Improving Compressive Strength of Cement Concrete Mix by Using M-Sand and Bamboo Fiber

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Abstract - **In the current world, concrete has become a very important part of the construction industry and the materials which are used in making concrete have evolved due to better quality of cement and better grade of coarse aggregates. The sand is an important part of concrete. It is mainly procured from natural sources. Thus the grade of sand is not under our control. The concrete cubes of M-20, M-25 & M-30 grade were threw in this trial explore work and tried to analyze different properties of concrete like compressive quality, workability. In this study M-sand is considered as a replacement of natural sand by 50, 70 & 90% by weight of sand in concrete design mix with 1% Bamboo fiber streams as an admixture. This study is carried out at the age of 7 and 28 days. In this work, the general properties of fresh and hardened concrete were tried and the outcomes were dissected. As concrete is a central material for the construction industry. In any case, in the present period where development is expanding quickly and development rate is coming to their statures, it is contrarily affecting our condition as well. So it is vital to utilize some optional materials as a part of concrete to minimize the cost, and to enhance the properties of concrete for better stability of the structures.**

Keywords: **Bamboo fiber, Manufacturing sand, Compressive Strength, Workability, setting time, admixture.**

I. INTRODUCTION

It is known that valuable aggregates play a crucial role in concrete. Fine aggregates generally represent over one third of the concrete volume. Studies have shown that changes within the properties of fine aggregates (sand) can alter the strength and fracture properties of the concrete.

To predict the behavior of concrete under general stress, it's necessary to understand the consequences of the sort of sand, the properties of the sand and therefore the mixing of the mixture. This understanding can only be achieved through in-depth tests and observations.

For normal strength concrete, the compression is almost exclusively due to the removal of the cement paste from the aggregates, which is named "matrix-aggregate interface" for the needs of this report. On the opposite hand, in high-strength concrete, aggregate particles and therefore the interface are defective, which clearly contributes to overall strength. Because the strength of the cement paste increases, the rigidity and resistance are more compatible between the normally stiffer and stronger fine aggregates and therefore the surrounding adjuvants [1].

Fig.1. Natural Sand

The micro-cracks therefore tend to propagate through the mixture particles because not only the matrix-aggregate bond is stronger than the low resistance concretes, but also the stresses thanks to the unbalance of the elastic properties are reduced. Sand resistance therefore becomes a crucial factor for high-strength concrete.

II. LITERATURE REVIEW

Roy et al. [2], the author described the experimental investigation on fiber-reinforced concrete with mineral sand. Look for the compressive and tensile strength of grades M25 and M30 with different grades of steel fibers (0%, 1%, 1.5% and 2%). The test is performed on 96 samples in total by means of compression and tensile strength tests. It was concluded that the resistance is obtained from natural sand and the replacement of natural sand with M sand in concrete with the addition of steel fibers.

Deepa and Kumar et al. [3] The present study revealed the effect of using GGBS and Sand M in partial substitution of cement and fine aggregates, as well as an optimal proportion of polypropylene and steel fibers. For this study, M30 grade concrete was developed. The partial replacement of cement with GGBS is carried out for different percentages such as 0%, 10%, 20% and 30% by weight. Together with M, mix with sand and optimal fiber content, such as polypropylene (0.4%) and steel fibers (0.6%). The strength properties of the concrete were examined from this study.

Manogna et al. [4] the detailed experimental study on plastic fiber reinforced concrete was carried out by partially replacing the natural sand with sand produced with different percentages (0%, 20%, 40%, 60%, 80%, 100%) and l addition of a fixed percentage (0.5% by weight of cement) to plastic fibers (PP fibers).

Uttamraj et al. [5] the author finds the effect of cold concrete properties, such as ease of implementation and hardened properties, such as the compressive strength, tensile strength and bending strength of concrete. using 0% and 50% and 100% natural rob sand in cubes of 18 cubes of 150 mm x 150 mm x 150 mm replaced 18 cylinders of 150 mm x 300 mm, 18 prisms of 150 mm x 150 mm x 700 mm were melted and tested at the age of 7 and 28 days. In the second phase, the 3s recon was mixed with concrete containing 100% sand in different proportions of 0%, 0.5%, 1%, 1.5% and 2% and cubes with 27 150 mm × 150 dice mm × 150 mm × 150 mm, 27 prisms of 150 mm × 150 mm × 700 mm expressed and tested at the age of 7 days and 28 days. Conclusion: the compressive strength of 0% replacement concrete samples for Rob sand provides a resistance of more than 50% and 100%.

