International Journal of Interdisciplinary Innovative Research & Development (IJIIRD)
ISSN: 2456-236X
Vol. 10 Issue 01 | 2025

STUDY OF RICE HUSK ASH TO REPLACE FINE AGGREGATE IN CONCRETE

Prof. Parag Chopade[1], Prof. G. N. Supe[2], Prof. S. H. Ingle[3]
[31] Lecturer, Civil Engineering Department Padm. Dr. V. B. Kolte college of Engg. Malkapur, Maharashtra, India
[2]HOD Civil Engineering Department Padm. Dr. V. B. Kolte college of Engg. Malkapur, Maharashtra, India

DOI: 10.5281/zenodo.16165526

ABSTRACT

Concrete is a composite material created by humans, was primarily used as a binding element for buildings throughout the construction area. The construction industry is one of the sectors in India that is expanding at the fastest rate. Due to increased demand for buildings and the high pace of development, traditional building materials like bricks, cement, sand, and wood are becoming scarce. The need for high-quality building materials to replace traditional ones and the need for reasonably priced and durable materials for affordable housing have compelled researchers to develop a variety of innovative and creative construction materials. This study investigated the effects of substituting rice husk for fine aggregate in terms of weight on the workability, bulk density, and compressive strength of concrete in order to maximize the use of locally available resources. The appropriateness of utilizing rice husk at 5%, 10%, 15%, 20%, and 25% as a partial replacement for fine aggregate in M-20 grades of concrete was also assessed. The type and quantity of curing that is done before to the test affect the concrete's compressive strength. According to experiments, the strength after 28 days is greater than that after 7 days. M20 with 10% replacement shows higher strength values than M20 with 15% replacement. This shows that when the proportion increases, the strength value decreases.

Keyword - Rice husk ash, waste, concrete, compressive strength and Building materials

1. INTRODUCTION:

During the construction area concrete, a composite man-made **Materials,** was mostly employed as building binding material. One of India's industries with the quickest rate of growth is the construction sector. Traditional building resources like bricks, cement, sand, and wood are in limited supply as a result of the rapid construction activity and rising demand for homes In addition to being a major employer, the manufacturing of concrete contributes significantly to societal advancement.

Pollution and waste management issues have historically been brought on by industrial and agricultural waste. Nonetheless, there are both practical and financial benefits to using industrial and agricultural wastes in addition to other conventional building materials. Since the wastes are locally accessible, their transportation costs are low, and they typically have no commercial value. Utilizing waste materials in building helps to preserve the environment and conserve natural resources. Several waste materials with pozzolanic qualities, such as fly ash, silica fume, volcanic ash, and corn cob, have been investigated for use in blended cements. Waste products from the rice business, including rice husks, are typically discarded in the open, harming the environment and providing no financial advantages.

To optimize the utilization of locally accessible resources, this study examined the effects of replacing fine aggregate with rice husk in terms of weight on concrete's workability, bulk density, and compressive strength. Additionally, it evaluated the suitability of using rice husk at 5%, 10%, 15%, 20%, and 25% as a partial substitute for fine aggregate in M-20 grades of concrete.

2. MATERIAL USED:

2.1 Cement

Lime and clay are ground into a powder and then combined with water to make mortar or with sand, gravel, and water to make concrete. In the production of cement, common ingredients include silica sand, iron ore, shale, clay, slate, limestone, shells, and chalk or marl. The silicates and aluminates of lime derived from clay and limestone make up the majority of cement. Calcination is the process of heating the materials mentioned above to 1450 °C in a kiln to create cement. This produces a hard material known as clinker, which is then processed into a powder with a tiny bit of gypsum to create OPC, the most widely used kind of cement (also referred to as

OPC). OPC, Portland Pozzolana Cement, Rapid Hardening Portland Cement, Portland Slag Cement, Hydrophobic Portland Cement, Low Heat Portland Cement, and Sulphate Resisting Portland Cement are the many cement kinds as defined by the Bureau of Indian Standards (BIS). The basic portland cement, OPC, works best in conventional concrete building where the soil and ground water are not exposed to sulphates. Compared to other cements, this one is clearly manufactured in greater quantities. Depending on the cement's compressive strength after 28 days, OPC is divided into three grades: 33, 43, and 53. In this investigation, OPC 43 grade was utilized.

