



Study on Incremental Replacement of Natural Sand with Manufactured Sand

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ABSTRACT

Concrete is the most extensively used construction material. Despite the rising cost of production, the demand for concrete is increasing. The negative consequences of the increasing demand for concrete include depletion of aggregate deposits, environmental degradation and ecological imbalance. Recently river sand mining was banned. To this effect, the work is carried out to study the prospects of the uses of manufactured sand (M-sand) in our country. In this present experimental investigation M20 and M25 concrete is used as control mix with M-sand in various percentages. Strength of M-sand concrete is compared with normal concrete. The results show that the significant improvement in the strength of the M-sand concrete.

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Introduction

Concrete is the world's most consumed man made material. Its great versatility and relative economy in filling wide range of needs has made it a competitive building material. Concrete production is not only a valuable source of societal development, but it is also a significant source of employment.

Production of concrete relies to a large extent on the availability of cement, sand and coarse aggregates, the costs of which have risen astronomically over the past few years. Despite the rising cost of production, the demand for concrete is increasing. The negative consequences of the increasing demand for concrete include depletion of aggregate deposits, environmental degradation and ecological imbalance. Anticipating this issue, various types of waste materials have been investigated, as aggregate replacement material in concrete production. Manufactured sand (M-sand) is the answer for this problem.

The main objective of the present work is to systematically study the effect of percentage replacement of natural sand by M-Sand by 0%, 25%, 50% 75% and 100%. The study was carried out on M20 grade concrete with w/c ratio of 0.5 and M25 grade concrete with w/c ratio of 0.45, properties like compressive strength, flexural strength, split tensile strength was studied and compared.

Materials and Methodology

Materials

Cement

Ordinary Portland cement of grade 53 conforming to IS12269-1987 is used for all mixes.

Water

As a general rule, potable water is considered satisfactory for mixing concrete (IS 456-2000), was used in the present investigation.

Aggregates

Crushed granite stone coarse aggregates, which are locally available was used. Locally available M-sand and river sand was used as fine aggregate.

River sand and M-sand, both having particles sizes of 4.75 mm to 75 micron was used in this investigation.

Methodology

Batching and mixing of materials

Batching of materials is done by weight. The percentage of replacement of natural fine aggregates by M-sand was 0%, 25%, 50%, 75% and 100%. The 0% replacement will be to serve as control for other specimens.

Concrete mix design

Concrete mix is designed for a compressive strength of 20 MPa and 25 MPa using existing Indian Standard code provisions of river sand concrete. The design basically involve the determination of water binder ratio, selection of water content, cement content, coarse aggregate content and fine aggregate content. The mix proportions obtained on the above procedure will be finalized with minor adjustments on the quantities of constituent materials.

Results and Discussions

Results

Compressive strength, split tensile strength and flexural strength of M20, M25 grade concrete is determined by conducting the tests on cubes of size 150 X 150 X 150 mm, cylinders of 100 mm diameter and 300 mm length and prisms of 100 X 100 X 500 mm size. Forty five specimens were tested after 28 days, as per Indian Standards. The results are tabulated in the tables.

Table1. Compressive strength of M20 grade concrete for various replacement percentages of M-Sand.

Percentage replacement of river sand by M-Sand	Compressive strength N/mm ²
0% M-Sand	28.58
25% M-Sand	29.11
50% M-Sand	29.54
75% M-Sand	31.19
100% M-Sand	32.14

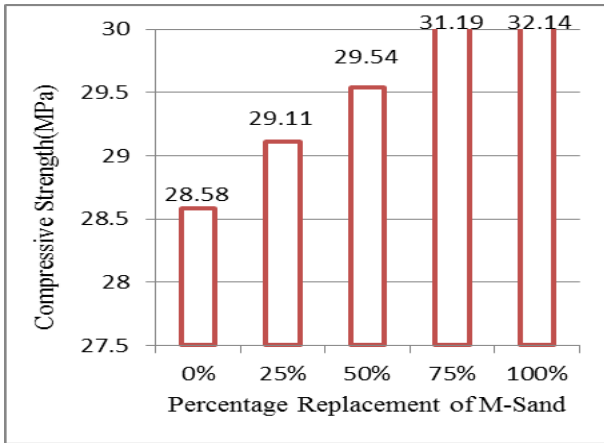


Chart1. Compressive strength of concrete for various replacement percentages of M-Sand.

