International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 06 | June 2020 www.irjet.net p-ISSN: 2395-0072

EXPERIMENTAL STUDY ON FLEXURAL BEHAVIOUR OF BEAM ELEMENTS WITH PARTIAL REPLACEMENT OF NATURAL SAND WITH M-SAND

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Abstract - *It is very important to make the concrete economical. We can see the construction industries growing day by day .The demand of good quality concrete increases, good quality concrete contains nearly 35% of fine aggregates so that excavation of river is increased to get river sand that lead to degradation of river sand so an alternative is determined. In this study experiments carried to know the flexural behavior of RCC beam elements with partial replacement of natural sand with M-sand. The experimental results proved that that the compressive strength of cubes with 25% M-sand gives the strength nearer as that of 0% M-sand and the compressive strength of cubes with 50% M-sand give the strength nearby same as that with 0% M-sand. From these results it concludes up to 50% there is increase in strength but beyond 50% replacement it gives lower in strength. The flexural strength test result proves that we can replace M-sand with 50% replacement effectively and it gives the strength nearby same as it with 0% replacement. From above we can conclude that we can replace Natural sand with 50% of M-sand effectively and it proves to be economical.*

Key Words: *MANUFACTURED SAND (MS), COMPRESSION STRENGTH, FLEXURAL STRENGTH, NATURAL SAND, RIVER SAND (RS).*

1. INTRODUCTION

Concrete is one of the major and most efficient developments being around the worldwide. The production of concrete which create solid adds contamination to nature and is likewise one of the significant reasons for greenhouse gas impact. The production of concrete requires tremendous amounts of normal sources, particularly, lime stone, coarse aggregate and natural sand and total are significant constituents of concrete and they involved around 75 % of its complete volume of Concrete of which fine totals alone comprise around 23 to 40%. To create great nature of concrete which can meet the basic evaluations i.e. structural grades, it is important to acquire the correct kind and quality of aggregates complying with IS 318 codal prerequisites. Till today, only river sand was majorly used in structural concrete. In any case, with the quick development in Construction industry and quick lessening of reasonable sources, natural sand is turning into an extremely rare material. The sand mining from our waterways have gotten shockingly over the top taking into account both economy and condition issues and right now numerous states have forced prohibition on sand mining from stream beds and other common assets. With the quick development in Construction industry, it is evaluated that the interest for fine aggregates can't be satisfactorily met from the accessible regular resources. Therefore, there is need to search for alternate types of fine aggregate. Because of quick development in deconstruction industry, the interest for sand has expanded immensely, causing inadequacy of appropriate Natural sand in most part of the word. Because of the exhaustion of good quality natural sand for the utilization of construction, the utilization of manufacturing sand has been expanded. Of the different choices being investigated in the laboratories, research centers, Manufacturing Sand have indicated significant guarantee as a substitution to natural sand.

1.1 Why M – Sand is used?

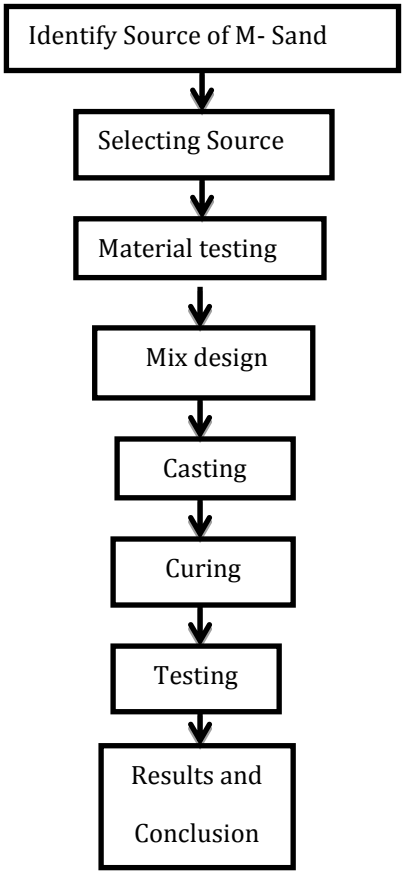
M – Sand is a one of the best alternative for river sand. Now a days the construction work for infrastructure development like Education Buildings, Commercial buildings and now country's main project smart India includes tremendous amount of concrete. In concrete main material is river sand and due to continuous using of river sand deficiency of good quality river sand has been occurred so as an alternative we can use m- sand which is readily available and transportation cost is also low.

Fig-1: M-sand used in this study

1.2 OBJECTIVES

- The main objective is to study Possibility and feasibility of using manufactured sand (M-sand) in structural concrete by investigating the Flexural behavior of RCC beam elements
- Characterization of ingredient materials including manufactured sand, steel bars, sand, cement, coarse aggregate.
- Design of Concrete mixes with different percentages (0, 25 and 50% and 100%) of M-sand.
- Assessment of fresh concrete properties including slump, segregation resistance, bleeding etc. for different mixes.
- Casting of flexure critical reinforced concrete specimens of size 150*150mm*1500mm.
- Determination of Strength properties of hardened concrete including Compressive strength, Flexural strength.
- Analysis of results.
- Recommendations on the use of M-sand in structural concrete.

