

# Experimental Investigation on Partial Replacement of Laterite as Fine Aggregate in M25 Concrete

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**Abstract-** Concrete is the most important engineering material in modern construction. The Concrete was obtained by mixing cement, fine aggregate, coarse aggregate and water and sometimes admixtures in required proportions. The demand for natural sand in the construction has increased tremendously resulting in the reduction of its sources and an increase in cost. Thus the increased need to identify a suitable substitute, that is eco- friendly and inexpensive can be used as an alternative to the sand in the production of concrete. One of the abundantly available building materials in Malabar regions of Kerala is Laterite. The laterite can use as building material in a different form such as wall brick for load bearing, the base for road work, etc.

In this present study, an attempt has been made to determine the feasibility of laterite as an alternative to natural sand and manufactured sand in concrete and in cement mortar. Natural sand is partially replaced by laterite sand at 10, 15, 20, 25%. Tests were conducted in laterite to the feasibility of laterite as fine aggregate.

**Keywords-** Laterite soil, construction, concrete, compressive strength, tensile strength, flexural strength Cement, Natural Coarse Aggregate (NCA).

## I. INTRODUCTION

In developing countries, the locally available building materials can be over emphasized because there is a huge imbalance between the demand for construction activities and the shortage of conventional building materials which in turn increases the cost of construction. The demand for concrete is very high due to the rapid growth of infrastructure development in India. Fine aggregate is a primary constituent of concrete. Hence the availability and cost of fine aggregate determine the viability and economy of concrete. In this experimental study, performance of M-25 grade Laterite sand concrete is investigated by partially replacing fine aggregate with laterite sand.

## II. OBJECTIVE

The objective of this work is to investigate the performance criteria and behavior of concrete made with laterite with partial replacement of fine aggregate with laterite sand/soil. For laterite to be used in structural concrete, it is necessary to carry out an in depth study of their material properties and how these properties in turn affect the quality of the second-generation concrete in presence of material like laterite.

Therefore following objectives of present work-

- 1) To characterize the laterite sand in terms of physical and chemical properties and also to study the properties of concrete made with partial replacement of laterite sand. This will be done by replacing the Natural Fine Aggregate by laterite sand.
- 2) To analyze the Compressive strength, Flexural Strength and Tensile strength of concrete made with partially replacing of natural fine aggregate with laterite sand.
- 3) To analyze the option for the use of laterite sand in concrete in main stream construction rather than using it as an infill material.

## III. EXPERIMENTAL WORK

### Materials:

Cement: In this study, ordinary Portland cement (OPC) 53 grade is used.

Laterite sand: commercially available nano-silica was used as 10,15, 20, 25% replacement of natural sand in this work.

Fine aggregates: Fine aggregate is from nearby vicinity which is obtainable river sand.

Natural coarse aggregates: Coarse aggregates used in the experimental study were 20 mm down size and tested as per IS: 2386-1963 and confirmed as per IS: 383-1970 specifications.

Water: Normal water was used in this experimental study.

**Mix design**

The mix proportions are by weight (1:2.28:3.31). The proportioning of concrete mix is carried out in accordance to IS 456-2000 and as per the guidelines of IS 10262:2009 (draft 2007). The process of determining an appropriate mix proportion involved a number of trials casting and testing.

**Compressive Strength Test:**

Compressive strength was calculated through proper procedure with the cube size being 150\*150\*150 mm and was cured for 7 and 28 days before testing respectively.

**Flexural Strength Test**

Flexural strength was calculated through proper procedure with the beam size being 15\*15\*70 cm and was cured for 7 and 28 days before testing respectively.