Table2. Split tensile strength of M20 grade concrete for various replacement percentages of M-Sand.

Percentage replacement of river sand by M-Sand	Split tensile strength (MPa)
0% M-Sand	2.87
25% M-Sand	2.91
50% M-Sand	3.26
75% M-Sand	3.41
100% M-Sand	3.45

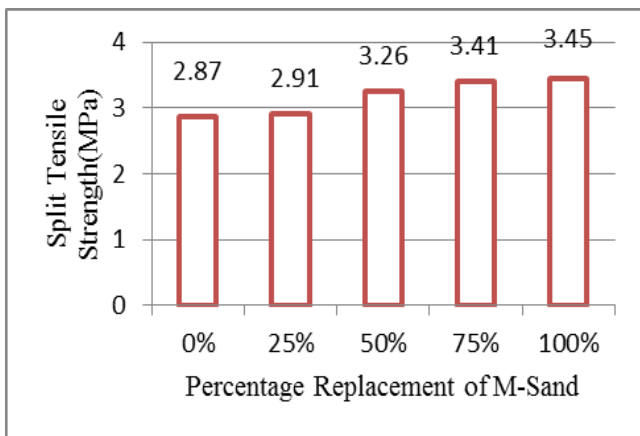


Chart 2. Split Tensile strength of M20 grade concrete for various replacement percentages of M-Sand.

Table 3. Flexural strength of M20 grade concrete for various replacement percentages of M-Sand.

Percentage replacement of river sand by M-Sand	Flexural strength (MPa)
0% M-Sand	5.78
25% M-Sand	5.94
50% M-Sand	6.12
75% M-Sand	6.21
100% M-Sand	6.43

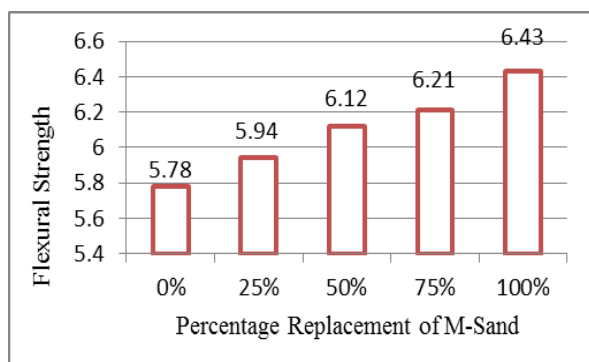


Chart 3. Flexural strength of M20 grade concrete for various replacement percentages of M-Sand.

Table 4. Compressive strength of M25 grade concrete for various replacement percentages of M-Sand.

Percentage replacement of river sand by M-Sand	Compressive strength (MPa)
0% M-Sand	30.33
25% M-Sand	31.12
50% M-Sand	31.17
75% M-Sand	32.28
100% M-Sand	34.44

