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Stability of Manufactured Sand as Fine Aggregate with Fiber Reinforced concrete

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ABSTRACT: Concrete is the most widely used composite construction material. Fine aggregate plays a very important role for imparting better properties to concrete in its fresh and hardened state. Generally, river sand is used as fine aggregate for construction. Due to the continuous mining of sand from river bed to the depletion of river sands and it became scarce material. Also, sand mining from river bed caused a lot of environmental issues. So, as a substitute to river sand in the concrete mix, M-Sand (manufactured sand) has been used also with 1% of Galvanized Iron Fibers.

In this present experimental study, a comparative study has been carried out to check the usage of M-sand in the place of river sand. This study involves determination of some major properties of concrete like compressive strength, tensile strength and durability in water made of both the river and m sands.

Based on proposed studies, quality of manufactured sand is equivalent to natural river sand in many respects, such as cost, strength, availability, presence of impurities and so on. Conclusion has been arrived that M-sand is the best alternative material to natural river sand and could be effectively used in making concrete which provides adequate strength and durability for the concrete.

In the design of structures, concrete is taken into account by taking its compressive strength value. A compressive strength of concrete made of M-sand is observed to be very nearer to the strength of concrete made natural river sand in the present investigation, thereby 100% replacement of M-sand is reasonable with 1% of G.I. fiber. Replacement of natural river sand by M-sand in this project has been done as 0%, 25%, 50%, 75%, & 100%.

The main objectives of our project is to study the different proportions of M-sands with fiber reinforced concrete (strength and durability)

I. INTRODUCTION

Concrete is the most prominent part in the structural construction, it is the most widely used construction material throughout the globe. Concrete is placed at very next position after water. Construction consisting of cement, fine aggregate coarse aggregate water and some admixture in required proportion for a quick and better result in different conditions.

The construction industries consumed the large quantity of concrete worldwide. Using natural sand conventional concrete is produced from river beds that as fine aggregate in India. The environmental problem is decreasing natural sources so that there is a restriction on sand quarrying resulted in scarcity and so that its cost is high. There are no normally particles are present in river sand in desired quantity. It is danger to the environment to dig excess amount of sand from river bed. It affects the water level in ground. So alternative material must be found. The easy and cheap way of getting substitute for natural sand is obtained from granite stone quarries, lime stone and crushing stone quarries. This is known the manufactured sand.

By the replacement of natural sand in may attain more or less compressive strength, tensile strength, permeability, modulus of rupture and lower degree of shrinkage as the control concrete. Concrete using various methods of obtaining sand as fully replacement for conventional natural sand. Then result are found better workability and high compressive strength and split tensile strength

In the present years, the expansion within the structural construction and therefore the sequence increase in consumption have result in fast decline of accessible natural resources in the opposite hand, a high volume of production has generated a substantial quantity in fact material that have adverse impact on the atmosphere. The developing industries are to be one in all foremost potential customers of mineral resources, so generating an excellent quantity of manufactured sand by crushing hard granite stone, lime stone, natural stone. It is very excellent sand which have been unique properties require for normal sand.



In this study, the scope of research will be contemplated on the use of m-sand as normal sand with and without steel fibers in concrete.

II. LITERATURE SURVEY

The research person Ilangovanaet.al in2008 studied the feasibility of usage of manufactured sand as hundred percent substitutes for natural sand in concrete. Using design approach of IS, ACI, USBR, RN.No.4 and BRTISH codes for both conventional concrete and M – Sand concrete Mix design has been developed for three grades. Tests were conducted for cubes and cylinders to study the strength of concrete made of manufactures sand and compared with the natural sand concrete. An attempt has also been made to durability studies on manufactured sand when compared with the natural sand concrete. And it is found that the compressive strength, spilt tensile strength and durability studies of concrete made of manufactured sand are nearly 10% more than the conventional concrete.

2.1.2 Present study:

In the present investigation wee design mix for M25 has been calculated using I.S code 10262-2009 for the conventional concrete and quarry dust concrete. Tests were conducted for cubes and cylinders to study the strength of concrete by using manufactured sand and the results compared with natural sand concrete. During the present study, 0%, 25%, 50%, 75% and 100% of traditional fine aggregate with replaced with the robo sand. Compressive strength, spilt tensile strengths and workability were found after 7 and 28 days curing.

