

# EXPERIMENTAL STUDY OF TENSILE STRENGTH OF CONCRETE WITH PARTIAL REPLACEMENT OF NATURAL SAND WITH MANUFACTURED SAND

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**Abstract** - Manufactured sand is a term used for aggregate materials less than 4.75mm and which are processed from crushed rock or gravel. Due to booming of construction activities in our country, natural sand resources are increasing depleted and its costs is becoming increasing high. This project was, therefore, conducted to study the influence that manufactured sand have in tensile strength of concrete, and to access the prospects of using manufactured sand as replacement of natural sand. The results of the hardened properties of the mixes have shown that concrete mixes with partial proportions of manufactured and natural sand achieved a higher tensile strength at all test ages. It can therefore, be concluded from the finding of this study 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.

**Key Words:** Manufactured sand, tensile strength, Bulking of sand, Fines, Workability. MS-Manufactured Sand, NS-Natural Sand

## 1. INTRODUCTION

It is generally known that, the fundamental requirement for making concrete structures is to produce good quality concrete. Good quality concrete is produced by carefully mixing cement, water, and fine and coarse aggregate and combining admixtures as needed to obtain the optimum product in quality and economy for any use.

Good concrete, whether plain, reinforced or prestressed, should be strong enough to carry superimposed loads during its anticipated life. Other essential properties include impermeability, durability, minimum amount of shrinkage, and cracking.

The environmental impact is attributed to the non-renewable character of the natural resources, the environmental impact on neighborhood, land use conflicts, high energy consumption needed for aggregate production and the potential environmental or health impact of materials produced due to leaching of heavy metals, radioactivity and to special mineral suspects to have hazardous health effects. Therefore, due to the above-mentioned facts, looking for viable alternatives to natural sand is a must. One possible alternative material that can be used as a replacement for natural sand is the use of

manufactured sand. Due to the forecast shortfall in the supply of natural sands and the increased activity in the construction sector, it is apparent that time will come, when manufactured sand may play a significant role as an ingredient in concrete production

## 1.1 Objectives

The general objective of this study work is to study the influence of manufactured sand on the Tensile strength of concrete and to compare the result with that of concrete produced using natural river sand.

The specific objectives of this study are:

1. To study background information on manufactured sand.
2. To find out the optimum quantity of sand required.
3. To draw conclusions and give recommendations based on the research findings and indicate areas for further study

## 2 TEST RESULTS

Table -1: Tests on material properties of sand

TESTS	NATURAL SAND	MANUFACTURED SAND
BULK DENSITY	1611.11 Kg/m <sup>3</sup>	1922.15 Kg/m <sup>3</sup>
SPECIFIC GRAVITY	2.6	2.86

### 2.1 Mix Calculations

The mix calculations per unit volume of concrete shall be as follows

a) Volume of concrete = 1 m<sup>3</sup>

b) Volume of cement = [weight of cement/specific gravity of cement]

= [394.32/2.94] x [1/1000] = 0.134 m<sup>3</sup>

c) Volume of water = [197.16/1] x [1/1000] = 0.197 m<sup>3</sup>

d) Volume of all in aggregates (d) = [a - (b + c)]

= 1 - (0.134 + 0.197) = 0.669 m<sup>3</sup>

e) Mass of coarse aggregates = d x Volume of CA x specific gravity of CA

= 0.669 x 0.64 x 2.86 x 1000 = 1224.54 kg

f) Mass of fine aggregates = d x Volume of FA x specific gravity of FA

= 0.669 x 0.36 x 2.60 x 1000 = 626.19 kg

## 2.2 Mix proportions

Cement = 394.32 kg/m<sup>3</sup>

Water = 197.16 kg/m<sup>3</sup>

Fine aggregate = 626.19 kg/m<sup>3</sup>

Coarse aggregates = 1224.54 kg/m<sup>3</sup>

Water cement ratio = 0.50

Aggregates are assumed to be in SSD. Otherwise corrections are to be applied while calculating the water content. Necessary corrections are also required to be made in mass of aggregates.

