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EXPERIMENTAL STUDY ON CONCRETE USING LATERITE SAND BY REPLACING NATURAL SAND

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ABTRACT :

Aggregates smaller than 4.75 mm obtained from crushed rock or gravel are classified as manufactured sand. With the rapid growth of the construction industry, natural sand resources are becoming increasingly scarce and expensive. Hence, this study aims to evaluate the cost-effectiveness of different mix compositions and examine the influence of manufactured sand and laterite soil on the compressive strength of concrete.

In this experimental program, the specified grade of concrete will be prepared by partially replacing natural sand with laterite soil at varying proportions of 0%, 10%, 20%, 30%, 40%, 50%, and 60%. The specimens will be tested for compressive strength at 7, 21, and 28 days of curing, while tensile and flexural strength will be evaluated after 28 days of curing.

The results indicate that laterite sand can effectively replace up to 30% of the fine aggregate in concrete without significant loss in strength, thereby offering a sustainable and economical alternative to natural sand.

Keywords: aggregate, compressive strength, concrete, cost, manufactured sand, workability.

INTRODUCTION

Concrete, after water, is the most widely utilized material in the world. Its versatility lies in its unique ability to be molded into any desired shape while in its fresh state. Essentially, concrete is a composite material composed of cement, aggregates, and water, which hardens over time to form a durable mass. Traditionally, river sand has been employed as the primary fine aggregate in concrete production. However, the overexploitation of river sand has led to severe environmental consequences, including depletion of natural resources, damage to aquatic ecosystems, riverbed erosion, and increased flood risks in vulnerable regions. As a result, river sand has become the second most exploited natural resource globally, following water.
The production of high-quality concrete is fundamental to the construction of durable and reliable structures. Achieving this requires careful proportioning and blending of cement, water, fine and coarse aggregates, and, when necessary, chemical admixtures. The goal is to obtain an optimum balance of strength, durability, and cost-effectiveness, ensuring that concrete meets the performance requirements of diverse construction applications.

LITERATURE REVIEW

The impact of employing processed lateritic fine aggregates on the functionality of cement mortars and concretes was examined by Yaragal et al. (2020). According to Indian specifications, lateritic FA is substituted with river sand at weight percentages of 0, 25%, 50%, 75%, and 100% at all fineness levels from Zone I to Zone IV. It was determined that at all replacement levels, the control concrete's compressive strength values were within ±3%.

The effectiveness of cement mortars made using offshore and manufactured sand as substitutes for river sand was examined by Arulmoly et al. in 2021. In this study, offshore sand was used to replace 0, 25%, 50%, and 75% of the produced sand. In both fresh and hardened test results, the blended sand at a 25% substitution of offshore sand for manufactured sand proved to be a workable way to fully replace river sand.

III . OBJECTIVE

- To create a concrete mix percentage that substitutes laterite for fine aggregate in place of regular strength grades M30
- This study aims to measure the strength of concrete by substituting 0–60% laterite sand for river sand and curing the concrete for 7, 21, 28, and 28 days to measure compressive strength and tensile strength.

IV .RESULTS AND DISCUSSIONS

Slump Value

The slump test was used to assess workability after fresh concrete was mixed and filled from the top of the slump mould. The mould was then gently and quickly raised from the concrete, and the height difference indicated the slump value. The concrete slump values for M30 are displayed in Figure 5.1.

TABLE 1 Slump Value, Flow in mm And Compaction Factor for M30 Concrete

SN	Sample Designation	% Replacement laterite sand	Slump Value in mm
			Slump Value in mm
1	NC	0	95
2	M30 LS10	10	89
3	M30 LS20	20	81
4	M30 LS30	30	79
5	M30 LS40	40	71
6	M30 LS50	50	60
7	M30 LS60	60	50

Slump Value

The slump test was used to assess workability after fresh concrete was mixed and filled from the top of the slump mould. The mould was then gently and quickly raised from the concrete, and the height difference indicated the slump value. The concrete slump values for M30 are displayed in Figure 5.1.