Figure 1: Ultra Tech OPC 43 grade

2.2 Aggregates:

The aggregates in this mixture serve to both limit the amount of space that the cement paste takes up and to provide a stiff skeletal framework. The ratios of various coarse aggregate sizes will fluctuate based on the specific mix needed for each end. There is no doubt that the aggregates have a significant impact on the different qualities and properties of concrete only by making up 70–80% of its volume. Aggregates are often divided into three categories: regular weight, light weight, and heavy weight. Natural and manufactured aggregates are two additional classifications for normal weight aggregates.
On the basis of their size, aggregates can also be divided into two categories: coarse and fine.

Figure 2: Crushed course stone aggregates of nominal size 20 mm.

Figure 3: Fine aggregates

2.3 Rice Husk Ash

Rice husk, an agricultural byproduct, when utilized as fuel, partially produced burnt husk from milling mills also contributes to pollution. To address this issue, attempts are being undertaken to use the material as sand and cementing material. It has been discovered that variations in paddy type, crop year, climate, and geographic location affect the chemical makeup of rice husk in different samples. About 22% of the paddy's weight is obtained as husk during the milling process. About 75% of its weight is made up of organic volatile stuff, which burns up during the firing process. The remaining 25% of the husk's weight is turned into ash, a process known as Rice Husk Ash (RHA). It is produced through combustion and has a highly reactive character.

Figure 4:Rice Husk Ash

It's a component of waste ash. Because waste ashes are not used for anything other than construction, their disposal in landfills has an adverse effect on the environment. As a greenhouse agent, it negatively intensifies the greenhouse effect and loses its eco-friendliness. Numerous studies had been conducted to determine its solution. RHA is used to lower the temperature of mass concrete with high strength. Higher substitution levels result in lower water absorption values, and the inclusion of RHA increases the compressive strength. RHA with a finer particle size than OPC also improves the characteristics of concrete.

3. Methods of concrete mix design

The mix design for this study was completed using the Bureau of Indian Standards (BIS) mix design approach, which is based on BIS: 10262-2009.

3.1 Compressive strength of concrete as per BIS: 516 -1959

For every batch (with different percentages of RHA and fine aggregates) were weighed individually. First, a dry, homogenous mixture of cement and RHA was made. This combination was combined with dried fine aggregates. After ensuring that the coarse aggregates were evenly distributed throughout the batch, water was added. After that, a mechanical mixer was used to fully combine all of the ingredients for three to four minutes. Concrete cubes of 100 mm by 100 mm by 100 mm were used to calculate the concrete's compressive strength. After cleaning, oil was sprayed to the cube molds. The cube molds were then filled with concrete. Concrete molds were vibrated to guarantee adequate compaction. Using a trowel, the concrete's surface was leveled with the mold's top. As seen in the illustration, the completed specimens were allowed to solidify in the air for a whole day. After a day of casting, the specimens were taken out of the molds and put in the laboratory's water tank, which was filled with drinkable water, as seen in the image.

Figure 5: Casted cube specimens

At 14 and 28 days of age, specimens were removed from the curing tank. Specimens were removed from the curing tank, surface water was cleaned off, and testing started right away.

As seen in the figure, concrete cubes' compressive strength was evaluated using a Universal Testing Machine (UTM). The compressive strength of concrete cubes was determined by applying the load gradually and without shock until the specimen failed.

4. Results and Discussion:

The following ratios apply S1 (0%), S2(5%), S3(10%), S4 (15%), S5 (20%) and S6(25%) of RHA when added to M20 grade concrete once fine aggregate is substituted with RHA.

Table 1: Test results for compressive strength

Mix	RHA	Avg.(14D) MPa	Avg.(28D) MPa
S1	0%	27.2	32.32
S2	5%	22.93	24.1
S3	10%	19.92	21.38
S4	15%	14.72	17.25
S5	20%	10.3	12.93
S6	25%	6.12	8.19

Rice Husk Ash can help boost compressive strength at modest replacement levels (up to 20% of fine aggregate). RHA has reduced permeability and provide denser concrete by filling up mix voids. Depending on additional variables like the curing conditions and the RHA's fineness, the concrete may exhibit a little drop in compressive strength or an increase at moderate replacement levels (more than 20%). The concrete's compressive strength may decline with high replacement levels (over 20%). RHA has a lower density than natural fine aggregates, therefore replacing too much of it could make the concrete weaker, particularly if the ash is not treated correctly or doesn't have pozzolanic reactivity.

