RESEARCH PAPER | Engineering | Volume : 6 | Issue : 5 | May 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 74.50

Suitability of Using Laterite as Partial Replacement of Fine Aggregate in Concrete

KEYWORDS: laterite sand, Gulbarga area best river bedded sand, Coarse aggregate, replacement, Concrete.

Tanveer Asif Zerdi
Director, Professor Head of Civil Department, KCT Engg College, C/o Dr Meenaz Hospital

Sayyed Saddam Hussain
UG Student Department Of Civil Engineering V.T.U University K.C.T.E.C Gulbarga Karnataka

Syed Zeeshan Ali
UG Student Department of Civil Engineering V.T.U University K.C.T.E.C Gulbarga Karnataka

Qizar Ansari
UG Student Department of Civil Engineering V.T.U University K.C.T.E.C Gulbarga Karnataka

ABSTRACT *Sand is a well-known building material and has occupied a very important place in construction work but Sand is more expensive because it is more difficult to collect sand from rivers. With the fast depleting state of natural resources like river sand and aggregates, it is time to look for alternative cheap materials (marginal materials) for making concrete, particularly when strength is not a primary parameter. One of the potential marginal materials for use in concrete is laterite. This paper presents the results of the laboratory tests carried out to investigate the suitability of using laterite as partial replacement of sand. At the rate of 0%, 15%, 30% by weight for design mix of M25 controlled concrete. A total of 18 specimens of size 150mm x 150mm x 150mm are prepared to determine the cube compressive strength after 7, 21 and 28 days of curing. The laterite sand used is available in Humnabad region, Bidar District of Karnataka state as a replacement of Gulbarga area best available river bedded sand in concrete. Data results revealed that the laterite fines used could satisfactorily replace the sand up to 30%.*

Introduction

Concrete is a composite material containing cement, aggregate and water which are added in different proportions based on the desired use. The aggregate is generally coarse gravel or crushed rocks such as limestone, or granite, along with fine aggregate such as sand. Portland cement is commonly used as binder and various chemical admixtures such as fly ash, silica fumes and ground granulated blast furnace can also be added to produce concrete with improved strength and durability.

Due to increasing cost of producing concrete using these conventional materials such as cement, river sand as fine aggregate and granite as coarse aggregate in Nigeria, researchers have been working on alternative, cheap and readily available materials that would serve perfect substitutes for such materials while still meeting the set requirements for concrete in the industry. The use of laterite in combination with river sand in particular have received much attention in Nigeria, laterite being a tropical soil that is abundantly available in the tropical belts of the world. This had attracted the interest of researchers both in the time past and in recent times. The efforts of these researchers have led to the production of laterized concrete. Laterized concrete is a concrete in which stable laterite replaces fine aggregate, basically sand. Results of investigations on laterized concrete as reported by most researchers have consistently shown that laterized concrete is inferior in compressive strength and durability when compared to conventional concrete. For this reason, laterized concrete has found little or no application in the Nigerian construction industry. Generally in the preparation of concrete, the addition of water to its dry constituents brings about chemical reaction between it and cement which is referred to as hydration thereby producing cement gel and Calcium Hydroxide (Ca(OH)2). From these products of hydration, Ca(OH)2 most readily react with Carbon IV Oxide (CO_2) to form Calcium Carbonate ($CaCO_3$) with the rate of carbonation of concrete increasing with an increase in concentration of CO_2. Carbonation could have some positive consequences because $CaCO_3$ occupies greater volume than Ca(OH)2 which it replaces and in turn reduces the porosity of concrete since it is generally accepted that the durability of concrete is related to the characteristics of its pore structure. proportions of mix, the method of compaction and other controls during placing, compaction and curing. The supply of sand is being threatened by a number of factors on one hand while its demand is increasing at alarming rate on the other hand. Increasing environmental consideration are among other factors besides being the only conventional fine aggregate that militate against supply of sand. It has been observed that based on the availability of laterite, a fine aggregate, laterite could either partially or wholly replace sand as fine aggregate. The criterion for concrete strength requirement is always based on the characteristic compressive strength obtained after 28-day curing. The compression strength of concrete is usually determined by performing compression test on standard sizes of concrete blocks (i.e., 150mm x 150mm x 150mm).The strength of concrete is affected partly by the relative proportion of cement and of the fine and coarse aggregates but the water-cement ratio is another important factor.

