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Replacement of River Sand by M Sand Concrete

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Abstract:- **Manufactured sand is a term used for aggregate material s less than 4.75mm and which are processed for from crushed rock or gravel. due to booming of construction activities in our country, natural sand resources are increasingly depleted and its cost is becoming increasingly high. This project was,therefore, conducted to study the influence that manufactured sand have in compressive strength, split tensile strength of concrete and to assess the prospects of using manufactured sand as fully replacement of natural sand. Fully manufactured sand samples to be used in the concrete mixes were collected and their physical properties were studied. By using M20 and M25 concrete grade for both natural and manufactured and were prepared for normal strength concrete using a water cement ratio and cement contents. The results of the hardened properties of the mixes have shown that concrete mixes with fully proportions of manufactured and natural sand achieved a higher compressive strength and split tensile strength at all test ages. It can therefore, be concluded from the finding of this project that when the availability of natural sand is scarce or in cities where the price of natural sand is as expensive as manufactured one, manufactured sand concrete mix is a viable and better alternative to the use of natural sand.**

Keyword: Aggregate, compressive strength, split tensile strength concrete, cost, manufactured sand, workability.

CHAPTER 1 INTRODUCTION

1.1 GENERAL

Sand is used as fine aggregate in concrete. Natural river sand is the most preferred choice as a fine aggregate material. River sand is a product of natural weathering of rocks over a period of millions of years. It is mined from the river beds and sand mining has disastrous environmental consequences. River sand is becoming a scarce commodity and hence exploring alternatives to it has become imminent. Rock crushed to the required grain size distribution is termed as manufactured sand (M- sand). In order to arrive at the required grain size distribution the coarser stone aggregates are crushed in a special rock crusher and some of the crushed material is washed to remove fines. This investigation is an attempt to evaluate the characteristics of concrete using M-sand as fine aggregate. For the purposes of comparison characteristics of concrete with river sand has also been explored.

1.1.1CEMENT

In the most general sense of the word, a cement is a binder, a substance that sets and hardens independently, and can bind other materials together. The word "cement" traces to the Romans, who used the term opus caementicium to describe masonry resembling modern concrete that was made from crushed rock with burnt lime as binder. The volcanic ash and pulverized brick additives that were added to the burnt lime

TYPES OF CEMENT

The division of cements into different types is necessarily no more than a broad functional classification, and there may sometimes be wide differences between cements of nominally the same type.

- Ordinary Portland cement
- Portland Pozzolana cement

1.1.2 AGGREGATES

Fine and coarse aggregates make up the bulk of a concrete mixture. Sand, natural gravel and crushed stone are used mainly for this purpose. Recycled aggregates (from construction, demolition and excavation waste) are increasingly used as partial replacements of natural aggregates, while a number of manufactured aggregates, including air-cooled blast furnace slag and bottom a share also permitted.

1.1.2.2 CLASSIFICATION OF AGGREGATES

The alternative used in the manufacture of good quality concrete, is to obtain the aggregate in at least two size groups, i.e.:

1) The size of aggregate bigger than 4.75 mm is considered as coarse aggregate
2) Aggregate whose size is 4.75mm and less is considered as fine aggregate

1.1.3 WATER

Water is a key ingredient in the manufacture of concrete. Water used in concrete mixes has two functions: the first is to react chemically with the cement, which will finally set and harden, and the second function is to lubricate all other materials and make the concrete workable. Although it is an important ingredient of concrete, it has little to do with the quality of concrete. One of the most common causes of poor-quality concrete is the use of too much mixing water.

Fundamentally “the strength of concrete is governed by the nature of the weight of water to the weight of cement in a mix, compacted, and adequately cured”. It has been said that there is much more bad concrete made through using too much good quality water than there is using the right amount of poor-quality water.

1.1.4 CONCRETE MIX SELECTION

MIX DESIGN

Mix design is a process that consists of two interrelated steps:

1) Selection of the suitable ingredients (cement, aggregate, water and admixtures) of concrete.

2) Determining their relative quantities (proportioning) to produce, as economically as possible, concrete of the appropriate workability, strength and durability.

