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Study of Clay Brick Waste and Coconut Shell Powder as Partial Replacement for Sand

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Abstract - **The dependency on natural sand will be reduced by using brick dust and coconut shell in the mortar as a partial replacement for sand. Sand mining in rivers caused an ecological imbalance in aquatic life. Sand has a significant role in the building industry as it is used to make concrete and mortars. The demand for sand is increasing rapidly along with regular construction. Therefore, sustainable sand replacement materials should be identified. It is possible to utilise coconut shell and waste clay brick powder as partial replacement of sand in concrete and mortars. In the present study, the cement sand ratio is taken as 1:3 and 70.6 mm × 70.6 mm × 70.6 mm cement sand cubes have been taken for compressive strength test as per Indian standards. The partial replacement of sand and coconut shell powder have been taken in three different percentages (10%, 20%, 50%). In the first mix, 10% of sand is replaced with brick dust. Similarly, in the next two mixes, 20% and 30% of sand are replaced. For all the mix strength tests, is carried out at 03 and 07 days. The study provides alternative sustainable material for the replacement of sand in concrete and mortars.**

Keywords – **Brick Powder, Coconut Shell, Mortar, Sand, Sustainable.**

I. INTRODUCTION

A significant amount of nonrenewable resources have been used in the manufacturing of concrete and mortar, which has also seriously damaged the environment. In the present scenario, the whole world is facing a major problem of environmental pollution by the waste industrial materials like as they are dumped as landfills. Fly ash, micro silica, steel slag etc., are a few examples of the waste materials. Hence these materials can be used as alternatives in the construction industry which will help meeting the sustainable development requirements [1]. Additionally, the distance and related transportation costs are growing between demolition sites and disposal locations. Due to the scarcity of landfills and locations for reclamation, the disposal of used clay bricks takes up valuable land space and degrades the soil, which lowers grain yields. Storage and disposal of waste are becoming important environmental issues, particularly in places that lack disposal facilities. Construction waste recycling would significantly reduce the amount of waste sent out to landfills [2]. It would not be cost-effective to import aggregates in locations lacking high-quality stones or gravel. Good natural aggregates are difficult to locate by, sand and stone supplies have slowly run out, and mining is getting harder in many urban areas. This experimental study investigates the potential use of waste clay brick powder and coconut shell powder for producing a low-cost cement mortar as a building material. Energy conservation, environmental protection, and the preservation of nonrenewable natural resources are all part of the idea of sustainable development. Crushed clay bricks must be explored into as a new potential civil engineering material because landfill space is scarce and natural aggregates are expensive. In today's culture, reusing and recycling waste is one way to conserve energy. Clay brick reuse reduces the challenge of waste storage while also contributing in the preservation of natural aggregate resources.The goal of this research project is to identify for a

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complete and suitable replacement of sand in the mortars so that the use of natural sand can be avoided at the same time maintaining all the requirements[3].

II. EXPERIMENTAL PROGRAM

For the experimental program pozzolana Portland cement and river sand have been chosen. Demolished clay brick has been collected from construction sites as shown in figure 1. These demolished clay brick crushed and converted in to brick powder as shown in figure 2. Crushed Coconut Shell (CCS) were collected from nearby grocery shops and a temple. The coconut shells were dried and cleaned from the husk and sunk. All samples were dried in hot weather for 1-2 months. After completely dry, the coconut shells were crushed using grinding machine as shown in figure 3. All crushed samples were kept in a closed container to avoid humidity. These clay brick powder and coconut shell have been used as partial replacement of sand in cement mortar.

Fig. 1 Demolished Clay Bricks

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Fig. 2 Clay Brick Powder

Fig. 3 Coconut shell powder

Standard consistency test has been performed as per IS: 4031 (part 4) 1988. The standard consistency of cement has been found as 30 percentage. Initial setting test has been performed as per IS: 4031 (Part 5) – 1988. The initial setting time of cement has been found as 30 minutes. Specific gravity by pycnometer of river sand and brick powder has been performed as per IS: 2720 (Part 3) 1980. The specific gravity of river sand and brick powder has been found as 2.8 and 2.35 respectively. Particle size distribution on river sand and brick powder as has been performed as per IS: 2386 (Part 1) 1963. The particle size distribution curve for sand, brick powder

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and coconut shell powder has been shown in figure 4. From the graph it is clear that the particle size distribution is almost similar in sand and brick powder due to which brick powder can be a good alternative for sand in cement sand mortar.

