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Study on Compressive Strength Test of Concrete Using Laterite Soil as an Alternate to Fine Aggregate

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Abstract - **This study focuses on the optimal construction work of lateritic concrete structures to better understand the material's characteristics and potential applications. The structural characteristics of lateritic concrete are evaluated using the best mix % currently in use. In this study, lateritic concrete is compared to control concrete and research is also done on M-sand concrete to see whether laterite soil may replace M-sand. Typical concrete blends, such as 25%, 50%, and 100%, that substitute laterite for some or all of the aggregate. Furthermore, M sand-containing concrete was cast, water-cured for 7, 14, and 28 days, and mixed with laterite aggregate in various ratios (25 and 50%). Tests for compressive strength and workability were conducted in accordance with the current standard. The results show that by substituting a sufficient laterite aggregate content, it is possible to produce workable concrete with an acceptable strength**.

Keywords* — *controlled concrete, compressive strength, M-sand, Lateritic concrete

I. INTRODUCTION

Days Days of difficulty in obtaining sand or fine aggregate leads to an increase in both the price of sand and the price of concrete. India is pursuing the use of other materials as a partial replacement. The use of coarse aggregate in concrete is a result of the expanding demand for concrete material in the building sector and the greater use of local natural granite aggregate mined from the environment. The price of concrete components could increase if natural aggregate eventually goes extinct due to its depletion. Reduced utilisation of natural aggregate in concrete produced from alternatives. In particular, the tropics and subtropics have an abundance of laterite, one of these marginal materials.
The peninsular region of India has bigger laterite deposits. Laterite is the result of intense and protracted tropical rock weathering, which is accelerated by heavy rainfall and high temperatures. The strengths of concrete containing M-sand nearly equal to conventional concrete[1].Replacement of M-sand with glass powder at various percentages from 0 to 50, they conclude that 40% replacement of glass powder was appreciable[2],Durability tests, penetration of water into concrete decreased by increasing in proportion[3],combination of laterite, granite an cement in different proportion have been used for structural concrete,

results have shown that laterite could be used as structural concrete[4],performance characteristics of concrete mixes such as workability and mechanical strength for M30 and M45 grade of concrete. Both grades had given significant results at replacement of M-sand by 25% laterite than control mix [5],laterite is suitable for subgrade and sub-base type but not as a base material in road construction and author recommends stabilization also equally important[6],water cement ratio of 0.65 has shown significant reduction in strength of lateritic concrete mixes[7].Laterite sand could be used as a fine aggregate to produce concrete for the purposes where the soil should not have to hold larger loads[8],concrete was found to be suitable for use as structure member for buildings and related structures where lateritic content did not exceed 50%. The concrete was found to have the best compressive strength results for the combination of 25% lateritic sand and 75% quarry dust[9],replacement of sand up to 30% by laterite fines could be used and test has been done for chemical attack to evaluate for the durability properties[10].

II. MATERIALS AND METHODS

This study examines the impact of replacing fine aggregate (river sand) with laterite soil and M- sand with laterite soil to create lateritic concrete and that is sustainable by analyzing compressive strength test at various percentages. PPC, river sand, laterite soil, M-sand (Manufacture sand), and water are the materials employed.

A. Materials Used

Cement used in this study is PPC of 43 grade confirming with Indian Standard[11] ,M-sand was supplied by local

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supplier, laterite soil was collected from 3 locations such as Mukka, Surathkal, Malpe to compare the richness of sand. **Figure 1** shows the gradation analysis of all three samples, soil samples are having similar percentage of passing. **Figure 2** shows the moisture content of laterite soil which gives the plasticity limits of soil and helps to consider water quantity for the experimental work. Preliminary tests of all the materials have been done according to Indian standard code, gradation curve of laterite soil[12] and their properties are shown in table and figure. The coarse aggregate and fine aggregate tests were satisfied Indian standard[13]

B. X-ray Diffraction Analysis

X-ray diffraction analysis to study the crystalline graphic structure of material. **Figure 3 and 4.** shows its peak (intensity) at aluminum and oxide content, this is due to more periodicity than other direction. This peak intensity represents the atomic position in the crystal structure. This will affect the hydration process in curing period and increases its compressive strength.