Since granite stone is using as coarse aggregate in structural construction, even the other materials available in huge quantity. The common people are not ready to use the other quality materials like lime stone, marble hard granite stone etc in the construction industry as concrete material. We should need to improve some awareness about this type of materials by performing some research on this type of materials. Due to this connection a small research work has been performed in the cube moulds and cylindrical moulds to the compressive strength, spilt tensile strength and of concrete and workability is carried out on fresh concrete respectively.

III. OBSERVATIONS

Concrete is the most prominent part in the structural construction, it is the most widely used construction material throughout the globe. In the construction industry natural aggregate is very essential component of concrete. Since from so many days' concrete manufactures in the construction industries have been understand that they should need to use of available sand materials in spite of searching for perfect suitable sand to make an ideal concrete.

We have some types of materials like m-sand as same as properties of natural sand. So in this process we have used crushed hard granite stone in certain proportions with using constant 1% of proportions of fibers. Accordingly, this investigation is on compressive strength and split tensile strength behavior of m-sand concrete with constant 1% proportions of fiber.

3.2 OBJECTIVES OF PRESENT STUDY:

1. To know the efficiency of m-sand for structural constructions.
2. To study the performance of fiber reinforced concrete.
3. To know the fresh concrete mix properties of m-sand and without galvanized iron fibers.
4. To study the compressive and split tensile strength properties of m-sand with and without fibers.

For above objectives some experimental work has been planned in following manner. Total 60 cubes and 60 cylinders are prepared. In that 6 cubes and 6 cylinders prepared with natural river sand and remaining 54 cubes and 54 cylinders are prepared by the replacement of natural river sand with manufactured sand (M-sand) proportion of 0%, 25%, 50%, and 75% 100%. Again this same process is repeated with 1% of fibers by the total volume of concrete.

3.3 DESIGN OF MIX PROPORTIONS:

M25 mix concrete

Water content: 186 liters

| W/C Ratio | Cement (kg/m3) | Fine aggregate (kg/m3) | Coarse aggregate (kg/m3) |
|------------|----------------|------------------------|--------------------------|
| 0.48 | 387.5 | 727.85 | 1106.39 |
| Proportion | 1 | 1.87 | 2.85 |

3.4 DETAILS OF CUBE SPECIMENS :**Table 3.1 Details of Different Cube Specimens**

| S. No. | Mix Proportion | N.S. | M.S. | Fibers | No. of Cubes | Size of cube (m3) |
|--------|----------------|------|------|--------|--------------|-------------------|
| 1 | MS – 0 | 100% | 0% | 0% | 6 | 0.15x0.15x0.15 |
| 2 | MS – 25 | 75% | 25% | 0% | 6 | |
| 3 | MS – 50 | 50% | 50% | 0% | 6 | |
| 4 | MS – 75 | 25% | 75% | 0% | 6 | |
| 5 | MS – 100 | 0% | 100% | 0% | 6 | |
| 6 | MS – 0 – 1 | 100% | 0% | 1% | 6 | 0.15x0.15x0.15 |
| 7 | MS – 25 – 1 | 75% | 25% | 1% | 6 | |
| 8 | MS – 50 – 1 | 50% | 50% | 1% | 6 | |
| 9 | MS – 75 – 1 | 25% | 75% | 1% | 6 | |
| 10 | MS – 100 – 1 | 0% | 100% | 1% | 6 | |

3.5 DETAILS OF CYLINDER SPECIMENS:**Table 3.2 Details of Different Cylinders Specimens**

| S. No. | Nomenclature | N.S. | M.S. | Fibers | No. of Cylinders | Size of Cylinder (m3) |
|--------|--------------|------|------|--------|------------------|-----------------------|
| 1 | MS – 0 | 100% | 0% | 0% | 6 | 0.0053 |
| 2 | MS – 25 | 75% | 25% | 0% | 6 | |
| 3 | MS – 50 | 50% | 50% | 0% | 6 | |
| 4 | MS – 75 | 25% | 75% | 0% | 6 | |
| 5 | MS – 100 | 0% | 100% | 0% | 6 | |
| 6 | MS – 0 – 1 | 100% | 0% | 1% | 6 | 0.0053 |
| 7 | MS – 25 – 1 | 75% | 25% | 1% | 6 | |
| 8 | MS – 50 – 1 | 50% | 50% | 1% | 6 | |
| 9 | MS – 75 – 1 | 25% | 75% | 1% | 6 | |
| 10 | MS – 100 – 1 | 0% | 100% | 1% | 6 | |