FACTORS GOVERNING CONCRETE MIX SELECTION:

If the designed quality of concrete cannot be achieved it may result in consequences like wastage of material, production of substandard structures, etc. The highest possible strength concrete will seldom be required so that the concrete producer shall select a concrete mix that ful fills all specified requirements. The basic factors in determining the proportions of the concrete mix are discussed as follows.

A) STRENGTH

Strength is one of the important properties of concrete as it influences many other desire able properties of hardened concrete. aim at a mean strength higher than a minimum.

B) DURABILITY

Every concrete structure should continue to perform its intended functions that is maintained its required strength and serviceability, during the specified or traditionally expected service life.

C) WATER CEMENT RATIO

The type of cementitious material used greatly affects the penetrability of the resulting concrete. Strength, type of cement and durability determine between them the water cement ratio required - one of the essential quantities in the calculation of mixes proportions.

D) ECONOMY

The cost of concrete is made up of the costs of materials, labour and equipment. However except for some special concrete, the costs of labour and equipment are largely independent of the type and quality of concrete produced.

E) WORKABILITY

Selection of mix proportions, which do not permit the achievement of appropriate workability, totally defeats the purpose of rational mix proportioning. The workability that is considered desirable depends on two factors:

(F) MAXIMUM SIZE OF AGGREGATES

In reinforced concrete, the width of the section and the spacing of the reinforcement govern the maximum size of aggregate, which can be used. governed by the availability of materials and by their cost.

(G) GRADING AND TYPE OF AGGREGATE

The coarser the grading the leaner the mix which can be used, but this is true with in certain limits only because a very lean mix will not be cohesive without a sufficient amount of fine material.

(H) CEMENT CONTENT

The choice of the cement content is made either on the basis of experience or alternatively from charts and tables prepared from comprehensive laboratory tests.

(I) QUALITY CONTROL

Quality control is meant the control of variation in the properties of the mix ingredients and also control of accuracy of all those operations, which affect the strength, or consistency of concrete: batching, mixing, transporting, placing, curing and testing.

(J) AIR VOIDS AND COMPACTION

The presence of voids in concrete greatly reduces its strength. Voids in concrete are either bubbles of entrapped air or spaces left after excess water has been removed.

1.1.5 WORKABILITY

Workability is generally defined interms of the amount of mechanical work, or energy, required to produce full compaction of the concrete without segregation, since the final strength of the concrete is in large part a function of the amount of compaction .

1.2 MANUFACTURED SAND

1.2.1 General

1.2.1PROPERTIES OF MANUFACTURED SAND

GREATER DURABILITY

M-Sand has balanced physical and chemical properties that can withstand any aggressive environmental and climatic conditions as it has enhanced durability, greater strength and overall economy. Usage of M-Sand can overcome the defects occurring in concrete such as honey combing, segregation, voids, capillary etc.

HIGH STRENGTH

The superior shape, proper gradation of fines, smooth surface texture and consistency in production parameter of chemically stable sands provides greater durability and higher strength to concrete by overcoming deficiencies like segregation, bleeding, honey combing, voids and capillary.

GREATER WORKABILITY

The crusher dust is flaky and angular in shape which is troublesome in working. There is no plasticity in the mortar which makes it even difficult for the mason to work, whereas the cubical shape with grounded edge and superior gradation gives good plasticity to mortar providing excellent workability.

OFFSETS CONSTRUCTION DEFECTS

M-Sand has optimum initial and final setting time as well as excellent fineness which will help to overcome the deficiencies of concrete such as segregation, bleeding, honeycombing, voids and capillary.

ECONOMY

Usage of M-Sand can drastically reduce the cost since like river sand, it does not contain impurities and wastage is NIL. In International Construction Scenario, no river sand is used at all, only sand is manufactured and used, which gives superior strength and its cubical shape ensures significant reduction in the cement used in the concrete.

ECO-FRIENDLY

M-Sand is the alternative to river sand. Dredging of river beds to get river sand will lead to environmental disaster like ground water depletion, water scarcity, threat to the safety of bridges, dams etc.

Beside with the Government contemplating ban on dredging of River beds to quarry river sand, as part of the growing concern for environment protection, MSand will be the only available option.