Significance of study

With the fast depleting state of natural resources like river sand and aggregates, it is time to look for alternative cheap materials (marginal materials) for making concrete, particularly when strength is not a primary parameter. One of the potential marginal materials for use in concrete is laterite. Laterite is a product of intense sub aerial weathering. Laterisation process involves leaching of alkalis, basis and silica with complimentary enrichment of alumina, iron and some trace elements. This type of weathering

Volume : 6 | Issue : 5 | May 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 74.50

advances for a faster degree in tropical regions where the temperatures and seasonal rainfall is the highest, giving rise to alternate wet and dry conditions.Invariably, all the rock types under these conditions give rise to laterite, which look similar in appearance. However, there is a pronounced change in mineralogical and migration of elements in laterite profiles. In India, laterite soils occupy an area of about 1,30,066 Sq.km and is well developed on the summits of Deccan hills, Karnataka, Kerala, the Eastern Ghats, West Maharashtra and central parts of Orissa and Assam. The laterite terrain of Kerala occupies the midland region of the state and covers about 60% of the state. Mature laterite is made up primarily of iron, aluminum, silica, titanium and water.

Scope of work.

1. The objective of this study is to determine the compressive strength of concrete by partially replacing Shahpur Sand with Laterite sand at 0%, 15%, 30% and curing the concrete for3,7,21,28 days of curing.

2. Preparing the normal concrete by utilising normal best quality river bedded sand of this area that is shahpur sand and ascertaining its compressive strength at 7, 21, 28 days of curing.

3. Comparing the compressive strength development of above two types of concretes and ascertaining the feasibility of using laterite sand.

Experimental Procedure

The parameters considered for the study are the workability, cube compressive strength. The mix proportion for M25 concrete designed as per provisions in IS Codes

were considered for this investigation. Laterite of proportions 0%, 15%, 30% of weight of sand were used to make corresponding concrete. 18 cubes (150mm x 150mm x 150mm) were tested in this investigation.

Constituent Materials

Pozzolana Portland cement 53 grade, Gulbarga area best available river bedded sand of specific gravity 2.59 passing through 4.75mm IS sieve conforming to zone II , coarse aggregate of specific gravity 2.73, laterite of specific gravity 2.68 and fineness modulus 2.73 and Potable water were used for making the various concrete mixes considered in this study.

Mix Design

M25 concrete mix was designed as per IS 10262:2009. The mix obtained as per IS code design is of proportion 1:1.736:3: 0.50. The quantity required for 1m3 concrete as given in Table 1. For all replacement level, the same mix ratio for normal concrete followed. In this investigation, the % of replacement of laterite made without effecting W/C ratio and mix proportion.

Mixing

Hand mixing is done. Slump test was conducted for each mix to assess the workability. Concrete cubes (150mm) for determining compressive strength. Specimens were demoulded after 24 hours of casting and were kept in a curing tank for water curing for next 28 days. The specimens to be tested were taken from the curing tank on 7th, 21st and 28th day of curing for compressive strength.

Table 1 - Quantity required for 1m³concrete.

Sl. No.	% of Laterite sand	Cement Kg/m³	Fine aggregate Kg/m³		Coarse Aggregate kg/m³	Water Kg/m³
			sand	laterite		
1	0%	397.333	710.518	0.00	1186.073	198.666
2	15%	397.333	603.940	106.578	1186.073	198.666
3	30%	397.333	497.363	213.155	1186.073	198.666

Properties of Concrete

Fresh concrete or plastic concrete is freshly mixed material, which can be moulded into any shape. The relative quantities of cement, coarse aggregate, fine aggregate and water mixed together, control the concrete properties in the fresh state. Workability of concrete was determined by conducting slump test. Test results are tabulated in

Table 2.

Table 2- Variation in workability

Mix	% Replacement of Fine Aggregates	Slump (mm)
F0	0	95
F15	15	80
F30	30	55

Cube Compressive Strength.

Compression test of cubes is the most common test conducted on hardened concrete partly because it is an easy test to perform and partly because most of the desirable properties of concrete are comparatively related to its compressive strength. For each mix of ordinary concrete and concrete with varying percentage of laterite, three cube specimens each of size 150mm×150mm×150mm were tested according to the I. S specifications, on the 7th, 21st and 28th day of curing and the average values obtained are given in Tables 3.

Table 3- Cube Compressive Strength for various mixes of M25 Grade concrete

Mix	%age laterite	7 days	21 days	28 days
F0	0	21.74	30.51	32.97
F15	15	17.91	22.59	26.95
F30	30	19.62	26.64	29.41

Test results shows that the addition of laterite to ordinary concrete is found to reduce the compressive strength.