TEST RESULTS AND DISCUSSION**Slump cone test:****Table 5.1: Slump cone values recorded for each mix batch**

| S.No | Percentage Mix | Slump value with 0% fibers (cm) | Slump value with 1% fibers (cm) |
|------|----------------|---------------------------------|---------------------------------|
| 1. | M-Sand – 0% | 3 | 2.7 |
| 2. | M-Sand – 25% | 2.6 | 2.4 |
| 3. | M-Sand – 50% | 2.2 | 2.3 |
| 4. | M-Sand – 75% | 2.1 | 1.8 |
| 5. | M-Sand – 100% | 1.5 | 1.2 |

Table 5.2.1 above shows the slump height recorded during the test for all mix batches. Figure 5.2 below shows a graphical representation of slump height for concrete containing no fibers and concrete containing different amounts of fibers. The above tabular diagram 5.1 shows a gradual increase in the slump height while we replace the natural sand with manufacturing sand and the addition of 1% galvanized fibers is also increases the slump valve. A small graphical picture of percentage replacement v/s slump has shown in the following figure 5.1

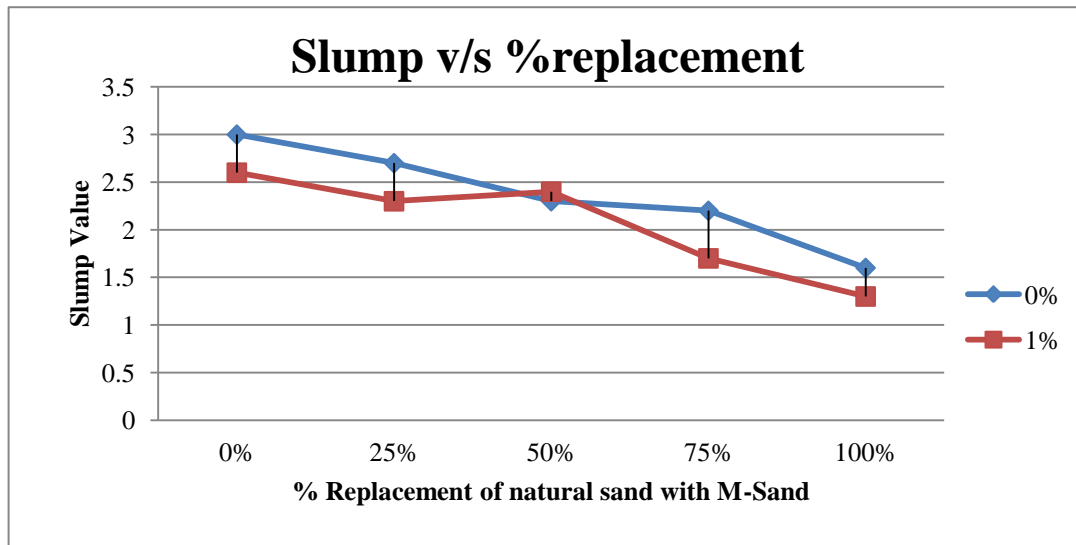


Figure 5.1: % Replacement V/s Slump value.

5.2.2 Compaction factor test:

Table 5.2: Compaction factor values recorded for each mix batch

| S.No | Nomenclature | C.F Value with 0% fiber | C.F Value with 1% fiber |
|------|---------------|-------------------------|-------------------------|
| 1. | M-Sand – 0% | 0.937 | 0.9 |
| 2. | M-Sand – 25% | 0.927 | 0.87 |
| 3. | M-Sand – 50% | 0.924 | 0.86 |
| 4. | M-Sand – 75% | 0.919 | 0.86 |
| 5. | M-Sand – 100% | 0.909 | 0.84 |

