

# Experimental Study on Concrete by using Manufactured Sand – A General Review

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**Abstract:** *This review paper gives an idea about the various studies on concrete by replacing the natural river sand into varying percentages of manufactured sand. Nowadays due to the environmental considerations and scarcity of natural river sand, we have to find out the suitable alternate material similar to those properties. Various research works have been going on for finding the suitable material, from that one such material is Manufactured Sand. Due to the high angularity of manufactured sand particles, higher water-cement ratio is required for maintaining the workability as compared to the natural river sand concrete. Concrete properties discussed in this paper are mechanical properties, workability and durability. Finally, conclusion has been made by quoting suitable percentage replacement of manufactured sand is feasible in concrete making process.*

**Keywords:** *Manufactured Sand, Mechanical Properties, River sand.*

## I. INTRODUCTION

Concrete is the most extensively used building construction material consists of cement, aggregates, water and admixtures. In fact, aggregates play a major role in concrete and they furnish bulk to the concrete, diminish shrinkage and effect financial system. Generally, 60 - 75% of the total volume of concrete is occupied by aggregates, which has two distinct categories- fine aggregate and coarse aggregate. Fine aggregate is the naturally occurring granular material consists of mineral particles and finely divided rock particles. Nowadays, because of the growth of building constructions and depletion of resources there is a huge demand for natural available sand material. Now need of the hour is partial or full replacement of fine aggregate with well processed manufactured sand as long term solution in current construction industry. As per IS 383:1970 clause 2, shape characteristics of fine aggregate using need to be studied and concrete properties such as shrinkage, creep, modulus of elasticity are to be studied. As analogous to the natural process of river sand, M-Sand is made by feeding varying size hard stones into primary and secondary crushers and also it is well graded in the required proportion. Manufactured sand is a replacement for naturally available river sand and is shaped by hard granite stone by crushing. Because of its low

impurity and consistent grading, manufactured sand is mostly used in all over the world [1]. The Manufacture sand properties augment the concrete to accept tremendous environmental circumstances and preventing the reinforcement deterioration by dropping moisture ingress, permeability and enhancing the durability of concrete structures [2]. Priyanka et al. (2012) studied the strength properties of concrete by varying water cement ratio along with varying the percentage replacement of manufactured sand with river sand [3]. Suresh et al. (2016) conducted an experiment on high strength concrete by replacing the natural sand by manufactured sand and concluded that concrete exhibits good strength [4]. Manufactured sand usage significantly reduces the cost of construction and it does not include impurities and wastages because it is prepared with modern machinery and technology. And also its usage overcome concrete defects such as segregation, honey combing, voids, etc [7]. Manufactured sand is selected based on the test related physical properties such as specific gravity, fineness and bulk density. The specific gravity of manufactured sand which is 2.61 is comparable to the natural river sand which is 2.47 and manufactured sand bulk density is somewhat superior to the natural river sand. With respect to the sieve analysis, natural river sand is finer than the manufactured sand but both the materials falls under the same category of zone II. [11]. Nowadays vastu shashtra is followed in all the construction activities. According to vastu, construction material should be free from the traces of human or animal body. The most feasible solution for this is usage of manufactured sand in construction activities [9]. The main objective of this review paper is to inculcate the usage of manufactured sand instead of natural river sand in the construction activities with evidence of appropriate strength obtained in concrete by quoting the varying research works.

## II. EXPERIMENTAL INVESTIGATION

### A. Natural Sand vs. Manufactured Sand

Natural river sand is obtained from the rocks in various weathering conditions and it is available in the riverbanks. Tremendous growth in the infrastructure and depletion of natural source of river sand seeks the vision in the direction of alternate product called Manufactured Sand [8]. Manufactured sand is obtained from crushing of hard granite stones. The crushed sand particles are washed and also by attrition process to make them appropriate to naturally available river sand surface texture. The flexural and compressive strength of the concrete had improved through better bonding by using the properly processed manufactured sand [4].

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Better quality control will be achieved in manufacture sand since it is manufactured in a controlled environment when compared to the river sand. Manufactured sand is made artificially so zero percent over sized materials will be available and it is highly recommended for reinforced cement concrete, brick or block works.