Volume : 6 | Issue : 5 | May 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 74.50

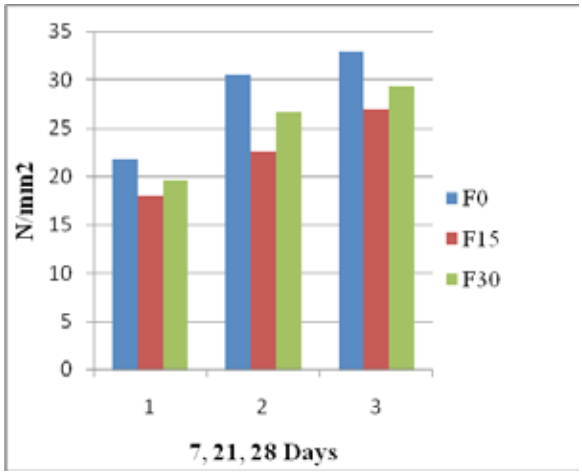

Fig.1 Comparison of 7th,21st and 28th Day

Compressive Strength of Ordinary Concrete and concrete with varying percentage.

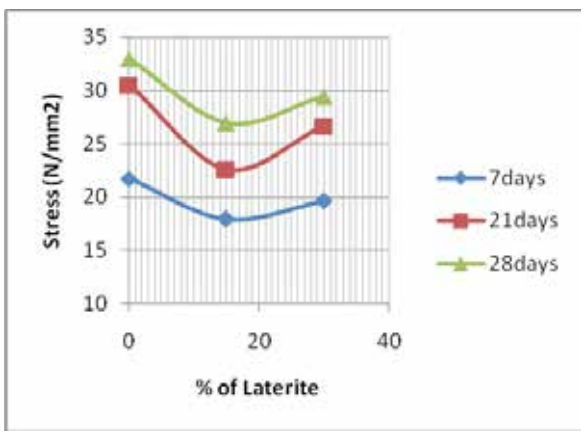

Fig. 2 Variation of compressive strength of concrete cube

CONCLUSION

From the experimental investigation, the following conclusions are arrived at

1. The development of compressive strength for normal mix concrete is giving the 21.74, 29.51, 32.07 N/mm^2 at 7,21, and 28 days of curing respectively.

2. similarly the compressive strength of laterite replaced concrete is giving 26.95, 29.41N/mm^2 at 15,,30 percentage replacement of laterite respectively.

3. if we compare the values of the two types of concretes studied shows that the incorporation of laterite sand by replacing normal shahpur sand is decreasing the compressive strength of concrete, but this decreament is not very large, hence authors feel that the replacement of laterite sand is a break through to the prevailing crisis of availability of river bedded sand. Hence authors recommends to utilize laterite sand in the manufacturing the concrete.

4. Introduction of laterite content into the concrete matrix is found to reduce the workability of the mix. This is due to finesse of laterite which ultimately increases the total surface area of concrete and consequently, more water is required to wet the surface of aggregate.

5. Addition of laterite to any particular concrete mix is found to reduce its compressive strength. This is due to finesse of laterite which ultimately increase the air voids as fine particle is at the bottom side and air voids at the top level do not fill properly.

6. Laterite content between 15% to 30% by weight of sand content has shown the best results. Thus indicating the possibility of using laterite as a partial replacement for sand.

Reference

[1] Biju Mathew, Dr. Benny Joseph, Dr. C Freeda Christy. (2013) Strength Performance of Concrete using Laterite as Sand Replacement. International Journal of Civil Engineering Research and Applications Vol. 1, Issue 3, August -2013. P. 38-42

[2] Festus Adeyemi Olutoge, Kikelomo Mulikat Adeniran, Oluwatobi Brian Oyegbile (2013).The Ultimate Strenght Behaviour of Laterized Concrete Beam. Science Research 2013; 1(3): 52-58. DOi: 10.11648/j.sr.20130103.14, July 2013.

[3] G. Sabarish, M.K.M.V. Ratnam, Dr. A.C.S.V. Prasad, Dr. U. Ranga Raju (2015). A Study on Strenght and Durability Characteristics of Concrete with Partial Replacement of Fine Aggregate by Lateritic Sand. IJIRST- International Journal for Innovative Research in Science & Technology. Vol. 02| Issue 03| August 2015. ISSN: 2349-6010. P. 134-141.

[4] Omotola Alawode, P.G. Dip, & O.I. Idowu. M.Sc.(2011). Effects of Water-Cement Ratios on the Compressive Strenght and Workability of Concrete and Lateritic Concrete Mixes.The Pacific Journal of Science and Technology, Vol. 12, Number 2. November 2011. P. 99-105.

[5] Shuaibu R.A, Mutuku R.N, Nyomboi T, (2014). A Review of the Properties of Laterite Concrete. International Journal of Civil and Structural Engineering, Vol. 05, No 2, Issue 2, 2014. ISSN: 0976-4399. P. 130-143.