Study of Performance of Concrete by Replacement of Fine Aggregate with Low Quality Laterite Stone Powder

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Abstract- *Concrete has several appealing characteristics that have made it as a widely used construction material. It is the material of choice where strength, durability etc..., are required and concrete is undoubtedly most versatile construction material. the present work consist of suitability of low quality laterite stone powder as fully replacement to fine aggregate in concrete without losing the appropriate strength of concrete.The main aim of this project is to determine the characteristics of the concrete by fully replacement of fine aggregate with low quality late-rite stone powder. Using the low quality laterite stone powder as fine aggregate to decrease the cost of construction. It is available abundantly nearby place low quality laterite stone powder is collected and crushed to powder using crushers, sieved by fine aggregate sieve set. The material pass through 4.75mm,2.36mm,1.18mm,600 µ,300 µ,150µ sieve.We are examining the concrete with mix design M20,M25 with fully replacement of low quality laterite stone powder cubes are casted using these ingredients. After curing period compression test conducted in 7, 14, 21 and 28days. The aim of this project work Experimentation is to find the suitable fine aggregate instead of natural sand, as the sand is available scarcely because of many problems..*

Keywords- Concrete, Laterite stone powder, Fine Aggregate,

I. INTRODUCTION

Concrete is made with coarse aggregate, fine aggregate, Portland cement, water and in some cases selected admixtures (mineral &chemical). In the last decade, construction industry has been conducting research on the utilization of waste products in concrete; each product has its own specific effect on properties of fresh and hard concrete.

Currently India has taken a major initiative on developing the infrastructures such as express highways, power projects and industrial structures etc.., to meet the requirements of globalization, in the constructions buildings and other structures concrete plays the rightful role and large quantum of concrete is being utilized.In present generation as the population is increasing rapidly and construction work is also increasing so to replace old process the new stone as the where are the cementing material like mud the lime paste and gums is replaced the by the cement of different kinds in different construction.

Modern Engineering practices become more demanding; there is a corresponding need for special types of material with novel properties. scientists, engineers and technologists are continuously on the searching for materials, which can act as substitute for conventional materials are which process such properties as would enable new designs and innovations resulting in to economy, so that a structure can be built economically.

Already many investigation have been going on the fully replacement of low quality laterite stone powder in place fine aggregate. In the present investigation laterite stone powder has been used as fully replacement of fine aggregate. Recent investigation of Indian low quality laterite stone powder has indicated greater scope for their utilization as construction materials. Greater utilization of low quality laterite stone powder will lead to not only saving such construction material but also assists in solving the problem of disposal of this waste product.

1.1 Need for the Replacement of Sand

- Large scale efforts are required for reducing on the usage of the raw materials that are present, so that large replacement is done using the various by-product materials that are available in the present day.
- The material that can be used is low quality late rite stone powder which is made while in the processing of the igneous category in to aggregates, this is form as a fine powder in the crushers that process the coarse aggregate.
- The properties of concrete in fresh and hardened state are study in the various papers that are use as a reference for this. Sum of the properties are workability, compressive strength are the major one that are considered.

1.2 Wastes as Replacement in Sand

- The global consumption of natural sand is very high, due to the extensive use of concrete or mortar. In general, the demand of natural sand is quite high in developing countries to satisfy the rapid infrastructure growth, in this situation developing countrylike India facing shortage in good quality natural sand. Properties of aggregates affect the durability and performance of concrete, so fine aggregate is natural is an essential component of concrete and cement mortar. The most commonly used fine aggregate is natural river or pit sand. Fine and coarse aggregate constitute about75%total volume.
- It is therefore, important to obtain right type and good quality aggregate at site, because the aggregate forms the main matrix of concrete or mortar.
- Now a day's sand is becoming a very scarce material, in this situation research began for inexpensive and easily available alternative material onatural sand. Some alternatives materials have already been used as a part of naturals and e.g. Fly ash, Ricehuskash, Coalash, Baggases ash, Cottons talk, Blastfurnaceslag, Fiber glass, Waste plastics, Rubber waste, Cow dung ash, Quarry dust, Slaglimestone and siliceous stone powder etc., are used in concrete mixtures as a partially or fully replacement of natural.

