

# Replacement of Natural Sand by Artificial Sand & Its Effect on Cost and Compressive Strength of Concrete

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## ABSTRACT

India is a developing country taking 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. Concrete is comprised of sand, aggregate, cement, water. The fine aggregates or sand used is usually obtained from natural resources specially river beds or river banks. The project presents review of research work on effects of replacement of natural sand with artificial sand on cost and compressive strength of concrete. A brief summary of the most significant investigations on the behavior 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:** Compressive Strength, Cost Comparison.

## I. INTRODUCTION

Concrete is a main constituent of the Civil Engineering structures. Approximately 80% of total volume of concrete is made up of aggregates. With natural sand deposits in the world drying up, there is an acute need for a product that matches the properties of natural sand in concrete. In the last 15 years, it has become clear that the availability of good quality natural sand is decreasing. Existing natural sand deposits are being emptied at the same rate as urbanization and new deposits are located either underground or too far away from the areas where it is needed, that is, the towns and cities where the manufacturers of concrete are located. Environmental concerns are also being raised against uncontrolled extraction of natural sand. Tests are conducted on cubes of M20 grade concrete using natural sand as well as artificial sand and its cost is compared along with test results.

### Objectives :

- ✓ To find the compressive strength of concrete using natural sand & artificial sand and its Comparison.
- ✓ To find the cost of concrete using natural sand & artificial sand and its comparison.

### Problem Statement:

Existing natural sand deposits are being emptied due to high rate of construction and new deposits are located either underground or too far away from the areas where it is needed. Hence, the natural sand is not easily available and the cost has increased up to 6500 Rs/Brass. Also contactors have to wait for 3-4 months for availability of sand. This leads to high cost of construction and uneconomical conditions. Apart from cost the natural sand is not available in uniform grades. Hence, to overcome these problems the natural sand will be replaced by artificial sand and its

effect on cost and compressive strength and will be compared in this project work.

**Materials Used:**

**Natural Sand:**

Natural sands show a variety of mineral compositions and chemical characteristics. Natural Sand is being used as fine aggregate in concrete making and is preferred as fine aggregate. It is mostly mined from the river beds. The fineness modulus of the natural river sand is 2.44, conforming to zone II as per IS: 383-1970 was used for the experimentation. The specific gravity of the natural sand is 2.6. The water absorption and moisture content values obtained for the sand used was found to be 1.51% and 0.7% respectively.

**Artificial Sand:**

It is obtained by crushing stone, gravel or slag which is used for aggregate material less than 4.75mm that is processed from crushed rock or gravel and intended for construction use. Apart from this, manufactured sand is of high quality in relation to non- refined

from coarse aggregate production. The artificial sand produced by proper machines can be a better substitute to river sand. The sand should be sharp and clean. The grains should be of durable material. The grain sizes must be such that it should give minimum voids. The artificial sand having fineness modulus of 2.75 and conforming to zone II as per IS: 383-1970. The specific gravity of the artificial sand was found to be 2.57.

**Cement:**

Ordinary Portland cement 53 grade was used. It is higher strength cement to meet the needs of customer for higher strength. Tricalcium Silicate and Dicalcium silicates are the most important compounds responsible for strength.

**Water:**

The water used for making concrete was clean and free from harmful impurities such as Oil, Alkali's, Acids, etc. In general the water which is fit for drinking is used for making concrete.

**II. RESULT**

**Table 1.** Compressive strength test for 7 Days

Sr. No.	Description	Identified Mark	Crushing Load ( x 10 <sup>3N</sup> )	Compressive Strength N/mm <sup>2</sup>	Avg. Strength N/mm <sup>2</sup>
1	100% Natural sand	N 1	320	14.22	14.74
		N 2	400	17.78	
		N 3	275	12.22	
2	100% Artificial sand	A 1	250	11.11	11.33
		A 2	275	12.22	
		A 3	240	10.66	
3	50-50 %	NA 1	325	14.44	14.81
		NA 2	350	15.56	
		NA 3	325	14.44	

