International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 05 | May 2021 www.irjet.net p-ISSN: 2395-0072

FLEXURAL BEHAVIOUR OF STEEL FIBRE REINFORCED CONCRETE BEAMS WITH M-SAND REPLACEMENT

G.SARAVANAN

M.E STUDENT(STRUCTURAL ENGINEERING)

Dr.P.ASHA.,

Professor / Department of Civil Engineering

St.peter's institute of higher education and research, chennai- 600 054.

P.SAMPATH.

Assistant Professor/Department of Civil engineering

St.peter's institute of higher education and research, chennai- 600 054.

---***---

Abstract - *Concrete is the basic engineering material used in most of the civil engineering structures. Its popularity as the basic building material in construction because of its economy of use, good durability and ease when it can be manufactured at site. The ability to mould it into any shape and size, because of its plasticity in green stage and its subsequent hardening to achieve strength . The purpose of this research is based on the investigation of the use of steel fibres and M-sand in structural concrete to enhance the mechanical properties of concrete. This investigation was carried out using several tests, compressive test and flexural test. The optimum percentage of M-SAND and FIBRE was found by replacing the ordinary sand by 0%, 10%, 20%, 30% of M-SAND and 0%, 1%, 3%, 5% of FIBRE is added additionally to the normal concrete and 'Hooked' steel fibres were tested to determine the enhancement of mechanical properties of concrete. The workability of concrete significantly reduced as the fibre dosage rate increases. M-sand properties also tested in an effective replacement of concrete.*

Key Words: **concrete, M-Sand, Construction, Steel Fibres.**

1. INTRODUCTION

For thousands of years, small and discrete fibers have been used to reinforce brittle materials. In ancient times, for example, the Egyptians used straws to improve the cracking resistance of sun-dried mud bricks used for constructing huts. The feasibility of using fibres to improve the ductility and tensile strength of concrete, however, was not fully realized until the publication of classic reports from Romualdi and Baston in 1963 followed by Romualdi and Mandel in 1964. Soon after, the modern era of research and development of fibre reinforcement technologies began. Fibre reinforced concrete (FRC) also provides advantages over the use of conventional reinforced concrete for non-structural applications. Studies have shown that FRC will result in smaller crack widths and better abrasion resistance relative to their non-fibrous counterpart. As a result, secondary reinforcements, such as shrinkage and temperature reinforcement, may also be eliminated with the addition of fibres.

1.1 RESULT SIGNIFICANCE

The main aim of the project is to adopt a material which improves the concrete and it should be environment friendly. The replacement results which can be highly used for low cost construction and quality housing. Based on these objectives this project was undertaken.

1.2 SCOPE AND OBJECTIVE

To find the optimum mix design with regards to the amount of water, steel fibres, coarse aggregates, M-sand and cement ratio

- To investigate the physical properties of steel fibres bending and compression, water absorption and moisture content.
- To study the strength development with m-sand replacement with control concrete.
- To study the compression test on SFRC on standard IS specimen size (150mm x 150mm x 150mm) and the split tensile test on SFRC on standard IS specimen size (100mm x 200mm)
- To find out the flexural behaviour of SFRC on standard IS specimen size (100mm x 100mm x 500mm and Reinforced concrete beam on SFRC on standard IS specimen size (1200mm x 150mm x 100mm).

2. LITERATURE REVIEW

Larbi (2010). "States that the effects of polymer dispersions on the structure of the interfacial zone between Portland cement paste and aggregates have been investigated". With increasing polymer content cement hydration products become indistinct, and micro cracks appeared to be bridged- up by the polymer film. The thickness zone of interfacial zone with respect to the polymer appears to be reduced to about 15μm by the polymer addition.

Raghuprasad (2011)., Investigated in this paper presents an approximate analytical solution for the progressive failure analysis of reinforced concrete shallow beams .crack initiation and propagation up to failure are characterized by one-dimensional model based on equilibrium equations and nonlinear fracture mechanics principles. The results obtained by the proposed model compare well with the available experimental results.

Vachon (2010)., States that as the use of blended silica fume in commercial concrete construction increases, it is important to evaluate the influence of such types of cement on important characteristics of fresh and hardened concrete. The objective of this paper is to provide data about various properties of concrete made with the relatively new type of cement, a blended silica fume cement, and to compare them to values obtained with similar mixtures containing standard Canadian CSA Type 10 and Type 20 portland cements. **Saccani (2011**) Investigated that the effect of polymer addition on alkali silica reactions in cementitious mortars containing high alkali concentractions has been investigated. A bicomponents epoxy resin was added to the mortars formulation up to a 20% wt of cement content. Mechanical properties were investigated. As the polymer content increases mortar expansion is reduced.