Sl No	Property	River sand	Manufactured sand	Remarks
1	Shape	Spherical particle	Cubical particle	Good
2	Gradation	Cannot be controlled	Can controlled be	

ENVIRONMENTAL CHALLENGES

a) sustainability in production, characterized by inferior mass balance. (i.e. A high percentage of e.g. surplus fines to be deposited) and a high energy consumption needed per ton of aggregate produced. This case might not fully apply in our country case.

a) The potential environmental or health impact of the very materials produced, due to e.g. leaching of heavy metals, radioactivity and to special minerals suspected to have hazardous health properties.

1.2.6 FACTORS AFFECTING CONCRETE STRENGTH

There are many factors that can affect the strength of concrete. Some of the more important follow:

CONCRETE POROSITY

Voids in concrete can be filled with air or with water. Air voids are an obvious and easily visible example of pores in concrete. Broadly speaking, the less porous the concrete , the stronger it will be as measured by compressive strength. Probably the most important source of porosity in concrete is the ratio of water to cement in the mix, known as the „water to cement" ratio.

2.3 METHODOLOGY

The following methodology has been employed to achieve the objectives of the research

LITERATURE REVIEW

A comprehensive literature review is made to understand the previous efforts, which include the review of textbooks, periodicals and academic journals, seminar, conference and research papers.

MAIN PROJECT

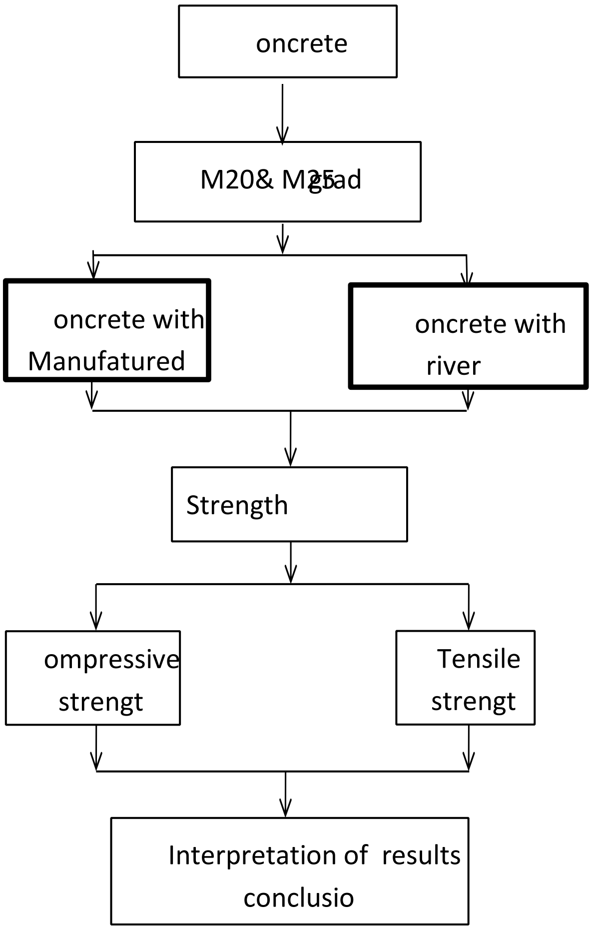
The methods followed to achieve the objectives are:

- Assessment is made on the existing standard methods and test results of concrete produced using manufactured sand.
- tests were conducted using river sand, manufactured sand and a combination of both with equal amounts of cement, coarse aggregate and water and with variable amounts of admixtures.
- a cost comparison of concrete produced using full replacement of the natural sand with manufactured sand was made.
- the results were presented in graphical form and interpretation and discussion were made on the project findings.
- based on the findings conclusions are drawn and recommendations are forwarded.

CHAPTER 3
LITERATURE REVIEW

18.8% greater compressive strength than conventional concrete when compared to 2.5 % and 1.5% of the silica fume. Average increase in compressive strength of concrete was found to be 11%, 12%, 18.8% and 5% for partial replacement of natural sand by M-Sand with 10 %, 30 %, 50% and 70%. Th.

