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Short Review Paper

Effect of stone dust on strength of concrete

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Abstract

In the presented Research, a fraction of fine aggregate used in concrete is replaced by stone dust, a by-product of stone crushing and the sample cube is tested to determine the compressive strength of concrete. Tests to determine the physical properties of sample cube such as specific gravity, fineness modulus, and moisture content are also performed. Stone dust is best alternative for the fine aggregate because fine aggregate (natural sand) and stone dust has similar physical and mechanical properties. This paper shows some relevant studies regarding the effect of stone dust on mechanical property like compressive strength. Hence in this paper strength and properties of conventional concrete and stone dust concrete are compared so that it will be helpful to other researchers.

Keywords: Compressive strength, Concrete, Natural sand, Mechanical properties, Stone dust.

Introduction

Concrete plays a vital role in construction industries. Concrete is composite material, which is comprised of coarse aggregate, fine aggregate, water and binding material. Fine aggregate is one of the most important materials for preparation of concrete. It is obtained from the river. However due to increased use of concrete in construction work t he demand for fine aggregate is increased, to attain the demand of natural sand in concrete, partial or fully replacement of natural sand with stone dust is one of the effective method. Stone dust is the best alternative for the natural sand, because properties of natural sand and stone dust are similar[1].

In the backdrop of Rapid growth, Construction industries are facing acute shortage of the conventional building material. Naturally occurring sand is being used as fine aggregate in concrete. For the past some year, Due to the environmental concerns and administrative restriction in India cost of sand rose higher and higher. Comparatively, cost of sand is three to four times higher than the stone dust, even in river banks and places where the natural sand is locally and easily available. It is proposed to ascertain the possibility of replacing the sand with locally available alternatives such as stone dust, without compromising quality, strength and workability of concrete[2].

Coarse aggregate is a prime constituent of RCC work of all types. With help of stone crusher large boulders of 100 to 150 mm size is reduced in smaller sizes. Crushed stone is separated by sieve and stone measuring less than 4.75 mm in building construction is termed as stone dust. This stone dust is heaped near the crushing site. The amount of accumulating stone dust increases day by day. Disposal of stone dust becomes major concern of owner of crusher.

Materials

Cement and aggregate: The cement used is Portland Pozzolana cement of 53 grade confining to IS-12269 was used for work. Specific gravity of cement is 2.62, Fineness modulus of cement is 2.9. Coarse aggregates available locally were used. Specific gravity of aggregates is 2.72, Water absorption by the aggregates is 1.30%.

The sieve analysis of 20mm and 10 mm aggregates and fine aggregates locally available from banks of river was used. Specific Gravity of sand is 2.55 Sieve analysis of sand was done and the sand was found to be of zone II as per IS383-1970 [3].

Stone dust: It is an industrial by product. It is a by-product of stone crushing which broken downs into fine aggregates. It is grey in colour and is like fine aggregate. The stone dust was obtained from nearby crushers from Spore.

It causes environmental problems like damping problems. Converting stones into useful by-product stone dust has many benefits like maintenance of ecological balance. Also it is used for different activities in construction industry such as road construction and manufacture of building materials such as light weight aggregates bricks and tiles. It is sieved through 1.18mm IS sieve[4].

Water: Water is one of the most important elements of concrete as it initiates the chemical reaction with cement. It is necessary to check quality of water which is being used. Potable water is used this is to ensures that the water is reasonable free from impurities as suspended solids and organic matter. This water is used for mixing and curing through the experiment.

Literature review

Physical properties like specific gravity, fineness modulus etc. of stone dust and fine aggregate should be comparable in order to use stone dust as a replacement of fine aggregate. Studies shows that optimum replacement of fine aggregate with stone dust gives maximum compressive strength, durability, flexure strength and other mechanical properties.

Manchiryal R.K., Dewangan A. and Gupta D.P. investigated that the physical and chemical properties of stone dust satisfied IS-2386 which could be used as replacement material of fine aggregate. Authors concentrated on cube compressive strength and beam flexure strength in order to give significance to their work. Ordinary Portland cement of 43 grade, Natural River sand with fineness modulus of 2.51 and granite aggregate as a course aggregate were used in the experiments. Quarry dust was obtained from local resource. In the experiments, river sand was 100% replaced by quarry dust and variation in strength was compared. It was concluded that compressive strength from concrete with quarry dust was comparatively 10% -12% more than the conventional concrete. They also concluded that durability under the influence of sulphate and acid attack of quarry dust concrete was higher than conventional concrete. Permeability of concrete decreased due to better relative density of quarry dust than that of conventional concrete[5].

