International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 04 | April - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

# An Experimental Study of Concrete Mixed with Coconut Shell as Partial Replacement of Course Aggregate

Megha Padgha[1]

Atma Malik Institute of Technology and Research, Shahapur

Akanksha Gaikwad[2]

Atma Malik Institute of Technology and Research, Shahapur

Nikita Telivare[3]

Atma Malik Institute of Technology and Research, Shahapur

Prof. Soniya Kadam[4]

Atma Malik Institute of Technology and Research, Shahapur

---

**Abstract -** The high cost of conventional construction materials affects the economy of structure. The possibility of utilizing recycled coconut shell aggregates in concrete as coarse aggregate is examined in the present study. An optimum percentage replacement of coarse aggregate with coconut shell aggregate is determined from the study. Coconut shell is a lightweight material thus producing lightweight concrete. The replacement of coarse aggregate of coconut shell by 10%, 20% and 30%. The Design mix used is M20 grade and testing of specimens are conducted after 7 and 28 days of curing. The flexural and compressive strength of concrete are tests. The main objective is to encourage the use of these waste products as construction materials in low-cost housing Aggregate is a major ingredient for making concrete, occupying almost 70-80% part of concrete. Conventionally crushed rocks are used as coarse aggregate and river sand as fine aggregate. Both are naturally available materials. Due to the speedy growth of construction works, conventional aggregate sources are exhaust very fast leading to a significant increase in the cost of construction. For sustainable development, these materials should be used wisely and alternative materials need to be searched to replace regular aggregate. A large number of studies have been done to search for alternative materials for the production of concrete. At the same time due to fast industrialization, production of waste material is increasing day by day. Its disposal has become a real problem. It can be concluded that the ideal amount of coconut shell replacement for coarse aggregate for M20 Concrete is 10% -20%.

**Key Words:** Concrete Mix, Coconut shell, Low cost housing, Flexural strength, Compressive strength, Design mix, Replacement of Course Aggregate.

## 1.INTRODUCTION

Concrete utilization is increasing at a higher rate by the development of infrastructures. Because of more extraction of the concrete, there is continuous aggregate extraction from natural resources that leads to ecological imbalance and depletion. To manage the imbalance, the waste that is produced from coconut shells is used in replacement of aggregates. In India, 90% production of coconut is in south India. The coconut shell is crushed in a crusher machine after sieving in a sieve 10 mm coconut shell is collected. Coconut shell is used as recycled lightweight aggregate in concrete.

A research effort has been made to “match society’s need for safe and economic disposal of waste materials. The use of waste materials saves natural resources and disposal spaces and helps to maintain a clean environment. The current concrete construction practice is thought unsustainable because, not only is it consuming enormous quantities of stone, sand, and drinking water, but also two billion tons a year of Portland cement, which releases greenhouse gases leading to global warming. Experiments have been conducted for waste materials like rubber tires, e-waste, coconut shells, blast furnace slag, waste plastic, demolished concrete constituents, wastewater, etc. Construction waste recycling plants are now installed in various countries but they are partly a solution to the waste

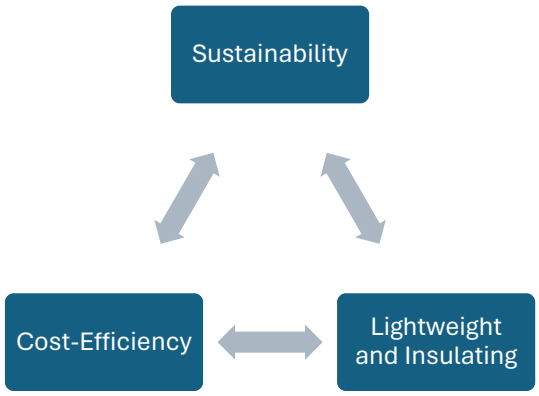
problems. The negative consequences of increasing demand for concrete include reduction of aggregate deposits; environmental deterioration and ecological imbalance. Concrete is one of the most adaptable construction materials. With more than 10 billion tons of concrete produced annually, it is considered to be the most important building material. Consequently, the concrete industry is going to use a considerable amount of natural resources to produce concrete. Production of concrete is increasing due to the high growth of infrastructure development and construction activities in the world. Also, the demand for concrete is expected to grow to approximately 18 billion tons a year by 2050.

