That high demand for concrete in the construction using normal weight aggregate such as gravel and granite drastically reduces the natural stone deposits and this has damaged the environment there by causing ecological imbalance, there is a need to explore and to find out suitable replacement material to substitute the natural stone. Therefore it is necessary to encourage or research on sustainable material which will help to use such waste material as construction material with less cost and safety of structure. The coconut shell is the agricultural waste product and simultaneously its use in construction material will reduces the environmental problem of solid.

1.1 History of Coconut Shell

Coconut is grown in more than 93 countries. India is the third production. Annual production is about 7562 million. However, it is the also the main contributor to the nation's pollution problem as a solid waste in the form of shells, which involves an annual production of approx. 3.18 million tones. It's also presents serious disposal problems for local environment, is an abundantly available agriculture waste from local coconut industries. This will have the double advantages of reduction in the cost of construction material and also as a means of disposal of wastes. [3]

1.2 Coconut shell as coarse 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. [9]

1.3 Properties of Coconut Shell

Coconut shell has high strength and modulus properties. It has added advantage of high lignin content. High lignin content makes the composites more weather resistance. It has low cellulose content due to which it absorbs less moisture as compare to other agriculture waste. Coconuts being naturally available in nature and since its shell are non- biodegradable; they can be used readily used in concrete which may fulfill almost all the qualities of the original form of concrete. [3]

2. RELEVANCE

The study about the concrete using Coconut shell i.e. to reduce mining activities for getting sand from beaches, inland dunes and dredged from ocean beds and coarse aggregate from natural stone deposits and therefore reduce impact on environment. Growing environmental restrictions to the exploitation of sand and coarse aggregate like gravel and granite from riverbed and mining have resulted in a search for alternative aggregate, particularly near the larger metropolitan areas. The increase in population also increases the industrial by – product, domestic waste etc. It has been noticed in India that coconut shell (CS) as an

agricultural waste, requires high dumping yards as well as an environmental polluting agent. This experimental investigation was aimed to quantify the effects of replacing partially the conventional coarse aggregate by coconut shell to produce concrete. This leads to reduce, reuse and recycle the agricultural waste. If structural light weight concrete can be developed from coconut shell, it would a great achievement for construction industry. This study will give the double advantage of reduction in the cost of construction material and also as a means of disposal of waste.

3. LITERATURE REVIEW

Teo DCL, Mannan MA, Kurian VJ (2006), have constructed the structure to show the potential use of oil palm shell (OPS) concrete. In actual project, a small footbridge of 2 m in span and a low cost house with a floor area of 59 m^2, both using OPS concrete were constructed on the campus of University Malaysia Sabah (UMS).These structures are located near the coastal area, which has an annual rainfall of about 2500 mm, air temperature in the range of 23–32°C and relative humidity of 72–91%. [8]

U. Johnson Alengaram, Hilmi Mahmud and Mohd Zamin Jumaat (2010), have made the comparison between the fresh, mechanical and bond properties of grade 30 lightweight concrete, namely oil palm kernel shell concrete (OPKSC) with normal weight concrete (NWC) of similar strength in this paper. Oil palm kernel shell (OPKS), an industrial waste has been used as lightweight aggregates (LWA) in the OPKSC. In addition, mineral admixtures, 10% of silica fume and 5% fly ash have been used. The OPKSC produced a density reduction of about 20% compared to NWC. The addition of silica fume enhanced the compressive strength and thus OPKSC produced 28-day compressive strength up to 37 MPa. The bond stress of the OPKSC was found about 86% of the corresponding NWC; however, there was no slip failure between OPKSC and the reinforcement. Further, the ultimate experimental bond stress of OPKSC was found nearly 2½ times higher than the theoretical values calculated based on BS standards. [12]

Dewanshu Ahlawat, L.G.Kalurkar (2010), have conducted the experimental study on M 20 grade of concrete with partial replacement granite by coconut shell. Forty five cubes were casted and their compressive strength and workability were evaluated at 7, 14 and 28 days. The compressive strength of concrete reduced as the percentage replacement increased. Concrete produced by 2.5%, 5%, 7.5%, 10% replacement attained 28 days compressive strength of 19.71,19.53,19.08,18.91 respectively. These results showed that Coconut shell concrete can be used in reinforced concrete construction. Its utilization is cost effective and eco-friendly. [5]

Gunasekaram K, Kumar PS, Lakshmipathy M (2011), have concluded that CS (coconut shell) concrete has better workability because of the smooth surface on one side of the shells. The air-dry densities of CS concrete of the typical mixes are within the range of structural LWC (Light Weight Concrete). The flexural strength of CS concrete is approximately 17.53% of its compressive strength. The splitting tensile strength of CS concrete is approximately 10.11% compressive strength. The impact resistance of CS concrete is high when compared with conventional concrete. [6]