Hence the ratio is **1:1.58:3.10:0.5**

**Table-2:** Overall results of Workability of Concrete.

Description of the mix	Slump obtained in mm	Compaction Factor
Reference mix (R)	105	0.97
20%	105	0.96
40%	95	0.95
60%	80	0.95
80%	75	0.94
100%	55	0.90

## 2.3 Overall results of tensile strength of concrete by partial replacement with manufactured sand.

**Table -3:** Overall results of tensile strength of concrete using Manufactured Sand

Description of the mix	Tensile strength (MPa)	% increase in Tensile w.r.t reference mix
Reference mix(R)	3.18	-
20%	3.42	+7.5%
40%	3.43	+7.8%
60%	3.49	+9.7%
80%	3.29	+3.5%
100%	3.64	+14.5%

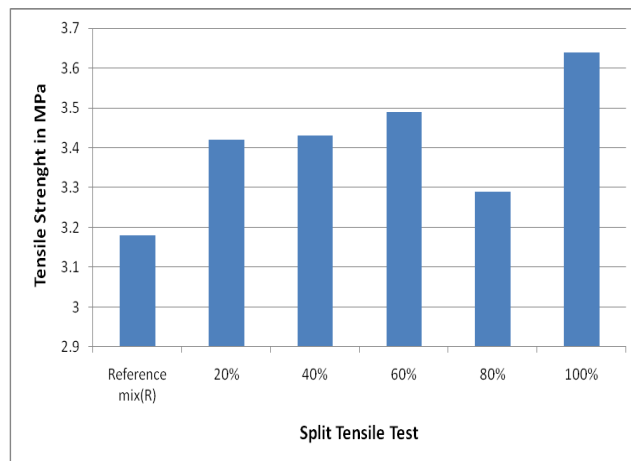


Chart-1: Tensile strength of concrete

## 4. CONCLUSIONS

The use of manufactured sand in producing concrete was studied and the following conclusions were made:

1. The results of the hardened properties of the mix have shown that the concrete mix with proportion of manufactured and natural sand achieved a higher tensile strength almost at all tested age of concrete when compared to the reference mix.
2. It can be concluded that the use of manufactured sand for high strength concrete production is more useful. However, special cares have to be taken to ensure that the concrete mix achieves a suitable finish.
3. Manufactured sands are made by crushing aggregate to sizes appropriate for use as a fine aggregate. During the crushing process the manufactured sand have irregular shapes and more fine particles contributing to improved tensile strength, compared to natural sand control mix.
4. Manufactured sand offers important economic advantages in regions where the availability of natural sand is scarce or in cities where transportation cost is high
5. The use of manufactured sand in the construction industry helps to prevent unnecessary damages to the environment and provide optimum exploitation of the resources.

## ACKNOWLEDGEMENT

I would like to thank Mr. Akhilesh Goje, Mr. Amesh Anvear and Mr. Sohail Bagban for their support during this project.

## REFERENCES

- [1] Swastik S Shinde, Swanand R. Kadam, Avinash A. Waychal, "EXPERIMENTAL STUDY OF COMPRESSIVE STRENGTH OF CONCRETE WITH PARTIAL REPLACEMENT OF NATURAL SAND WITH MANUFACTURED SAND", International Research Journal of Engineering and Technology (IRJET), Volume: 03 Issue: 12 | Dec -2016.
- [2] Priyanka A. Jadhava, Dilip K. Kulkarni, "AN EXPERIMENTAL INVESTIGATION ON THE PROPERTIES OF CONCRETE CONTAINING MANUFACTURED SAND", International Journal of Advanced Engineering Technology, Vol.III, Issue II/April-June, 2012/101-104.
- [3] Mark James Krinke, "The Effect of Admixtures in Concrete Containing Manufactured Sand", October 2004.
- [4] Odd Hotvedt, Bard Pedersen, "Production and Utilisation of Manufactured Sand", SINTEF Building and Infrastructure, COIN Project report 12 – 2009.
- [5] STACY GOLDSWORTHY, "MANUFACTURED SANDS IN PORTLAND CEMENT CONCRETE – THE NEWZEALAND EXPERIENCE".Barmac Sand Technical Specialist, Metso Minerals (Matamata) Limited.
- [6] IS 10262-2009, Indian Standard Concrete Mix Proportioning - Guidelines, BIS, New Delhi.
- [7] IS 383-1970, Indian Standard Specification For Coarse And Fine Aggregates For Natural Sources For Concrete (second revision), BIS, New Delhi.
- [8] IS 456-2000, Indian Standard Plain and Reinforced Concrete Code of Practice, BIS, New Delhi.

## BIOGRAPHIES



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