

An Experimental Study on Concrete with Partial Replacement of Fine Aggregates by Laterite Sand

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ABSTRACT: Concrete is one of the most extensively used building materials. Concrete is made up of materials such as cement, fine aggregates, coarse aggregates and water. Laterite produces a wide variety in the thickness, grade, ore mineralogy and chemistry of the soil. Laterite is obtained by the leaching process of parent sedimentary rock, metamorphic rock and igneous rock. Laterite is very rich in clay content, which means can hold water in higher capacity than the sandy soil. Very little work is being carried out in India on suitability of laterite sand as a constituent material of concrete and concrete related works. An experimental investigation is carried out to study the properties of concrete by partially replacing cement with certain percentage of laterite soil. Further, Workability and Mechanical properties are studied on these mix proportions.

KEYWORDS: Concrete, Laterite Soil, Fine Aggregates, Workability and Mechanical Properties.

I. INTRODUCTION

Concrete is one of the most extensively used building material, since two billion tons of concrete is used as a construction materials in worldwide. Concrete is made up of materials such as cement, fine aggregates, coarse aggregates and water. But excavation of sand from environment leads to environmental imbalance, so using alternative material for sand results in reducing environmental impact. Because of the river sand mining results in lowering of river-beds, damages the bridge foundation and other structures situated closer to the river and coastal areas. Laterite is obtained by the leaching process of parent sedimentary rock, metamorphic rock and igneous rock. Laterite sand is well graded soil which is one of the ingredients with locally available source and cheap in cost, hence river-sand with laterite sand from Mangalore (Karnataka) region which is located in south part of India is rich source for laterite sand.

II. RESEARCH SIGNIFICANCE

Natural sand is the most frequently used material in the preparation of concrete. Its continued use over decade has a serious problem with regarding its availability, cost and environmental impact, due to excessive extraction of river sand and also huge scale depletion of these resources causes environmental hazards. A replacement to river sand is the need of present day in the concrete industry. A search for an alternative material for fine aggregates in concrete is proved satisfactory from its strength and durability requirements. Laterite sand is one such material found suitable for the use as alternative material for sand in concrete. An experimental investigation is carried out to study the properties of concrete by partially replacing cement with certain percentage of laterite soil. Further, Workability and Mechanical properties are studied on these mix proportions.

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III. MATERIALS AND PROPERTIES

This paper describes a procedure to achieve concrete mix using laterite soil as a partial replacing material for cement. In addition, the test results for acceptance characteristics for concrete mix such as Workability characteristics (Slump flow) & Mechanical characteristics (Compressive strength, Split Tensile strength) are presented.

1. Cement It is a binder that holds the aggregate (fine & coarse aggregates) together and reacts with mineral materials in hardened mass. In this present work, OPC 53 grade Chentind Cement conforming to IS: 12269-1987 has been used and tested for their properties; it is presented in Table 1.

Table 1: Properties of Cement

SI No	Property	Results	IS:12269-1987
1	Standard consistency	29%	≤ 40%
2	Initial setting time	30 min	≥ 30 min
3	Final setting time	520 min	≤ 600 min
4	Specific gravity	3.12	2.9 - 3.3
5	Fineness	3%	≤ 10%

2. Fine Aggregate In this investigation fine aggregate used is 4.75 mm down, manufactured sand obtained from the local market in Hassan and are tested as per IS: 2386, presented in Table 2.

Table 2: Properties of Fine Aggregate

SI No	Property	Result
1	Type	Manufactured
2	Surface Texture	Crystalline
3	Specific gravity	2.62
4	Water absorption	1 %
5	Grading Zone	Zone 2
6	Fineness modulus	3.76

3. Coarse Aggregate Coarse aggregate crushed granite of 12.5 mm maximum size and retained on IS 4.75 sieve has been used, obtained from the *local market in Hassan*, and are tested as per IS: 2386, results is presented in Table 3.

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Table 3: Properties of Coarse Aggregates

Sl No	Property	Result
1	Surface Texture	Crystalline
2	Specific gravity	2.76
3	Water absorption	1%
4	Bulk density	1524 kg/m ³
5	Fines Modules	6.78

4. Laterite sand Laterite sand from Mangalore region was used for replacement for fine aggregates which contributes to the concrete mix. Laterite sand which passes through 4.75mm and retained on 75 micron sieve size is selected. The properties of laterite soil are tabulated in Table 4.