Payam Shafigh, Mohd Zamin Jumaat, Hilmi Bin Mahmud, Norjidah Anjang Abd Hamid (2012), have carried out the experiment by replacing normal weight aggregate by Oil palm shell (OPS) which is a waste lightweight aggregate originating from the palm oil industry, which is approximately 50% lighter than conventional aggregate. In this study, crushed old OPS was used as coarse aggregate. Compressive strength under different curing conditions and the splitting tensile and flexural strengths were compared with those of the normal weight granite concrete. The test results showed that OPS concrete with a compressive strength in the range of 34–53 MPa has a splitting tensile strength rang of 2.8–3.5 MPa and flexural strength range of 4.4–7.0 MPa. The sensitivity of compressive strength of OPS concrete in this study is significantly lower than uncrushed OPS concrete reported in the literature. The sensitivity of OPS concrete, under poor curing regime, can be reduced by decreasing the water/cement ratio, increasing the OPS content or reducing the cement content. It was found that there was no substantial difference in 28-day compressive strength for OPS concretes cured initially for 3, 5 and 7 days. The28-day compressive, splitting tensile and flexural strengths of OPS concrete was found to be 38%, 28% and 17%, lower than that of granite concrete, respectively. [7]

Amarnath Yerramala, Ramachandrudu C (2012), have carried out the experimental investigation on properties of concrete with coconut shells (CS) as aggregate replacement. Control concrete with normal aggregate and CS concrete with 10 - 20% coarse aggregate replacement with CS were made. Two mixes with CS and fly ash were also made to investigate fly ash effect on CS replaced concretes. Constant water to cement ratio of 0.6 was maintained for all the concretes. Properties like compressive strength, split tensile strength, water absorption and moisture migration were investigated in the laboratory. The results showed that, density of the concretes decreases with increase in CS percent. Workability decreased with increase in CS replacement. Compressive and split tensile strengths of CS concretes were lower than control concrete. Permeable voids, absorption and sorption were higher for CS replaced concretes than control concrete. Coarse aggregate replacement with equivalent weight of fly ash had no influence when compared with properties of corresponding CS replaced concrete. [2]

Tomas U. Ganiron Jr (2013), have studied on generating product using agricultural waste as well develop an alternative construction material that will lessen the social and environmental issues. It also paved the way to the recognition of using coconut shells and fiber as substitute for aggregates in developing concrete hollow blocks. This paper

presents the result on the workability and compressive strength of concrete containing various percentage of coconut shell content as partial aggregate replacement. Workability test and compressive strength test were conducted in accordance to ASTM C136 and ASTM C137 respectively. Results show that replacement of appropriate coconut shell content able to produce workable concrete with satisfactory strength. Integration of coconut shell enhanced the strength of concrete making it to be the highest as compared to conventional concrete mixture. [11]

B.Damodhara Reddy, S.Aruna Jyothy, Fawaz Shaik (2014), have conducted the experimental investigation on concrete with different coarse aggregate.The properties of coconut shell and coconut shell aggregate concrete is examined and the use of coconut shell aggregate in construction is tested. The project paper aims at analyzing flexural and compressive strength characteristics of with partial replacement using M30 grade concrete. The project also aims to show that Coconut shell aggregate is a potential construction material and simultaneously reduces the environment problem of solid. Beams are casted, tested and their physical and mechanical properties are determined. The main objective is to encourage the use of these "seemingly" waste products as construction materials in low-cost housing. [4]

T.R.M.Nandhini, P.Balamurugan (2016), have concluded that the project will 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. [9]

T.Subramani, A.Anbuvel (2016), have carried out the experimental investigation on behavior of reinforced concrete beam with coconut shells (CS) as coarse aggregate. Control concrete with normal aggregate and CS concrete with 0 - 20% coarse aggregate replacement with CS were made. Two mixes with CS and fly ash were also made to investigate fly ash effect on CS replaced concretes. Constant water to cement ratio of 0.6 was maintained for all the concretes. Properties like compressive strength, split tensile strength, water absorption and moisture migration were investigated in the laboratory. The properties of coconut shell and coconut shell aggregate concrete is examined and the use of coconut shell aggregate in construction is tested. The project paper aims at analyzing flexural and compressive strength characteristics of with partial replacement using M25 grade concrete. [10]