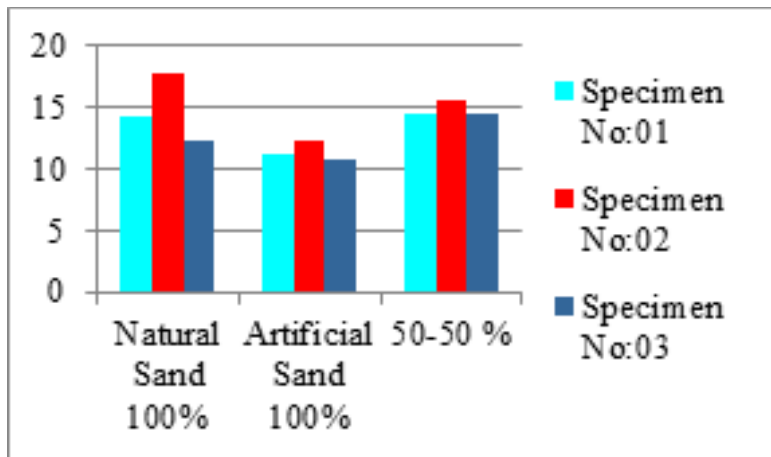


Figure 1. Compressive strength for 7 days

Table 2. Compressive strength test for 28 Days

Sr. No.	Description	Identified Mark	Crushing Load ( x 10 <sup>3N</sup> )	Compressive Strength N/mm <sup>2</sup>	Avg. Strength N/mm <sup>2</sup>
1	100% Natural sand	N 1	825	36.67	32.22
		N 2	575	25.56	
		N 3	775	34.44	
2	100% Artificial sand	A 1	665	29.56	26.96
		A 2	575	25.56	
		A 3	580	25.77	
3	50-50 %	NA 1	625	27.78	30.66
		NA 2	775	34.44	
		NA 3	670	29.78	

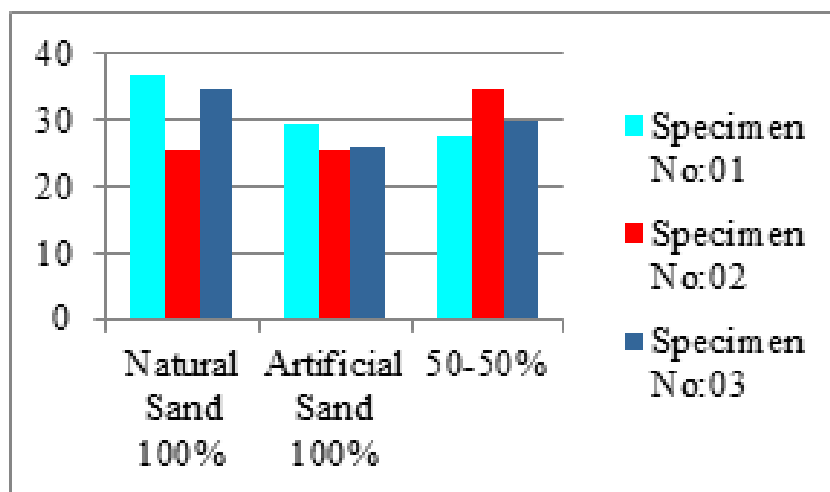


Figure 2. Compressive strength for 28 days

**Table 3.** Cost per M<sup>3</sup> of Concrete by Using 100% Natural Sand

Sr. No.	Material Name	Material in Kg	Cost / Kg	Amount Rs.
1	Cement	372	6	2232
2	Fine Aggregate- Natural Sand	687.5	1.20	825
3	Fine Aggregate- Artificial Sand	-	-	-
4	Coarse Aggregate	1143.41	0.55	628.87
Total				3685.87

**Table 4.** Cost per M<sup>3</sup> of Concrete by Using 100% Artificial Sand

Sr. No.	Material Name	Material in Kg	Cost / Kg	Amount Rs.
1	Cement	372	6	2232
2	Fine Aggregate- Natural Sand	-	-	-
3	Fine Aggregate- Artificial Sand	679.61	0.65	441.74
4	Coarse Aggregate	1143.41	0.55	628.87
Total				3302.61

**Table 5.** Cost per M<sup>3</sup> of Concrete by Using 50% Natural Sand & 50% Artificial Sand

Sr. No.	Material Name	Material in Kg	Cost / Kg	Amount Rs.
1	Cement	372	6	2232
2	Fine Aggregate- Natural Sand	343.77	1.20	412.52
3	Fine Aggregate- Artificial Sand	339.81	0.65	220.87
4	Coarse Aggregate	1143.41	0.55	628.87
Total				3494.26

### III. CONCLUSION

- ✓ The overall performance of concrete with natural sand is better than concrete with artificial sand.
- ✓ But however, when 50% natural sand is replaced with 50% artificial sand, good results are obtained in compressive strength and the cost is reduced comparatively.
- ✓ From our study it is concluded that different artificial sand gives different results for

compressive strength depending on different quarries and also by using 100% artificial sand as a fine aggregate. Satisfactory results are obtained, achieving the minimum target compressive strength.

- ✓ From the analysis of result it is observed that cost of construction (using artificial sand as 50% partial replacement over natural sand) is also reduced comparatively.

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