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AN EXPERIMENTAL INVESTIGATION ON PARTIAL REPLACEMENT OF LATERITE STONE AS COARSE AGGREGATE IN A CONCRETE.

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Abstract: This research work review on partial replacement of coarse aggregate as laterite stone in concrete. Concrete is consuming huge quantity of coarse aggregate which is depleting the natural resource. It is the call of the day to find the alternative for coarse aggregate as the same source used as raw material in the production of M-sand which is substitute for river sand. Because of great demand, pollution and high energy consumption due to crushing of natural stone there is need to find alternative. This research is focusing on one such natural alternative which is available in excess in the Western and Eastern Ghats of the sub – continent - Laterite. The partial replacement of laterite stone as coarse aggregate in 5%, 10%,15%, 20% of concrete. It enhances the compressive strength of concrete.

Keywords: Compressive strength, Flexural strength, Laterite stone, Split tensile strength

I. INTRODUCTION

Laterite is a natural rock rich in iron and aluminium and is commonly considered to have formed in hot and wet tropical areas. Nearly all laterite is of rusty-red coloration, because of high iron-oxide content. The majority of the land which containing laterite is generally occurs between the tropic of cancer and tropic of Capricorn[7]. Aggregate are considered one of the main constituents of concrete since they occupy more than 70% of the concrete matrix. In many countries there is scarcity of natural aggregates that are suitable for construction while in other countries there is an increase in the consumption of aggregate due to the greater demand by the construction industry. Transportation of aggregate from one place to another is costly. In order to reduce dependence on natural aggregate as the main source of aggregate generated from industrial wastes provide an alternative for the construction industry. Therefore without proper alternative aggregates being utilized in the near future , the concrete industry globally will consume 15 billion tons annually natural aggregate after the year 2010. Such large consumption of natural aggregate will cause destruction to the environment [16]. Laterite was first observed in Malabar Region of coastal kerala and Dakshina kannada & other part of Karnataka. Telangana was the leading state in production of laterite (41%) followed by Andhra Pradesh (38%) Madhya Pradesh (13%),Kerala (3%),Karnataka (2%) and the remaining 3% was contributed by Gujarat and Maharashtra.

AS per UNFC System as on 1.04.2013, the total resources of laterite is placed at 559 million tonnes. Out of these , 60 million tonnes are placed under Reserves category and 499 million tonnes are under Remaining Resources category.Hence we can use the laterite stone as aggregate in concrete.as partial Replacement for conventional aggregate like granite,quartz,talc etc.in laterite available region in our country[10] .

II. EXPERIMENTAL PROCEDURE

A. Materials

Cement:

The Bureau of Indian Standards (BIS) has classified OPC in three different grades. The classification is mainly based on the compressive strength of cement-sand mortar cubes of face area 50 cm^2 composed of 1 part of cement to 3 parts of standard sand by weight with a water-cement ratio arrived at by a specified procedure. The grades are (i)33 grade (ii) 43 grade (iii) 53 grade. The grade number indicates the minimum compressive strength of cement sand mortar in N/mm^2 at 28 days, as tested by above mentioned procedure. In this project, Dalmia 53 Grade Ordinary Portland Cement was used conforming IS

12269:1987. The specific gravity of cement is 3.15,Fineness of cement is 7.5%.

Fine Aggregate:

Fine aggregate which passed through 4.75 mm IS Sieve and retained on 75 micron (0.075 mm) IS Sieve is termed as fine aggregate. Fine aggregate is added to concrete to assist workability and to bring uniformity in mixture. Usually, the natural river sand is used as fine aggregate. Ordinary river sand conforming IS 383-1970 was used in this project. The specific gravity of fine aggregate is 2.48,Fineness modulus of fine aggregate is 3.29.

Coarse Aggregate:

Coarse aggregate for the works should be river gravel or crushed stone. Angular shape aggregate of size is 20 mm and below. The aggregate which passes through 75 mm sieve and retain on 4.75 mm are known as coarse aggregate. The grading of coarse aggregates should be as per specifications of IS 383-1970.In this project, maximum normal size of coarse aggregate was 20 mm for controlled concrete. The specific gravity of Coarse aggregate is 2.65, Fineness modulus of coarse aggregate is 2.2,water absorption of coarse aggregate is 0.25% .

