Research Paper Engineering

Behavior of Concrete Under Compression Cast by Using Lateriate and Basalt as Aggregates

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ABSTRACT

For many years, sand has been predominantly used as fine aggregate in civil engineering construction. More recently, the source of quality sand has been fast diminishing resulting in ever increasing cost of construction. Laterite is now seen as a possible replacement for sand in concrete mix. In this paper we tried to study the behavior of concrete under compression when fine aggregate that is locally available river bedded sand is partially replaced with laterite sand by 0%, 7.5%, 15%, 22.5%, and 30% to the weight of fine aggregate for design mix of M30 concrete with 0.45 as water cement ratio and the coarse aggregate used is locally available basalt stone. The laterite used is taken from basavakalyan, Bidar District of Karnataka state. The numbers of specimens prepared are 60 and size of specimens is 150mm x 150mm x 150mm. The cube compressive strength is determined at 3, 7, 21, 28 days of curing. These results are compared with the results of normal concrete, and suitability of it is studied.

KEYWORDS : laterite sand, fine aggregate, ballistic nature of Coarse aggregate, replacement, Concrete.

Introduction

Concrete is a composite material composed of coarse aggregate bonded together with a fluid cement which hardens over time. Most concretes used are lime based concretes such as Portland cement concrete. When the aggregate is mixed together with the dry cement and water, they form a fluid mass that can be moulded into shape. The cement reacts chemically with the water by hydration and other ingredients to form a hard matrix which binds all the materials together into a durable stone-like material that has many uses. Often, additives such as pozzolans or superplasticizers are included in the mixture to improve the physical properties of the wet mix or the finished material. There are many types of concrete available, created by varying the proportions of main ingredients. In this way or by substitution for cementitious and aggregate phases, the finished product can be tailored to itys application with varying strength, density or chemical and thermal resistance properties.

Fine and coarse aggregates make up the bulk of a concrete mixture. Sand, natural gravel, river bedded and crushed stone are mainly used. Sand. is a well-known building material and has occupied a very important place in construction work but Sand is more expensive than laterite because it is more difficult to collect sand from rivers than to dig laterite from pits. The locations of the collecting sites of sand are usually far from many construction sites whereas laterite may be easily dug from the foundation of a building or near the site thereby reducing the cost of transportation and the price of laterite**.** Locally available aggregates are used. The natural aggregates can be replaced if required. The size distribution of aggregates determines how much binder is required. Aggregate with a very even size distribution has the biggest gaps whreas adding aggregates with smaller particles tends to fill these gaps. The binder must fill the gaps between the aggregates. Concrete has relatively high compressive strength, but much lower tensile strength. Concrete has a very low coefficient of thermal expansion and shrinks as it matures.

Aim of investigation.

1. The objective of this study is to determine the compressive strength of concrete by partially replacing Shahpur Sand with Laterite sand at 0%, 7.5%, 15%, 22.5%, and 30% and curing the concrete for 3,7,21,28 days of curing basalt as coarse aggregates.
2. Preparing the normal concrete by utilising normal best quality river bedded sand of this area that is shahpur sand and basalt ascertaining its compressive strength at 3, 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.

Methodology

In this investigation workability, cube compressive strength are considered. The mix proportion for M30 concrete designed as per provisions in IS Codes were considered for this investigation. The Laterite is replaced by 0%, 7.5%, 15%, 22.5%, and 30% of weight of sand were used to make concrete. 40 cubes (150mm x 150mm x 150mm) were tested in this investigation. Also the cubes are prepared from normal concrete, and both the types of concretes were tested in compressive testing machine for obtaining the compressive strength of concrete.

Materials

Cement : Pozzolana Portland cement 53 grade.

Sand : locally available good quality Shahpur sand of specific gravity 2.59 and fineness modulus 2.73 passing through 4.75mm IS sieve conforming to zonell.

Lateritic Sand : The specific gravity of laterite sand is 2.68.