II. LITERATURE REVIEW

According to Makasa , the soil name "laterite" was given by Buchanan in India, from a Latin word "later" meaning brick. Laterite is used extensively in the construction of embankments for roads and earth dams. Lateritic soils, according to Osadebe and Nwakonobi are widely used as construction material in Nigeria and other under-developed and developing countries of the world. However, they argue that laterites have not been extensively used in constructing medium to large-size building structures, probably because of lack of adequate data needed in the analysis and design of structures built of lateritic soils. This underscores the need for more research efforts in this area. According to Adoga , Laterite is a highly weathered material rich in secondary oxides of Iron, Aluminium or both. It is nearly devoid of base and primary silicates but may contain large amount of quarts, and Kaolinite.

Laterite has been used for wall construction around the world; it is cheap, environmentally friendly and abundantly available building material in the tropical region .Ayangade et al., reported that approximately 30% of the world's present population still lives in lateritic structures. They observed that the restriction of laterite building to rural areas is due to lack of accepted standard design parameters for the effective structural applications of laterized concrete. They described Terracrete as a mixture of laterite (as fine aggregate), granite or gravel (coarse aggregate), cement and water in a chosen weight proportion, mixed by means that are available and equally allowed to undergo curing processes.

Laterized concrete is defined as concrete in which stable laterite fine replace aggregate (i.e., Sand) .Adepegba was identified as the first to study the effect of using laterite as fine aggregate in concrete . This was supported by Salau when he asserted that "Adepegba recommended laterite up to 40% in clay for laterized concrete". In a further research by Adepegba, he compared resistance to high temperature, modulus of elasticity and compressive and tensile strength of laterized concrete mixes (1:2:4; 1:1.5:3 and 1:1:2 by weight) with that of normal concrete. He concluded that for high strength and workability only 25% of sand in concrete should be substituted with lateritic fine, while the mix ratio should be 1:1.5:3 (cement: sand/laterite: granite) with a water/cement ratio of 0.65.

According to Osunade, laterized concrete is concrete in which the fine aggregates are lateritic soils. Laterite is a mixture of clayey iron and aluminium oxides and hydroxides formed as a result of the weathering of basalt under humid, tropical conditions. It is readily available in all parts of Nigeria. The quest of having concrete which is cheaper has prompted many researchers to work on laterized concrete. Different properties of laterized concrete have been considered at different stages with far reaching recommendations in favour of laterite as suitable for use in the construction industry. Working on shrinkage deformations of laterized concrete, Salau and Balogun recommended that laterized concrete with up to 25% laterite content of the aggregate could be used in load-bearing structural elements. It was also found out in another work by Balogun and Adepegba that the most suitable mix for structural application of laterized concrete was 1:1.5:3 with about 0.65 water/cement ratio provided that the percentage of laterite content was kept below 50%. They asserted also that compressive strength of not less than 25 N/mm2 was obtained at 28days for the mix with laterite content of about 25-50%. A combination of crushed granite, sharp sand and fine laterite was used in their experiment.

Lasisi and Osunade listed mix proportion, water/cement ratio, curing ages, grain size ranges, stress level, laterite soils- river sand variation as some of the factors that affect the strength and creep properties of laterized concrete. They observed that increase in cement content and decrease in water/cement ratio results in increase in the compressive strength of laterized concrete. According to Lasisi and Osunade , the creep of laterized concrete, unlike that of conventional concrete which showed some definite recovery

after unloading, did not show any form of recovery. Lasisi and Ogunjidealsoestablished that the higher the laterite/cement ratio, the lesser the compressive strength, and the fewer the grain size range, the higher the compressive strength.