III.OBJECTIVE

Following are the main objectives of our study are as follow:

- Determination of m-sand use in place of natural sand to stop environmental hazard.
- Determine compressive strength of concrete with varying percentage of m-sand replacing natural sand.
- To establish a proper mix of m-sand and fiber for its future implementation on field.
- To determine the cost effectiveness & availability of manufacturing sand over natural sand.

IV. METHODOLOGY

The different lab tests were directed on aggregates according to pertinent IS code and blend outline of M-25 review of concrete. The research center test modified is outlined beneath.

- Sieve examination and fineness modulus.
- Specific Gravity
- Water Ingestion

The compressive strength, flexural strength and split tensile strength at 28 days of curing of concrete cubes/beams/cylinders will be investigated. Five trial blends were readied,to be specific ;

- ➢ Special Mix (Trial-1) i.e. Cement + Sand + Coarse Aggregate + 0 % Msand (Bamboo fiber 1%) +Water.
- ➢ Special Mix (Trial-2) i.e. Cement +Sand +Coarse Aggregate+50 % Msand (Bamboo fiber 1%) +Water.
- ➢ Special Mix (Trial-3) i.e. Cement + Sand + Coarse Aggregate+70 % Msand (Bamboo fiber 1%)+Water.
- ➢ Special Mix (Trial-4) i.e. Cement + Sand + Coarse Aggregate+90 % Msand (Bamboo fiber 1%)+Water.

A. *Sample Preparation*

- To build a structure first we need to build its base or foundations. Likewise, first of Mix design for different grades, grade of concrete is prepared according to the Indian standards code" IS 10262:2009.
- In the preparation of mix design for considered grades i.e. M20, 25 & 30, grade of concrete various physical properties of the materials like specific gravity, nominal size, water absorption capacity, fineness Modulus etc. are required, also some other conditions like type of exposure to sun and water, material mixing technique etc. are to be assumed in accordance with Indian standard code IS 456:2000.
- After working out the quality of different materials in an appropriate proportion, it's time for the selection of materials.
- Keeping in mind the "Indian standards" materials are selected i.e., aggregates:-
- Conforming/full filling the varied conditions as per IS 383:1970 and cement 53 grade OPC conforming to IS 12269:1987 are taken.
- Selected materials are mixed during a fixed proportion as per mix design to accumulate the specified strength.

Sampling & analysis of concrete is completed consistent with IS 1199:1959.

- IS 2386 (Part 1): 1963 is used for the methods of tests for aggregates for concrete
- Specifically for shape and size of aggregates.
- Two important tests are performed on concrete namely
- Slump cone test
- Compaction factor test, after preparation of mix for physical properties of concrete.
- Standard moulds of size 150 mm x 150 mm x 150 mm are then cleaned and oiled.
- Concrete is poured into the moulds and differently shaped reinforcements are placed within the Moulds.
- After 24 hrs. Concrete cubes are unbolted from moulds and named with waterproof paint and placed within the curing tank filled with normal water at 27 ± 2 0C for 28 days.
- At the top of seven, and 28 days curing it's time for the final test which provides the actual strength of concrete i.e., compression strength test in accordance with the "Indian Standards code" IS 516:1959 for the test of concrete.

B. Experimental Setup

I. Seive Analysis

The gradation of fine aggregate is done by performing sieve analysis .For defining the classifications (fine, medium & coarse) of fine aggregates as per their designation.