Mirza (2012)., States that the results of an ongoing test program to evaluate the performance of polymer-modified cement-based mortars for repairing surfaces of concrete structures up to a depth of 75mm.25 selected commercially available polymer-modified products,7 containing styrene butadiene rubber(SBR) and 18 containing acrylics were evaluated. They were compared with those of pure cement- based mortar containing 8% silica fume by wt of the cement, with W/MC (water/cementitious material (cement +silica fume) ratio of 0.31.

3. MANUFACTURING SAND (M-SAND)

3.1 WHAT IS M-SAND?

Manufactured sand (M-Sand) is artificial sand produced from crushing hard stones into small sand sized angular shaped particles, washed and finely graded to be used as construction aggregate. It is a superior alternative to River Sand for construction purpose.

Superior Strength: M-Sand has higher compressive and flexural strength. Due to weathering natural sand particles are rounded, whereas M Sand particles is angular and have a rougher surface texture, allowing better bonding with the mortar in concrete, thereby providing improved strength properties.

Better Workability: M-Sand is graded with precision and consistency thus it has higher Fineness Modulus compared to natural sand and crusher dust. This gives good workability for concrete and masonry.

Lesser Cement Consumption: M-Sand is free of impurities such as clay, dust and silt and has denser particle packing than natural sand particles thereby reducing the voids in aggregate and hence saves cement requirement in concrete production.

Readily Available: M-Sand can be produced near to the construction sites, thus bringing down the transportation costs and consistent supply for demanded quantity can be assured.

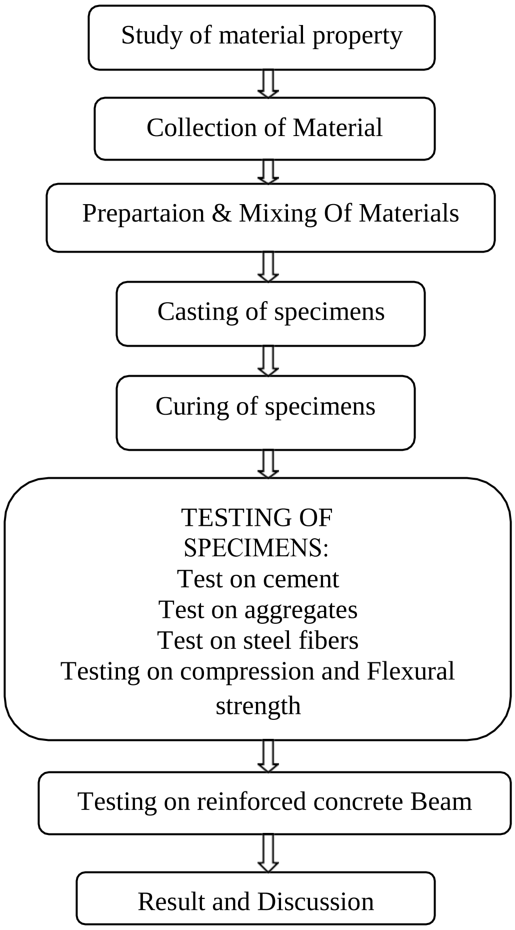
Eco-friendly-The mining of river sand has led to many environmental disasters like erosion of riverbed and banks and is damaging to the natural eco-system. Manufactured Sand is an eco-friendly and sustainable resource for construction purpose.

Fig -1: Manufacturing Sand (M-Sand)

4. METHODOLOGY

In this chapter the brief description of the methodology and the sequence of the works carried out in this completed duration of project are presented.

A Simple flow chart showing the sequence of activities carried out throughout the project:



International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 05 | May 2021 www.irjet.net p-ISSN: 2395-0072

4.1 BASIC INGRIEDIENTS OF SFRC

4.1.1 CEMENT:

Cement is a hardened material with adhesive as well as cohesive properties. It is a building materials that is a powder made of a mixture of calcined limestone and clay; used with water and sand or gravel to-make concrete and mortar. Cement when mixed with water gets hardened. Cement and strength criteria are directly proportional to one another. Cement is useful to construct the walls, bricks, R.C.C works, plastering purposes etc..