Coconut is grown in more than 93 countries and South East Asia is regarded as the origin of coconut. By using agricultural waste, namely the coconut, replacing the stone aggregate in concrete, concrete has been developed which possesses the potential to be used in lightweight construction. Structural lightweight aggregate concrete is a significant and resourceful material. This type of concrete has various applications such as the construction of multistory building frames and floors, bridges, offshore oil platforms, and prestressed or precast elements

### 1.1 Scope of Work

It can reduce the dependency on natural resources' strength given in compression as compared to conventional concrete. This is waste material that is considered a disposal problem and it is available in high amounts in easily in India. So when partially replaced with aggregate then cost will be reduced. Natural aggregates are limited natural resources. Thus coconut shell aggregate concrete can be the best cheap material instead of natural sand. This project can open a new benchmark in research. Our study had many limitations, of which the time was a major concern. The Durability properties of coconut shell concrete are to be rested before practically applying our project. Durability Tests on CSC which may take around a year to complete can be conducted as future work

**BENEFITS OF USING COCONUT SHELL AS PARTIAL REPLACEMENT**




## 2. LITERATURE REVIEW

**2.1 Satish Shinde, Ramiz Sayed (2016):** In this paper authors mainly discussed basic things needed to make humans alive like meals, lodging, and clothes. They replaced M20 grade concrete with coconut shells as a coarse cluster. In a ratio of 1:1 cubes and circular solids were lobbed respectively and their confining and elastic strength at 4 weeks test. The confining strength and ductile strength of concrete were reduced because the proportion replacement inflated. Concrete made by replacing 10%, 15%, and 20% of the coarse mixture with coconut shell earned by twenty-eight days confining strength and ductile strength. They got the results which made a big price difference and more than that it is environment friendly.

**2.2 Sanjay Kumar (2019):** published a paper that looks at the examination of the usage of coconut shells as mostly replacement for coarse aggregate. In his work, the compressive strength of M20 grade had been thought by trading normal coarse aggregate as 0%,5%,10%,20%, and 30% by weight with the coconut shell. The compressive strength of the coconut shell was assessed on 7, 14, 21 and 28 days. On 10% trading of coarse aggregate with coconut shell the compressive strength has gotten 20.10Mpa at 28 days. On further replacement of coconut shell, there is a decrease in the compressive strength. This outcome shows that coconut shell concrete can be utilized as a lightweight concrete. Weight concrete

**2.3 Lopa M. Shinde (2015)** This paper reviews the possible use of agricultural wastes as aggregate in the concrete industry. Large volumes of natural resources and

raw materials are being used for concrete production around the world in the laboratory. To reduce or minimize the undesirable environmental effects of the concrete industry and promote the environmental sustainability of the industry, the use of wastes from the industry as materials for concrete construction is considered an alternative solution for preventing the excessive usage of raw materials. It aims to support the notion of using these wastes by explaining their engineering properties. This review of existing knowledge about the successful use of agricultural wastes in the concrete industry helps to identify other existing waste products for use in concrete manufacturing. Recycling such wastes and using them in construction materials appears to be a feasible solution not only to the pollution problem but also an economical option in construction.

**2.4 Apeksha Kanoja (2017):** In 2017 published a paper on the execution of coconut shells as coarse aggregates in concrete. This experimental examination was intended to evaluate the partial replacement of coarse aggregates with coconut shells to create concrete. Results uncovered that 40% substitution of ordinary coarse aggregates by coconut shell, 7 days compressive strength of concrete. Results uncovered that 40% substitution of ordinary coarse aggregates by coconut shell, 7 days compressive strength of concrete diminished by 62.6% where, as a decline in 28 days was just 21.5%.40 % substitution makes the concrete lighter by 7.47%

**2.5 Daniel Yaw Osei (2013):** In 2013 presented a paper that paper concerns with the study of M20 concrete with partial replacement of aggregate with coconut shell in an increasing fashion which is 20%,30%,40%,50% and 100% and the day compressive strength were found, out.19.7N/mm2,18.68N/mm2,17.57N/mm2,16.65N/mm 2and,9.29N/mm2. This shows that concrete was replaced by 20%. Coconut shells can be used as a partial replacement for crushed granite or other conventional aggregates in reinforced Increase in percentage replacements by coconut shells reduced.

