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COMPARISON OF HIGH VOLUME FLY ASH CONCRETE (HVFAC) AND LOW VOLUME FLY ASH CONCRETE (LVFAC) WITH STONE DUST

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ABSTRACT

The replacement of aggregates in concrete matrix with other economical options not only brings down the cost of production but also serve as a mean to achieve more green concrete by reducing waste and making it into a resource. The study analysis the effect of stone dust replacement on the compressive properties of high volume fly ash concrete and low volume fly ash concrete. The high volume fly ash concrete (HVFAC) consisted of 40% of fly ash content by weight of cement while low volume fly ash concrete (LVFAC) consisted of 10% fly ash by weight of cement. The stone dust was used as replacement of natural aggregates by 5%, 10% and 15%. The concrete specimens were tested at 3 days, 7 days and 28 day of curing. The study analysed and compared the results of the concrete tests to determine the increment in the strength of concrete matrix.

KEYWORDS: Aggregates, Concrete, Stone dust, HVFAC, LVFAC

INTRODUCTION

The infusion of fly ash into concrete has been around quite some time now. The addition of fly ash does helps in improving the mechanical properties of concrete owing to its cementitious properties. After the construction boom in India the alternative options for enhancement of concrete properties was undertaken. Fly ash can be used to replacement cement by a small percent only. Fly ash can improve the workability and reduces the heat of hydration in fresh concrete. It can improve the strength, permeability, and resistance to chemical attack of the hardened concrete. [Roohul et. al., Saman et. al.]

However, the bulk of concrete matrix consists of aggregates. Extensive research has been undertaken to analyse the alternative options for natural aggregates to bring down the cost of the concrete production without comprising its quality. The replacement of fine aggregate by stone dust improves considerably the flexural strength of concrete especially at 28 days. Stone dust can be effectively used in partial replacement of fine aggregate in concrete. Reported that replacing 10 % natural aggregate by recycled aggregate without chemical admixtures, the tensile strength has been gradually increased by 5.88% has been reported in literature. [Roohul et. al., Saman et. al.]

MATERIALS

Cement

In the present study, 53 grade Ordinary Portland Cement (OPC) of a single batch was used throughout the investigation. The physical and chemical properties of OPC as determined are given in table 1. The cement satisfies the requirement of IS: 12269-1987.

Fine aggregate: The fine aggregate used was locally available river sand, which was passed

through 4.75 mm. The specific gravity of fine aggregate is 2.74 and fineness modulus is 2.87.

Coarse aggregate: Two aggregate sizes (20 and 10 mm) were used in this investigation. The specific gravity of coarse aggregate was 2.76 for both the fractions. The 20 and 10 mm aggregate were mixed in the ratio of 60:40.

Stone dust: Stone dust was obtained from local stone crushing units of Uttar Pradesh. It was initially dry in condition when collected and was sieved before mixing in concrete. Specific gravity of stone dust was 2.50 and water absorption was 0.5%.

METHODS AND METHODOLOGY

An experimental investigation was conducted on HVFAC to get the strength of specimens (cubes) made with the use of stone dust and recycled aggregates as partial replacement of fine aggregates and coarse aggregates respectively. The strength of conventional concrete and other mixes were determined at the end of 7 and 28 days of water curing. To study the effect of stone dust and recycled aggregates inclusions, cubes of a design mix M25 grade concrete were cast. The 150 mm cubes were tested for compressive strength. The M25 mix proportion was (1:1.56:2.91) at w/c ratio of 0.40.

RESULT AND DISCUSSION

The casted concrete specimen for low volume fly ash and high volume fly ash were tested for compressive strength of concrete. A control specimen with 0% stone dust was also tested to determine the increase in strength owing to infusion of stone dust into concrete mix.