Ajay Tharwani, Ashish Sablani, Gaurav Batra, Sakshi Tiwari, Divya Reel, Manish N. Gandhi (2017), have studied the effect of coconut shell on the strength of concrete when used in replacement of aggregate. The tests were conducted on concrete with varying percentage of coconut shell (5%, 10% and 15%). Data presented include strength and slump value of concrete. The use of coconut shells can also help the prevention of the environment and also help economically. Sun drying shell should be used to make sure biodegradable materials decay before its mixing with concrete. It also contributes to sustainable construction. The aim of this paper is to spread awareness about the utilization of coconut shell as a construction material in civil engineering. [1]

4. OBJECTIVES

- To study the flexural behavior of RC beam with partial replacement of coarse aggregate by coconut shell.
- To prepare mix design for M20 grade and M30 grade concrete.
- Experimental investigation of the concrete cube and beam specimen that are cast with different Coconut shell content for replacement of coarse aggregate.
- To study the behavior of compressive and flexural strength of coconut shell concrete.
- To find out the optimum percentage for replacement of coarse aggregate by coconut shell.
- To study the cost comparison for production of conventional concrete and Coconut shell concrete.

4. METHODOLOGY

The purpose of this research is to investigate the optimum percent replacement of conventional aggregate by coconut shell.

To study the flexural behavior of RC beam with partial replacement of coarse aggregate by coconut shell. Prepare mix design for M20 grade and M30 grade concrete. Carry out the experimental investigation of the concrete cube and beam specimen that are cast with different Coconut shell content for replacement of coarse aggregate. Study the behavior of compressive and flexural strength of coconut shell concrete. Find out the optimum percentage for replacement of coarse aggregate by coconut shell. Finally study the cost comparison for production of conventional concrete and Coconut shell concrete.

5. CONCLUSIONS

It is expected that coconut shell can be used in concrete production. The study of coconut shells will not only provide a new material for construction but will also help in the preservation of the environment in addition to improving the economy by providing new use for the coconut shells.

REFERENCES

[1] Ajay Tharwani, Ashish Sablani ,Gaurav Batra, Sakshi Tiwari, Divya Reel, Manish N. Gandhi," Study of Strength of Concrete by Using Coconut Shell " , IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 4 Issue 5, May 2017.

[2] Amarnath Yerramala, Ramachandrudu C," Properties of Concrete with Coconut Shells as Aggregate Replacement", International Journal of Engineering Inventions ISSN: 2278-7461, Volume 1, Issue 6 (October2012) PP: 21-31.

[3] Apeksha Kanojia, S.K.Jain, "Performance Of Coconut Shell As Coarse Aggregate In Concrete",A Review (IRJET),Vol.02,Issue:04 July-2015.

[4] B.Damodhara Reddy, S.Aruna Jyothy , Fawaz Shaik,"Experimental Analysis of the Use of Coconut Shell as Coarse Aggregate ",IORS Journal Mechanical and Civil Engineering(IOSR-JMCE) Volume 10,Issue 6(Jan. 2014) PP 06-13.

[5] Dewanshu Ahlawat, L.G.Kalurkar, "Coconut Shell as Partial Replacement of Coarse Aggregate in Concrete", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) Dec.(2010) PP 61-64.

[6] Gunasekaran K, Kumar PS, Lakshmipathy M," Mechanical and bond properties of coconut shell concret", Const Build Mater 2011;25(1):92–8.

[7] Payam Shafigh, Mohd Zamin Jumaat, Hilmi Bin Mahmud, Norjidah Anjang Abd Hamid, "Lightweight concrete made from crushed oil palm shell: Tensile strength and effect of initial curing on compressive strength", Construction and Building Materials 27 (2012) 252-258.

[8] Teo DCL, Mannan MA, Kurian VJ ," Structural concrete using oil palm shell (OPS) as lightweight aggregate" ,Turk J Eng Environ Sci 2006;30:251–7.

[9] T. R. M .Nandhini, P. Balamurugan ,"Experimental behavior of R.C. Beam by the partial replacement of coarse aggregate using cocos nusifera (Coconut Shell)",International Research Journal of Engineering and Technology (IRJET) Volume: 03 Issue: 04 ,Apr-2016.

[10] T.Subramani, A.Anbuvel,"Experimental Behavior Of Reinforced Concrete Beams With Coconut Shell As Coarse Aggregate", International Journal of Application or Innovation in Engineering & Management (IJAIEM)Volume 5, Issue 5, May 2016 ISSN 2319 – 4847.

[11] Tomas U. Ganiron Jr, "Sustainable Management of Waste Coconut Shells as Aggregates in Concrete Mixture ",Journal of Engineering Science and Technology Review 6 (5) (2013) 7-14.

[12] U. Johnson Alengaram, Hilmi Mahmud and Mohd Zamin Jumaat ,"Comparison of mechanical and bond properties of oil palm kernel shell concrete with normal weight concrete",International Journal of the Physical Sciences Vol. 5(8), pp. 1231-1239, 4 August 2010.