**2.6 Anjali S. Kattire (2017):** In 2015 published a paper where they studied a total of 16 specimens cast 8 cubes and 8 cylinders and their compressive and tensile strength were measured after 28 days. The coconut shell was used as a partial replacement and the percentages at which it was replaced were 0%,10%,15%, and 20% respectively. Although with increasing replacement the above-mentioned mechanical properties started to show decrement, some of them were still good for the construction of lightweight members.

**2.7 P. Jayabalan and A. Rajaraman (2014)** carried out an experimental investigation to know the effects on concrete by the addition of natural coconut fiber and replacement of cement (by weight) with different percentages of fly ash on flexural strength, splitting tensile strength, compressive strength and modulus of elasticity. Test results demonstrate that the replacement of 43-grade ordinary Portland cement with fly ash showed an increase in compressive strength, modulus of elasticity, flexural strength, and splitting tensile strength for the chosen mix proportion. The addition of coconut fibers resulting in fly ash mixed concrete composite (FMCC) did enhance the mechanical properties of fly ash mixed concrete composite and at the same time increased the energy levels reflected by increased failure strain, making the material suitable for seismic sustenance.

**2.8 Olanipekun (2006):** carried out the comparative cost analysis and strength characteristics of concrete produced using crushed, granular coconut and palm kernel shell as substitutes for conventional coarse aggregate. The main objective is to encourage the use of waste products as construction materials in low-cost housing. Crushed granular coconut and palm kernel were used as a substitute for conventional coarse aggregate in the following ratios: 0%, 25%, 50%, 75%, and 100% for preparing mix ratios 1:1:2 and 1:2:4. Total of 320 cubes were cast, tested and their physical and mechanical properties were determined. The result showed that the compressive strength of the concrete decreased as the percentage of the coconut shell increased in the two mix ratios, Coconut shell exhibited a higher compressive strength than palm kernel shell in the test. Moreover, there is a cost reduction of 30% and 42% for concrete produced from coconut shells and palm kernel shells respectively

**2.9 Damre Shraddha and Shrikant Varpe (2014)** replaced conventional coarse aggregate with coconut shells and concluded that- with 50% replacement of coarse aggregates by coconut shells, the strength attained reduces invariably from 10%-20% as compared to the conventional coarse aggregate concrete. With 50% replacement of coarse aggregates by coconut shells, the flexural strength attained reduces invariably from 10%-15% as compared to the coarse aggregate concrete.

**2.10 Maninder Kaur & Manpreet Kaur (2012)** published a review paper in which it is concluded that the use of coconut shells in cement concrete can help in waste reduction and pollution reduction. It is also expected to serve the purpose of encouraging housing developers to invest these materials in house construction. It is also concluded that the Coconut Shells are more suitable as strength-giving lightweight aggregate when used to replace common coarse aggregate in concrete production.

## 3. METHODOLOGY

In this project The materials used for this research are Ordinary Portland cement (OPC) 53 grade, coarse aggregate, fine aggregate (sand), and coconut shell aggregate as raw materials. The materials were used in our project. Coconut, shell, cement, Coarse aggregates, Fine aggregate, water.

### 3.1 COLLECTION OF COCONUT SHELL

The coconut shell is the strongest part covered in coconut fruit. The coconut shell is located in between the coconut flesh and coconut husk. This shell is naturally created to produce the inner part of the coconut. The coconut shell is a high-potential material due to its high strength and modulus properties. Coconut shell is collected from the temple and local coconut vendors.

