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CREEP AND SHRINKAGE BEHAVIOUR OF HIGH VOLUME FLY ASH MORTAR

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ABSTRACT
The investigation was carried out in fly ash as cement based material to shrinkage reducing agent. The mortar mixes including ordinary Portland cement and high volume fly ash was prepared. The experimental investigation dealing with concrete incorporating high volume fly ash of Class F ash replaced with various percentages.The use of High Volume Fly Ash (HVFA) reduces the shrinkage and also improves the workability and strength. The main objective of using High Volume Fly Ash to reduce the heat generation and to obtain better durability properties and also decrease the porosity and pore size.

Key Words: Fly ash, Shrinkage, Concrete, Strength

INTRODUCTION

The investigation of this study using fly Ash in concrete on creep and shrinkage properties and reported that fly ash results in reduction in shrinkage of concrete and concluded that the shrinkage of fly ash concrete is reduced as the fly ash replacement ratio increased. Fly ash is usually found to improve the workability and contribute to strength development and hence considered to be an effective cementitious component of concrete. It also is widely replacement of cement in concrete. The concrete mixtures made with fly as 60%,70%,80%,90%. The water cementitious material ratio is 0.36.

Shrinkage of concrete is the potential for cracking, either in the plastic or hardened state, and any subsequent adverse impact on concrete durability or serviceability. In most construction situations, particularly pavement, bridge deck, and slab applications, the likelihood of plastic and drying shrinkage is often greater than that of other types of shrinkage, such as thermal contraction, autogenous shrinkage, and carbonation shrinkage. The expansive property of fly ash most probably contributed to the reduction in drying shrinkage. .

LITREATURE REVIEW

Barret et al. (2011), has investigated reducing the risk of cracking in high volume fly ash concrete by using internal curing and result of the discussion the influence of HVFA on mechanical properties of the concrete. In addition of this work has introduced a new test method called the dual ring test which is used to quantify the early-age stress development when the concrete is prevented from internal curing provided sufficient early age strength compared to a typical concrete bridge deck mixture design. Shrinkage and residual tensile stress are reduced in high volume fly ash mixtures with internal curing.

I**smail et al. (2007),** has investigated The sample has been evaluated for its chemical composition by X-ray diffraction (XRD) with graphite monochromator .the sample is taken about 5-8 gm and the sample is scanned from 2q of 0±80°. The test results confirms the presence of chemicals in the sample. The chemical composition of the sample has been obtained with the help an X-ray diffraction (XRD*)*

Mertol et al. (2006), has investigated the shrinkage and creep properties of high strength concrete up to 120 Mpa and the variables considered in this investigation were compressive strength (70-120 Mpa) the creep co-efficients and shrinkage strains were obtained for the range of concrete compressive strength,evaluated and compiled with the current predictions to the design specifications. Research findings indicates that the current specifications could be used to estimate the creep coefficient for moist cured high strength concrete. The current specifications predict the shrinkage behavior very well therefore can be used to estimate the shrinkage strain of moist and heat cured high strength concrete.

METHODLOGY

The methodlogy is framed according to the goal of the project. The methodlogy is started with reviewing the literatures,material study by LOI and XRD analysis, creep and shrinkage value calculated by various mix proportion

MATERIALS INVESTIGATION

1. Cement

The cement used in concrete is Ordinary Portland Cement (OPC). OPC is the most commonly used cement in

construction.OPC is available in 3 grades namely grade 33, grade 43 and grade 53. In this study carried out by OPC 53 grade cement. 53 Grade cement is used when immediate high compression strength is required. Specific gravity of cement is 3.16. Initial and final setting time of cement is 3.5 and 4.5 hr respectively.

2. *Fly ash*

Fly ash is the siliceous material that has the capacity to create cementitious compounds when combined with water. It classified as Class C and Class F. Cement replaced with Class F Fly ash increased compressive strength and also Increase the workability. It can also act as shrinkage reducing agent. The specific gravity of Class F Fly Ash is 2.70.