Limits of fineness modulus (F.M) with fine, medium & coarse as per IS:2386 (PART-1) – 1963 are as follows 2.2 - 2.6, 2.6 - 2.9, 2.9 - 3.2 .In sieve analysis, at constant weight at a temperature of 110 + 5ºC a test sample is dried and weighed. Then by using set of sieves (80mm, 63mm, 50mm, 40mm,31.5mm, 25mm, 20mm, 16mm, 12.5mm, 10mm, 6.3mm,4.75mm, 3.35mm, 2.36mm, 1.18mm, 600µm, 300µm, 150µm and 75µm) sample is sieved and the left material on each sieve is weighed. As a percentage of the total sample weight, Cumulative weight passing through each sieve is calculated. On addition of cumulative percentage of aggregates retained on each sieve and dividing the sum by 100, the desired fineness modulus is obtained.

II. Specific Gravity

Mass of a sample to that of an equal volume of a standard substance is generally defined as specific gravity of any material. Specific gravity test is conducted for all solid, liquid and gases. In terms of solid it is the difference in the two weights i.e. the weight noted first in air, then while immersed in water. Pycnometer apparatus is generally used while conducting the test. IS:2720-3.1 (Part-3) follows.

The formula is given,

$G_S = W_2\text{-}W_1/ (W_2\text{-}W_1)\text{-}(W_3\text{-}W_4)$

Where,

W_1 = Mass of empty Pycnometer W_2 = Mass of Pycnometer + Sand W_3 = Pycnometer + Sand + Water W_4 = Pycnometer + Water

III. Slump Cone Test

Slump Cone test is performed to review the properties of fresh concrete like workability and fluidity also indirectly concretes consistency or stiffness. They're of three main types namely three types collapse, shear and true.

The mould dimension of slump test is 300 mm of height, 200 mm base and 100mm at smaller opening which shows its appearance like frustum of cone. Container is crammed with concrete (whose workability is to be tested) in three layers, each tempted 25 times with standard steel rod (16mm) of shape at top. With the help of temping rod(screening and rolling) ,the top surface of mould is leveled with concrete mix after completion of filling process of concrete having smooth and firmly held against its base.IS:1199-1959-"Method of Sampling and Analysis of concrete" is follows. It must be assured that mound is firmly held against its base thanks to which movement during pouring process is nearly negligible. After the completion of filling and leveling of concrete, cone is gently and punctiliously lifted vertically, an unsupported concrete will now slump. Slump measurement is completed by placing cone besides slump concrete where temping rod is placed over the cone in order that it also comes over slumped concrete.

IV. Water Absorption test

According to IS: 2386 (Part III) – 1963, water absorption test is carried out for coarse aggregates. Minimum sample of 2000g is washed thoroughly to remove all dust, drained and then immersed at a temperature of between 22 and 32ºC in distilled water in an apparatus called wire basket. The entrapped air is removed by lifting the basket and dropping it 25 times in 25 seconds of time period after immersion is done. Afterwards, basket and the sample should remain immersed for a period of 24 + ½ hrs.

V. *Compressive Strength of Concrete*

Concrete characteristics are often easily determined by conducting this single test. Compressive strength test, utmost among all other tests performed. Depending upon the sizes of aggregate, two sorts of specimens are used either cubes of dimension 15 cm X 15 cm X 15 cm or 10cm X 10 cm x 10 cm but mostly 15 cm X 15 cm X 15 cm size of mould is preferable.IS:516-1959.Edition-1.2(1991-07) is follows. Cubes of desire mix proportions are casted by pouring concrete into mould and by proper tempering to avoid any voids. To get rid of moisture content these cubes were left for twenty-four hrs in open environment afterwards poured into water for curing. All the four sides of cube must be even & smooth. The test is performed on 7, 14 or 28 days of curing with compression testing machine by applying load at the speed of 140 kg/cm2/min till specimens fail. Compressive strength of concrete is given by load at failure thereto of area of specimen.

VI. *Preparation of Samples*

All materials might be conveyed to room temperature, ideally 27°C ' ± 3°Cbefore beginning the test. The cement tests, on landing in the research facility, might be altogether blended dry either by hand or in an appropriate blender such a way as to guarantee the best conceivable mixing and consistently in the material. The cement might then be put away in a dry place, ideally in air-tight metal compartments.

