

Strength Studies of Concrete by Partial Replacement of Natural Sand with Manufactured Sand

Sellakkannu N¹, Anjali K C²

Assistant Professor, Department of Civil Engineering , JCT College of Engineering and Technology, Pichanur,
Coimbatore, India ¹

P.G Student Department of Civil Engineering, JCT College of Engineering and Technology, Pichanur,
Coimbatore, India ²

ABSTRACT: This paper presents a study conducted to determine the sustainability of partial replacement of sand with manufactured sand in M30 grade of concrete. The first phase is to find the maximum percentage of sand that can be replaced with manufactured sand for M30 grade concrete. Here the concrete mixes containing 40, 50 and 60% sand replacement levels were cast with superplasticizers as admixtures. Compressive strength, split tensile strength and flexural strength tests were conducted in accordance to the existing standards. Arrived results shows that 50% replacement of sand by manufactured sand gave maximum strength. Mix proportioning of concrete mix was worked and arrived as 1:2:3.42

KEYWORDS: Manufactured sand, Fine aggregate, Superplasticizer.

I. INTRODUCTION

Concrete has several characteristics that make it as a versatile and widely used construction material. New developments backed by years of research have provided today's concrete user with a unique, attractive, and practical product. Architects, engineers and builders have used concrete with imagination and skill to create exciting and distinctive structures. The global consumption of natural sand is very high due to the extensive use of it in concrete and mortar. In general, the demand of natural sand is quite high in developing countries to satisfy the rapid infrastructure growth, in this situation developing country like India facing shortage of good quality natural sand. Particularly in India, natural sand deposits are being depleted and causing serious threat to environment as well as the society. Manufactured sand offers viable alternative to natural sand and it is purpose made fine aggregate produced by crushing and screening.

II. MATERIALS

Cement:

Ordinary Portland cement of 53 grade is used in this study. The OPC is classified into three grades, namely 33 grade cement, 43 grade cement & 53 grade cement. Generally use of high grade cements offer many advantages for making stronger concrete. Although they are little costlier than low grade cement, they offer 10-20% savings in cement consumption and offer many other hidden benefits. One of the most important benefits is the faster rate of development of strength.

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Table1 : Properties Of Cement

Properties	Observation
Fineness	3%
Standerd consistency	33%
Initial setting time	110
Final setting time	390
Specific gravity	3.16

Fine aggregate

The fine aggregate serve the purpose of filling all the open pores in the concrete. Thus, it reduces the porosity of the final mass and considerably increases its strength. The material which passes through 4.75 mm sieve is termed as fine aggregate. Usually, natural river sand is used as a fine aggregate. However, at places, where natural sand is not available economically, finely crushed stone may be used as a fine aggregate.

Table2: Properties of Fine Aggregate

Properties	Observation
Water absorption	1
Fineness modulus	2.59
Moisture Content	0.657

Manufactured sand

It is a substitute of natural river sand for construction purposes, sand produced from hard granite stone by crushing is used here. The crushed sand is of cubical shape with grounded edges, washed and graded to as a construction material. The size of manufactured sand (M-Sand) is less than 4.75mm. It can be dust free; the sizes of m-sand can be controlled easily so that it meets the required grading for the given construction. It does not contain impurities such as clay, dust and silt coatings, increase water requirement as in the case of river sand which impair bond between cement paste and aggregate. Thus, increased quality and durability of concrete.

Table 3: Properties of M-Sand

S.NO	Properties	Values
1	Specific Gravity	2.56(2.5-2.9)
2	Water Absorption (%)	0.14%(0.1%-2%)
3	Fineness modulus	2.52(2.20-3.20)
4	Bulk Density(kg/m ³)	1573.33kg/m ³

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Coarse aggregate

The material which is retained on 20 mmsieve is termed as coarse aggregate. Crushed stones of size 20 mm are used as coarse aggregate. The coarse aggregate used in concrete cube should be hard, durable, clean, cubical, angular and minimum of flat and elongated particles.