Grade	Mixing Proportion (IS 456-2000)	w/c Ratio	Wt.of aggregate Kg	Wt.of cement Kg	Wt. of sand Kg
M25	1:1:2	0.35	5.24	2.62	2.62
M20	1:1.5:3	0.5	4.9	1.67	2.45



Investigations on flexural behavior of high strength manufactured sand concrete by V. Bhikshma, R. Kishore & C.V. Raghu Pathi resulted that the Compressive strength of concrete using manufactured sand as fine aggregate New Generation Admixture for Improvement of Concrete with Manufactured Sands' by Corrigan, B., D'Sourza, B. Dumitru resulted that, there are two major aspects that should be considered in the characterisation of manufactured sands Guide to Concrete Construction, Cement and Concrete Association of Australis.
Concrete Workability with High Fines Content San The Effect of Admixtures in Concrete Containing Manufactured Sand" University of Southern Queensland by Mark James.

4.2.4 MANUFACTURED SAND

M-Sand was used as fully replacement of fine aggregate. It was collected from Karur, Tamil Nadu, India. The physical properties of fine aggregates are also shown in Tables 3.5 below.

TABLE 3.5 PHYSICAL PROPERTIES OF FINE AGGREGATE.

Mix proportion	W/C ratio	Slump (mm)	
		River sand in concrete	M- sand in concrete
M25 1:1:2	0.35	90	65

4.3 MIX PROPORTIONS

In order to analyze the effects of manufactured sand and natural sand Fully replacement of manufactured sand and Natural sand samples to be used in the concrete mixes .

4.4 PREPARATION OF SPECIMENS AND MIXING PROCEDURE

The specimen of standard cube of (150mm x 150mm x 150mm) and standard Cylinder of (100mm x100mm x 300mm) were used to determine the compressive strength \
TABE3.6: MIX PROPORTIONS

CHAPTER 5
TEST RESULTS AND DISCUSSION

5.1 GENERAL

It was stated above that the main objectives of the laboratory test specimens were to:

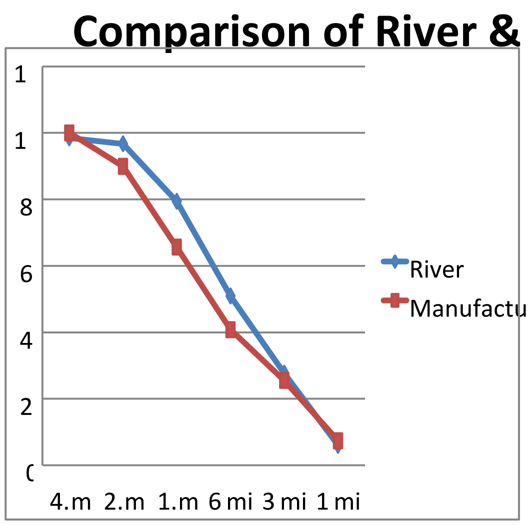
- determine if a suitable workability and strength can be achieved in concrete containing manufactured sand as a complete replacement for natural sand.
- determine what percentage of superplasticizer is required to achieve a suitable workability for concrete with or without manufactured sand.
- determine the rate of strength gain for the concrete with and without manufactured sand.
- In the following sections, the test results are presented and evaluated in light of the requirements of concrete strength and workability.

5.2 TEST RESULTS

5.2.1 SIEVE ANALYSIS

The results of sieve analysis, as expected, have shown that manufactured sand has larger amount of fine materials than the natural sand. The grading of the natural and manufactured sand is dissimilar requiring different aggregate blending. The results of all sieve analysis for all aggregate samples used in the concrete mix .

FIG 4.1: SIEVE ANALYSIS: COMPARISON OF RIVER & MANUFACTURED SAND



5.2.1 FRESH CONCRETE PROPERTIES
WORKABILITY

This was measured by conducting a slump test. Keeping the water- cement ratio at 0.35 and 0.50 and using super plasticizer (at 15ml per kg of cement) the slump values were determined for both M20 and M25 mixes using river sand and M-sand as fine aggregate.

FIG: 2 SLUMP TEST

5.2.2HARDENED CONCRETE PROPERTIES
COMPRESSIVE STRENGTH

The compressive strength of the concrete was determined by testing concrete cube 150x150x150mm,these cube were tested in accordance with Is 45620.

The compressive strength of the concrete is determined from the following formulae **f =P/A** Where:

f Is the compressive strength of the concrete; *P* Is the maximum force measured during testing; *A* Is the area of the cylinder being tested.