4.1.2 AGGREGATES:

Aggregates are the important constitute of concrete which influence the strength of hardened concrete. Aggregate passing through 20mm sieve andretainedon12.5mm.

4.1.3 FINE AGGREGATE (M SAND):

Fineaggregatepassingthesieve1.18sievewasused.

4.1.4 WATER:

Thenormalrangeforp H insurfacewatersystemsis6.5to 8.5 and for groundwater systems 6 to 8.5. In general, water with a low pH (<6.5) could be acidic, soft, and corrosive which is not suitable in concrete mix.

4.1.5 STEEL FIBRES:

The use of steel fibre in concrete can improve its many properties. The benefits of using steel fibres in concrete are as follows:

Fig - 2 Steel fibers (hooked end)

- Steel Fibres are generally distributed throughout a given cross section whereas reinforcing bars or wires are placed only whererequired
- Aspectratiosbetween40-80arecurrentlyused.
- Steel fibres are relatively short and closely spaced as compared with countinuous reinforcing bars of wires.
- It is generally not possible to achieve the same area of reinforcement to area of concrete using steel fibres as compared to using a network of reinforcingbarsofwires.
- Steel Fibers are typically added to concrete in low volume dosages (often less than 1%), and have been shown to be effective in reducing plastic shrinkagecracking.
- Steel Fibers typically do not significantly alter free shrinkage of concrete,howeverathighenoughdosagesthey can increase the resistance to cracking and decrease crack width (Shah, Weiss, and Yang 1998).

4.2 IMPROVEMENT IN CONCRETE PROPERTIES BY STEEL FIBERS

- Compressive strength - Improved strength
- Tensile strength - Improved tensile
- Flexural Strength – Its improved up to 3 times more as compared to conventional concrete.
- Fatigue Strength -Increase in 1.5 times
- Impact strength- Improved and better resistance to wear and tear
- Permeability-Improvedpermeabilitybyinclusionoffibers
- Corrosion–Itmayaffect,butinextremecondition
- Split Strength – Increased up to 25 – 30%.

4.3 SPECIMENS CASTED

The wooden formworks required for casting the reinforced beam are fitted and the required reinforcement is being tied up as per the beam calculation. The covers are being provided to avoid the formworks contact with reinforcement. The formwork and reinforcement details provided are shown in the figure below.

The wooden formworks required for casting the reinforced beam are fitted and the required reinforcement is being tied up as per the beam calculation. The covers are being provided to avoid the formworks contact with reinforcement. The formwork and reinforcement details provided are shown in the figure below.

Fig -3 Casted Specimen

Beam Specimen	No. of Beams
Conventional beam	2
10 % of M-Sand and 1% of S.F	2
20% of M -Sand and 3% of S.F	2
30% of M- Sand and 5% of S.F	2

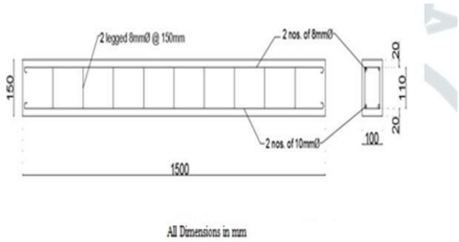


Fig - 4 Reinforcement Details of RC beam

4.4 Load Vs Deflection for SCC Control Beam

Load (KN)	Deflection (mm)			
	0 % of M-Sand and 0% of S.F	10 % of M-Sand and 1% of S.F	20 % of M-Sand and 3% of S.F	30 % of M-Sand and 5% of S.F
0	0	0	0	0
2	3	2.3	2.4	2.1
3	4.7	2.9	2.6	2.3
4	6.4	3.1	3.8	3.1
5	8.6	3.6	3.9	3.6
6	12	3.9	4.1	4.3
8	15.4	4.2	4.2	4.4
10	17.5	4.5	4.5	4.5
11	18.8	4.9	5.0	5.0
12	19.9	5.1	5.1	5.3
13	-	6.3	5.3	5.9
14	-	8.9	5.9	6.3
15	-	10.1	7.1	7.5
16	-	12.2	8.2	8.3
17	-	13.2	9.2	9.8
18	-	-	10.3	10.9
19	-	-	11.3	11.6
20	-	-	12.3	12.6