2. METHODOLOGY



2.2 Mix Design of M – 20 Concrete

As per IS 10262:2019

- The concrete strength: 27N/mm^2
- Cement: 304 kg/m^3
- Water: 152 litre/m^3
- Fine aggregate: 759kg/m^3
- Coarse aggregate : 1320kg/m^3
- Water cement ratio : 0.5
- Proportion adopted : 1:2.49:4.32

In the present Study, We used M-20 Grade concrete for casting of Cubes and RCC Beams.

- Cubes of Size : 150mm x 150mm X 150mm
- RCC beam of size: 150mm x 150mm X 1500mm
- Number Of Cubes Casted : 12
- Number of RCC Beams : 12

Reinforcement used in this study is Top- 2No.s 8mm ϕ and Bottom- 2No.s 8mm ϕ.

In the present Study Percentages used to replace natural sand by M-sand is 0%, 25%, 50%, and 100%.

3. EXPERIMENTAL SETUP AND TESTING.

The beam subjected to point load on loading frame is as shown below

Fig-2: Beam placed on loading frame

3.1. Testing

Beam is subjected to point load and load is gradually increased until the beam fails and crack obtained is as shown below

Fig-3: cracks obtained after testing

4. RESULTS AND OBSERVATIONS

Below results are the average value taken by testing 3 cubes for compression test and 3 beams for flexural test.

Table -1: Compressive strength results of 28 days

Mix proportion	Compressive strength for 28days of curing (N/mm2)
0 % (MS) + 100 % (RS)	31.30
25 % (MS) + 75 % (RS)	31.34
50 % (MS) + 50 % (RS)	32.04
100 % (MS) + 0% (RS)	28.00

Table -1: Flexural strength results of 28 days

Mix proportion	Flexural strength for 28days of curing, Mpa
0 % (MS) + 100 % (RS)	5.12
25 % (MS) + 75 % (RS)	4.70
50 % (MS) + 50 % (RS)	4.88
100 % (MS) + 0% (RS)	2.64

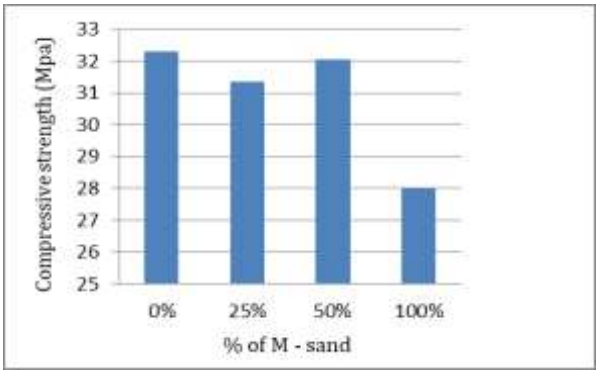


Fig-4: Variation in Compression strength (28 days) for M-20 grade concrete.

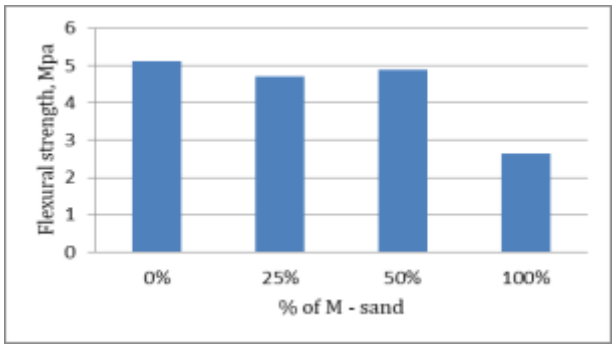


Fig-5: Variation in Flexural strength (28 days) for M-20 grade concrete.

4.1. OBSERVATIONS

- In this work we determine the compressive strength of the casted cube specimens at various percentage replacements of M-sand, 0%, 25%, 50%, and 100%.
- Test is conducted using digital compression testing machine, rate of loading in the range of 10KN/s, and application of load up to the failure of specimen takes place.
- Compressive strength of M-20 Grade concrete with different percentages of M-sand having 28 days of curing is represented in the graph.
- Flexural strength of M-20 Grade concrete with different percentages of M-sand having 28 days of curing is represented in the graph.
- The graph clearly depicts that the variation in compressive strength and flexural strength with respect to the percentage variation of M-sand.
- 28 days test results also strength gradually increase in percentage of M-sand up to 50% and then strength decreases with increase in percentage of M-sand.
- The maximum strength is achieved at 50% replacement of recycled aggregates. Therefore 50% replacement of M-sand referred as the optimum. The minimum strength is achieved at 100% M-sand.

5. CONCLUSIONS

The result of present work concludes that compressive strength is significantly improved. And we can use M-sand as Fine aggregate in 50 % replacement.

- The experimental results proved that the compressive strength of cubes with 25% M-sand is 31.3N/mm^2 which is nearer to 32.30 N/mm^2 of 0% M-sand.
- The compressive strength of cubes with 50% M-sand is 32.04 N/mm^2 gives the strength nearby same as that with 0% M-sand.
- From the results it concludes up to 50% there is increase in strength but beyond 50% replacement it gives lower in strength.
- The flexural strength test result proves that we can replace M-sand with 50% replacement effectively and it gives the strength nearby same as it with 0% replacement.
- From above we can conclude that we can replace Natural sand with 50% of M-sand effectively and it proves to be economical.

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