**Fig No.1 : Coconut Shell**

Table no.1 : Properties of coconut shell

| Sr no | Physical properties | Result |
|---|---|---|
| 1 | Bulk density (kg/m3) | 800 |
| 2 | Shell thickness | 2-6mm |
| 3 | Specific gravity | 1.33 |

**Crushed Coconut shell:** After collection of coconut shell, the shell is crushed with the help of crushing

**Coconut shell aggregate (CSA):** Coconut shells were obtained from a local market and allowed to dry under the sun for a period of half a month before being crushed

**Crushed coconut shell aggregates:** The coconut shells had fairly smooth concave and rough convex faces. CS aggregates have a relatively high water absorption value of nearly 6.71%, compared to the conventional fine aggregate (3%).

**Fig No.2 : Crushed Coconut Shell**

**Cement:** Ordinary Portland Cement was used for this experiment. It is the main ingredient used for the bonding of concrete. OPC 53 sets quicker than OPC 43. OPC53 has a low Initial setting time. It is used in structures where rapid strength gain is required like load-bearing structures. OPC 53 grade cement is a type of cement preferred for its high compressive strength. The term “53 Grade” signifies that the cement attains a minimum compressive strength of 53 mega pascals (Mpa) after 28 days of curing period. The OPC 53 grade cement has reduced permeability that corroborates with minimizing the moisture content, chemicals, and pollutants, resulting in the long-term integrity of structures. Due to its high strength and durability characteristics, structures require less frequent repairs and maintenance.

**Coarse aggregate:** The aggregate which is more than 4.75mm is known as Coarse aggregate. The material that is retained from crushed rock or crushed gravel. The Size of coarse aggregate used is 10mm and 20mm. The choice of aggregate is primarily determined by its physical and mechanical properties. Basic properties of aggregates include mineralogical composition, surface texture and grain shape, dustiness, porosity, frost resistance, resistance to abrasion and polishing, and asphalt absorption capacity The aggregates used were 20mm

nominal maximum size and are tested as per Indian standards and the results are within the permissible limit.

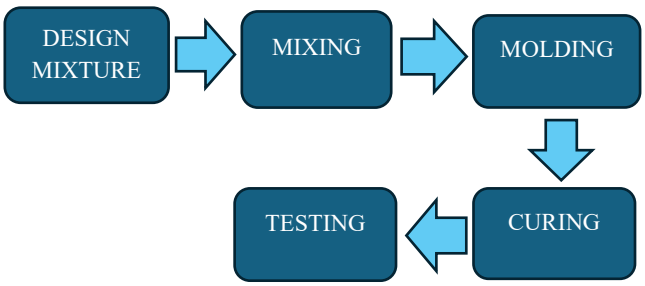
Table no 2 : Properties of Course Aggregate

| Sr No | Properties | Value |
|---|---|---|
| 1 | Specific Gravity | 2.76 |
| 2 | Size OF Aggregate | 10 mm |
| 3 | Water Absorption | 0.4 |

**Fine aggregate :** Fine aggregates used were available on-site and are tested, the results are as per Indian standards BIS: 383:1970. The use of fine aggregate improves the compressive strength of concrete. The use of fine aggregates provides better bonding or interlocking of both fine and coarse aggregates. The tests conducted on fine aggregate are specific gravity and water absorption. The specific gravity of fine aggregate is 2.65. The use of fine aggregates provides better bonding or interlocking of both fine and coarse aggregates.

**Water:** Clean tap water and a constant water-cement ratio of 0.45 were used for the manufacture of the concrete.

**Testing Methodology** : A Test is carried out to find compressive strength by using the following experimental procedure




### 3.2 TEST TO BE CONDUCTED

**Compressive strength test**

This test determines the maximum compressive load a concrete sample can withstand before failure. It helps assess the structural strength of the concrete mix. It is a mechanical test measuring the maximum amount of compressive load a material can bear before fracturing. The test piece, usually in the form of a cube, prism, or cylinder, is compressed between the platens of a compression-testing machine by a gradually applied load. Compressive strength of concrete depends on many factors such as water-cement ratio, cement strength, quality of concrete material, quality control during the production of concrete, etc.

**Fig No.3 : Compressive strength Machine**

**Flexural Strength Test**

Performing a flexural test in an experimental study of concrete mixed with coconut shell husk as a partial replacement of coarse aggregate helps assess the material's ability to withstand bending forces. Flexural strength is another method of measuring the tensile strength of concrete. It is a measure of and reinforced concrete beam to resist failure in bending. Flexure tests, also called bending tests, are used to test or compare plastics, including their compounds. Flexure tests provide a reliable test method with a relatively simple test arrangement. They are use to determine the stress-strain behavior of material in the range of low specimen of strain.