Udoeyo et al.,had also agreed with other researchers that with up to 40% replacement level of sand by laterite, laterized concrete attained the strength of 20N/mm2. They recommended laterized concrete for the construction of buildings and rural infrastructures. Laterized concrete has also been found to have similarity with conventional concrete in some properties: Falade found that the already established variations in workability and compressive strength of normal concrete with water/cement ratios are valid for laterized concrete. Salau observed in his paper "Long-term deformations of laterized concrete short columns" that there were not many variations between the creep deformations of laterized concrete and normal concrete short columns. He further recommended 25% laterite content of the aggregate for long-term resistance and usage in load-bearing short column members. Efe and Salau showed that normal concrete cannot withstand appreciable load above 250°C while laterised concrete with 25% laterite in the fine aggregate is able to resist higher load with increase in age and at temperature up to 500°C. They achieved compressive strength of up to 30.44N/mm2 for laterized concrete with 25% laterite and 75% sand at 500°C. Laterized concrete accordingEfe and Salau can be classified as normal- weight concrete as the density of all test specimens of 28- day curing age exceeds 2000Kg/m3. They also observed that there is economic saving if laterized concrete is used in areas of high temperature up to 500°C. This differs from the findings of Udoeyo et al., that the strengths of laterized concrete and normal concrete decreased in a similar manner when subjected to elevated temperatures of between 200°C and 600°C. Udoeyo et al., also found that the workability of laterized concrete increases with laterite content with slump values ranging from 22 - 20mm, while the water absorption showed a reverse trend, i.e., decrease with increase in laterite content. Also Adepegba recommended 0.65 water/cement ratio as suitable for normal workability.

Joseph O. Ukpata, Maurice E. Ephraim and Godwin A. Akeke, "The compressive strengths of concrete using lateritic sand and quarry dust were measured in the laboratory. Compressive strength was found to increase with age as for normal concrete. The 28 - day compressive strength was found to range from 17 - 34.2N/mm2 for different mixes. The above strength properties were found to compare closely with normal concrete. The proportion of 25% laterite to 75% quarry dust produced higher values of compressive strength. For the same proportion of 25% laterite and 75% quarry dust at 1:1.5:3 mix and 0.54 water/cement ratio, a logarithmic model has been developed for predicting the compressive strength of concrete between 0 and 28 days".

A.Jayaraman, V.Senthilkumar, M.Saravanan,"The compressive strength and tensile strength of concrete using lateritic sand lime stone filler are measured in the laboratory. Compressive strength and tensile strength is found to increase with age as for normal concrete. The 28 – day compressive and tensile strength is found 21.06 -35.2 N/mm2 and 10.06 - 15.5 N/mm2 for different mixes. The above strength properties the proportion of 25% laterite to 75% lime stone filler produced higher values of compressive strength. For the same proportion of 25% laterite to 75% lime stone filler at 1:15:3 mix and 0.55 water cement ratio, a logarithmic model has been developed for predicting the compressive strength and tensile of concrete between 0 and 28 days..

III. METHODOLOGY

Cement

Cement is a material that has cohesive and adhesive properties in the presence of water. such cements are called hydraulic cements. these consist primarily of silicates and aluminates of lime obtained from lime stone and clay.

Coarse Aggregate

Ordinary granite broken stone aggregates of size greater then 12mm are used for the study.

The coarse aggregate are granular materials obtained from rocks and crushed stones of limestone or granite. They may beal so obtained from synthetic material likes lag, shale, fly ash and clayforuse in light-weight concrete .The material whose particles are of size as are retained on I.S sieve no.4.75mm is termed as coarse aggregate. The size of coarse aggregate depends upon the nature of the work.