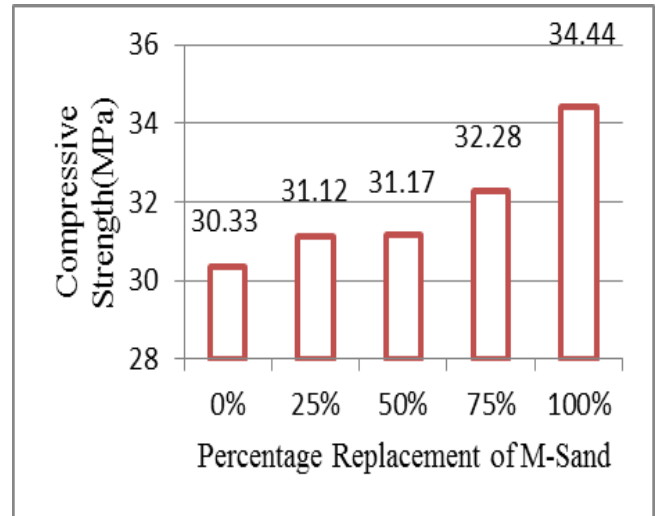


Chart 4. Compressive strength of M25 grade concrete for various replacement percentages of M-Sand.

Table 5. Split tensile strength of M25 for various replacement percentages of M-Sand.

Percentage replacement of river sand by M-Sand	Split tensile strength (MPa)
0% M-Sand	3.39
25% M-Sand	3.34
50% M-Sand	3.40
75% M-Sand	3.47
100% M-Sand	3.51

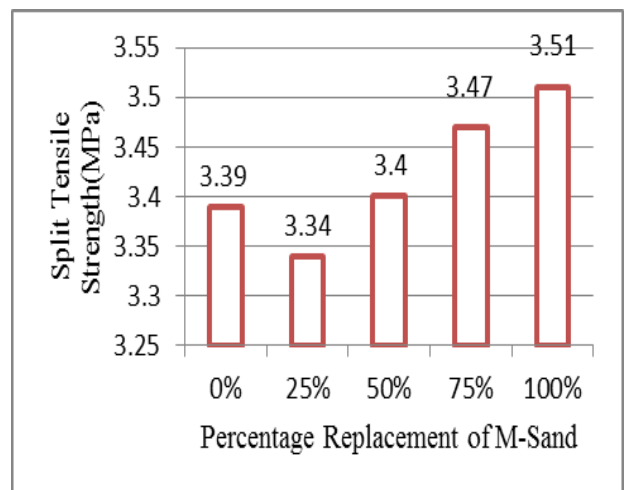


Chart 5. Split tensile strength of M25 grade concrete for various replacement percentages of M-Sand.

Table 6. Flexural strength of M25 grade concrete for various replacement percentages of M-Sand.

Percentage replacement of river sand by M-Sand	Flexural strength (MPa)
0% M-Sand	6.67
25% M-Sand	6.71
50% M-Sand	6.83
75% M-Sand	6.99
100% M-Sand	7.14

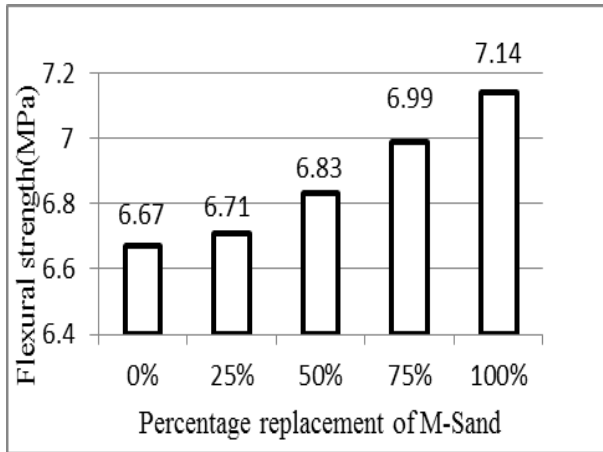


Chart 6. Flexural strength of M25 grade concrete for various replacement percentages of M-Sand.

Discussions

From the test results, we can infer that, all the mixes of concrete formed by replacement of natural sand by M-Sand exhibits improved strength when compared to normal concrete with river sand. All specimens with M-sand have higher compressive strength, split tensile strength and flexural strength. During the crushing process the manufactured sand particles have more angular shapes and finer than river sand, which fills voids more effectively in concrete. This property contributes to improved strength compared to river sand control mix. The test results exhibits that the river sand can be fully replaced with M-Sand

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