**Fig No.3 : Flexural strength Machine**

## 4. CONCLUSION

The coconut shell has the potential as a lightweight aggregate in concrete Also, using the coconut shell as aggregate in concrete can reduce the material cost in construction because of the low cost. The use of coconut shells in concrete can help in waste reduction and pollution reduction. Generally, the compressive strength of concrete added with coconut shell decreased as the percentage of coconut shell added increased. The same result goes for the workability test, the workability of concrete decreased as the percentage of coconut shells added to concrete increased. Coconut shell can be use as a fractional replacement of the coarse total as there is negligible difference in quality between coconut shell and traditional total. Because it is a waste material and abundantly available in the area of its production and near the industry-used coconut, one can reduce the effective cost of the concrete and it is also helpful from the environmental point of view.

## 5. REFRENCES

[1] Alengaram UJ, Muhit BAA, Jumaat MZB (2013) Utilization of oil palm shell as lightweight aggregate in concrete—a review. Constr Build Mater 38:161–172

[2] Reddy BD, Jyothy SA, Shaik F (2014) Experimental analysis of the use of coconut shell as coarse aggregate. IOSR J Mech Civ Eng 10(6):06–1

[3] Olanipekum EA, Olusola KO, Ata O (2006) A comparative study of concrete properties using coconut shell and palm kernel shell as coarse aggregates. J Build Environ 41(3):297–301.

[4] Gunasekaran K (2008) Lightweight concrete using coconut shells as aggregate. In: Proceedings of the international conference on advances in concrete and construction, ICACC, Hyderabad, 2008, India, pp 450–59

[5] Muthusamy K, Sabri NA (2012) Cockle shell: a potential partial coarse aggregate replacement in concrete. Int J Sci Environ Technol 1(4):260–267

[6] Amarnath YerramalaRamachandrudu C, "Properties of Concrete with Coconut Shells as Aggregate Replacement," International Journal of Engineering Inventions, 1(6) (2012)

[7] Gunasekaran, K., Annadurai, R., & Kumar, P. S. (2012). Long-term study on compressive and bond strength of coconut shell aggregate concrete.

[8] U. Ganiron, "Sustainable management of waste coconut shells as aggregates in the concrete mixture," J. Eng. Sci. Technol. Rev., vol. 6, no. 5, pp. 7–14, (2013)

[9] Chanap, R. (2012). Study of Mechanical and Flexural Properties of Coconut Shell Ash Reinforced Epoxy Composites Bachelor of Technology in Mechanical Engineering BY, (May), 1–41

[10] Neetesh Kumar and Dilip Kumar, "Utilization of Coconut Shell in Different Forms in Concrete" IJSRD-International Journal for Scientific Research and Development |Vol.2, Issue 07,2014 | ISSN (online): 2321-0613

[11] Abdullah A. "Basic strength properties of lightweight concrete using agricultural wastes as aggregate", proceedings of the international conference on low-cost housing for developing countries, Roorkee, 1984.

[12] Gopal charan Behera, coconut shell and coarse aggregate, International Journal of Engineering Research and Technology (IJERT), vol, issue6, June 2018"

[13] J.Parvesh, "Concrete added with M-Sand, Coconut shell, Steel fibers" International Journal of latest trends in Engineering and Technology, vol-03, Issue-03,2014.

[14] B. Damodhara Reddy, S. Arjuna Jyothy and Fawaz Shaik "Experimental Analysis of the Use of Coconut Shell as Coarse Aggregate", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 10, Issue 6 (Jan. 2014), pp 06-13.

[15] Ajim S Shaikh1, Sagar B Thorat, Rahul V Unde and Prasad S Shirse, "Advanced ConcreteAggregate replaced by Coconut shell" International Research Journal of Engineering and Technology (IRJET) e-ISSN:2395-0056 Volume: 02 Issue: 05 Aug-2015 p-ISSN: 2395- 0072