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IMPROVING THE STRENGTH OF THE CONCRETE BY REPLACING OF CEMENT WITH FLY ASH AND FINE AGGREGATE WITH LATERITE

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Abstract: In the present scenario, several buildings are being constructed ranging from ordinary residential buildings to sky-scrap structures. Invariably in all the structures, concrete plays a vital role in construction. Generally concrete is a mixture of cement, fine aggregate (River sand), coarse aggregate, water and type of admixtures used depends upon the situations. Now-a day's good sand is extracted and transported from river bed being in a long distance. The extraction of sand has become a serious issue, posing environmental degradation, thereby causing serious threats of flood or diversion of water flow. Never the less the resources are also exhausting very rapidly and economical. To overcome from this crisis, partial replacement of cement with fly ash and fine aggregate with Laterite can be an economic alternative. This project focuses on investigating the characteristics of M60 grade of concrete with cement partially replace with fly ash 0%, 5%, 10%, 15%, 20% and fine aggregate replace with laterite of 20% respectively. The compressive strength of concrete is increases at 10% of fly ash and 20% of laterite replacement.

Keywords: laterite, fly ash, M60.

I. INTRODUCTION

In developing countries, the locally available building materials can be overemphasized because there is a huge imbalance between the demand for construction activities and the shortage of conventional building materials which in turn increases the cost of construction. The demand for concrete is very high due to the rapid growth of infrastructure development in India. Fine aggregate is a primary constituent of concrete. Hence the availability and cost of fine aggregate determine the viability and economy of concrete..

During the hydration of Portland cement, Calcium Silicate Hydrate (C-S-H) and Calcium Hydroxide ($Ca(OH)_2$) are produced. The C-S-H gives strength to concrete whereas $Ca(OH)_2$ in hydrated cement paste gives a negative effect to concrete quality. It is an undesirable material which reduces the strength of concrete. When SCMs are added to the Portland cement concrete, the amorphous silica present in SCMs reacts with more of $Ca(OH)_2$ and converts them into C-S-H. This gives strength and reduces the permeability of

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concrete as well as improves the durability of the concrete. The addition of SCMs enhances the concrete properties due to pozzolanic effect and filler effect. Blending of SCMs in Portland cement concrete enhances the resultant concrete by making it stronger and more durable. Mineral admixtures have been incorporated into binary, ternary and quaternary concrete mixes (Shi et al. 2012). Many researchers prove that these materials improve the properties of blended cement concrete.

II. LITERATURE REVIEW

Rafat Siddique (2003) carried out experimental investigation which deals with concrete incorporating high volumes of class F fly ash. Portland cement was replaced by 40, 45 and 50 percent respectively with class F fly ash. Tests were performed for both fresh and hardened concrete properties. He concludes that the replacement of cement with these percentages of fly ash content reduced the compressive strength, splitting tensile strength, flexural strength and modulus of elasticity of concrete at the age of 28 days, but there was a continuous and significant improvement in strength properties beyond 28 days. The strength of concrete with 40%, 45% and 50% fly ash content, even at 28 days is sufficient enough for use in reinforced cement concrete construction. Abrasion resistance of concrete was strongly influenced by its compressive strength, irrespective of fly ash content. Abrasion resistance was found to increase with the increase in age for all concrete mixtures

Hardjito and Rangan, (2005) devised the study of fly ash – alkaline solution ratio. The research was carried over with fly ash and alkaline solution (NaOH and Na_2SiO_3). The reaction of above said composition performs equally well with OPC concrete. Davidovits (1978) initiated the concept of activated by products to perform substantially well than OPC.

Cho and Jee (2012) have proposed prediction equation of efficiency factors which relates the efficiency to the water binder ratio and replacement percentage of fly ash. Efficiency values have varied from 0.71 to 1.24 at water binder ratio of
0.35 to 0.6 and fly ash replacement of 0 to 70%. It has also been reported that at given fly ash replacement with increase in w/b efficiency increases. As the w/b ratio increases yield of $Ca(OH)_2$ increases.

III. OJECTIVES AND METHODOLOGY

3.1 OBJECTIVES

- Comparative study on the properties of conventional concrete and concrete containing laterite as sand and fly ash as cement partial replacement.
- Study on the workability of conventional concrete and fly ash & laterite - based concrete.
- Determine its mechanical properties such as compressive strength of fly ash & laterite based concrete.