Table 4: Properties of Coarse aggregate

S.No	Description	Result
1	Specific gravity	2.74
2	Water absorption	0.50%
3	Crushing Value	19.64%
4	Impact Value	24.98%
5	Fineness modulus	6.98
6	Bulk Density	1819.88g/m ³

Superplasticizer

CONPLAST SP430 is a high range super plasticizing admixture. It is used in this study to achieve the required workability. The product has been primarily developed for applications in high-performance concrete where the highest durability and performance is required. It is based on SulphonatedNaphthalene Polymers and supplied as a brown liquid instantly dispersible in water. It has been specially formulated to give high water reduction upto 25% without loss of workability or to produce high quality concrete of reduced permeability. CONPLAST SP430 confirm to the code IS:9103:1999 and BS:5075 is used for casting of specimens.

Table 5: Properties of Superplasticizer

Descriptions	Conplast Values
Structural of the material	Poly carboxyl ether based
Aspect	White liquid
Specific gravity	1.220 to 1.225 at 30°C
Air entrainment	Approx. 1% additional air is entrained

III. EXPERIMENTAL INVESTIGATION AND RESULTS

Compression Test of concrete cubes

The important property of concrete is believed to be in its strength in compression. The strength in compression has definite relationship with all other properties of concrete i.e. these properties are improved with the improvement in compression strength. The aim of these experimental tests is to determine the maximum load carrying capacity of test specimen. The specimen and setup is shown in figure 5.4 and 5.5. All concrete mixes were prepared using a mechanical mixer. Cube specimens of 15×15×15cms are used here. The specimens were cured in a curing tank. Latex modified concretes were tested at 7 and 28 days of age to get compressive strength and 7 and 28 days for flexural strength values.

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Table 5: Test results of compressive strength

Replacement of sand (%)	7Days (N/mm ²)	14Days (N/mm ²)	28 Days (N/mm ²)
0	22.8	24.92	27.86
40	17.11	19.45	22.56
50	24.22	26.85	28.86
60	19.33	20.33	23.34



Split Tensile strength

Split tensile strength of concrete is usually found by testing plain concrete cylinders of size 150x300mm were casting using M30 grade concrete. Specimens with Conventional Concrete and Manufactured sand replaced concrete of different percentage were casted. After 24 hours, the specimens were removed from the mould and subjected to water curing for 7 and 28 days. After curing, the specimens were tested for Split tensile strength as per 5816-1999 using a calibrated compression testing machine of 1000 KN capacity is used.

Table 6: Test results of split tensile strength

Replacement of sand (%)	7Days (N/mm ²)	14Days (N/mm ²)	28Days (N/mm ²)
0	2.15	3.65	4.12
40	1.66	2.86	3.47
50	2.68	4.05	5.08
60	2.22	3.82	4.23

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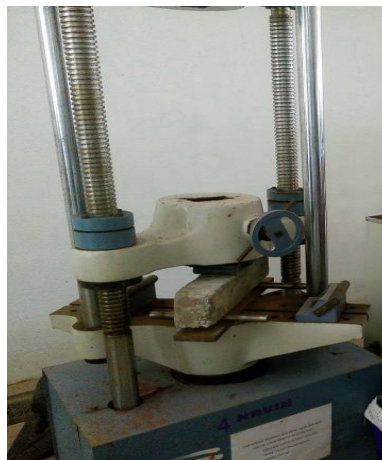
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Flexural Strength Test

Flexural strength of concrete is usually found by testing plain concrete prism of size 500x100mm were casting using M30 grade concrete. Specimens with Conventional Concrete and M-sand concrete of different percentage were casted. After 24 hours, the specimens were removed from the mould and subjected to water curing for 7 days. After curing, the specimens were tested for flexural strength.

Table 6: Test results of split tensile strength

Replacement of sand(%)	7Days (N/mm ²)	14Days (N/mm ²)	28Days (N/mm ²)
0	3.85	4.85	7.28
40	3.77	4.09	5.63
50	4.25	6.28	7.98
60	3.87	4.69	6.25



IV. CONCLUSION

The following conclusions are drawn from the study of partial replacement of fine aggregate with Msand in the cement concrete:

In this study of partial replacement of fine aggregates with M-sand have greater strength than the conventional concrete were found out based on the arrived test results.

- The compressive strength of concrete are increased with the addition of M-sand upto50% by weight of fine aggregate and any further addition of M-sand ended in compressive strength loss.
- High workability is observed for super plasticiser added concrete.
- Split tensile strength also tends to improve for M-sand replaced concrete compared to plain concrete in the same replacement ratio of 50%.
- Flexural strength tends to improve for M-sand Concrete compared to plain concrete.
- Hence from the arrived results, Optimum content of M-sand is found to be at 50%.

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