### B. Material Properties

The usual ingredients of concrete mix such as cement, coarse aggregate, river sand, water and admixtures were used in all the research works. While preparing the concrete mix, river sand was replaced by manufactured sand with varying percentages and strength of the concrete was determined. The natural sand properties such as specific gravity, water absorption, dry loose bulk density, fineness modulus and organic impurities were compared with the manufactured sand and found similar values [5].

### C. Casting of Specimens

Specimens were casted by varying percentage replacement of manufactured sand against natural river sand. Concrete mix was proportioned by IS 10262: 2009 to obtain the appropriate mechanical strength properties. Contractors, material suppliers, designers need to understand the characteristics of manufactured sand on concrete durability and concrete water demand [1]. While preparing the concrete mix, dry ingredients were mixed for two minutes in the concrete mixer after that water were added and mixing further two minutes continuously for achieving the rich concrete. In the previous research works, specimens were casted for testing compressive strength, split tensile strength, flexural strength and durability test aspects.

## III. RESULTS AND DISCUSSION

Manufactured sand properties such as reduced surface area and proper gradation improved the binding effect of concrete mix with 100% natural river sand replacement [1]. Panimayam et al. (2017) concluded based on the research work as no fines concrete compressive strength fully depends on the size of the coarse aggregate and percentage of manufactured sand used in the concrete mix and however addition of manufactured sand results in improved strength properties [2]. Adams Joe et al. (2013) conducted the experimental investigation by varying the manufactured sand with natural river sand in certain replacement percentages and test results revealed with 50% fine aggregate replaced with manufactured sand given the maximum result towards strength and durability aspects [7]. Suseela et al. (2017) had made natural river sand had been partially replaced by manufactured sand in concrete, their strength analysis test results shown that 60% replacement of manufactured sand along with 0.6 % glass fibre yielded higher strength in 28 days [8]. The reasonable content (7-10.5%) of stone dust in the manufactured sand concrete would not reduce the workability meanwhile shrinkage and creep effect also similar to that of the natural sand. The main reason was that stone dust improves the shortcoming of manufactured sand rough surface and reducing the friction between the manufactured sand particles. Hence the workability would be improved in the manufactured sand concrete [6]. The mineral additive, Alccofine with 30% replacement of coarse

aggregate by manufactured sand combination had achieved 21% greater than the target strength at the age of 56 days and the durability properties such as rapid chloride penetration, water penetration, drying shrinkage shown slightly greater value than the concrete with river sand [5]. M20 grade concrete mix design was prepared by replacing the natural river sand by varying percentages of manufactured sand and specimens were casted for testing the mechanical properties. The test results shown that 60% replacement of river sand by manufactured sand achieved superior strength in all the mechanical properties [4]. Any percentage replacement of natural river sand to manufactured sand will reduce the appropriate workability however 60% replacement by manufactured sand had obtained better shear and compressive strength [9]. Sagura et al. had made experimental study on the mechanical properties of manufactured sand concrete by different curing methods and finally concluded that workability of concrete with manufactured sand got reduced as compared to the concrete with natural river sand but mechanical properties would be more for manufactured sand concrete. Finally, they concluded that concrete specimens casted by means of 0.3% Super Absorbent Polymer along with Manufactured sand yielded greater strength when compared all the proportions.

## IV. CONCLUSION

The main conclusion arrived from this general review are as follows: This general review has given the guidelines for replacing the natural river sand by manufactured sand while preparing the concrete mix. Manufactured sand properties are comparable to that of the natural river sand and values are within the ranges specified by the Indian Standards. Normally, workability will be slightly lesser for concrete manufactured by replacing the natural sand by manufactured sand. To satisfy the workability properties water-cement ratio is increased slightly along with cement content. Based on the previous research works, concrete prepared with 100% replacement of natural sand by manufactured sand had given best results with respect to the mechanical and durability properties. Typically, 60% replacement of naturally available river sand by manufactured sand in concrete manufacturing was recommended. Due to the scarcity and environmental considerations of natural river sand, we can use the 100% replacement of natural river sand by manufactured sand is feasible with slightly increased water-cement ratio and cement content.

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