TABLE 2 Slump Value, Flow in mm And Compaction Factor for M30 Concrete

SN	Sample Designation	% Replacement laterite sand	Slump Value in mm	Compaction Factor	Flow in mm
			Slump Value in mm	Compaction Factor	Flow in mm
1	NC	0	95	0.93	75
2	M30 LS10	10	89	0.89	70
3	M30 LS20	20	81	0.85	65
4	M30 LS30	30	79	0.83	61
5	M30 LS40	40	71	0.85	55
6	M30 LS50	50	60	0.86	53
7	M30 LS60	60	50	0.81	51

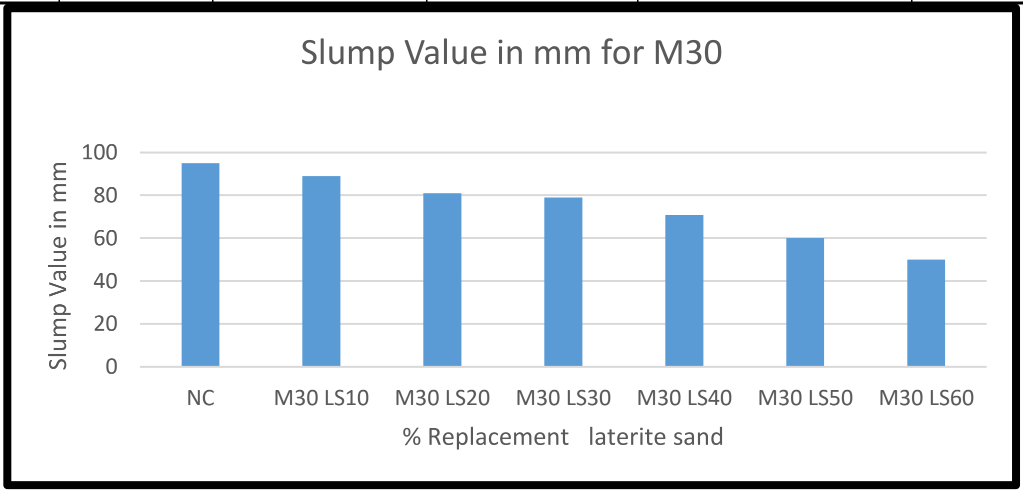

Figure 1 Slump Value in mm for M30 at various percentage of Laterite Sand

Table 3 Compressive strength variation in M30 grade concrete with replacement of fine aggregate by Laterite Sand

SN	Sample Designation	% Replacement laterite sand	compressive strength in N/mm2			% increse in strength
			7 days	21 day	28 day	% increse in strength
1	NC	0	21.45	31.34	39.34	0
2	M30 LS10	10	22	32	40	1.68

3	M30 LS20	20	23.56	33.12	41.25	4.86
4	M30 LS30	30	27	33.45	42.67	8.46
5	M30 LS40	40	24.75	33	41.32	5.03
6	M30 LS50	50	23	29.45	38	-3.41
7	M30 LS60	60	22.34	28.45	35.76	-9.10