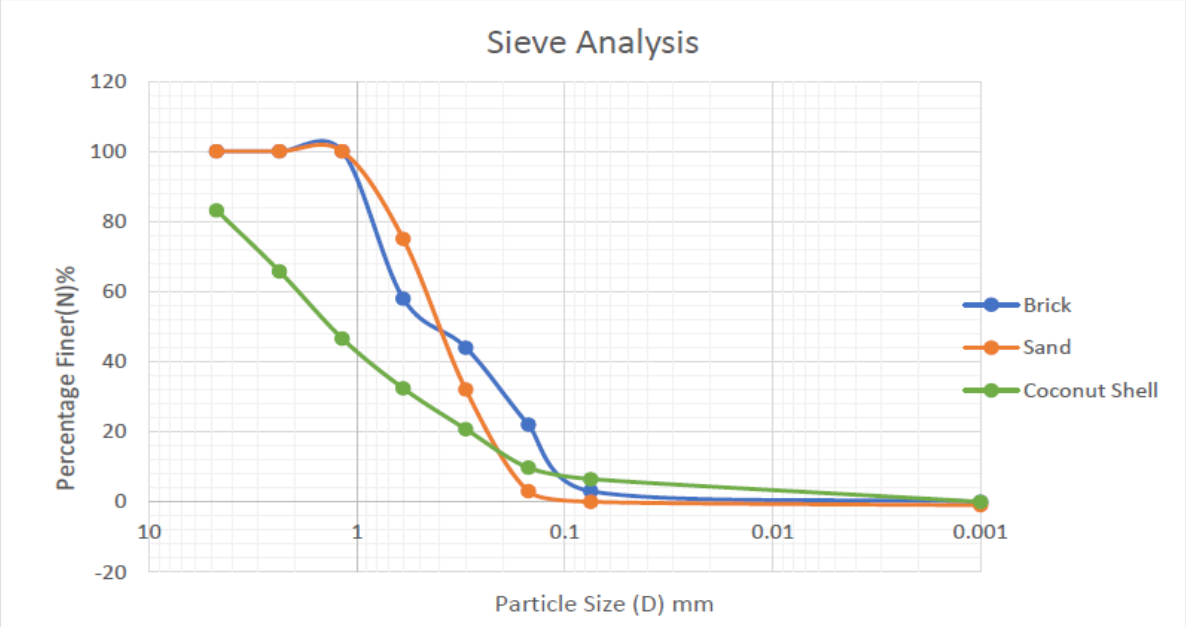

Fig 4. Particle size distribution comparison of clay brick powder, river sand and coconut shell

III. RESULT AND DISCUSSIONS

A. Compressing strength comparison for cement sand mortar cube (CS) and partial replacement of sand with brick powder (CS-%B) is tabulated and shown in table 1 and figure 5 respectively. It has been observed that for 10 percentage compressive strength decreases by 39 percentage, for 20 percentage the reduction is 34 percentage and for 50 percentage it is decreases by 20 percentage. It has been found that on increasing the replacement percentage, compressive strength does not decrease much as compared to conventional cement sand mortar.

Table 1. Compressive strength comparison of CS and CS-%B mortar

Mix	Compressive Strength (3 Days) (N/mm^2)	Compressive Strength (7 Days) (N/mm^2)
CS	19.26	23.08
CS-10B	10.2	14.05
CS-20B	11.65	15.08
CS-50B	15.87	18.17