C. Mix Design Method

Characteristic compressive strength of 20Mpa was targeted. To reach this, natural sand or river sand replaced with laterite soil in different percentages (25%,50%,100%) and compare with controlled concrete (normal concrete). Replacement of M-sand with laterite soil at 25% and 50%, water cement ratio used for whole experiment is 0.4.The resulting mixes designated as A0 for controlled concrete (normal concrete) B25, B50, B100 for laterite concrete and corresponding number shows the replacement percentage of river sand with laterite soil, C0, C25, C50 for M-sand concrete and corresponding number shows the replacement percentage of M-sand with laterite soil are shown in **table 3.**

Table 1. Properties of aggregates

S l.no	Physical property	M-sand	Laterite soil	Coarse aggregate	Fine aggregate
1	Specific Gravity	2.73	2.73	2.74	2.59

Table 2. Test results of Cement

Type of Cement, Brand, Grade	Property	Values
Portland Pozzolana Cement, Ultra tech,43 grade	Specific Gravity	2.9
	Initial Setting Time	50 minutes
	Final Setting time	600 minutes

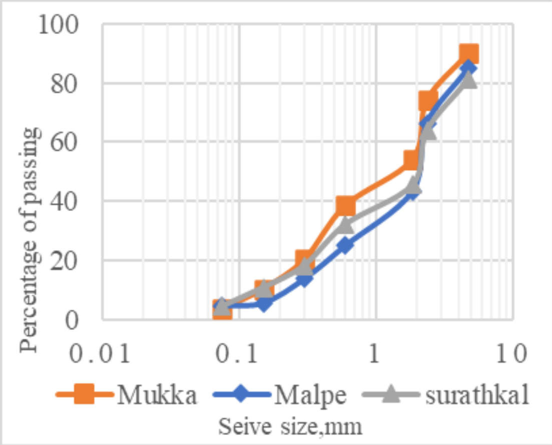

Figure 1. Shows Gradation curve of Laterite soil

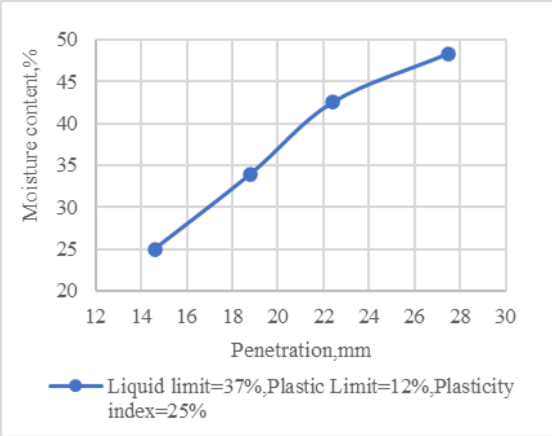

Figure 2. Shows Moisture content of Laterite soil

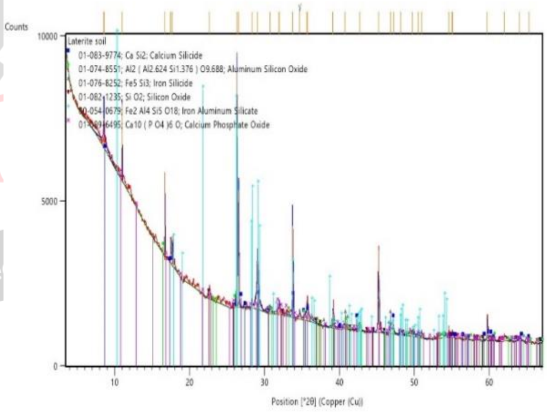

Figure 3. Shows chemical composition of Laterite soil

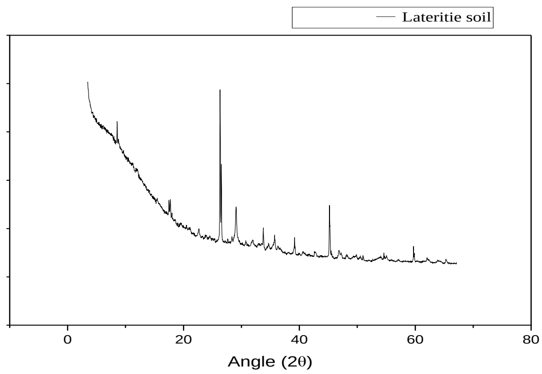

Figure 4. Shows XRD analysis of Laterite soil

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D. Experimental Program

In order to reach the strength of concrete, we determined homogenous freshly mixed types of concrete and their workability test[14].**Table 3** shows the mix proportions of concrete for 1 cubic metre ,the resulting mixes designated as A0 for normal concrete or controlled concrete. In A25, A50, A100-number represent the percentage of replacement of river sand with laterite sandy soil. B0 for concrete containing M-sand, B25, B50 – number represents the percentage of addition of laterite soil along with M sand. Samples were prepared in cubical moulds of size 150mmX150mm,compressive strength test was done as per IS code[15].In this study 3 batches of concrete cubes were casted and each batch has 9 moulds for a curing period of 7,14 and 28 days room temperature. After the specified duration cubes were taken out to perform test.