Compressive strength value recorded for each mix batch with 0% fibers (28 days)

| S.No | Percentage Mix | Load (KN) | Compressive Strength (N/mm ²) | Average compressive Strength (N/mm ²) | % difference in compressive strength |
|------|-------------------------------------|-----------|---|---|--------------------------------------|
| 1. | M-Sand -0% 0% replacement | 700 | 31.11 | 29.1 | +7.06% |
| | | 515 | 22.88 | | |
| | | 750 | 33.33 | | |
| 2. | M-Sand -25%-1% 25% replacement | 760 | 33.77 | 30.29 | +11.44% |
| | | 760 | 33.77 | | |
| | | 525 | 23.33 | | |
| 3. | M-Sand -50%-1% 50% replacement | 780 | 34.66 | 36.14 | +32.96% |
| | | 790 | 35.11 | | |
| | | 870 | 38.66 | | |
| 4. | M-Sand -75%-1% 75% replacement | 760 | 33.77 | 37.03 | +36.28% |
| | | 760 | 33.77 | | |
| | | 980 | 43.55 | | |
| 5. | M-Sand -100%-1% 100% replacement | 760 | 36.88 | 38.12 | +40.25% |
| | | 830 | 38.5 | | |
| | | 850 | 39 | | |

Table 5.6: Compressive Strength value recorded for each mix batch with 1% fibers

| S.No | Percentage Mix | Load (KN) | Compressive Strength (N/mm ²) | Average compressive Strength (N/mm ²) | % difference in compressive strength |
|------|--------------------------------------|-----------|---|---|--------------------------------------|
| 1. | M-Sand -0% -1% 0% replacement | 770 | 34.22 | 29.77 | +9.52% |
| | | 580 | 25.77 | | |
| | | 660 | 29.33 | | |
| 2. | M-Sand -25% -1% 25% replacement | 775 | 34.44 | 35.7 | +31.34% |
| | | 855 | 38 | | |
| | | 780 | 34.66 | | |
| 3. | M-Sand -50% -1% 50% replacement | 750 | 33.33 | 36.29 | +33.51% |
| | | 750 | 33.33 | | |
| | | 930 | 42.22 | | |
| 4. | M-Sand -75% -1% 75% replacement | 775 | 34.44 | 38.51 | +41.68% |
| | | 975 | 43.33 | | |
| | | 850 | 37.72 | | |
| 5. | M-Sand -100% -1% 100% replacement | 950 | 42.22 | 40.44 | +48.78% |
| | | 880 | 39.11 | | |
| | | 900 | 40 | | |

A graph between compressive strength and percentage replacement of manufactured sand along with 0% & 1% fibers.

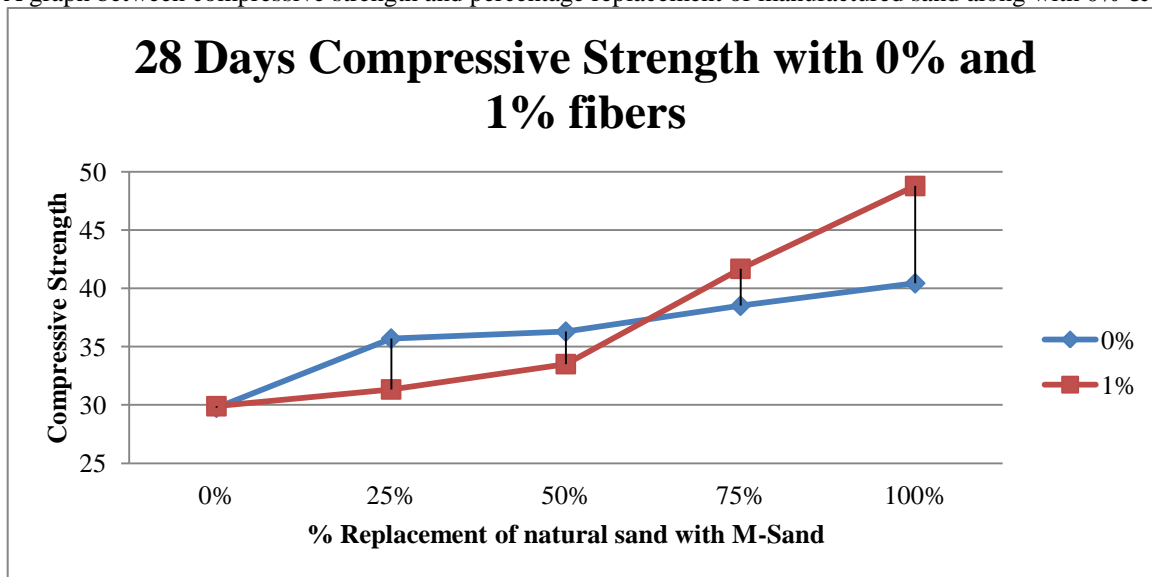


Figure 5.4 : % Replacement v/s compressive strength

Comparison between compressive strength & split tensile strength:

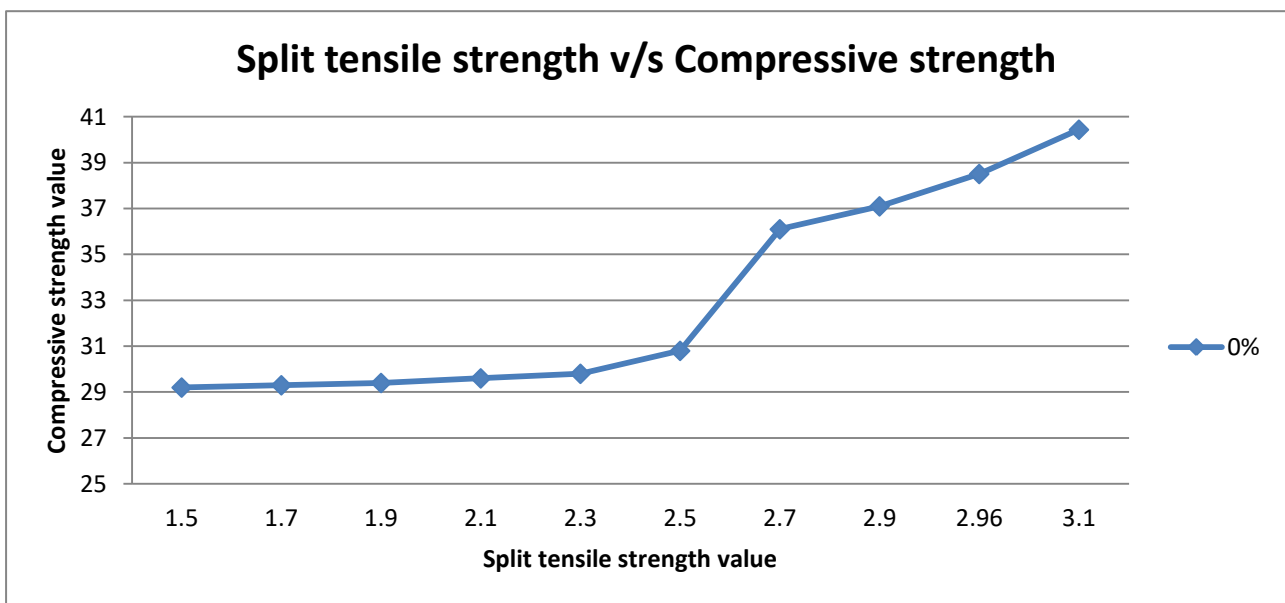
| S.NO | Percentage mix | Compressive strength (N/mm ²) | Split tensile strength (N/mm ²) |
|------|--------------------------------------|---|---|
| 1 | M-Sand – 0 %. 0 % replacement | 29.1 | 2.04 |
| 2 | M-Sand – 25 %. 25 % replacement | 30.29 | 2.58 |
| 3 | M-Sand – 50 %. 50 % replacement | 36.14 | 2.84 |
| 4 | M-Sand – 75 %. 75 % replacement | 37.03 | 2.87 |
| 5 | M-Sand – 100 %. 100 % replacement | 38.12 | 2.91 |
| 6 | M-Sand – 0 % - 1 % | 29.77 | 2.63 |



| | | | |
|----|---|-------|------|
| | 0 % replacement | | |
| 7 | M-Sand – 25 % - 1 % 25 % replacement | 35.7 | 2.87 |
| 8 | M-Sand – 50 % - 1 % 50 % replacement | 36.29 | 2.96 |
| 9 | M-Sand – 75 % - 1 % 75 % replacement | 38.51 | 2.99 |
| 10 | M-Sand – 100 % - 1 % 100 % replacement | 40.44 | 3.2 |

A graph between split tensile strength values & Compressive strength values for 0 % fibers.