Table 4: Properties of Laterite sand

Sl No	Properties	Values
1	Specific gravity	2.42
2	Bulk density	1680 kg/m ³
3	Fineness modulus	3.58
4	Classification zone	Zone 2

IV. METHODOLOGY

Experimental investigation is carried out to study the properties of concrete by partially replacing fine aggregate with certain percentage of laterite soil, for mix design for M-25 grade (IS 10262 – 2009). To achieve optimum mix, trial mix is done by varying cement, coarse and fine aggregate and water. Once getting the optimum mix, laterite soil is added to determine the suitability and adaptability, Laterite soil is added in proportions (0%, 10%, 20%, 30%, 40% and 50%) by the weight of fine aggregates in the mix design.

Experimental programme are carried out in two phase.

- In the First Phase, for each mix tests are conducted to assess fresh workability property (slump flow) of concrete.
- In Second Phase, fresh concrete are cast into cubes and cylinders. Specimens are cured in water till testing (3, 7, 28 days), than are used to determine Mechanical characteristics (Compressive Strength and Split Tensile Strength).

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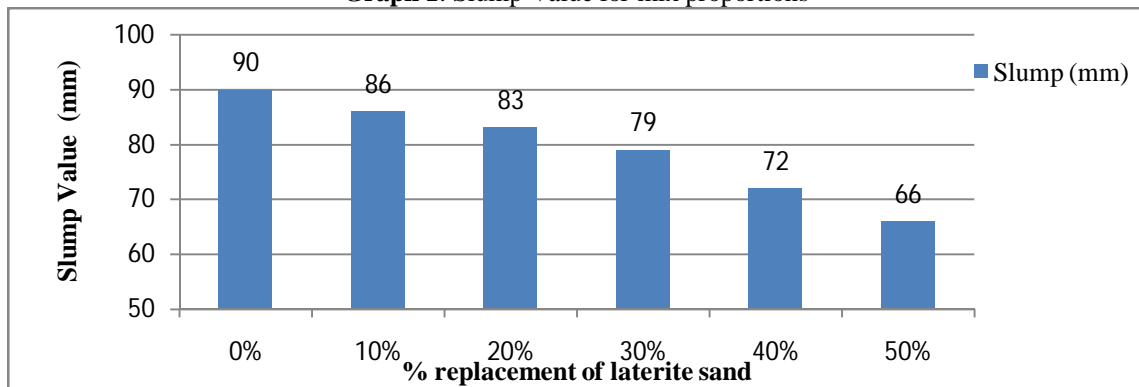
V. RESULTS AND DISCUSSIONS

1. Workability - Slump Cone Test

Table 5: Slump value for mix proportions

SI No	Mix Proportion	Slump (mm)
1	M25 - 0 %	90
2	M25 - 10%	86
3	M25 - 20%	83
4	M25 - 30%	79
5	M25 - 40%	72
6	M25 - 50%	66

Graph 1: Slump Value for mix proportions



2. Mechanical Properties of Concrete

a. Compressive Strength Tests

Table 6: Compressive Strength of Cubes

SI No	Mix Proportions	Compressive Strength (N/mm ²)		
		3 Days	7 Days	28 Days
1	M25 - 0%	25.95	29.75	34.75
2	M25 - 10%	27.91	32.48	41.35
3	M25 - 20%	32.54	35.64	46.52

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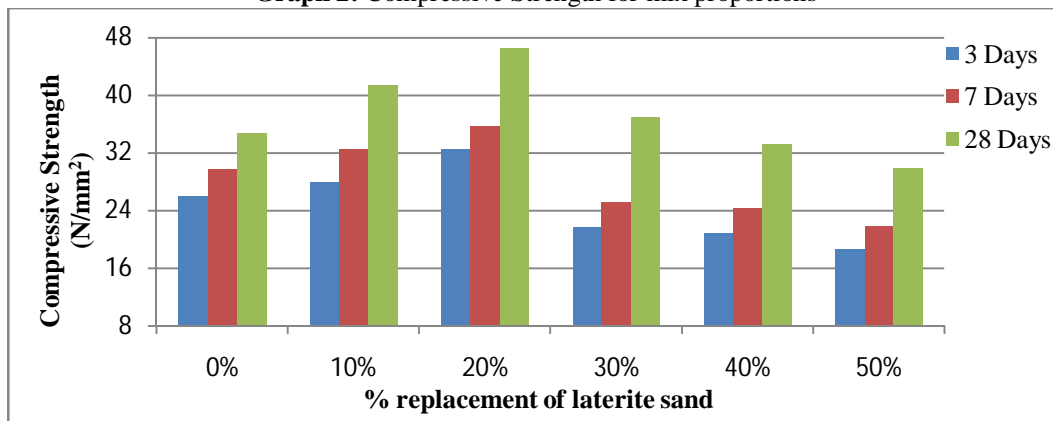
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4	M25 - 30%	21.63	25.10	36.91
5	M25 - 40%	20.88	24.31	33.2
6	M25 - 50%	18.70	21.80	29.87