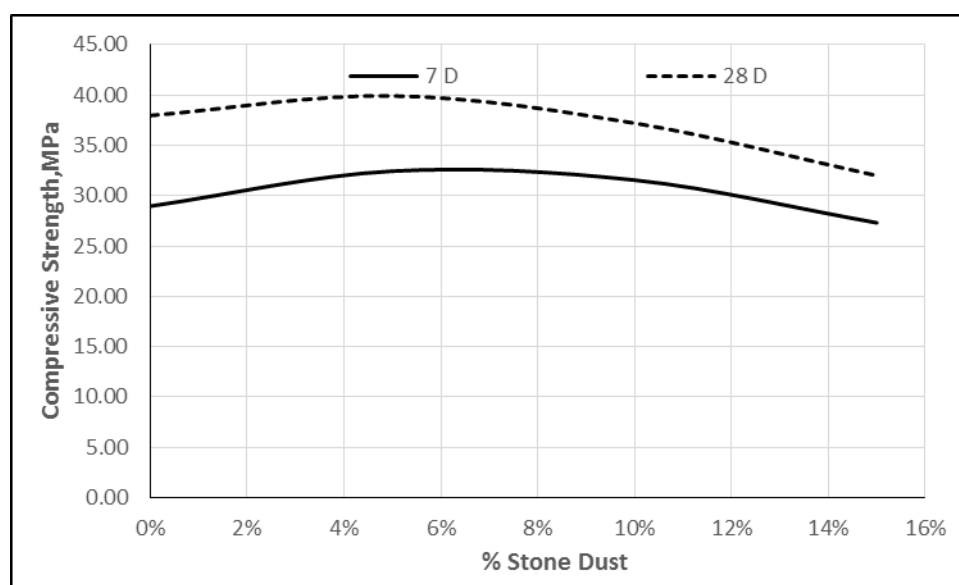


Figure 1 Compressive strength of high volume fly ash concrete

The Figure 1 represents the Compressive strength of high volume fly ash concrete. The concrete specimens were tested at 7 days and 28 days to analyse the rate of gain of strength. At 7 days the rate of gain of strength was 115%, 130 %,

126% and 9% for the design mix of M25 for 0%, 5%, 10% and 15% stone dust respectively. At 28 days the rate of gain of strength was 152%, 159%, 148% and 128% for the design mix of M25 for 0%, 5%, 10% and 15% stone dust respectively.

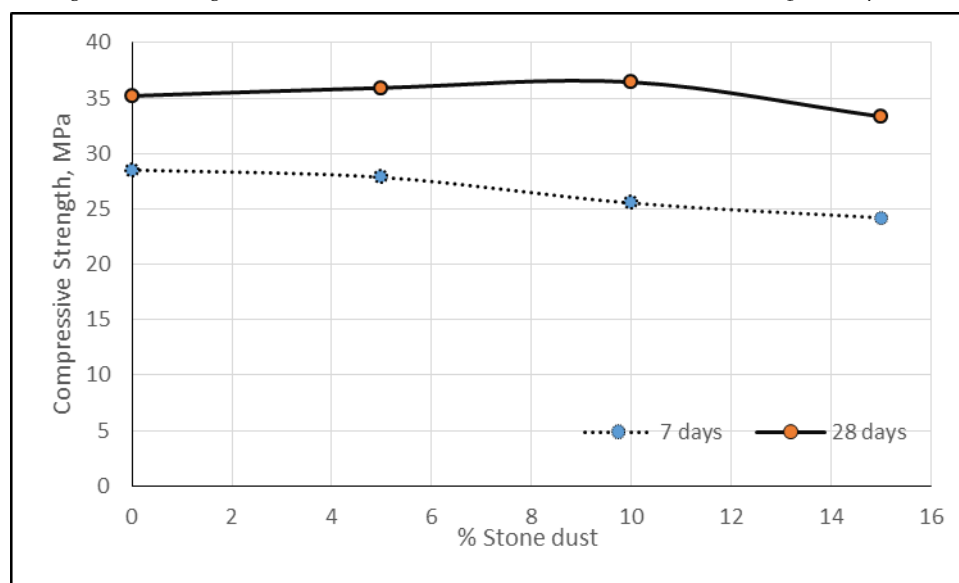


Figure 2 Compressive Strength of Low Volume fly ash concrete

The Figure 2 represents the Compressive strength of low volume fly ash concrete. The concrete specimens were tested at 7 days and 28 days to analyse the rate of gain of strength. At 7 days the rate of gain of strength was 114%, 111% and 96% for the design mix of M25 for 0%, 5%, 10% and 15% stone dust respectively. At 28 days the rate of gain of strength was 140%, 143%, 146% and 133% for the design mix of M25 for 0%, 5%, 10% and 15% stone dust respectively.

CONCLUSION

The rate of gain of strength for low volume fly ash concrete is analysed to conclude that with or without stone dust in both cases the rate is higher. When comparison for stone dust replacement of natural aggregate is considered then the optimum dosage is found to be 5%-10%. Even though the rate of gain of strength is higher than conventional concrete but the increase is lesser than at 0% of stone dust which is the result of 10% of fly ash content.

When the analysis of HVFAC is done it is observed that it also surpasses the rate of gain of strength of conventional concrete. When the optimum dosage is concerned at 7 days the dosage is 5% and 10% but at 28 days the dosage is only 5% as the 0% concrete specimen depicted higher rate of strength gain owing to 40% fly ash content.

On comparing the results for both LVFAC and HVFAC it can be concluded that in both cases the common optimum dosage of stone dust is 5%. At 10% the fly ash contributes more in rate of gain of strength than stone dust at other varied percentages.

Hence the study concludes that the addition of fly ash at low or higher volume will accelerate the rate of gain of strength of concrete. If the stone dust is added by the percent than till 5% the stone dust will enhance the rate of gain of strength more than the fly ash content.

AREA OF FURTHER RESEARCH

Further research can be done to estimate the amount that can be saved by incorporating fly ash in replacement of cement. The analysis can be done for natural aggregates replacement with stone dust and recycled aggregates. And finally more research work is needed to determine the amount of carbon foot print saved by incorporating fly ash and recycled aggregates into the concrete matrix.

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