3. ***Fine aggregate***

Manufactured sand/M Sand is fine aggregate, which is an eco friendly and economical alternative to river sand. It is manufactured by crushing suitable stones and are finely graded to match the IS standard requirements.
The specific gravity of M-Sand is 2.622.

4. Coarse aggregate

Coarse aggregate are the crushed stone, used for making concrete. The maximum size of coarse aggregate used for this investigation is 20mm and the specific gravity is 2.78.

5. Water

Water to be used for mixing and curing of mortar should be free from injurious or deleterious materials as per the standards prescribed in IS 3025: Part (1987). Potable water is generally considered satisfactory. In the present investigation, locally available tap water is used for both mixing and curing purposes.

6. Loss of ignition

Unburned carbon in fly ash can significantly affect its beneficial applications in concrete mixtures. The loss of ignition (LOI) test is generally accepted method for estimating the un burned carbon content of Fly ash. It has been observed that LOI results may over estimating the amount of organic carbon as the ignition mass loss in not only due to burning of organic carbon, but also due to other possible reactions such as calcinations of inorganic carbonates desorption of physically and chemically bound water and oxidation of sulfur and iron minerals. The method was performed with 1.0±0.5g of fly ash as measured with an analytical balance.

The loss of ignition (LOI)% which is traditionally considered as the combustible carbon was obtained as 1.25% . The moisture % is 0.26.

Fig.1 LOI Crusible

Fig.2Muffle Furnaces

7. *XRD ANALYSIS*

X-ray diffraction (XRD) and bulk chemical analysis were also used to better assess changes in composition and mineralogy of ashes during the ignition process. Bulk chemical analysis was performed on digested fly ash sample using lithium metaborate fusion technique. The fly ash which has less than 7% of calcium oxide that should be Class F type of fly ash. The XRD analysis of the ash revealed that hematile, mullite, quartz, gypsm and magnesioferrite were the major minerals in First Energy ash. The good compliance with the bulk chemical analysis of ash as the iron, silicon, and aluminum oxides weight percentages were predominant. From this XRD analysis obtain 2.27% of CaO.The test results for XRD analysis shown in table no.1

Table.1 XRD Analysis Test Result

S.NO	COMPOUND NAME	QUANTITY (%)
1	Silicon Oxide	59
2	Magnesium Oxide	4.0
3	Calcium Oxide	2.0
4	Calcium Sulfate	6.0
5	Calcium aluminum Oxide	1.0
6	Sodium Hydrogen sulfate	11.0
7	Potassium sulfate	5.0

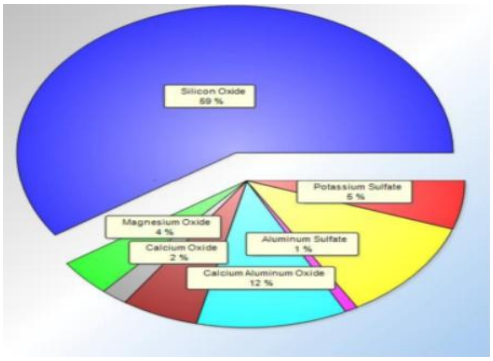

Fig.3 XRD Analysis Image Report

From this image (Fig 3) 2.0% of Calcium Oxide was obtained and the Fly Ash is Class F F.