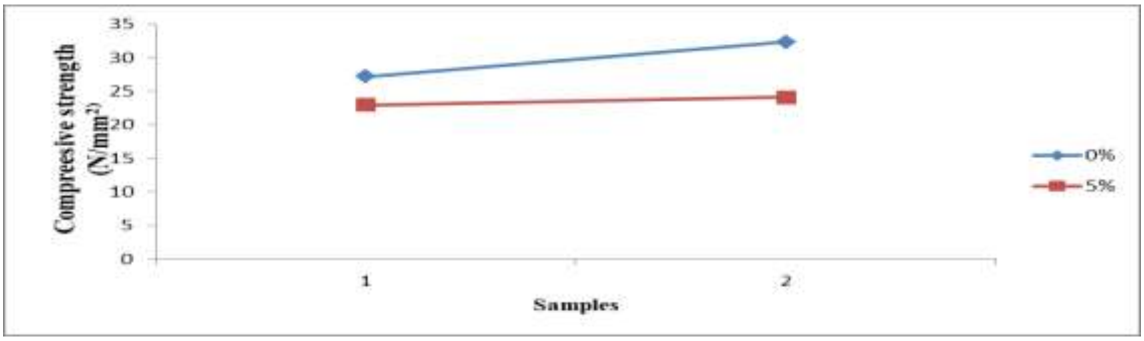

Figure 6: Comparison of Compressive strength of concrete with replacement of fine aggregate with 5% RHA

It's found that compressive strength values of M20 with 5% replacement of RHA are higher than those of M20 with 10% replacement. RHA contains silica (SiO_2), which can help generate more calcium silicate hydrate (C-S-H) gel when activated by water. This increases the strength and durability of concrete. The RHA's fineness and carbon content, however, determine how much of this benefit is realized (unburned material can diminish the reactivity).

Concrete's compressive strength can be increased by substituting rice husk ash (RHA) for fine aggregates, particularly when the RHA is ground fine and utilized in moderate amounts (10–20%). Concrete's compressive strength may suffer from excessive RHA use. To get the greatest strength-to-durability ratio, the replacement percentage must be optimized. Achieving positive outcomes also depends on managing the curing procedure and the mix design as a whole.

4. CONCLUSIONS

1. The type and quantity of curing that is done before to the test affect the concrete's compressive strength. According to experiments, strength after 28 days is greater than that after 7 days.
2. The strength values of M20 with 5% replacement of RHA are higher than those of M20 with 10% replacement.
3. Compared to M20 with 15% replacement, M20 with 10% replacement exhibits greater strength values. This indicates that the strength value falls as the proportion rises.

5. REFERENCES

1. BIS: 10262-2009: Recommended guidelines for concrete mix design, Bureau of Indian Standard, New Delhi-2004
2. BIS: 1199-1959 (Reaffirmed 2004): Methods of Sampling and Analysis of Concrete, Bureau of Indian Standard, New Delhi-1999
3. BIS: 2386 (Part I)-1963 (Reaffirmed 2002): Methods of Test for Aggregates for Concrete, Bureau of Indian Standard, New Delhi-1963
4. BIS: 456-2000 (Reaffirmed 2005) : Code of practice- plain and reinforced concrete, Bureau of Indian Standard, New Delhi-2000

5. BIS: 516-1959 (Reaffirmed 2004): Methods of tests for strength of concrete, Bureau of Indian Standard, New Delhi-2004
6. BIS: 4031 (Part 4, 5&6)-1988: Methods of Physical Tests for Hydraulic Cement, Bureau of Indian Standard, New Delhi-1988
7. Chandrasekhar S, Satyanarayana K G. Pramada N, Raghavan P and Gupta N (2003) Review Processing, properties and applications of reactive silica from rice husk. *Mat Sci* **38**:3159–168
8. Chandraul K , Singh M K, Saxena A K and Arora T. R. (2015) Experimental Study of RHA Concrete.*Res App Sci & Engg Tech* **3**:77-82.
9. Chindaprasirt P and Rukzon S (2008) Strength, porosity and corrosion resistance of ternary blend Portland cement, rice husk ash and fly ash mortar.Const & Buld Matr**22**: 1601–1606.
10. Ghosal S and Moulik S (2015) Use of Rice Husk Ash as Partial Replacement with Cement In Concrete. *Engg Res***4**: 506-09.
11. Hossain T, Sarker K S and Basak C (2011) Utilization potential of rice husk ash as a construction material in rural areas. *Civ Engg* **2**: 175-88.
12. Kachwala A, Pamnani and Raval A (2015) Effect of Rice Husk Ash as a Partial Replacement of Ordinary Portland cement in Concrete.*Intl Res Engg & Tech* **2:**175-77.
13. Tuana N, Yea G, Breugela V K, Fraaija A and Buib D (2011) The study of using rice husk ash to produce ultra-high performance concrete. *Const & Build***25**:2030–35