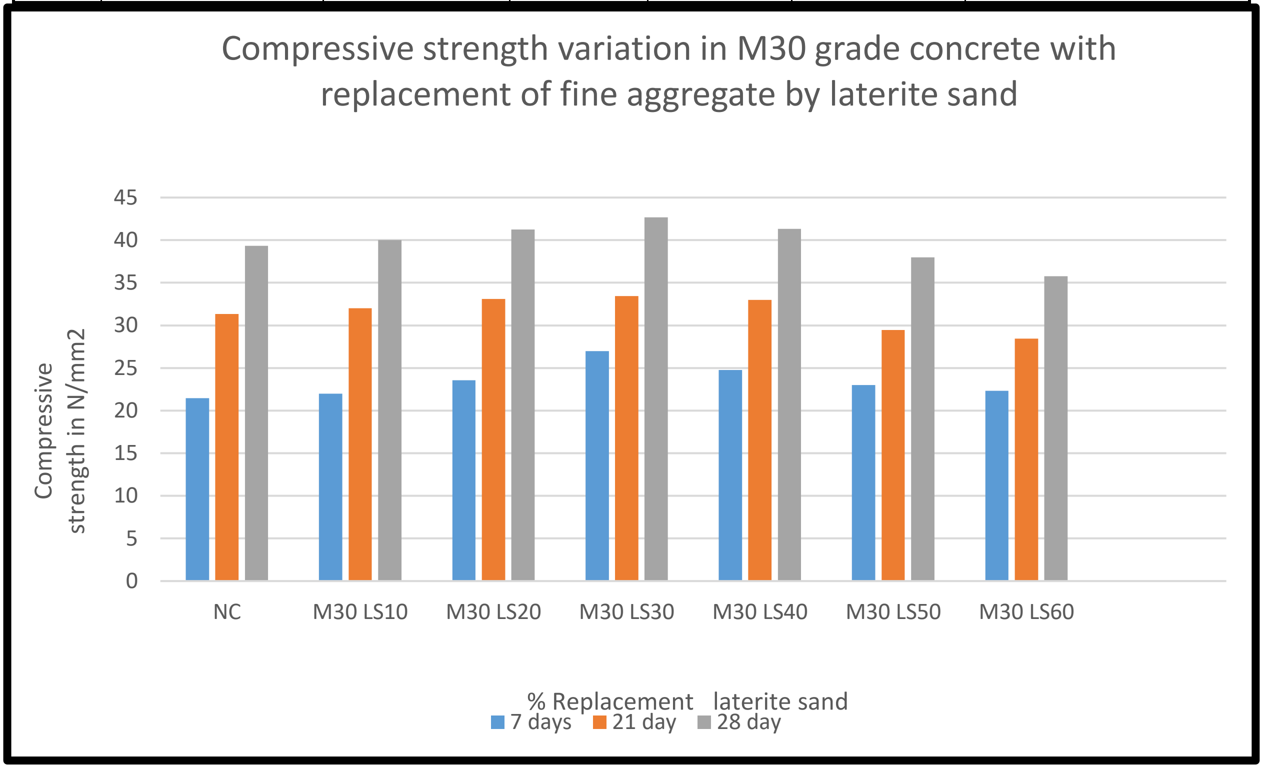

Figure 2 Compressive strength variation in M30 grade concrete with replacement of fine aggregate by Laterite Sand at 7 ,21,28 day

After 28 days of curing, the M30 grade laterized mix with 30% substitution had an 8.46% higher compressive strength than the control mix, while the M45 grade laterized mix with 25% substitution had 8.14% higher strength values than the control concrete. According to the tests, the ideal replacement percentage for fine aggregate in concrete in terms of compressive strength is 30%. This is because the aggregates with rougher surfaces form a stronger connection with the paste, increasing its strength. The rough surface texture and angular particles of C-sand and laterite sand, thus, boost the laterized concrete's compressive strength. Since clay absorbs water and swells, increasing water consumption, the downward trend after 25% replacement may be explained by the higher clay content brought on by the addition of laterite.

V. CONCLUSION

Concrete with up to 30% laterite replacement outperforms control concrete, according to tests conducted on both fresh and hardened laterized concrete. Because laterite aggregate has a rough texture and dust particles, workability declines as the amount of laterite increases. When the amount of laterite in the mix reaches 60%, the amount of clay increases as well, which impacts the concrete's fluidity and causes the workability of the concrete to decline by 14%, 11%, and 10%. Due to the angular particles of laterite sand, concrete containing laterite greatly improves its strength characteristics by up to 30%. This is because the aggregates with rougher surfaces form a stronger connection with the paste, increasing its strength. Since clay absorbs water and swells, increasing water consumption, the downward trend after 30% replacement may be explained by the higher clay content brought on by the addition of laterite. It has been shown that mixing 30% laterite fine aggregate with 3% C-sand results in a workable concrete that influences strength characteristics after hardening, unlike regular concrete.

REFERENCE

[1] Adepegba, D 1975, 'The Effect of water content on Compressive strength of Laterized Concrete', Journal of Testing and Evaluation, vol. 3, no. 6, pp. 449-453.

[2] Amadi, A Akande, W Okunlola, I Jimoh, M & Deborah, G 2015, 'Assessment of the Geotechnical Properties of Lateritic Soils in Minna, North Central Nigeria for Road design and Construction', American Journal of Mining and Metallurgy, vol. 3, no. 1, pp. 15-20

[3] Benny, J 2014, 'The experimental study of physical properties of aggregate with replacement of late rite for mix design', International Conference on Advanced Trends in Engineering and Technology, pp. 74-78

[4] Haque, M & Kayali, O 1998, 'Properties of High- strength concrete using a fine fly ash', Cement and Concrete Research, vol. 28, no. 10, pp. 1445-1452.

[5] Idagu, F 2016, 'Compressive Strength of Laterized Concrete Using Palm Kernel as Partial Replacement of Coarse Aggregate', International Journal of Engineering Research & Technology, vol. 5, no. 6, pp. 547-551.

[6] Ilangovan, R 2008, 'Strength and durability properties of concrete containing quarry rock dust as fine aggregate', ARPN journal of Engineering and Applied Sciences, vol. 3, no. 5, pp. 20-26.

IS 1199 1959, Methods of sampling and analysis of concrete, Bureau of Indian Standards, New Delhi

[7] IS 12269 2013. Indian Standard Ordinary Portland Cement, 53 Grade. Bureau of Indian Standards, New Delhi.

[8] IS 2386-3 2016, Indian Standard Method of test for aggregate for concrete- specific gravity, density, voids, absorption and bulking. Bureau of Indian Standards, New Delhi