Table 3. Mix proportions of concrete in kg/m^3

Mix type	Cement kg/m^3	Fine aggregate kg/m^3	Coarse Aggregate kg/m^3	Lateritic Soil kg/m^3	M-sand kg/m^3	water litre kg/m^3
A0	492.5	743.13	984.82	-	-	197
A25	492.5	743.13	984.82	185.78	-	197
A50	492.5	743.13	984.82	371.56	-	197
A100	492.5	743.13	984.82	743.13	-	197
B0	492.5	743.13	984.82	-	743.13	197
B25	492.5	743.13	984.82	185.78	557.35	197
B50	492.5	743.13	984.82	371.56	371.56	197

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III. RESULTS AND DISCUSSION

A. Compressive Strength Test for Sand Replacement with Laterite Soil

The compressive strength and percentage of strength variation of laterized concrete replaced by fine aggregate (river sand) at various percentages of 7,14- and 28-days curing period as shown in **figure 5.** It shows the replacement of 25% laterite soil can produce laterite concrete exhibiting comparable strength with controlled concrete (A0),50% replacement of sandy soil proves to be economical with 75% strength gain,100% soil replacement proves to be weak.

B. Compressive Strength Test For M-Sand Replacement with Laterite Soil

The compressive strength and percentage of strength variation of laterized concrete containing M-sand at 25% and 50% for curing period of 7,14,28 days as shown in **figure 6**. Figure shows the strength gain at 25% replacement of M-sand with laterite soil due to texture of M-sand and later decreases due to laterite soil fineness and voids formation.

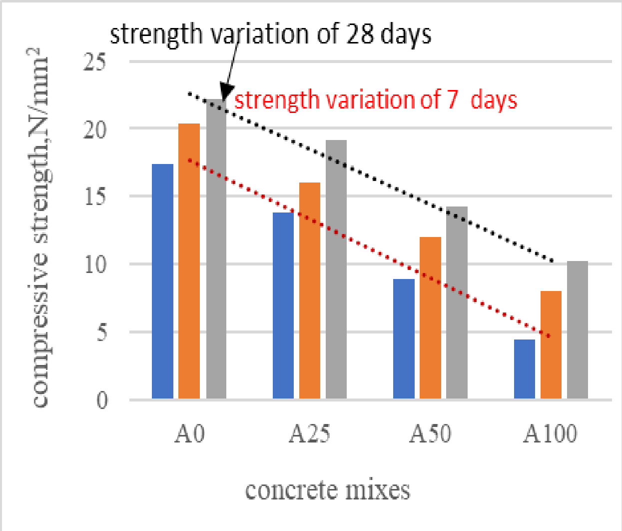

Figure 5. Shows Compressive strength test of laterite concrete Mixes

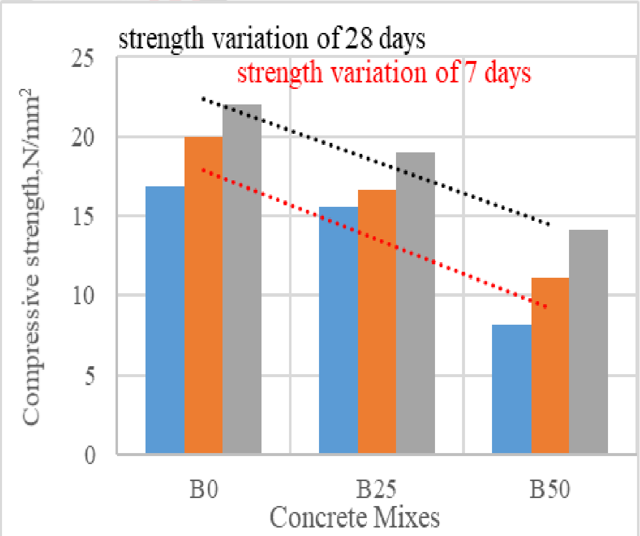

Figure 6. Shows Compressive strength test of M-sand concrete Mixes

IV. CONCLUSION

The use of laterite soil as partial fine aggregate for the replacement of M-sand and river sand has influence towards engineering properties of concrete. From the study it is found that the replacement of 25% laterite aggregate can produce laterite concrete exhibiting comparable strength with normal concrete. 50% replacement of sandy soil proves to be economical with 75% strength gain. Use of laterite soil will directly help to decrease the use of the

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conventional sand and there by decrease the environmental effect from river mining for sand.

V.FUTURE SCOPE

To find out the characteristics of the concrete created, the research can be done using various water-to-cement ratios and different grades of concrete. It's necessary to test the permeability of the concrete as well as other influential hardened concrete features like shrinkage and expansion, chemical resistance, and shrinkage resistance. By substituting steel slag, fly ash, or GGBS for cement, the strength of the concrete can be further modified.

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