Fig-5 Loading Frame Setup

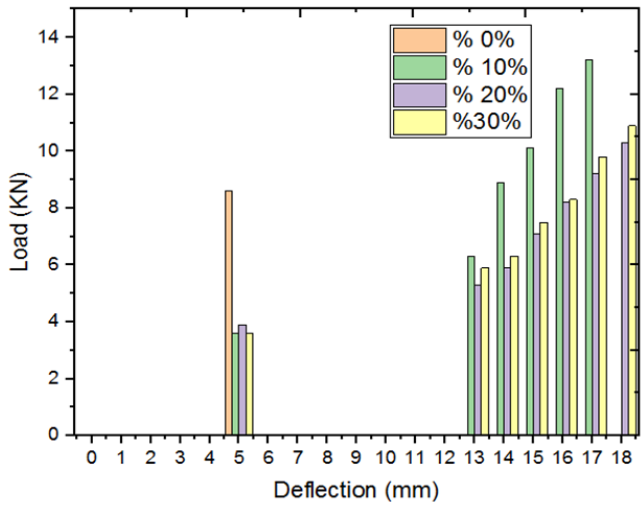


Fig – 6 Load Vs Deflection

5. CONCLUSION

Based on the experimental study on M-SAND for various fineness modulus and test results, the following observations are made:

This concludes the different properties of cement as well as concrete which is affected due to the introduction of m- sand and steel fibers. The water requirement decreases with increase in fineness modulus which means that coarser the aggregates lesser is the water requirement. The specimen was casted for compression and tensile strength and testing 7, 14 & 28 days. Also discussed the Improvement In Concrete Properties By Steel Fibers . The compression strength of
36.62 N/mm2 and tensile strength of 2.21 N/mm2 was obtained. The drying shrinkage of cement mortar decreases with respect to increase in fineness modulus. There is substantial increase in compressive and bond strength of mortar with admixture compared to mortar mix without admixture. This is due to usage of relatively lesser water cement ratio. Plastering Sand produced having a better particle size distribution with maximum particle size as

2.36mm and Fineness Modulus between 1.8 and 2.0, is more suitable to produce quality Plastering Mortar.

In this project the study on flexural strength of Steel fibre concrete beam with M-Sand and Steel Fiber beams are cast and tested in loading frame. The ultimate load, Deflection and flexural strength are obtained from the testing results and the results are summarized and the following conclusions are made.

Based on the experimental results from this project the following conclusions are made.

- Compressive strength and split tensile strength of steel fiber while replaced with 25% of M-Sand which gives increase in value compare with control concrete.
- The experimental results of all the control beams are compared with the partially replaced M-Sand with Steel Fiber Beams.
- Their behavior throughout the test is described using mechanically obtained data on deflection behavior and the load carrying capacity.
- All the beams are tested for their ultimate strengths and flexural strength is obtained.
- It was observed that 20% replacement of M-Sand with 3% of S.F beam has 14.5% higher strength compare to conventional concrete mix.
- By using M-Sand the amount of Fine Aggregate used for concrete will be reduced by 25%.
- Availability of M-Sand is in Quarry. During scarcity of River Sand only the cost of M-Sand will be costlier
- The beam replaced with 25% of M-Sand and 5% Steel fiber are obtained good strength and gives cost effective compare to other obtained results.

6. References

1) J.A.Larbi, J.M.J.M.Bijen, et al (2010) ,"influence of polypropylene fibres on the performance of nanosio2- incorporated mortar" iranian journal of science & technology, transaction b: engineering, vol. 34, no. B4, pp 385-395 printed in the islamic republic of iran, 2010 © shiraz university.

2) B.K.Raghuprasad, H.Ananthan, et al(2011). "Mechanical Properties of Synthetic Fibres Reinforced Mortars" International Journal of Scientific & Engineering Research, Volume 4, Issue 4, April 2011ISSN2229-5518

3) K.H.Khayat, M.Vachon, et al (2010), Fibre reinforced cementitious composites. vol. 34, no. B4, pp 385-395.

4) A.Saccani and A.Motori,, Fibre reinforced cementitious composites" Elsevier applied science London and Newyork 1990.

5) J.Mirza, M.S.Mirza, et al(2012)., ASTM C1018 – 89, Standard Test Method for Flexural Toughness and First Crack Strength of Fibre Reinforced Concrete (Using Beam with Third – Point Loading), 1991 Book of ASTM Standards, Part 04.02, American Society for Testing and Materials, Philadelphia, pp.507 – 513.

.