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An Experimental Investigation on, Effects on the Properties of Concrete by Partial Replacement with M-Sand

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***Abstract*: From last ten years the river sand has become expensive, due to excessive cost of transport from natural resources. The man source of river sand is river, due to the continuous removal of river sand from natural resources they get depleted due to which our environment gets badly affected. So there is need of alternative to overcome these impacts. The manufactured sand becomes an economical alternative. Manufactured sand is obtained by grinding of granite stone. Manufactured sand has been used in large scale, used in highways as surface finish. Manufactured sand is also used for making hollow blocks and in light weight concrete in this investigation we are mainly concerned with compressive strength, specific gravity, slump value, compaction factor, vee bee time. We will compare the tests of concrete containing the river sand with the tests of concrete containing M- sand. Therefore, the construction engineers and contractors have decided to use manufacture sand in making concrete instead of river sand. The results of investigation and evaluation of study has proved that the selected materials as mentioned above may be useful for partial replacement of cement as presented in the results and ultimately helping the environment.**

***Keywords*: high strength concrete, compressive strength, split tensile strength, water cement ratio, compaction factor vee bee time, flexural strength.**

1. Introduction

Concrete may be defined as the mixture of sand, cement, aggregates and water. Cement concrete is the product obtained artificially by hardening of mixture of cement, fine aggregates, coarse aggregates and water. Cement in the aggregate acts as binding material, fine aggregates as sand, coarse aggregates as broken stones. The mixture of cement and water in concrete mix is known as matrix while as mixture of cement sand and water is known as mortar. The process of making concrete is known as concreting the concrete is mainly divided in two headings,

Plane Cement Concrete

Reinforced Cement Concrete

Plane cement concrete is good in high compressive strength only, while as reinforced cement concrete is having duel advantages of high tensile and compressive strength. Unit weight of plain cement concrete is 2400N/mm^3. While as unit weight of RCC. is 2500N/mm^3.

Concrete operations must be performed strictly as per specifications of IS: 456–2000. Thevarious concrete operations are as under.

Collection and storage of materials.

Batching of materials.

Mixing of materials.

Transportation of prepared concrete.

Placing of concrete.

Compaction of concrete.

Jointing and finishing of concrete.

Curing of concrete.

The two important properties of concrete are: bleeding and segregation.in plastic stage concrete should be free from bleeding and segregation.

Bleeding: separation of cement paste from main mass. Bleeding may be due to the extra amount of water added to the cement paste, therefore it is necessary to add desired amount of water as per specifications of Indian standard

Segregation: separation of coarse aggregates from main mass. Whenever the any ingredient that is any material used for the making of concrete is not used in desired proportion. segregation is mainly due to undesired shapes of aggregates used in concrete.

In hardened stage concrete should be durable strong impermeable and should undergo least dimensional change Compressive strength of concrete is expressed in terms of N/mm^2 or MPa.

Characteristic strength of concrete is defined as the strength of material below which not more than 5% of the test results are expected to fail.

M-sand:

Manufactured sand may be defined as purpose made crushed fine aggregates produced from a suitable source-material. Production generally involves crushing, screening, washing, separation into discrete fractions recombining and blending.

At the beginning the manufactured sand produced (by jaw

crusher, cone crusher, roll crusher, hammer mill) contains flaky and elongated particles. But now manufactured sand is produced by V.S.I (vertical shaft impactor) is a suitable.

Manufactured sand is produced with zero fines. As it does not contain silt and clay, setting properties of cement are not altered.

The civil engineers, architects, builders, contractors agrees that the natural sand, which is available today, is deficient in many respect. It does not contain the fine particles, in proper proportions as required.

A. Advantages of m-sand

- It is highly economical.
- Use of M-SAND is environmentally friendly as the waste materials from industries are effectively being used to create quality building materials.
- The concrete mixture generates a very low heat of hydration which prevents thermal cracking
- The shrinkage of M-SAND concrete is very less.
- The use of M-SAND gives concrete good work ability, durability and finish.

B. Disadvantages of m-sand

- The quality of M-SAND can affect the quality and strength of Cement concrete.
- Poor quality M-SAND can increase the permeability of the concrete and cause damage to the buildings

C. Objectives

The use of M-SAND is most commonly used to obtain high strength of concrete in these days as it contains more amount of silica content. The uses of M-sand in the concrete have attracted the attention of researchers throughout the World. The following are the objectives of using M- SAND in concrete:

- To determine the effect of M-SAND on the compressive and flexural strength of concrete.
- To study the effect of M-SAND in concrete when mix design.
- To study the effect of M-SAND on workability of concrete.
- To study some physical property like initial setting time, final setting time,

Consistency, flexural strength, split tensile strength, compaction factor.