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3.2 METHODOLOGY

- Collect the laterite and sieve with IS Sieve 4.75mm, passed material used as sand replacement in the concrete.
- Collect the fly ash and sieve with IS Sieve 75microns, passed material used as cement replacement in the concrete.
- Physical properties tests on basic materials fly ash, laterite, coarse aggregate, fine aggregate, cement.
- Mix design for M60 and its proportions. Find out the individual proportions for partial replacement of 20% sand with laterite and 5% - 20% cement with fly ash.
- Find out the fresh properties of concrete by slump cone test.
- Prepare the Cubes (150 x 150 x 150 mm)
    - Find out the Harden properties of concrete by Cube Compressive strength **Designed Values of Materials**

S. No	Item name	As per mixed design(kg/m3)
1	Cement	492.9
3	Fine aggregates	611.43
4	Coarse aggregates	1098.74
5	water	197.16

3.3 MIX PROPORTIONS

M60 grade of concrete is considered. Cement is replaced with fly ash with various percentages 0, 5, 10, 15, 20%. Sand is replaced with Laterite by 20%. The mix design for concrete is carried out as per IS 10262-2019. Details of mix proportion for M60 concrete given below:

Mass of ingredients required will be calculated for 9 no's cubes assuming 10% wastage
Volume of the one Cube = 1.1 x $(0.15)^3$ =0.0037125 m^3

Laterite - Fly ash (%)	Cement (kg)	Fly ash (kg)	FA (Kg)	Laterite (kg)	CA (Kg)	Water (Lit)
0 - 0	1.829	0	2.269	0	4.079	0.731
20 - 0	1.829	0	1.8152	0.4538		
20 - 5	1.74	0.09				
20 – 10	1.646	0.183				
20 – 15	1.56	0.27				
20 - 20	1.463	0.366				

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Test for Fresh Properties of Concrete (Workability Test) Slump Test

Which can be employed either in laboratory or at site of work? It is not a suitable method for very wet or very dry concrete. It does not measure all factors contributing to workability, nor is it always representative of the placability of the concrete. It is not a suitable method for very wet or very dry concrete. It does not measure all factor contributing to workability. The slump test was carried in accordance with B.S:1882 PART2:1970.

Harden properties of concrete (Testing) Compressive Strength of Concrete

The compression test was conducted according to IS 516-1959. This test helps us in determining the compressive strength of the concrete cubes. The obtained value of compressive strength can then be used to assess whether the given batch of that concrete cube will meet the required compressive strength requirements or not. For the compression test, the specimen's cubes of 15 cm x 15 cm x 15 cm were prepared by using concrete as explained earlier. These specimens were tested under universal testing machine after 7 days, 14 days and 28 days of curing. Load was applied gradually at the rate of 140kg/cm^2 per minute till the specimens failed. Load at the failure was divided by area of specimen and this gave us the compressive strength of concrete for the given sample.

IV. RESULTS

Fresh properties of concrete (Slump cone test)

Laterite - Fly ash (%)	Slump (mm)
0 - 0	125
20 - 0	129
20 - 5	132
20 – 10	138
20 – 15	141
20 - 20	148