Split tensile strength v/s Compressive strength



A graph between split tensile strength values & Compressive strength values for 1 % fibers.

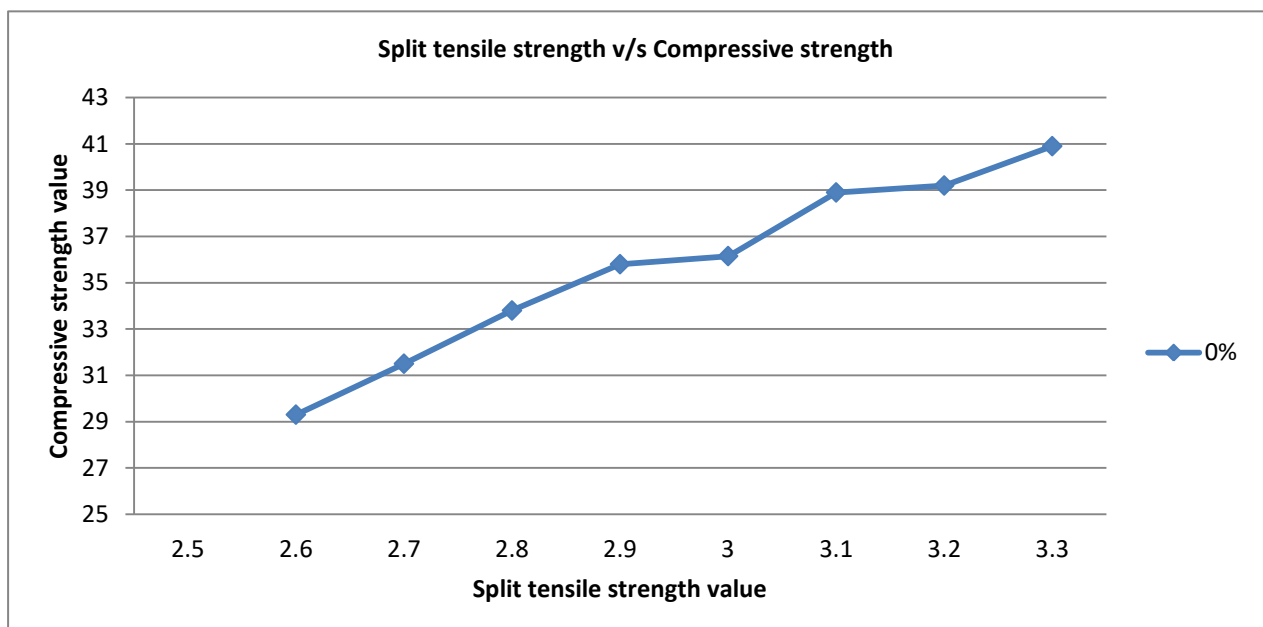


Figure 5.8: Split tensile strength v/s Compressive strength

IV. CONCLUSION

The Effect of Percentage of replacement of river sand by manufacture sand of strength and workability were evaluated and compared with the reference mix of 0 % replacement of river sand by manufacture sand.

1 The compressive strength of concrete mix increased when the replacement of natural sand with manufacturing sand increases gradually up to 100 % by 48.25 % and the addition of galvanized fibers increases the compressive strength by 48.78 %.

2 The split tensile strength value of concrete mix increased when the replacement of natural sand with manufacturing sand increases gradually up to 100 % by 47.71 % and by the addition of galvanized fibers that increases the split tensile strength by 62.43 %.

3 Workability of concrete decreased with replacement of natural sand with manufacturing sand. But up to some extent even replaced concrete mix batches got optimum results. At the same time after 75 % replacement of natural sand the workability of concrete mix decreases gradually.

4 By considering all the above parameters like slump cone value, compaction factor value compressive strength value and split tensile strength value it is recommended that is better to limit the replacement of natural sand with manufacturing sand up to 75 % only for better fresh and hardened concrete.

5 Failure patterns of cube moulds and cylindrical moulds are almost similar only for better sand and manufacturing.

6 The whole study is mainly to make awareness about the recourses like manufacturing sand and galvanized iron fibers to use in the present structural construction works.

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