Reddy, M.V. (2010) carried out some experiments using waste product like stone dust and ceramic scrap as partial and full replacement of fine aggregate. He prepared six samples of concrete in which first sample was prepared by replacing 100% fine aggregate by stone dust. Other samples were prepared by replacing 10%, 20%, 30%, 40%, 50% and 100% replacement of coarse aggregate by ceramic scrap. Mix proportion of M25 and water cement ratio of 0.48 was chosen for the investigation. He casted cubes of 150mm size, cylinders of 150*300mm size and prisms of 100*100*500mm. These samples were subjected under experimental test of compressive strength, split tensile strength and modulus of elasticity. From the result of experiment, he concluded that stone dust can be effectively used as replacement of fine aggregate but ceramic scrap should not be replaced more than 20% of coarse aggregate in order to achieve significant structural strength[6].

Patel, A.N. and Pitroda J.K. investigated the strength properties and economic feasibility of concrete, when it was prepared using stone dust as a partially replacement of cement. Portland Pozzolana cement of grade 53 was used for mix design. They prepared mix of M25 using 0.40 water cement ratio. Six samples of concrete were prepared. While controlling the mix design, 10%, 20%, 30%, 40% and 50% of cement is replaced by stone dust. Cube specimens of concrete of size 150*150*150mm was cast and 7days, 14 days and 28 days compressive strength was analyzed. It was found that compressive strength of cubes decreased as the percentage of replacement of cement was increased. On the other hand, the research showed economically feasible as the cost in preparation of cube is reduced by replacing cement by stone dust[7].

Abbas S.Y., Srivastava V. and Agarwal V.C. conducted their research on the mix design of M25 concrete. They carried out their work using PPC cement of grade 43. Stone dust was obtained from local stone crusher mill of Mirzapur, India. Cube sample of size 150mm size was prepared and compressive strength at 7 days and 28 days were obtained. From their research, they have concluded that optimum percent of replacement of fine aggregate by stone dust is 60%. Replacement of 60% of fine aggregate by stone dust gave better strength at 7 days as well as at 28 days. They also specified that increase in strength might be due to change in the composition of matrix of concrete[8].

Syam Prakash V., Krishnan D. and Jeenu G. investigated the effect of stone dust on M60 grade of high strength concrete. They used Ordinary Portland Cement of 53 grade, fine aggregate of zone II and coarse aggregate of less than 20mm size. Superplasticizer was used to mitigate water cement ratio as it was needed for high strength concrete. Standard specimens of cube, cylinder and prism were cast to study different parameters. They studied compressive strength, split tensile strength, flexural strength, acid resistance property, water absorption characteristic, porosity and sorptivity through their experiments. Different samples of conventional concrete and stone dust concrete were prepared and tested. It was concluded that strengthen properties like compressive strength and tensile strength increased when stone dust was replaced by more than 60%[9].

Bhiksham V., Kishore R. and Raju N.H.M. worked on concrete of M40 grade. They prepared standard cubes and under reinforced concrete beams of size 150*230*1500mm for their experiments. The essential parameters for their study area were compressive strength, ultimate load carrying capacity, moment carrying capacity and deflection of RCB (Reinforced Concrete Beam). In their experiments, authors used OPC of 53 grade, stone dust and superplasticizer to reduce w/c ratio. Cubes and under reinforced beams were casted by replacing fine aggregate 25%, 50%, 75% and 100% by stone dust and test have conducted for their relevant parameters. They concluded from the experiments that replacement of sand by stone dust improved the strength of concrete by 20%. It also decreased total deflection of beam. From the economical point of view, concrete preparation became cheaper by eight percent[3].

Conclusion

This literature shows that many researchers have conducted many experiments on stone dust as a replacement material for fine aggregate. All the researches shows the definite effect on the property of concrete. Following significant points can be concluded form their study: i. Concrete shows higher compressive strength after replacing fine aggregate by stone

dust. So stone dust can be used as an additive in concrete preparation. ii. Workability of concrete increases with the use of stone dust. iii. Stone dust can be used as an alternate material of fine aggregate both in lean concrete as well as in high strength concrete.

It is reported in this paper that stone dust increases the strengthen properties of concrete. However other parameters like temperature, humidity, climate conditions, air-entrapped etc. also effects the same.

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