D. Objective of the investigation

- To prepare concrete cubes of nominal mix (M20) using m -sand.
- To evaluate the optimum mix design with regards to the amount of water, FA (Fly Ash), cement ratio under the effect of admixture. To perform test for strength and workability as per IS 516:1959.
- To study the relative strength development with different percentage of M- sand Concrete.
- To assess the economy aspects of concrete.
- To justify the safeguard to the environment by utilizing typical wastes.

E. Methodology to be adopted

- Collection of materials
- Computation of Mix Design.
- Casting and testing of cube specimens for its compressive strength.
- Casting and testing of cylinder specimens for its split tensile strength.

2. Experimental investigation

A. Introduction

The experimental investigation is carried out with an objective to study the effects of using M- sand as partial replacement of river sand on the properties of concrete. The main parameters investigated in this study were compressive strength and flexural strength.

The experimental programme included the following:

Sieving of M –sand with the series of sieves having different sizes.

- Testing properties of cement like soundness, specific gravity, Initial and final setting time and consistency test.
- Development of concrete mix (M20) of desired strength by making trials
- Casting and curing of specimens.
- Compressive strength test on M- sand based concrete mix
- Flexural strength test on M- sand based concrete mix
- Workability Test

B. Material used

Locally available river sand from river Sindh of Ganderbal district, manufactured sand is collected from the crusher plant available in wahidpora area of Ganderbal district

C. Tests on materials

The main aim of calculating the fineness modulus of fine aggregates (m-sand) and course aggregates is to find the least amount of cement to be used for good workable mix and a most economical and workable mix with minimum quantity of cement. Certain limits for the fineness modulus of fine and coarse aggregate have been prescribed. A sample under test should satisfy the result so that the aggregate may gives good workability under economical conditions. If the test aggregate gives higher fineness modulus, the mix will be harsh and if on the other hand gives a lower fineness modulus. It results in an uneconomical mix.

For given workability coarse aggregate requires lesser water cement ratio.

D. Fineness modulus of fine aggregate

Total weight of sand taken= 1000gm
Time of sieving = 15 minutes
Sieve Analysis of Fine Aggregate (As Per Is: 383- 1970).

Table 1
Fineness modulus of fine aggregates

S No.	IS sieves (mm)	Mass retained on sieves (gm)	Percentage passing (wt.)	Cumulative % age retained
1	4.75	0	100	0
2	2.36	30	95	3.5
3	1.18	350	62	39
4	600 microns	440	18	83
5	300 microns	150	3	98

Calculations:
Fineness modulus of sand= 323.5/100=3.23

E. Fineness modulus of coarse aggregates

Total weight of coarse aggregate = 5000gm
Time of sieving = 15 minutes

Table 2
Fineness modulus of coarse aggregates

Is sieve (mm)	Mass retained on sieve (gm)	% age passing by weight	Cumulative retained
40	0	100	0
20	675	86.5	13.5
10	4320	13.5	100
4.75	0	0	100
2.36	0	0	100
1.18	0	0	100

Total cumulative retained = 413.5

Calculations:
Fineness modulus of curse aggregates=413.5/100=4.13

3. Experimental investigation and tests

A. Workability

Fig. 1. River sand

The workability of green concrete is determined by slump cone, compaction factor and vee-bee time tests, as these tests are suitable for low workable mixes also. While casting the specimens only the workability is measured, if any mix does not have required slump of 40-80mm then the mix would be made again with plasticizer. The tests were conducted on both M20 and M30 grade concrete. In accordance with workability the percentage of admixture required for low workable mixes to make their slump reach 40-80mm is also determined. Table 2 and 3 determines the workability properties of different proportions of natural sand replaced by manufactures sand. The slump test is essentially a measure of consistency or wetness of mix. The test is suitable only for concrete of medium to high workability. The slump test has been found to be useful in ensuring the uniformity among different batches of similar concrete under field conditions. The slump test is limited to concrete with maximum size of aggregate less than 38mm.

Fig. 2. M-sand

Table 3
Variation of slump, compaction factor, vee bee time and % mix for slump for 40-80mm by wt. of cement with different quantity of M- sand.

% of M-sand	Slump mm	Compaction factor	Vee bee time (sec.)	% mix for slump 40mm-80mm by wt. of cement
M20 with 0% M-sand	25	0.87	8.9	0
M20 with 20% M-sand	35	0.97	12.6	0.1
M20 with 40% M-sand	18	0.72	20.2	0.2
M20 with 60% M-sand	7	0.66	27.2	0.3
M20 with 100% M-sand	0	0.59	34.8	0.5

Fig. 3. Slump test

B. Compressive strength test

Compressive strength test is the most important test of concrete in order to determine the compressive strength of hardened concrete. The compression test is carried out on specimens cubical or cylindrical in shape. Sometimes the compression strength of concrete is determined using parts of

beam tested in flexure. The end parts of the beam are left intact after failure in flexure and, because the beam is usually of square cross section, this part of beam could be used to find out the compressive strength.