Laterite:

Laterite stone is the most abundant material in some of the hot and wet tropical areas. So by using this as a replacing material we can reduce the cost of construction It is a highlyweathered material, rich in secondary oxides of iron, aluminium or both. It is either hard or capable of hardening on exposure to moisture and drying.. . The mean particle size of Laterite stone is between 4.75mm - 20mm is used .The particle shape of Laterite stone is vermicular. The specific gravity of Laterite stone is 2.87, Fineness modulus of Laterite stone is 7.25,water absorption of coarse aggregate is 0.5%.

Fig-1 Laterite stone

Particulars	values
BS classification	MH
Elastic modulus(kN/mm^2)	22.72
Compressive strength(N/mm^2)	2.57
Maximum dry density(kg/m^3)	1.33
Liquid Limit, LL (%)	72.8
Plastic limit ,PL (%')	35.6
Plasticity index, PI	37.2

Tab -1 Mineralogical composition of Laterite

Constituents	Composition (%)
Ferric dioxide(Fe_2O_3)	29.4
Aluminiumdioxide (Al_2O_3)	24.31
Silica dioxide (SiO_2)	21.55
Phosphorous	16.71
Sulphur trioxide (SO_3)	3.98
Carbon dioxide (CO_2)	3.65
Potassium dioxide (K_2O)	0.11
Sodium dioxide (Na_2O)	0.07

Tab-2 Engineering properties of Laterite Stone.

MIX DESIGN OF CONCRETE:

In this project .we have make M30 grade concrete with partial replacement of laterite stone as coarse aggregate in accordance with IS 10262:2009 the mix proportion is done. Five types of mixes were made for the experimental study. The mixes were done with 0%, 5%, 10%,15% and 20% of partial replacement of laterite stone as coarse aggregate in concrete. All the mixes were prepared in the ratio of 1:1.2:1.8 with 0.4 w/c ratio.

Casting and Testing:

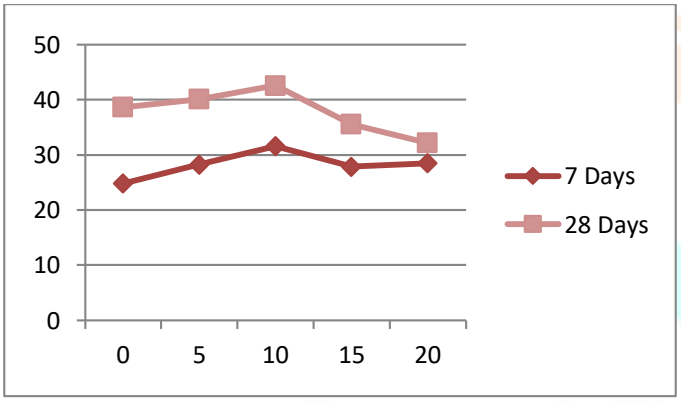
A total of 30 cube specimens with the size of 150X150X150mm were tested for compressive strength of control specimen 0% , 5%,10%,15% and 20% partial replacement of laterite.The specimens were tested at 7

and 28 days after curing in water.A total of 30 cylindrical specimens with the size of 150X300mm were tested for split tensile strength of control specimen, 5%,10%,15% and 20% partial replacement of laterite.The specimens were tested at 7 and 28 days after curing in water.A total of 30 beam specimens with the size of 150X150X 70mm were tested for flexural strength of control specimen, 5%,10%,15% and 20% partial replacement of laterite. The specimens were tested at 7 and 28 days after curing in water.

