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EXPERIMENTAL INVESTIGATION ON HIGH VOLUME FLY ASH CONCRETE BY INCORPORATING FOUNDRY SAND AS FINE AGGREGATE

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Abstract-*Sand mining is a current problem faced by the construction industry in the present day. Hence there is a need to identify suitable alternatives to natural river sand as fine aggregate in concrete to cater the future demand of fine aggregate. Foundry sand , a waste product obtained from metal foundry be identified as a potential replacement to river sand. The present investigations is focussed on high volume fly ash concrete mixes incorporating foundry as fine aggregate. In this study, the strength and durability properties with partial replacement of cement with fly ash with different levels of replacement (0%, 25%, 50%, 75%, 100%) of river sand with foundry sand are evaluated. The present study will address the disposal related problem of fly ash and foundry sand, thus reducing environmental hazards and also will lead to the conservation of natural fine aggregate for future.*

Key Words: *High volume fly ash, Foundry sand, Strength properties.*

1. INTRODUCTION

In the recent years, the global warming and ecological issues have become major issues. The augmented emissions of CO_2 and other gases from industrial establishments and infrastructure development projects have caused several changes in the climatic conditions. Concrete being the most widely and extensively used building materials for all the construction activities. The use of industrial waste materials for concrete production has become the latest trend in the research and construction industry. Over the years, researchers have identified several industrial wastes such as Ground Granulated Blast Furnace Slag (GGBFS), Fly Ash (FA), silica fume etc. which have been found to provide satisfactory performance in the concrete. The inclusion of such wastes may be done by replacing the cement binder or may be by replacing the natural aggregates. Concrete containing more than 50% fly ash as binder may termed as High Volume Fly Ash Concrete (HVFAC)

The Foundry sand is a waste product from the foundry and moulding industry. These waste by-product are easily used in concrete and also associated with better workability, lower shrinkage etc. available and lesser cost compared to naturally available river sand. The obtained waste by-product can be recycle and reuse many times till it is no longer reused and it is termed as waste foundry sand (WFS). WFS gives better strength properties compared to naturally available sand. The use of WFS as fine aggregates in concrete will provide partial solution to the increased demand of aggregates and also will reduce the cost of disposal of WFS. The present study focuses to evaluate the performance of HVFAC with WFS as fine aggregates. The mechanical properties of HVFAC with WFS are evaluated. Such a type of concrete comes with several advantages especially in India which has huge amount of fly ash production and having crisis of non availability of river sand for construction

2. OBJECTIVE

1) To optimize the mix design for HVFAC containing foundry sand as fine aggregate.

2) To evaluate the mechanical properties such as compressive strength, split tensile strength.

3. LITERATURE REVIEW

3.1 General

The waste materials and various industrial products are utilized in greater quantities. These all materials are of most important concern in the globe. Fly ash foundry sand are the by-product obtained from industries. Since, these materials are very finer which increases the strength of concrete to some extent. The present chapter discusses the various research carried out on high volume fly ash and foundry sand in conventional cement concrete.

3.2 High Volume Fly Ash Concrete (HVFAC)

Aravindkumar.B. Harwalkar, S.S.Awanti (2013), done a study on bonding between high volume fly ash concrete (HVFC) and lean high volume fly ash concrete (LHVFC) under both static and flexural fatigue loading. A amount of 60% low calcium fly ash as a cement replacement used in both pavement and lean concrete. By maintaining constant amplitude and also using non

reversed cyclic loading, composite beams are tested. A M35 grade of concrete is prepared for HVFC and for LHVFC 60% cement replacement is done. The water to cementitious material ratio of 0.30 is maintained. Mix proportions for HVFC and LHVFC is 1:1.95:2.40 and 1:3:5 respectively. Strength properties of all the specimens were tested at 28days. The modulus of elasticity of HVFC and LHVFC were determined by pulse wave velocity technique. Fatigue strength were tested under loading of 4Hz. Nature of failure of fatigue strength was brittle. Fatigue strength of composite section was higher than HVFAC section.

