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SHORT COMMUNICATION

Optimum Replacement Level of Fine Aggregate with Stone Dust in Concrete with Reference to its Compressive Strength

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Abstract

Naturally occurring aggregates such as coarse aggregate and fine aggregate approved to Indian criteria is becoming scanter and expensive due to its non-availability in time because of commandment of land, illegitimate scouring by sand faction and ease of use to the river cradle during inclement season. This study was investigated to estimate the effect of fractional spare of natural sand with stone dust in concrete. Investigational plan was directed using 0, 20, 30, 40, 50 and 60% partial replacement of fine aggregate with stone dust taken for concrete of M25 grade with 0.48 water cement ratio. Set of cubes and beams were cast for compressive strength and concrete samples were verified after 7 and 28 d damp preserving. From the findings it was noted that 40% addition of fine aggregate with stone dust is adjustable.

Keywords: Coarse aggregate, fine aggregate, concrete, partial replacement, compressive strength.

Introduction

Indian construction industry prefers use of concrete with compressive strength in the range of 20-85 MPa. The properties of concrete are influenced by the properties of the aggregate and water/cement ratio. Additives are those substances added to concrete that do not come under the binding agents and aggregates. The proper use of additives compromises certain beneficial effects to concrete, including improved quality, enhanced frost and sulphate resistance, control of strength development and improved workability (Masood *et al.,* 2002). Aggregate is one of the main ingredients in producing concrete which covers 75% of the total for any concrete mix. Strength of concrete produced depends on the properties of aggregates used (Srivastava and Mishra, 2011). Conventionally concrete is a mixture of cement, sand and aggregate since all the ingredients of concrete are of geological origin, the construction industries are in stress to identify alternative materials to replace the demand of natural sand and aggregate. The key to achieving a strong, durable concrete rests in the careful proportioning, mixing and compacting of the ingredients. Every year 250-400 tons of stone wastes are generated on site. The stone cutting plants are dumping the powder in any nearby pit or vacant spaces, near their unit although notified areas have been marked for dumping. This leads to serious environmental and dust pollution and occupation of a vast area of land, especially after the powder dries up so, it is necessary to dispose the stone waste quickly and use in the construction industry (Patel and Pitroda, 2013; Nagpal *et al.,* 2013). The advantages of utilization of by products or aggregates obtained as waste materials are pronounced in the aspects of reduction in environmental load and waste management cost, reduction of production cost as well as improving the quality of concrete. Considering the above facts in view, the effect of partial replacement of fine aggregate with stone dust on concrete strength under compression was investigated.

Materials and methods

Cement: Portland Pozzolana Cement (PPC) of Ambuja brand attained from single consignments during the investigation was used.

Mix design: The design mix proportion of 1:1.65:3 (where 3 is proportion of 20 mm) and W/C ratio of 0.48 is used for M25 grade of concrete and the amount of cement is 380 kg/m^3.

Fine aggregate: The fine aggregate was locally available river sand which is passed through 4.75 mm sieve. The specific gravity of fine aggregate is 2.9 and fineness modulus of fine aggregate is 2.52.

Coarse aggregate: The coarse aggregate was locally available quarry passed through 20 mm. The specific gravity of coarse aggregate is 2.66.

Stone dust: Stone dust is composed from stone crushing units of Lucknow, Uttar Pradesh. It was originally dehydrated in form when collected.

Experimental design: Investigational plan was directed using 0, 20, 30, 40, 50 and 60% partial replacement of fine aggregate with stone dust has been taken for

concrete of M25 grade with 0.48 water cement ratio. Set of cubes and beams were cast for compressive strength and concrete samples were verified after 7 and 28 d damp preserving.

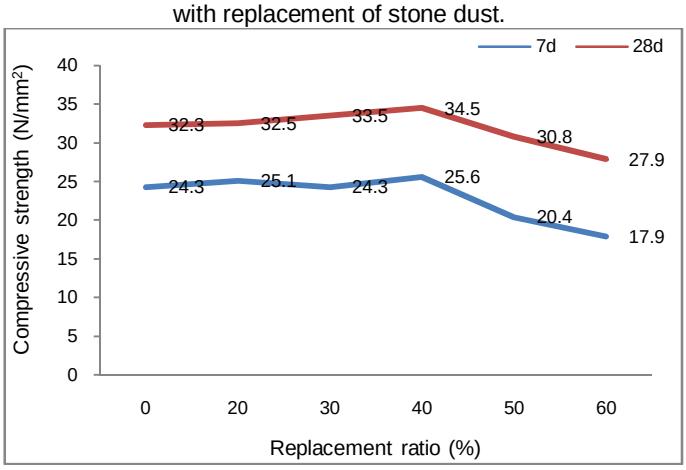
Results and discussion

The result of compressive strength with replacement of stone dust for 7 and 28 d are shown in Table 1 and its graphical representation is shown in Fig. 1. It was observed that at 30% replacement, strength was decreased but at 40% replacement, strength increased and then decreased at each replacement. At 0% replacement, compressive strength is 24.3 N/mm^2 and 32.3 N/mm^2 at 7 and 28 d respectively and at 40% replacement, the compressive strength of stone dust concrete is 25.6 N/mm^2 and 34.5 N/mm^2 at 7 and 28 d respectively. At 60% replacement, the compressive strength of stone dust concrete is 17.9 N/mm^2 and 27.9 N/mm^2 at 7 and 28 d respectively.

Table 1. Compressive strength of samples with replacement of stone dust.

Cube designation	Average compressive strength (N/mm^2)		% replacement of fine aggregate
	7 d	28 d	
A1	24.3	32.3	0
A2	25.1	32.5	20
A3	24.3	33.5	30
A4	25.6	34.5	40
A5	20.4	30.8	50
A6	17.9	27.9	60

Fig. 1. Line chart for compressive strength of samples with replacement of stone dust.



Conclusion

From the above study, replacement of fine aggregate with stone dust does not disturb the compressive strength up to the replacement level of 40%, regardless of the number of days. The replacement of fine aggregate by stone dust enhanced compressive strength significantly at 28 d.

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