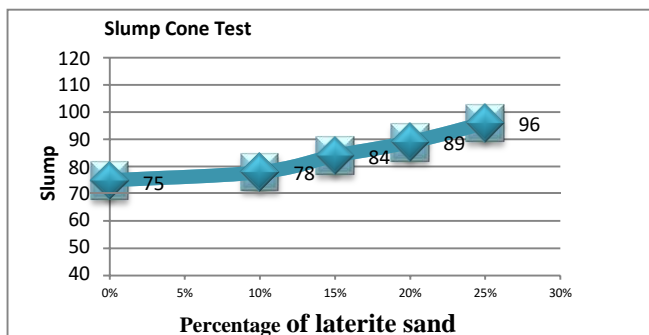
**Split Tensile Strength Test**

Sampling of Concrete Cylinders:

The cylindrical mould shell is of metal, 3mm thick. The mean internal diameter of the mould is 15 cm and the height is 30 cm. Each mould is provided with a metal base plate, mould and base plate must be coated with a thin film of mould oil before use, in classify to check bond of concrete.

**IV. RESULTS & DISCUSSION**

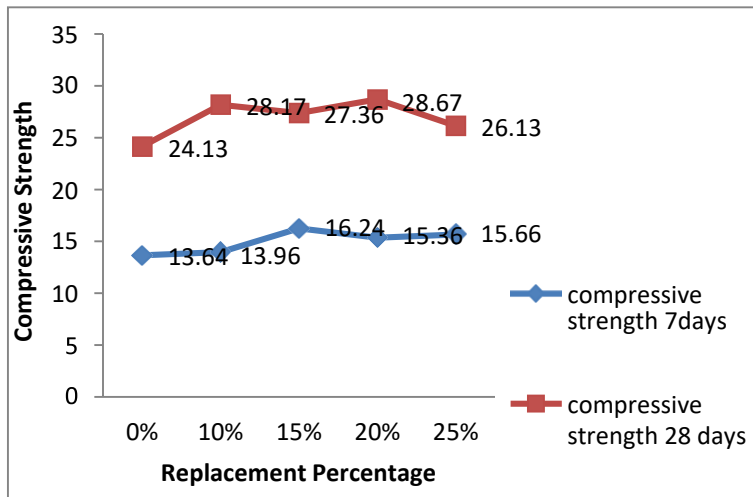
**Workability Test:**



**COMPRESSIVE STRENGTH TEST RESULT**

**Variation of compressive strength with age**

% of LS	0%	10%	15%	20%	25%
<b>7 Days</b>	32.07 Mpa	32.96 Mpa	33.62 Mpa	34.16 Mpa	30.21 Mpa
<b>28 Days</b>	44.81 Mpa	45.70 MPa	47.18 MPa	48.81 MPa	44.22 MPa



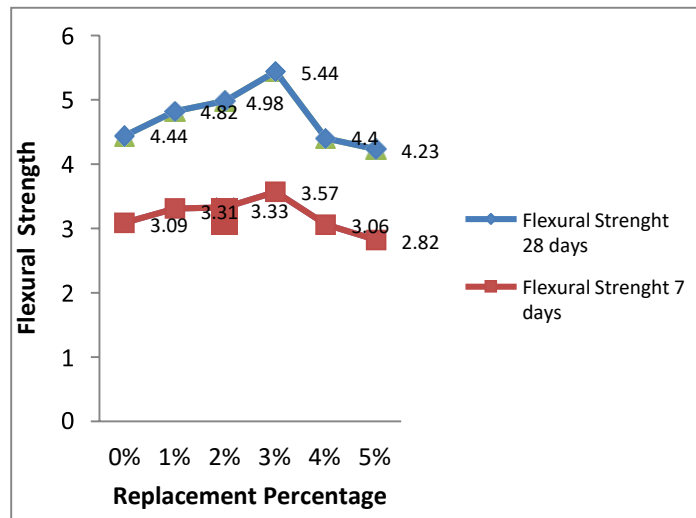
As shown in the graph: 2 (7 days strength), when sand is partially replaced 20% by Laterite sand, compressive strength is increased by 7.67%. Afterwards when addition of % of Laterite sand is replaced, strength starts decreasing, a minimum strength is achieved.

As shown in graph: 3 (28 days strength) show an increment of 10.12% of strength of 15% replacement of Cement as compared with conventional concrete. Again strength is decreased when addition of percentage of Laterite sand.