Low quality laterite stone powder

Laterite is a type of residual soil that occurs extensively in the humid tropical and sub-tropical zones of the world, including much of central, southern and western Africa. Lateritic soils are formed in the tropics through weathering processes that favour the formation of iron, aluminium, manganese and titanium oxides. Laterite has been used for wall construction around the world; it is cheap, environmentally friendly and abundantly available building material in the tropical region .Ayangade et al., reported that approximately 30% of the world's present population still lives in lateritic structures. They observed that the restriction

of laterite building to rural areas is due to lack of accepted standard design parameters for the effective structural applications of laterized concrete. They described Terraces as a mixture of laterite (as fine aggregate), granite or gravel (coarse aggregate), cement and water in a chosen weight proportion, mixed by means that are available and equally allowed to undergo curing processes below the figure

Figure 1: low quality laterite stone powder

Test Conducted:

- Specific gravity
- Particle size analysis
- Bulking
- Workability
- Compressive Strength
- Slump Cone Test
- Compaction Factor Test

Mixing of the material

The normal grade that is used is M20,M25 for normal construction purposes in India. The normal mix is done separately low qualitylaterite stone powder using replace using the sand minimum void ratio methods and maximum density method.

Nominal mix

In the past the specifications for concrete prescribed the proportions of cement, fine and coarse aggregate. these mixes of fixed cement-aggregates ratio which ensures adequate strength or termed normal mixes. these offer simplicity and under normal circumstances, have a margin of strength above that specified. however, due to the variability of mix ingredients of the nominal concrete for a given workability varies widely in strength.

IV. RESULTS AND DISCUSSION

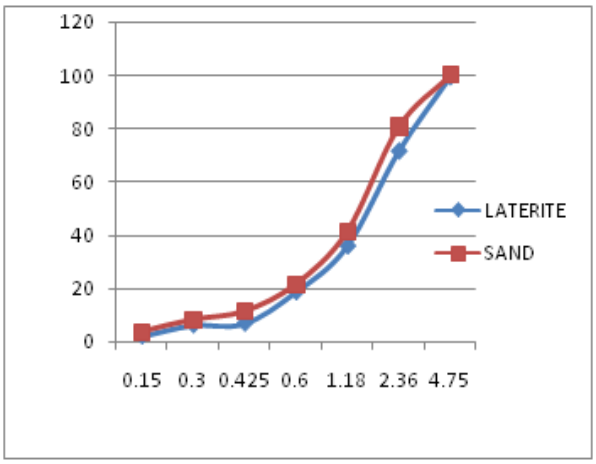
The results of the physical properties like specific gravity, particle size analysis, workability and bulking are the most needed for determining the nominal mix design of the concrete

Specific gravity

The average value specific gravity of natural sand is 2.62, and the average value of the specific gravity of laterite stone powder is 2.56.

Sieve analysis

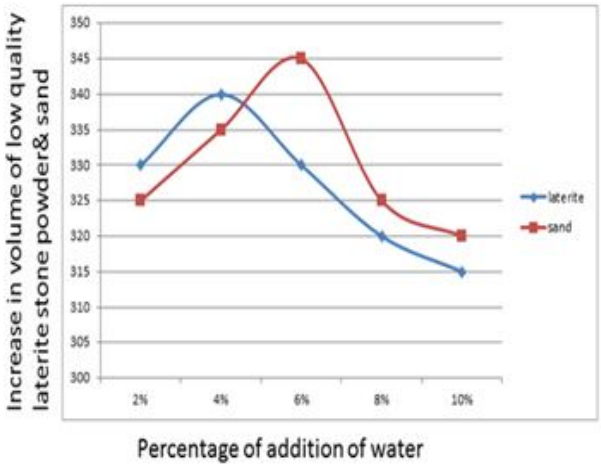
A gradation test is performed on a sample of aggregate in a laboratory. A typical sieve analysis involves a nested column of sieves with wire mesh cloth (screen). The grain analysis is widely used in classification of soils. The data obtained from grain size distribution curves is used in the design of filters for earth dams and to determine suitability of soil for road