3.3 Foundry Sand

Raffat Siddique et al.,2010, conducted study on concrete design by varying foundry sand as a replacement of fine aggregate (i.e, varying 10% up to 60%). Various test results are carried out at 28, 90, 365 days. The obtained results shown concrete has required strength and durability property. The obtained slump for normal mix is 30mm and for foundry mixes is 40mm. The strength properties in which compressive strength is maximum at 30% foundry sand mixes at 28, 90, and 365 days. Also, it observed at 60% foundry mixes there is sudden reduction of strength. Even the strength of F30, F40, F50 mixes was also higher than control mix, but F30 mix was maximum of all mixes. Split tensile strength was found to increases with the age. The concrete mix in split tensile strength was maximum at F30 mix at 28, 90, and 365 days. The obtained results has enabled foundry sand can be used as construction material.

4. MATERIALS AND METHODOLOGY

4.1 Cement

In this study, ordinary portland cement (OPC) 53 grade cement were used in various concrete mixes. The cement was fresh and without lumps. The testing of cement was done as per IS: 12269-1987.The specific gravity of cement was found to be 3.14

4.2 Fine aggregate

As per IS 383-1970, sand used for experimental program was locally produced and was conforming zone-II. The specific gravity of fine aggregate was found to be 2.64.

4.3 Coarse aggregate

Locally available coarse aggregate having maximum size of 20mm and 10mm were used. The specific gravity was found to be 2.69 and water absorption is 0.5%. Fineness modulus of coarse aggregate was found to be 6.86.

4.4 Fly Ash

The fly ash used in this project were obtained from chandrapur thermal power station(CTPS). The specific gravity of fly ash was found to be 2.22.

4.5 Foundry sand

Foundry sand is procured from local metal industries. The specific gravity was found to be 2.45 and water absorption is 0.8%. Fineness modulus of coarse aggregate was found to be 6.86.

4.6 Admixture

Commercially available conplast SP-430 super plasticizer is used to enhance the workability of fresh concrete.

4.7 Water

Portable tap water was used for the preparation of specimens and for the curing of specimens.

4.8 Mix design

The mix was designed as per IS 10262:2009 for M40 grade. High volume fly ash concrete mixes are prepared by incorporating foundry sand as fine aggregate sand with different percentages (0%, 25%, 50%, 75%, 100%) respectively. The mix proportion is 1:1.29:2.55

4.9 Testing Procedure

The cast specimens are kept for curing till the required period. After the specimen are taken out of the curing tank and is kept for dry till its surface gets wiped off. The mechanical properties such as compressive strength, split tensile strength are tested based on the code requirement.

5. RESULTS AND DISCUSSION

5.1 Compressive Strength

In this study, Compressive strength tests were conducted on size of 150mm X 150mm cube specimens for various different percentages of foundry sand for a curing period of 7, 28, 90 days. The table 5.1 gives the compressive strength for different ages

Table 5.1: Compressive strength of HVFAC

Designation	High volume fly ash (%)	Foundry sand (%)	Compressive strength (Mpa)		
			7 days	28 days	90 Days
F-0	55	0	27.25	47.25	62.66
F-1	55	25	26.51	46.29	59.10
F-2	55	50	24.15	38.81	52.15
F-3	55	75	21.62	36.59	48.15
F-4	55	100	19.11	35.92	45.48

5.2 Split Tensile Strength

The tensile strength were conducted on cylinder specimens of size 150mm X 300mm for HVFAC with various different percentages of foundry sand. The specimens were tested for curing period of 7, 28, 90days. The obtained results were given in table 5.2 for different ages

Table 5.2: Split tensile strength of HVFAC

Designation	High volume fly ash (%)	Foundry sand (%)	Compressive strength (Mpa)		
			7 days	28 days	90 Days
F-0	55	0	2.38	3.37	4.23
F-1	55	25	2.33	3.32	3.99
F-2	55	50	2.17	2.83	3.82
F-3	55	75	2.02	2.80	3.64
F-4	55	100	1.82	2.60	3.40

6. CONCLUSION

The conclusions of the project are as follows:

1. Compressive strength of the HVFAC decreased with increase in percentage of foundry sand.
2. The Compressive strength of HVFAC for different percentage of foundry sand (i.e, 25%, 50%, 75%, 100%) is decreased by 1.05%, 1.19%, 1.29%, 1.36% respectively when compared with HVFAC with foundry sand of 0% replacement at 90 days.
3. Split tensile strength of the HVFAC decreased with increase in percentage of foundry sand.

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