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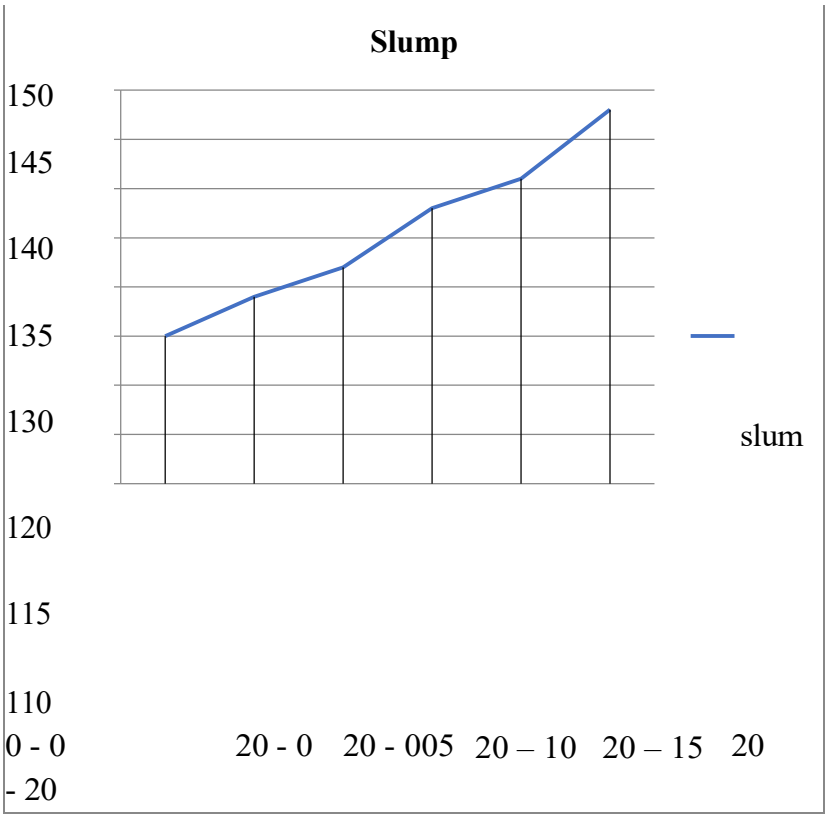

Harden properties of concrete Compressive Strength Test

The compressive strength test was performed on the cubes of size 15 cm x 15 cm x 15 cm to check the compressive strength of laterite and fly ashconcrete and the results obtained are given in Table

Slump values	**7days**	**14days**	**28days**
0 - 0	43.7	52.8	58.9
20 - 0	45	53.4	61.2
20 - 5	46.3	54.7	61.9
20 – 10	**47.5**	**55.2**	**63.4**
20 – 15	46.4	54.5	63
20 - 20	44.8	53.1	62.1

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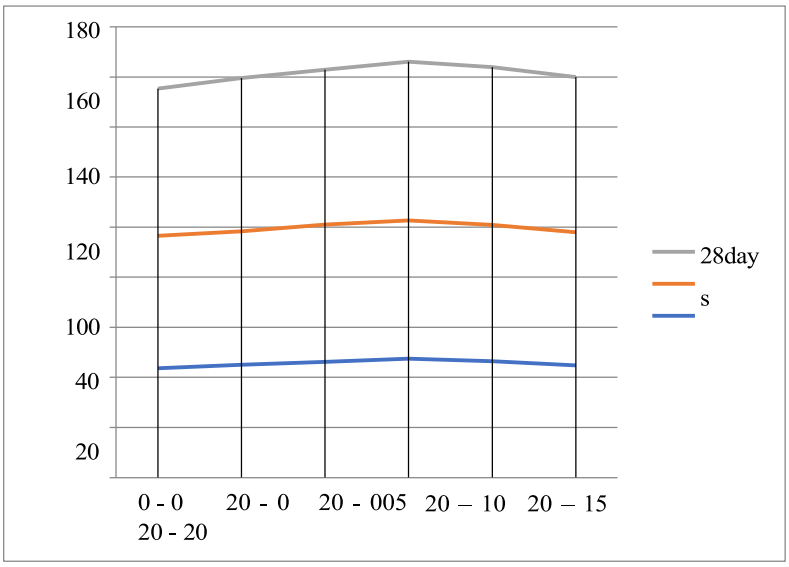

Compressive strength graphs

v. CONCLUSION

In this experimental investigation, the effect of Laterite and fly ash blended in control concrete with respect to compressive behaviour of the concrete cubes have been investigated. The experimental results have been compared with the control mix concrete. The following conclusions are drawn from the present experimental investigation.

- The absence of deleterious and the mineral compositions of laterite reveal the possibility of using the laterite as partial replacement of natural sand.
- Workability increases with increasing in the Laterite and fly ash replacement in the concrete.
- The compressive strength highest gains for 20% Laterite and 10% fly ash as sand and cement replacement in the preparation of concrete
- By replacing Supplementary Cementitious Materials (SCMs) such as fly ash the cost of construction decreases and disposable problem of industrial wastes reduces.
- The maximum strength gained for 20% Laterite and 10% fly ash replacing in the preparation of concrete. The compressive strength increased by 7.2% as compare to the conventional concrete

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