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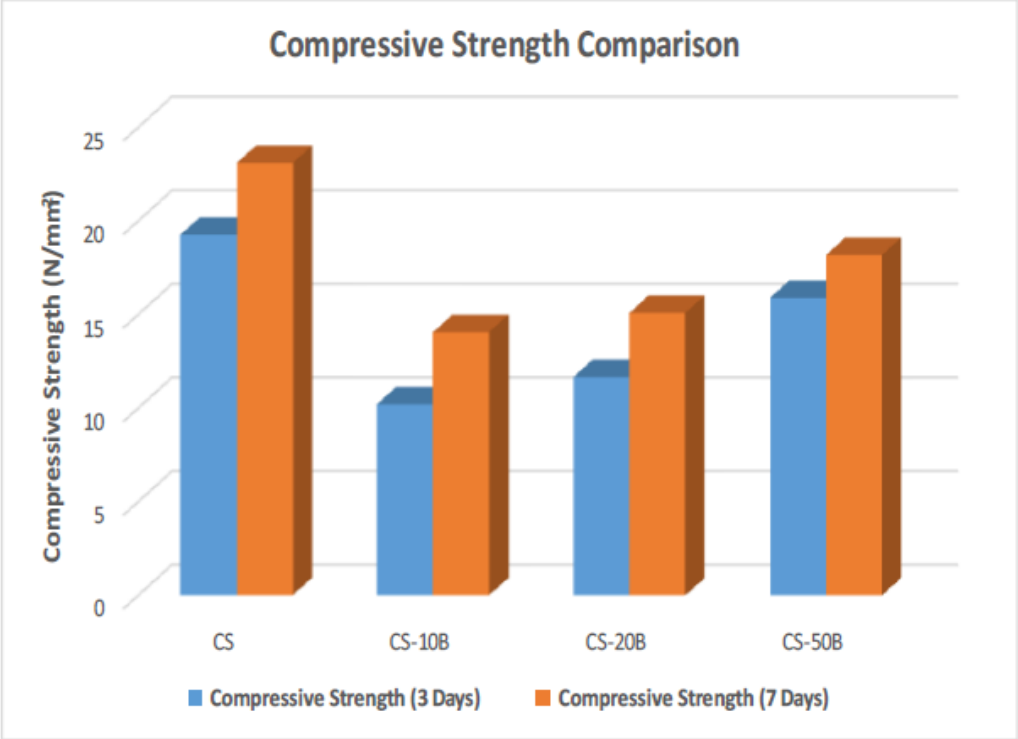

Fig. 5. Compressive strength comparison of CS and CS-%B mortar

B. Compressing strength comparison for cement sand mortar cube (CS) and partial replacement of sand with coconut shell powder (CS-%CS) is tabulated and shown in table 2 and figure 6 respectively. It has been observed that for 10 percentage compressive strength decreases by 34 percentage, for 20 percentage the reduction is 68 percentage and for 50 percentage it is decreases by 68 percentage. It has been found that on increasing the replacement percentage, compressive strength decreases drastically as compared to conventional cement sand mortar.

Table 2. Compressive strength comparison of CS and CS-%CS mortar

Mix	Compressive Strength (3 Days) (N/mm^2)	Compressive Strength (7 Days) (N/mm^2)
CS	19.26	23.08
CS-10CS	10.24	15.17
CS-20CS	4.93	7.23
CS-50CS	4.70	7.17

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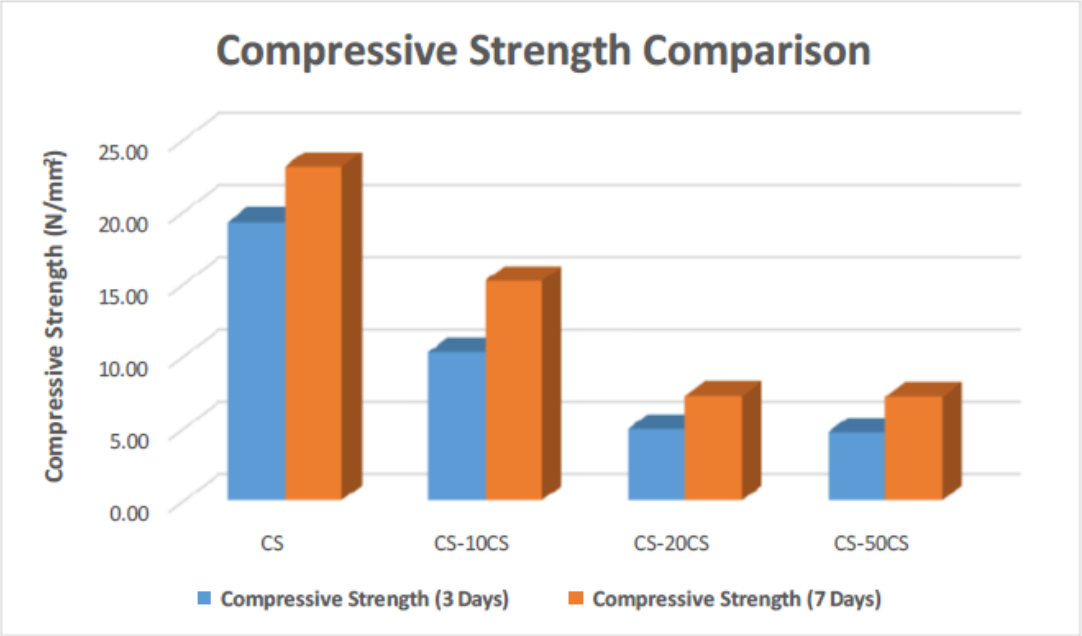