Graph 2: Compressive Strength for mix proportions



b. Split Tensile Strength Test

Table 7: Split Tensile Strength of Cylinders

Sl No	Mix Proportions	Split Tensile Strength (N/mm ²)		
		3 Days	7 Days	28 Days
1	M25 - 0%	2.80	3.15	3.70
2	M25 - 10%	3.32	3.80	4.20
3	M25 - 20%	3.50	3.99	4.50
4	M25 - 30%	2.70	2.95	3.30
5	M25 - 40%	2.55	2.74	3.11
6	M25 - 50%	2.30	2.50	2.90

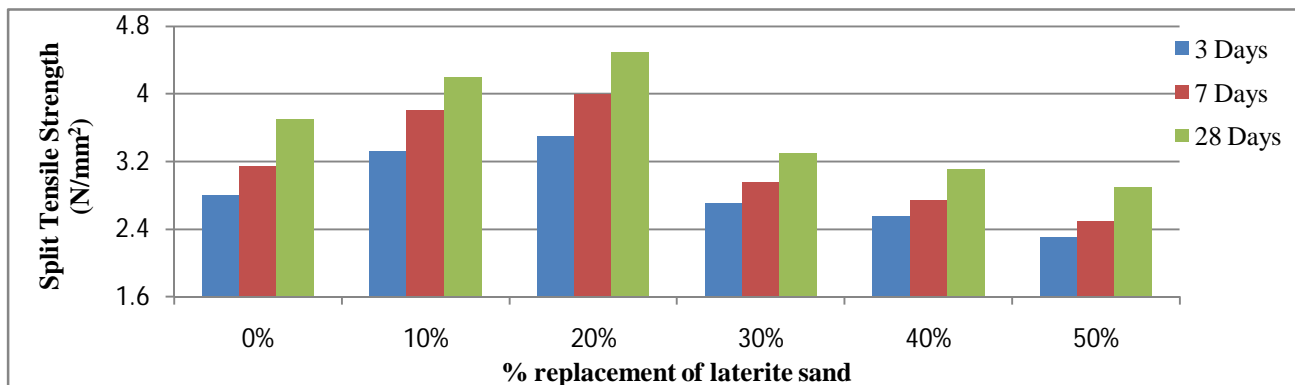
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Graph 3 Split Tensile Strength for mix proportions



VI. CONCLUSIONS

1. Specific gravity of laterite sand (2.42) is near to the Specific gravity of manufactured sand (2.62).
2. Laterite sand replaced concrete shows lesser workability when compared to that of normal concrete considered for the study. Reduction in workability may be due to the presence of finer particles of laterite sand and clay content, which demands more water content.
3. The compressive strength value increases as the replacement levels of laterite sand increases up to 20%. For 20% replacement gives highest strength value of 46.52 N/mm² compares to other replacements and this strength is near to the conventional concrete compressive strength value 34.75 N/mm² and for 50% there is decrease in compressive strength of 29.87 N/mm².
4. The split tensile strength value increases as the replacement levels of laterite sand increases for 20% replacement gives highest strength value 4.50 N/mm² compares to the other replacement and this strength is near to the conventional concrete split tensile strength 3.70 N/mm² and for 50% there is decrease in strength of 2.90 N/mm².
5. In the present investigation, there is a reduction in strength when compare with normal concrete as percentage of laterite sand replaced is increased, but with regards to the target mean strength, it holds good.

REFERENCES

- [1] **Amar R Dongapura and Shivaraj S Mangalgi** "Strength of Concrete Using Laterite Sand and Quarry Dust as Fine Aggregates" International Journal of Engineering Research and Technology- Volume 3 Issue 12, December-2014
- [2] **L O Ettu, O M Ibearugbulem,** "Suitability Of Using Laterite As Sole Fine Aggregates In Concrete", International Journal of Scientific And Engineering Research, Volume 4, Issue 5, May- 2013.
- [3] **Joshua, Amusan,** "Effects of Partial Replacement of Sand with Lateritic Soil in Sandcrete Blocks". Covenant journal of research in the built environment - Volume 1 No 2 March 2014.
- [4] **J Santhiya Jenifer, S Ramasundaram,** "Strength and Durability Characteristic of Laterite Sand Mixed Concrete", International Journal of Chemtech Research Volume 8, No 3, April 2015.
- [5] Concrete Technology by **M.S Shetty**.
- [6] Properties of Concrete by **A.M. Neville**.

CODE OF PRACTICE

- [1] IS 383- 1970 (specifications for coarse and fine aggregates from natural sources of concrete).
- [2] Testing for cement IS 12269- 1987.
- [3] IS 456:2000 plain and reinforced concrete
- [4] IS 10262:2009 concrete mix design proportions
- [5] Hand book on concrete mixes SP: 23-1982.