Coarse aggregate : Locally available Ballastic nature of coarse aggregate of specific gravity 2.73 is used.

Water : Potable water were used, for making the various concrete mixes considered in this study.

Mix Design

M30 concrete mix was designed as per IS

10262:2009. the mix proportion is obtained as per IS code design is 1: 1.48: 2.67: 0.45. The quantity required for 1m3 concrete as given in Table 1. For all concrete mixes same mix ratio is followed. In this investigation, the percentage of replacement of laterite is made without disturbing W/C ratio and mix proportion.

Casting.

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 27 days. The specimens to be tested were taken from the curing tank on 3rd, 7th, 21st, 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%	442.666	674.666	0.00	1176.29	199.2
2	7.5%	442.666	624.066	50.6	1176.29	199.2
3	15%	442.666	580.966	93.7	1176.29	199.2
4	22.5%	442.666	522.866	151.8	1176.29	199.2
5	30%	442.666	472.266	202.4	1176.29	199.2

Fresh 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	100
F7.5	7.5	90
F15	15	80
F22.5	22.5	70
F30	30	60

Compressive Strength.

This 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, cube specimens each of size 150mm×150mm×150mm were tested according to the I. S specifications, on the 3rd, 7th, 21st, 28th day of casting and the average values obtained are given in Table 3.

Table 3-Cube Compressive Strength for various mixes of M30 Grade concrete

Mix	%age laterite	3 days	7 days	21 days	28 days
F0	0	15.8	25.71	34.84	37.47
F7.5	7.5	11.4	18.46	25.14	27.45
F15	15	12.7	20.64	28.94	31.93
F22.5	22.5	14.6	23.81	32.68	34.92
F30	30	11.67	19.24	27.46	30.28

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

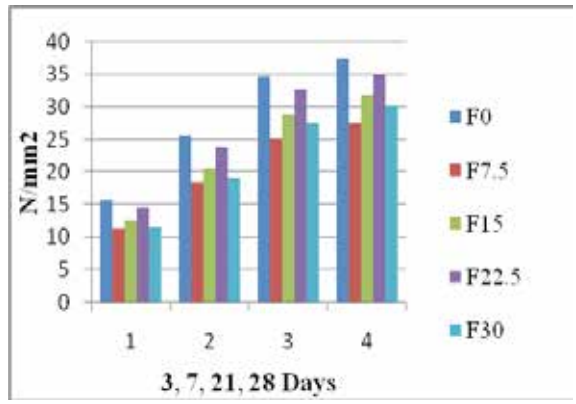

Fig.1 Comparison of 3rd, 7th, 21st, 28th Day

Compressive Strength of Ordinary Concrete and concrete with varying percentage.

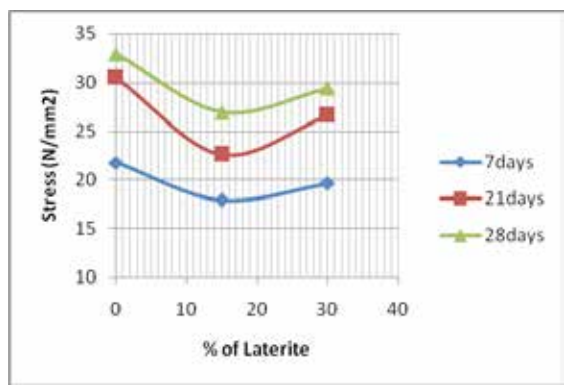

Fig. 2 Variation of compressive strength of concrete cube

CONCLUSION

From the experimental investigation, the following conclusions are arrived at

1. The development of compressive strength for normal mix concrete is giving the 15.8, 25.71, 34.84, 37.47 N/mm² at 3,7,21, and 28 days of curing respectively.
2. Similarly the compressive strength of laterite replaced concrete is giving 27.45, 31.93, 34.92, 30.28 N/mm² at 10,20,30 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 nearly 20% by weight of sand content has shown the best results. Thus indicating the possibility of using laterite as a partial replacement for sand.

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