Fig. 6. Compressive strength comparison of CS and CS-%CS mortar

IV. CONCLUSION

The potential use of waste clay brick powder, saw dust and coconut shell as a fine aggregate substitute in cement sand mortar summarised in this study. Fine aggregate is replaced by 10 percentage, 20 percentage and 50 percentage. Compressive strength has been compared for different replacement proportions. Following conclusions can be drawn from the experimental investigations

1. The pozzolanic activity of brick powder allowed brick powder to partially replace cement to produce mortar. Brick powder could be used to produce cement sand mortar, even though the mechanical properties of this mortar were less than those of normal concrete. The addition of brick powder in mortar improved the durability of cement sand mortar in some cases.
2. On replacing 50 percentage fine aggregate with brick powder the compressive strength has been shown to be feasible; it could reduce the consumption of natural resources and encourage the reuse of construction waste.
3. The result show that coconut shell can be used as replacement of fine aggregate but the performance of coconut shell mortar in strength is little bit lower than the normal mortar.
4. The use of less than 10percentage of crushed coconut shell shall be effective in terms of strength. As the coconut shell replacement percentage increases, the compressive strength decreases due to possible lack of effective bonding within the particle sizes in mortar.

REFERENCES

[1]. I. Zabalza Bribi´an, A. Valero Capilla, and A. Aranda Us´on, "Life cycle assessment of building materials: comparative analysis of energy and environmental impacts and evaluation of the eco-efficiency improvement potential," *Building and Environment*, vol. 46, no. 5, pp. 1133–1140, 2011.

[2]. M. Lennon, "Recycling Construction and Demolition Wastes: A Guide for Architects and Contractors, Commonwealth of Massachusetts", *Department of Environmental Protection*, Boston, MA, USA, 2005.

[3]. Rao, K. N. Jha, and S. Misra, "Use of aggregates from recycled construction and demolition waste in concrete," *Resources, Conservation and Recycling*, vol. 50, no. 1, pp. 71– 81, 2007.

[4]. S. Manfredi, R. Pant, D. W. Pennington, and A. Versmann, "Supporting environmentally sound decisions for waste management with LCT and LCA," *5e International Journal of Life Cycle Assessment*, vol. 16, no. 9, pp. 937–939, 2011.

[5]. Shakir, S. Naganathan, and K. N. B. Mustapha, "Effect of quarry dust and billet scale additions on the properties of fly ash bricks," *Iranian Journal of Science and Technology- Transactions of Civil Engineering*, vol. 38, no. C1, pp. 51–60, 2014.

[6]. Z. Xiao, T.-C. Ling, S.-C. Kou, Q. Wang, and C.-S. Poon, "Use of wastes derived from earthquakes for the production of concrete masonry partition wall blocks," *Waste Management*, vol. 31, no. 8, pp. 1859–1866, 2011.

[7]. IS 4031-4 (1988): Methods of physical tests for hydraulic cement, Part 4: Determination of consistency of standard cement paste, Bureau of Indian Standards, New Delhi.

[8]. IS 4031-5 (1988): Methods of physical tests for hydraulic cement, Part 5: Determination of initial and final setting time, Bureau of Indian Standards, New Delhi

[9]. IS 2386-1(1963): Methods of Test for Aggregates for Concrete, Bureau of Indian Standards, New Delhi.