III. RESULTS AND DISCUSSIONS

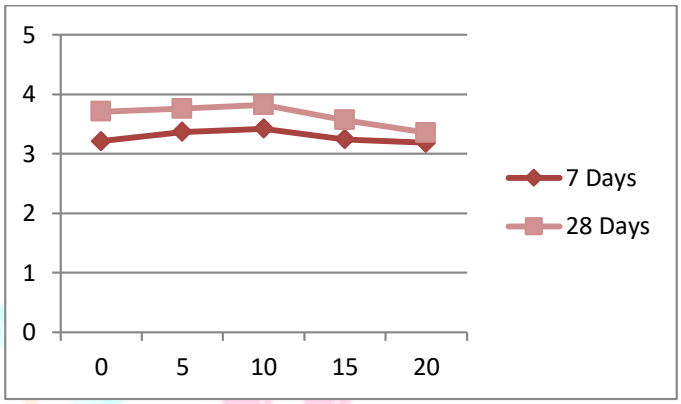
A) Compressive strength

Tests were carried out on each mix based on IS 516-1959 to evaluate the characteristics compressive strength of concrete. From the result the compressive strength of nominal concrete at 7 days and 28 days was 24.80 N/mm^2 and 38.68N/mm^2 respectively. After the replacement of coarse aggregate by 10 % of laterite aggregate the compressive strength was increased to 31.60N/mm^2 and 42.55N/mm^2 for 7 and 28 days respectively. replacement of coarse aggregate by 15 % of laterite aggregate the compressive strength was decreased to 27.86N/mm^2 and 35.56N/mm^2 for 7 and 28 days respectively. This was clearly shows that 10% of laterite aggregate was found to be optimum value.



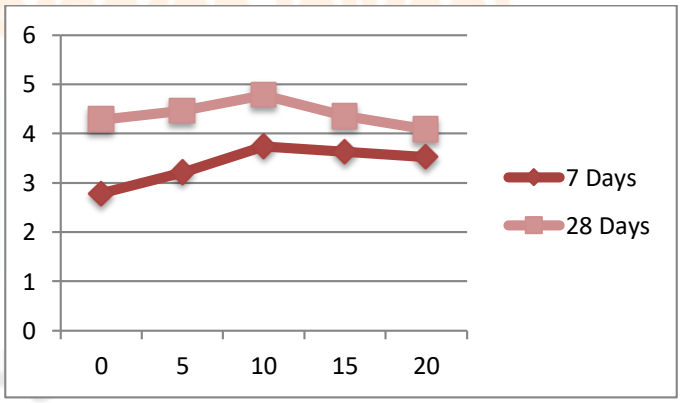
B) Split tensile strength

Tests were carried out on each mix based on IS 516-1959 to evaluate the characteristics Split tensile strength of concrete .From the result the Split tensile strength of nominal concrete at 7 days and 28 days was 3.211N/mm^2 and 3.706N/mm^2 respectively. After the replacement of coarse aggregate by 10 % of laterite aggregate the Split Tensile strength was increased to 3.423N/mm^2 and 3.820N/mm^2 for 7 and 28 days respectively. Replacement of coarse aggregate by 15 % of laterite aggregate the Split Tensile strength was decreased to 3.243N/mm^2 and 3.560N/mm^2 for 7 and 28 days respectively. This clearly shows that 10% of laterite aggregate was found to be optimum value.



C) Flexural strength

Tests were carried out on each mix based on IS 516-1959 to evaluate the characteristics Flexure strength of concrete .From the result the Flexure strength of nominal concrete at 7 days and 28 days was 2.781N/mm^2 and 4.281N/mm^2 respectively. After the replacement of coarse aggregate by 10 % of laterite aggregate the Flexure strength was increased to 3.741N/mm^2 and 4.782N/mm^2 for 7 and 28 days respectively. replacement of coarse aggregate by 15 % of laterite aggregate the Flexure strength was decreased to 3.626N/mm^2 and 4.352N/mm^2 for 7 and 28 days respectively. This clearly shows that 10% of laterite aggregate was found to be optimum value.



IV.CONCLUSION

From the observation indicates that the partial replacement of laterite stone with a coarse aggregate in a concrete. Clearly, denotes that compressive strength increase with partial replacement of laterite by 10%.If we replace more the 10% of laterite stone in a concrete the compressive strength starts decrease due to porosity and texture of laterite. The minimal voids in laterite can be filled by using blended(pozzolanic)cement. The shape and

Size of aggregate greatly influence on concrete strength. The smooth granular laterite aggregate have less compressive strength than rough granite aggregate.

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