

# Effect of Artificial Sand on Compressive Strength and Workability of Concrete

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**Abstract:** *India is a developing country taken an initiative on developing infrastructure to meet the requirements of globalization in the construction of structures. Concrete is the only material to fulfill this demand & volume of concrete consumed by the construction industry is very large. A volume of concrete is comprised of sand, aggregate, cement, water & admixtures as required. The fine aggregates or sand used is usually obtained from natural sources specially river beds or river banks.*

*The paper presents review of research work on effects of artificial sand on compressive strength and workability of concrete. A brief summary of the most significant investigations on the behaviour of concrete by replacing natural sand with artificial sand due to which environmental and social problems arise due to acute shortage of natural sand will be overcome.*

**Keywords:** Artificial sand, Concrete, Compressive strength, Workability

## 1. Introduction

Concrete is a main constituent of the Civil Engineering structures. We cannot imagine the structures without concrete. It becomes the backbone of infrastructural development of whole world. River sand is commonly used as fine aggregate in concrete. It is formed due to natural weathering of rocks over a period of million years. In the last 10 years, it has become clear that the availability of good quality natural sand is decreasing. River sand is generally obtained from the river bed through mining operation. Due to large use of natural sand as fine aggregates in concrete, it's getting depleted and its sources too. Hence not only in India but worldwide there is restriction on sand mining from river beds to keep the environment in natural condition and conserve the natural resources for sustainable development. The cheapest & easiest alternative to natural sand is manufacturing sand by crushing stones in desired size & grade by suitable method. Sand produced by such means is known as artificial or manufactured sand. This paper presents the results of experimental investigation of partial and full replacement of natural sand by artificial sand. In this paper, comparative result has been produced on compressive strength & workability of concrete with varying proportions. The results show that concrete with manufactured sand shows higher compressive strength whereas workability decreased with increasing proportion of manufactured sand.

## 2. Literature Review

Nimitha Vijayaraghavan and A S Wayal (2013) concluded from experimental research that the river sand can be fully replaced by manufactured sand.

Rajendra P. Mogre et. al. (2013) studied the replacement of natural sand by artificial sand. They concluded from experimental results that, mixes with artificial sand as a fine aggregate gives better strengths than mixes of natural sand due to sharp edges of the particle in artificial and provide better bond with cement than rounded particle of natural sand. Sheetal A. Sahare et. al. (2015) has been investigate an effects of artificial sand with quarry dust on compressive strength, split tensile strength and flexural strength of different concrete mixes when natural sand is completely replaced by artificial sand.

## 3. Experimental Investigation

### 3.1 Materials

PPC conforming to IS 1489-1991 part 1 was used in the experiment. Coarse aggregates of maximum 20 mm size were having specific gravity of 2.66 and natural sand conforming to zone I having specific gravity of 2.71 was used. Artificial sand conforming to all four zones was having specific gravity of 2.76 also used to full replacement of natural sand. The fineness modulus of coarse aggregate, natural sand and artificial sand was 7.81, 5.18 and 4.62 respectively. The water absorption was 0.50% and 0.52% for coarse aggregate and natural sand respectively. The physical and chemical properties of all these materials were tested as per IS 383-1970. Potable water was used for the experimentation.

### 3.2 Mix Proportions and Mix Details

In this investigation concrete mix design was specified as per guidelines. Table 1 shows the mix proportions of Concrete. Concrete mixtures with different proportions of manufactured sand for natural sand ranging from 0% to 100% were casted.

Table 1. Mix Proportions

Mix Proportions			
Proportion	100 %	50 % natural	100 %
Material	natural	+ 50 %	artificial
	sand	artificial	
Cement	1	1	1
Fine Aggregate	2.34	1.81	1.41
Coarse Aggregate	4.23	2.72	2.04
Water Cement ratio	0.43	0.43	0.43
Superplasticiser	0.5 % by wt. of cement		

## 4. Experimental Procedure

### 4.1 Compressive Strength

The specimen of standard cube of (150 mm x 150 mm x 150 mm) was used to determine the compressive strength of concrete. Three specimens were tested for 7, 14 and 28 days with varying proportion of artificial sand replacement. The constituents were weighed and the materials were mixed in a mixer. The mixes were compacted with the help of tapping rod. The specimens were de molded after 24 h, cured in water for 7, 14 and 28 days, and then tested for its compressive strength as per Indian Standards. Table 2 & Figure 1 give the detail idea about the results of compression test.

Table 2. Compression Test Results

Proportion	100 % natural sand	50 % natural + 50 % artificial	100 % artificial
7 Days	25.25	27.41	28.53
14 Days	27.41	30.12	31.57
28 Days	31.93	35.82	37.76

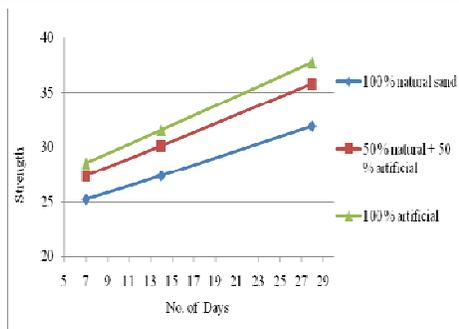


Figure 1: Compressive Strength of Concrete with Varying Proportion of Artificial Sand

### 4.2 Workability

The workability of the mixes was determined using a slump cone test having same water cement ratio for all the three mixes. Table 3 & Figure 2 show the results of slump cone test.

Table 3. Slump Cone Test Results

Mix Proportion	Slump value (mm)
100 % natural sand	87
50 % natural + 50 % artificial	59
100 % artificial	33

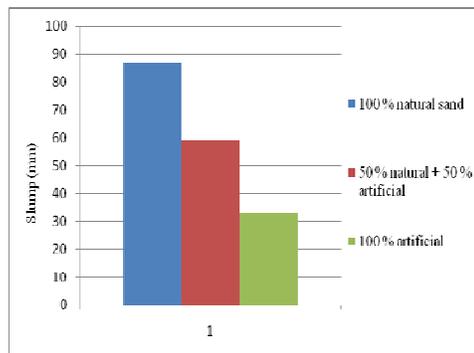


Figure 2: Workability of Concrete with Varying Proportion of Artificial Sand

## 5. Results and Conclusions

1. All mixes of concrete formed by replacement of natural sand by artificial sand when compared to reference mix i.e., 0% replacement, reveal higher compressive strengths.
2. In 50% replacement with admixture the compressive strength increases by 12.18 %.
3. In 100% replacement of natural sand by artificial sand, the compressive strength increases by 18.26 %, which is maximum.
4. Concrete mix becomes harsh with increase in proportion of manufactured sand.
5. Workability reduces significantly with increase in % of artificial sand.
6. Results show that the river sand can be fully replaced by manufactured sand.

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