Compressive Strength behaviour of High Volume Fly Ash Concrete with varying Percent of Stone Dust and Recycled Aggregates

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Abstract— *Disposal of Fly Ash in form of building material is in practice in concrete industry worldwide. The pozzolanic properties of fly ash have resulted in enhancement of concrete properties. Many researches have been carried out utilizing fly ash in varying volume or in partial replacement of cement to serve as binders for concrete matrix. The current study focuses on the compressive strength of concrete by adding fly ash (40%) along with stone dust and recycled aggregate to serve as a more optimum solution for disposal of additional two wastes. The addition of fly ash enhanced the compressive strength and the optimum dosage was found to be 3% for both recycled aggregate and stone dust at the constant fly ash volume of 40%.*

Keywords— Fly Ash, Pozzolanic, Compressive Strength, Recycled Aggregate, Stone Dust

I. Introduction

The thermal power plants and the booming constructing industry worldwide have resulted in the problem of disposal of by-products. The government agencies have taken care of these issues by formulating policies to incorporate these waste in building materials to serve as a resource rather than a waste. Fly ash, Recycled aggregates and Stone dust are such waste which result from thermal power plant, construction industry and stone quarries respectively. The incorporation of these by products in building materials in partial replacement of the materials of concrete matrix not only save the natural resources but also turn the waste into a resource rendering concrete matrix more green and sustainable. [Saman et. al. 1, 2,3 Roohul et al.4,5]

II. Materials

A. 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.

B. 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.

C. 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.

D. 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%.

III. Method and Methodology

An experimental investigation was conducted Study of High Volume Fly Ash Concrete with Recycled Aggregates (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. [Saman et.al, 6, 7 & 8]

IV. Result & Discussion

The casted concrete specimen for high volume fly ash was tested for compressive strength of concrete at 28 days. 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. The ratio of stone dust was varied at the rate of 5%, 10% and 15% for HVFAC is represented in Figure 1 & 5 respectively. The recycled aggregates were varied at the rate of 5%, 10% and 15% along with stone dust for HVFAC and are represented in Figure 2-4.

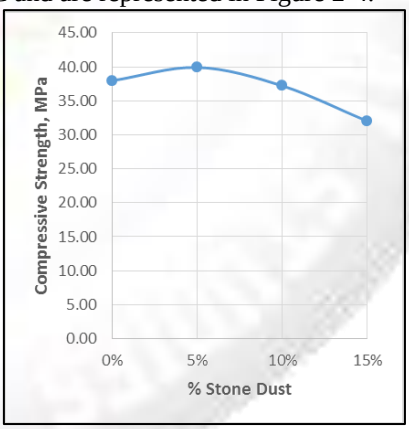

Fig. 1: Compressive strength of concrete at 0% recycled aggregates

The figure 1 represents the compressive strength behaviour of HVFAC in partial replacement with stone dust at 0% recycled aggregate. The compressive strength after 28 days for HVFAC increased to 37.98 MPa and the percentage increase in HVFAC was about 151%.

The Fig. 2 represents the compressive strength behaviour of HVFAC in partial replacement with stone dust at 5% recycled aggregate. The compressive strength after 28 days for HVFAC increased to 37.55 MPa and the percentage increase in HVFAC 150%.

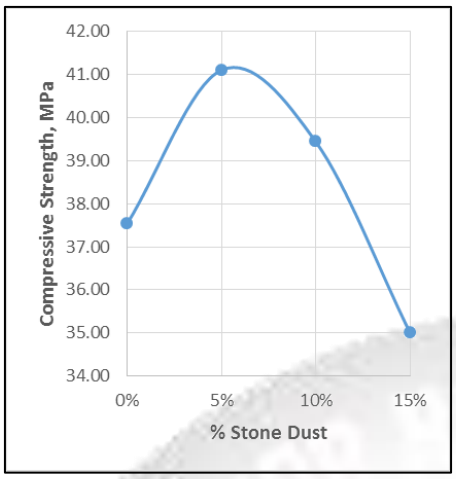

Fig. 2 Compressive strength of concrete at 5% recycled aggregates

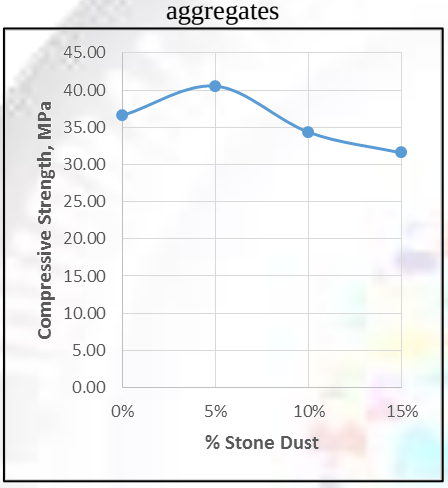

Fig. 3: Compressive strength of concrete at 10% recycled aggregates

The Fig. 3 represents the compressive strength behaviour of HVFAC in partial replacement with stone dust at 10% recycled aggregate. The compressive strength after 28 days for HVFAC increased to 37 MPa and the percentage increase in HVFAC was about 147%.

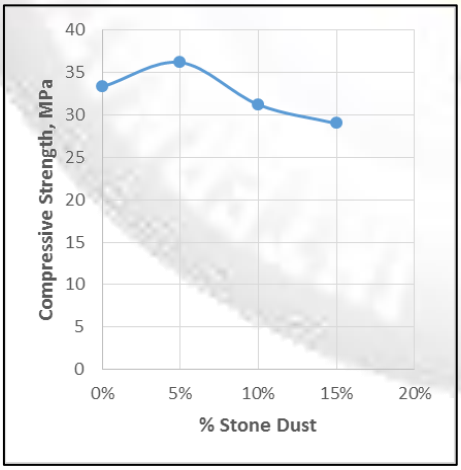

Fig. 4 Compressive strength of concrete at 15% recycled aggregates

The Fig. 4 represents the compressive strength behaviour of HVFAC in partial replacement with stone dust at 15% recycled aggregate. The compressive strength after 28 days for HVFAC increased to 33 MPa and the percentage increase in HVFAC was about 133%.

V. Conclusion

Stone dust was used for partially replacing natural aggregates at the varied rate of 5%, 10% and 15% which resulted in increase of strength for the specimen of HVFAC, the maximum being achieved at 5% of stone dust content i.e. 39.93 MPa.

Recycled Aggregates were used in addition of stone dust for further replacement of natural aggregates at the rate of 5%, 10% and 15%. The maximum strength gain was achieved at 5 % of Stone dust in all the cases for both HVFAC i.e. 41 MPa, 40.55 MPa, 36.21 MPa.

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