VII. Mixing of Concrete

The concrete should be blended by hand, or ideally, in a research facility cluster blender, in such a way as to keep away from loss of water or different materials, each bunch of concrete might be such a size as to leave around 10 percent overabundance subsequent to embellishment the coveted number of test examples.

VIII. Hand Mixing

The concrete bunch ought to be mixed on a watertight, non-retentive stage with a scoop, trowel or tantamount sensible realize, using the going with technique:

- The cement and fine aggregate ought to be mixed dry until the point that the mix is totally blended and is uniform in shading.
- The coarse aggregate may then be incorporated and mixed with the cement and fine aggregate until the point that the moment that the coarse aggregate is reliably scattered all through the gathering, and
- The water may then be incorporated and the entire bunch mixed until the point that the concrete appears, in every way, to be homogeneous and has the pined for consistency.

Fig. 2. Mixing of concrete

If repeated mixing is necessary, the batch must be discarded and a new lot must be created without interrupting the mixing for consistency testing.

IX. Compaction

Compaction is removing the air from concrete. Specimens were compacted by utilizing temping bar for good compaction of concrete. This is the technique for disposing of entangled air from the concrete, either by methods for rodding, slamming or by vibrating.

The reasons for compacting concrete being to get a thick mass of concrete without voids, to get the concrete to encompass all support and to fill all corners. Amid the procedure of fabricate of crisp concrete a lot of air is entangled framing voids in it. Voids show in concrete as little pores, decrease the quality and thickness of concrete. There are two sorts of concrete voids specifically, water void and air void.

Honeycombed Concrete does not build up a decent bond with fortification. Water may infiltrate through these voids and consume the steel. The operations received for acquiring a genuine and uniform concrete surface are called completing operations.

X. *Curing of Concrete*

The care keeps the concrete moist for a period of time to reach maximum strength. Prolonged hardening gives a more resistant concrete.

Concrete is usually hardened with water, although tartar is used. It makes the concrete stronger, more durable, more waterproof and more resistant to abrasion and frost. The hardening was carried out with the sample stored in the tempering tank. As a general rule, curing begins as soon as the concrete is hard enough. However, the hardening rate of the concrete decreases a lot with the lowering of the room temperature.

V. Results

A. Seive Analysis & Fineness Modulus

Sieve analysis and fineness modulus of coarse aggregates for 20mm size and 10mm size is given in table 5.1 and table 5.2 respectively. Total Weight of Coarse aggregate to take sieve analysis: 2 Kg, Coarse aggregate size: 20 mm.