### Flexural Strength

#### Variation of flexural strength with age

% of LS	0%	10%	15%	20%	25%
7 Days	3.09	3.31	3.33	3.57	3.06
	MPa	Mpa	MPa	MPa	MPa
28 Days	4.44	4.82	4.98	5.44	4.40
	MPa	MPa	MPa	MPa	MPa



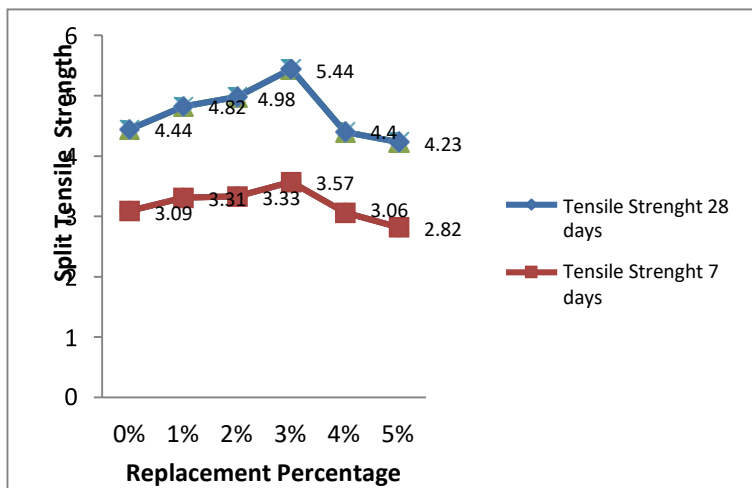
As shown in the graph: 5 (7 days strength), when cement is partially replaced 20% by Laterite sand, Flexural strength is increased by 15.57%. Afterwards when addition of % of Laterite sand is replaced, strength starts decreasing, a minimum strength is achieved.

As shown in graph: 6 (28 days strength) show an increment of 22.22% of strength of 15% replacement of Laterite sand as compared with conventional concrete. Again strength is decreased when addition of percentage of Laterite sand.

### Split Tensile Strength

Variation of Tensile strength with age

% of LS					
	0%	10%	15%	20%	25%
7 Days	2.62	2.87	3.28	3.33	2.69
	MPa	MPa	MPa	MPa	MPa
28 Days	4.70	5.10	5.26	5.64	4.60
	MPa	MPa	MPa	MPa	MPa



As shown in the graph: 8 (7 days strength), when cement is partially replaced 15% by Laterite sand, Tensile strength is increased by 27.07%. Afterwards when addition of % of Laterite sand is replaced, strength starts decreasing, a minimum strength is achieved.

As shown in graph: 9 (28 days strength) show an increment of 20% of strength of 20% replacement of Laterite sand as compared with conventional concrete. Again strength is decreased when addition of percentage of Laterite sand.

### V. CONCLUSIONS

Based on the investigations, the following conclusions were drawn.

The absence of deleterious and the mineral compositions of laterite reveal the possibility of using the laterite as partial replacement of natural and manufactured sand.

Also, the combined use of both Laterite sand and Natural Coarse Aggregate demonstrated excellent performance due to efficient micro-filling capacity. Therefore Laterite sand can be used as a good alternative to natural sand in concrete mix.

Compressive strength, Flexural strength, Split tensile strength test of concrete Mixes made with and without Laterite sand has been determined at 7 & 28 days of curing. The strength gained has been determined of Laterite sand added concrete with addition of 10%, 15%, 20%, & 25% for M25 grade as a partial replacement of sand in conventional concrete. After performing all the tests and analyzing their result, the following conclusions have been derived:

1. Workability of concrete increases as proportion of laterite sand increases.
2. Maximum compressive strength was observed when laterite sand replacement is about 20% of cement.
3. Maximum split tensile strength was observed when laterite sand replacement is about 20% of cement.
4. Maximum flexural strength was observed when laterite sand replacement is about 20% of cement.

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