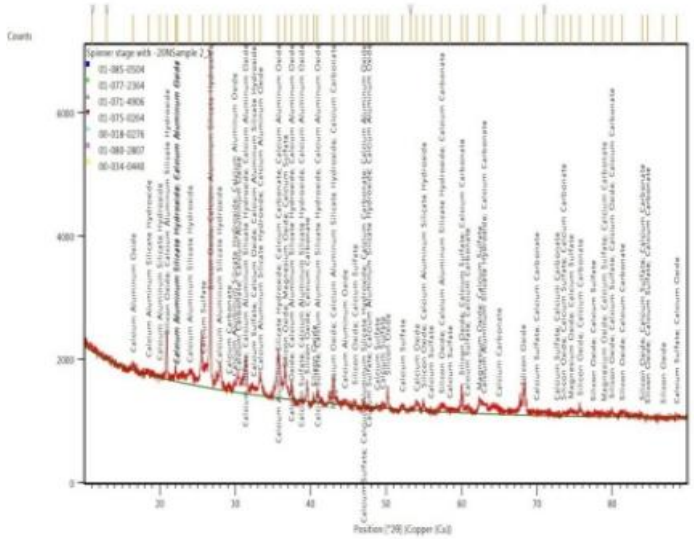

Fig 4XRD Analysis Graphical Report

EXPERIMENTAL PROCEDURE

1. MIX PROPORTION FOR CONCRETE

The mix proportion for the conventional concrete is made for the mix ratio of M40. Mix design is the process of determining the relative proportions of various ingredients of concrete with the object of producing concrete of certain minimum strength and durability as economically as possible.

In this the sample mortar was prepared with mix proportions 60%, 70%, 80%, and 90%. The water cement ratio is 0.36. The size of the mortar is 100mm*100mm*100mm. The mould is fabricated by the material "Poly Ethylene" shown in Fig 5 The grade of cement is M40.

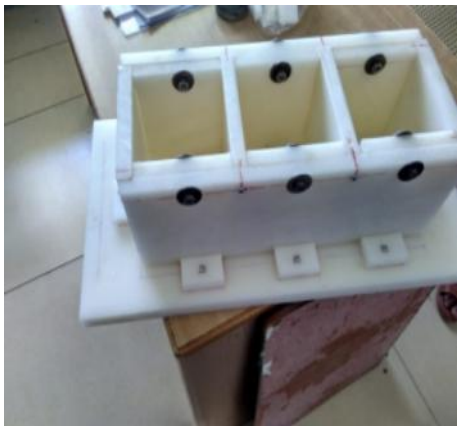

Fig.5 Poly Ethylene Mould

Water Cement Ratio = 0.36

2. VARIOUS MIX PROPORTIONS

The various mix proportions are obtained at different percentage of 60%, 70%,80% and 90%. High Volume Class F Fly Ash is replaced instead of cement to determine the compressive strength value. The material calculations of concrete in various mix proportion has shown in Table 5.3.

3. COMPRESSIVE STRENGTH PROPERTY

The compression test was conducted as per IS 516 – 1959. The specimens (cube) of size 100 mm x 100 mm x 100 mm were kept in oven in 1 day. The load was applied without shock and increased continuously at a rate of approximately 95 kg/sq mm/min until the resistance of the specimen to the increasing load breaks down and no greater load can be sustained. The Fig.6 shows the cube specimen under compressive load

Fig.6 Compressive strength

Formula

Compressive Strength = Load / Area (MPa or /mm^2)

RESULTS AND DISCUSSION

1. COMPRESSIVE STRENGTH RESULT

Compressive strength of concrete mixes made with Fly ash and cement was determined .The specimens (cube) of size 100 mm x 100 mm x 100 mm were kept in oven for 1 day and tested in dry condition and grit present on the surface. The load was applied without shock and increased continuously until the resistance of the specimen to the increasing load breaks down and no greater load can be sustained. The failure pattern of cube specimen is shown in Fig **.7**

Fig .7 Testing and failure pattern of cube

The compressive strength of cube with various mix proportion shown in Table.2

Table.2 Compressive Strength

S.NO	MIX PROPORTION	COMPRESSIVE STRENGTH OBTAINED (N/mm^2)
1	60%Fly ash and 40% Cement	43
2	70% Fly ash and 30% Cement	50
3	80% Fly ash and 20% Cement	65
4	90% Fly ash and 10% Cement	73

CONCLUSION

- From the results of the loss of ignition (LOI)% which is traditionally considered as the combustible carbon was obtained as 1.25% . The moisture % is 0.26.
- From this bulk chemical analysis of Fly ash as the iron, silicon, and aluminum oxides weight percentages were predominant and obtain 2.27% of CaO The result concluded that the Fly Ash is Class F
- The 60%,70% ,80%&90 replacement of fly ash by weight of cement obtained compressive strength.

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