Table 4
Compressive strength of different grades of concrete at 7 and 28 days. (N/mm^2)

Grade of concrete	Compressive strength at 7^{th} day	Compressive strength at 28 day
M20	12.5	21
M25	19	26
M30	23	32
M35	26.5	42

C. *Split tensile strength test*

Apart from flexure test, the other method used to determine the tensile strength of concrete can be broadly classified as direct and indirect method. There is difficulty in performing the direct test, in holding the specimen properly in the testing machine without introducing the stress.

Table 5
Split tensile strength of concrete at 7th and 28th day. (N/mm^2)

Grade of concrete	Split tensile strength at 7^{th} day	Split tensile strength at 28^{th} day
M20	2.24	2.59
M25	2.4	2.85
M30	2.64	3.2
M35	2.86	3.76

D. *Flexural strength test*

The determination of flexural tensile strength is essential to estimate the load at which the concrete members may crack.

Table 6
Flexural strength of concrete N/mm^2

S. No	specimen	River sand %	M-sand %	Average flexural strength at 28 days
1	S1	75	25	7.3
2	S2	65	35	7.8
3	S3	50	50	8.6
4	S4	40	60	7.43

Fig. 4. Compressive strength testing machine

Fig. 5. Tensile strength test

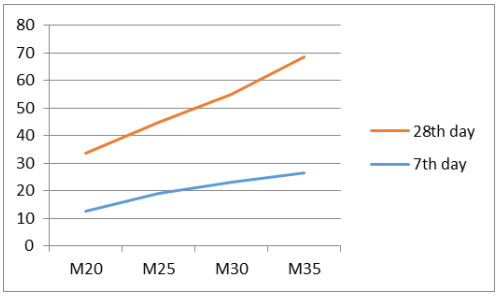

Fig. 6. Variation of compressive strength at 7th day and 28th day

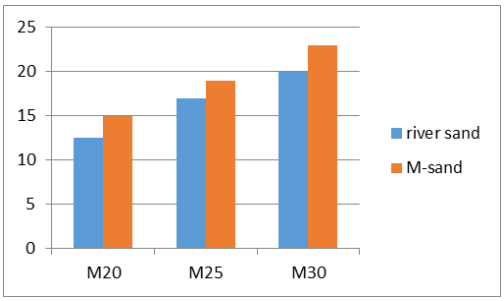

Fig. 7. Compressive strength of concrete with river sand and M-sand at 7th day (N/mm^2)

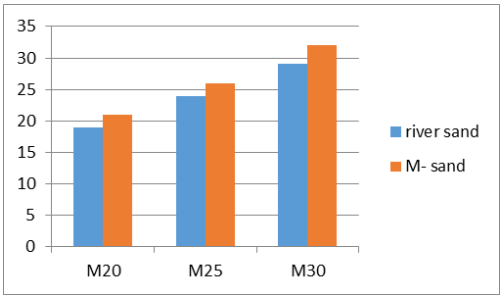

Fig. 8. Compressive strength of concrete with river sand and M-sand at 28th day (N/mm^2)

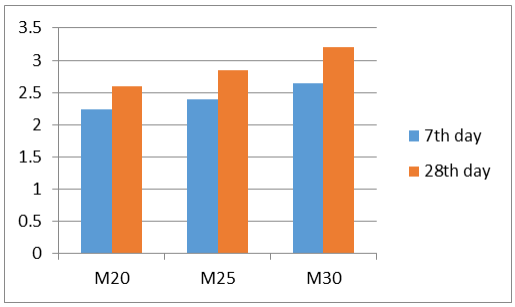

Fig. 9. Split tensile strength of concrete at 7th day and 28th day (N/mm^2)

4. Conclusions

The following conclusions have been drawn.

- The maximum compressive strength obtained for 7 days is 26.5 N/mm^2.
- The maximum compressive strength obtained for 28 days is 42 N/mm^2.
- Seventh day compressive strength of concrete is 69%.
- Fourteenth day compressive strength of concrete is 90%
- Twenty eighth day of compressive strength of concrete is 99%.
- The maximum split tensile strength for 7 days is 2.86 N/mm^2.
- The maximum split tensile strength for 28 days is 3.76 N/mm^2.
- Compressive strength of concrete with river sand for 7 days is 23 N/mm^2.
- Compressive strength of concrete with river sand for 28 days is 39 N/mm^2.
- Flexural strength of concrete at 28 days containing 75% of river sand and 255 of M- sand, is 7.3N/mm2.
- Flexural strength of concrete at 28 days containing 65% of river sand and 35% of M-sand, is 7.7 N/mm^2.
- Flexural strength of concrete at 28 days containing 40% as river sand and 60% of M- sand, is 8.9 N/mm^2.
- The workability of concrete gets decreased with the addition of M-sand.

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