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Viability of Sand Alternatives

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Abstract An average 800 kg of sand is required for 1 cubic meter of concrete, and further assuming that capacity of one truck is 5 tons, we can conclude that India needs approximately 14 crore truckloads of sand each year. The dredging of natural sands has already affected the environment and ecology of many regions of the country. This consequently necessitates a paradigm shift in concrete making practices, calling for the development of manufactured sand as an alternative to natural sand. This paper depicts the results for an experimental study to replace the natural sand with brick powder and quarry dust. Compressive strength and workability of 8 mixes each of M30 and M40 were found out for replacements of fine aggregate by 10-70% of brick powder and quarry dust respectively.

Keywords Sand, brick powder, quarry dust, compressive strength, workability

1. INTRODUCTION

Cement, sand and aggregate are essential needs for any construction industry. Sand is a major material used for preparation of mortar and concrete and plays an important role in mix design. India produces roughly 260 million tons of cement per year. This quantity of cement is being used for the production of concrete and mortar. Assuming that on average 300 kg of cement is needed to produce 1 cum of concrete/ mortar, then calculating appropriately, we can conclude that India produces 90 crore cubic meters of concrete and mortar. Assuming that on an average 800 kg of sand is required for 1 cubic meter of concrete, and further assuming that capacity of one truck is 5 tons, we can conclude that India needs approximately 14 crore truck loads of sand each year. Clearly, we demand for sand will increase progressively with each year.

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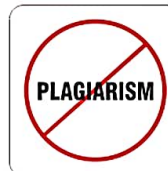
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Viability of Sand Alternatives

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I. INTRODUCTION

Cement, sand and aggregate are essential needs for any construction industry. Sand is a major material used for preparation of mortar and concrete and plays an important role in mix design. India produces roughly 260 million tons of cement per year. This quantity of cement is being used for the production of concrete and mortar. Assuming that on average 300 kg of cement is needed to produce 1 cum of concrete/ mortar, then calculating appropriately, we can conclude that India produces 90 crore cubic meters of concrete and mortar. Assuming that on an average 800 kg of sand is required for 1 cubic meter of concrete, and further assuming that capacity of one truck is 5 tons, we can conclude that India needs approximately 14 crore truck loads of sand each year. Clearly, we demand for sand will increase progressively with each year.

The collection of 14 crore truckloads of sand every year from river beds, stratum beds, and pits creates tremendous environmental problems, such as meandering of watercourse, denudation of river banks, and interference with the natural flow pattern of rivers and streams. The dredging of natural sands has already affected the environment and ecology of many regions of the country. This consequently necessitates a paradigm shift in concrete making practices, calling for the development of manufactured sand as an alternative to natural sand.

In general consumption of natural sand is high, due to the large use of concrete and mortar. Hence the demand of natural sand is very high in developing countries to satisfy the rapid infrastructure growth. A developing country like India faces shortage of good quality natural sand and in particular, natural sand deposits are being used up and causing serious threat to environment as well as the society. Rapid extraction of sand from river bed causes so many problems like loss of

water retaining soil strata, deepening of the river beds, bank slides, loss of vegetation on the bank of rivers, disturbance of the aquatic life as well as disturbance to agriculture due to lowering of the water table in the well etc. are some of the examples. The heavy-exploitation of river sand for construction purposes in India has led to various harmful problems.

II. LITERATURE REVIEW

Tikalsky, Smith and Ray (1998) to evaluate the potential of using spent foundry or casting sand as a constituent controlled low-strength material (CLSM). The physical characteristics of spent casting sand or foundry sand are similar to those characteristics of fine aggregate used in high quality CL SM. This study developed different mixture proportions for CLSM containing spent casting sand that had strengths between 300 to 800 kPa at 7-days and sufficient flowing characteristics to be self-compacting and self-leveling. Each mixture was tested for strength, water demand, rate of strength development and fluidity. The results show that the spent casting sands provide high quality material for CLSM. The spent chemically-bonded casting sands are excellent replacements for portions of the fine aggregate, while clay-bonded casting sands must be more carefully proportioned and tested to prevent fluidity problems.

Tiwari and Patel (2012), studied that concrete is the most indisputable and indispensable material being used in infrastructure development throughout the world. Umpteen varieties of concretes were researched in several laboratories and brought to the field to suit the specific needs. Although, natural fine aggregates (i.e. river sand) are so far and/or will be superior to any other material in making concrete but their availability is continuously being depleted due to the intentional overexploitation throughout the globe due to rapid urbanization and construction of other amenities. Hence, partial replacement of fine aggregate by the other compatible

material like sintered fly ash, crushed rock dust, quarry dust, glass powder, recycled concrete dust and others are being researched from the past two decades, in view of conserving the ecological balance. In this direction, an experiment investigation of strength and durability was undertaken to use "Spent Fire Bricks" (SFB) (i.e. waste material from foundry bed and walls; and lining of chimney which is adopted in many industries) and

Appukutty, Murugesan (2009) substitution of crusher dust for sand in cement mortar for brick masonry is experimented with brick masonry prisms cast in different ratios of 1:8, 1:6, 1:5 and 1:4. Bricks with basic compressive strength above 3.5 N/MM² and 7.5 N/MM² were used to cast brick masonry