Graph 1: Sieve analysisfine aggregate

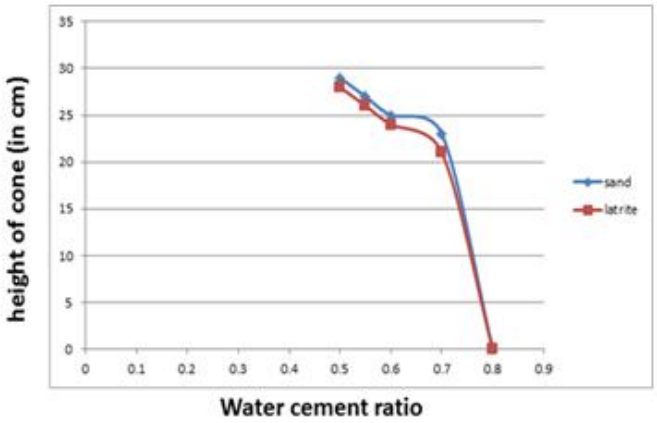
Bulking of Aggregates

Average percentage of bulking of low quality laterite stone powder is 13.3%, average percentage of bulking of sand is 15.25%.



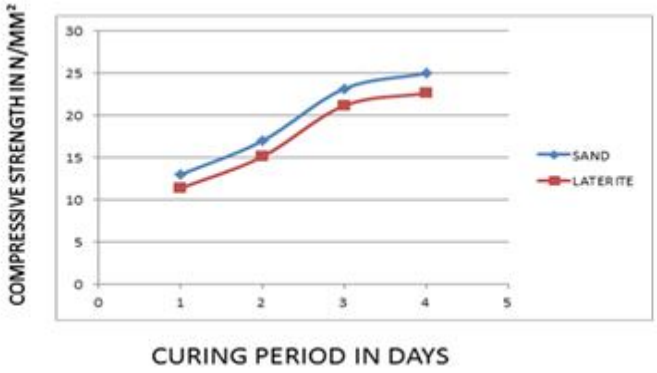
Workability of low quality laterite stone powder

The workability test was conducted by replacing of sand with low quality laterite stone powder and at various water cement ratio.



Compressive Strength

The compressive strength results as tabulated reading with replacement of sand by low quality laterite stone powder with give averages.



VI. CONCLUSION

By Replacing The low quality laterite stone powder The following conclusions were drawn based on the experimental results as follows :

1. The compressive strength of concrete is found to be 22.65 and 29.91N/mm2 for M20 & M25 design mixes.
2. The specific gravity and bulking of sand is more than natural sand (fine aggregate specific gravity value is 2.56 and bulking of sand is 13.3%)
3. The delay in construction due to lack of sand can be avoided .
4. Low quality laterite stone powder can be used for construction of rural roads and stone pitching of embankments etc.
5. Indirectly consequences of excavations of sand in Rivers can be avoided by replacement of this laterite stone powder ,wherever feasible.
6. The specific gravity and bulking of sand is more than natural sand
7. Low quality laterite stone powder can be replaced in place of conventional river sand to produce concrete and can be used for construction industry without loosing the strength of concrete.
8. The cost of low quality stone powder is 50% cheaper than the cost of river sand.
9. All the required tests like sieve analysis, bulking of sand conducted on the low quality laterite stone powder and the material laterite stone powder met the permissible values.
10. The usage of low quality laterite stone powder depends on the availability abundantly near to construction location to avoid excessive transportation cost.

VII. SCOPE OF FURTHER STUDY

Still there is a further scope in the project is partial replacement of sand (various percentages) by using low quality laterite stone powder need to obtain the required compressive strength

ACKNOWLEDGEMENT

The authors wish to thank Er.R.Rama Krishna garu, Er.S.Ashok Kumargaru Dr. R Dayakar Babugaru, Department of Civil Engineering, and Management of KITS Engineering College for guidance and providing facilities to complete this project.

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