Fig. 3. Seive Analysis

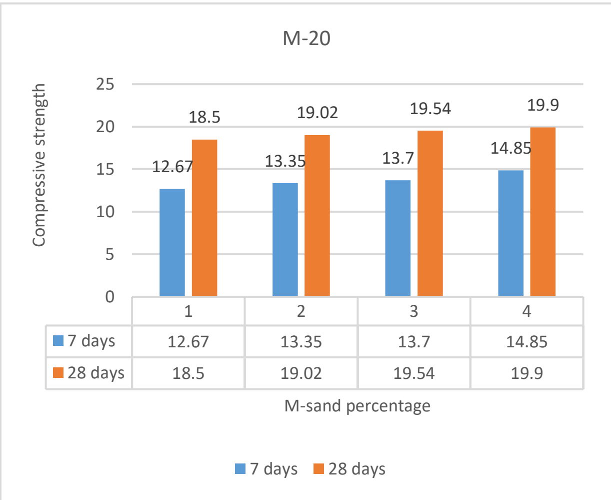

Fig. 4. Compressive Strength of M-20 mix

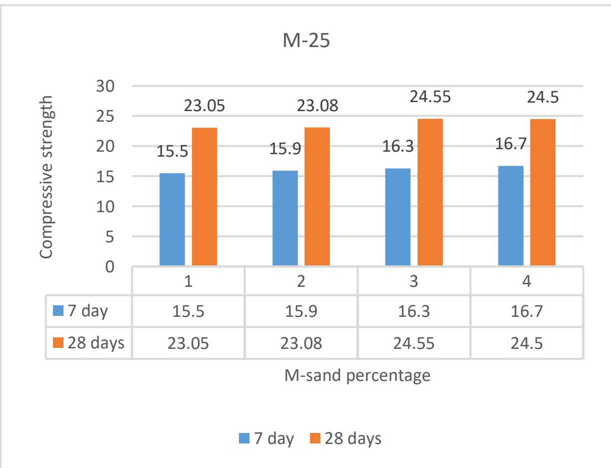

Fig. 5. Compressive Strength of M-25 mix

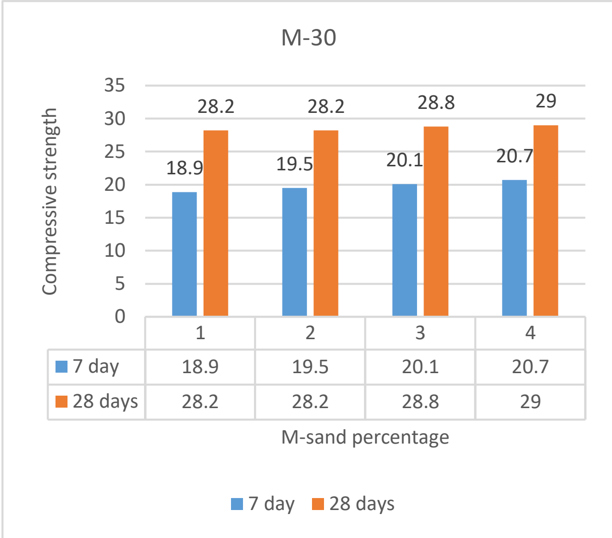

Fig. 6. Compressive Strength of M-30 mix

VI. Conclusion

Based on the present study, the following conclusions were drawn. The addition of M-sand significantly increased the compressive of concrete with maximum strengths in each case being achieved at 90% of M-sand.

- The compressive strength of concrete with M-20, M-25 and M-30 design mix increased by about 4.5% by addition of bamboo fiber significantly improved engineering properties of the concrete like water resistivity and cracking due to load.

- Compressive strength increased significantly with the addition of bamboo fiber and M-sand replacement in each design mix and strength is increased as percentage of M-sand in increased.

VII. Future Scope

- In this study Bamboo fiber is considered whereas in future glass fiber can be consider for future researches.
- In this study M-sand is replaced by 90% maximum whereas in future one can completely replace the natural sand by M-sand.
- In this study compressive strength is considered whereas in future we can select tensile and flexure strength too.

References

[1] Magudeaswaran, Eswaramoorthi C, Ravichandran P T and Kannan Rajkumar P R, 2016, High Performance Concrete Using M Sand", *Indian Journal of Science and Technology*, Vol 8, issue 28, DOI: 10.1748, 2018

[2] Roy Mary Ealias., Rajeena, A.P., Sivadutt, S., Life John. "Effect of Steel Fibres on Concrete with M-Sand as a Replacement of Natural Sand" *IOSR Journal of Mechanical and Civil Engineering*. Vol. 11, pp. 16-24, 2018

[3] Deepa & Kumar, "Experimental Study On Hybrid Fibre Concrete With Using GGBS And M Sand" *International Journal of Science, Engineering and Technology Research (IJSETR),* Volume 3, Issue 6, June 2018.

[4] Manogna and Guruprasad, "Experimental study on the properties of PFRC using M-Sand", *IJSRD*, 2017.

[5] Uttamraj and Rafeeq "A Experimental study on m- sand and recron 3s fiber for m30 concrete" *International Research Journal of Engineering and Technology (IRJET),* June-2017.

[6] Suresh and Revathi, Kuswah S S, Amit Vishwakarma, "High Performance Concrete with M-Sand and Its Further Aspects", *IJSRD-International Journal for Scientific Research & Development,* Vol. 3, 2017.

[7] Vishal Gadgihalli, "analysis of properties of concrete using manufacture sand as fine aggregates SSRG" *International Journal of Civil Engineering (SSRG-IJCE),* 2017.