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"AN STUDY OF FIBER REINFORCED LIGHT WEIGHT FERROCEMENT BEAMS UNDER MONOTONIC AND REPEATED LOADING"

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Abstract— Ferrocement is a comprehensive technology and holds outstanding distinctive properties such as virtuous tensile strength, developed durability, water stiffness, lightness, fire resistance, resistance to cracking, cost reduced, time and substantial effective construction expertise. ACI Committee recommended that: "Ferrocement is one of small reinforced concrete usually made-up of hydraulic cement grout reinforced by thoroughly spaced coatings of unbroken and moderately small dimension wire mesh. Meshes are may be metallic or any other appropriate constituents. The present work is concentrated on two major aspects, (i) Effect of fibers on first crack & ultimate strength and (ii) Behavior of fibers reinforced ferrocement beams under Monotonic & Repeated flexural loading. The first part of the present study has been focused on the effect of fibers on First crack & Ultimate Strength with replacement of fibers by 0%, 0.5%, 1%&1.5% and second part of the work focusing the behavior of fiber reinforced ferrocement beams under monotonic & repeated loads with increased load. The results obtained from this work is expected to be useful in determining the strength and behavior of fiber reinforced ferrocement beams subjected to similar types of forces and thus will help toward designing ferrocement beams to withstand monotonic and Repeated flexural loading.

Keywords- Light weight ferrocement, fiber reinforce, wire mesh, monotonic & repeated loading.

1. INTRODUCTION

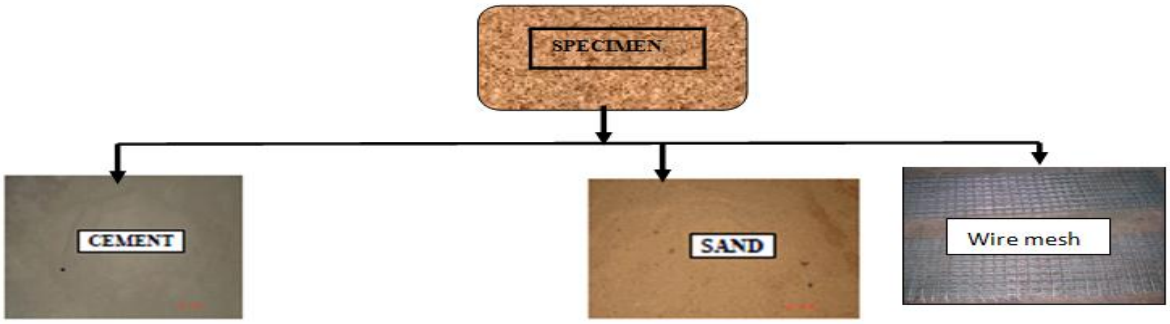
As modern engineering practices become more demanding, there is an increasing need for a wider spectrum of construction materials with novel properties. It includes developing existing materials in to ones with modified properties in combination with other suitable materials. Cement concrete is a processed construction material of immense importance not only in the field of civil engineering but also in the history of mankind.

Fibre reinforced Light weight ferrocement is a composite material consisting of cement-sand mortar (matrix) with steel fibers ,reinforced layers of small diameter wire meshes and Blast Furnace Slag . It consists of closely spaced, multiple layers of mesh / fine rods completely embedded in cement mortar.The steel bars are used in addition, to form a steel skeleton, which helps in retaining the required shape of the ferrocement components until the cement mortar hardens. From conventional reinforced concrete primarily by the manner in which the reinforcement is arranged within the brittle matrix It differs. it is classified as a separate material and Its behavior is quite different from that of conventional reinforced concrete in performance, potential applications and strength. The high resistance against cracking; also many of its engineering properties such as fatigue against resistance and toughness and impermeability etc are improved in the reinforced concrete Fibre reinforced Light weight ferrocement. Fiber reinforced Light weight ferrocement is used often because the constructions made from it are better resistant against earthquakes. Earthquake-resistance is dependent on good construction technique and additional reinforcement of the cement, In India.

2. EXPERIMENTAL WORK

The properties of cement and sand are tested in laboratory and are reported in section 2.1. 0.45 of Water cement ratio by weight is taken. The Adding of fiber by volume fraction considered in this study are 0.0%, 0.5%, 1% and 1.5 % which are adopted for the preparation of flexure specimens.

2.1MATERIALS USED AND ITS PROPERTIES



I. Cement

Table-1:Physical Properties of Cement

Physical property	**Results obtained**	**IS specifications**
Normal consistency (%)	34	!Not specification
Initial setting time	40 minutes	Not less than 30 minutes
Final setting time	450 minutes	Less than 600 minutes
cement Fineness	2.5%	!Not more than 10%
Specific gravity	3.15	3.15
Compressive strength @3-days	29.5 N/mm^2	23.0 N/mm^2
Compressive strength@ 7-days	39.5N/mm^2	33.0 N/mm^2
Compressive strength @28-days	44.20 N/mm^2	43.0 N/mm^2

II. Fine aggregatre

Table-2:Physical Properties of FineAggregate

Sand FM	3.05
Sand Density	1.6
Sand Water content (%)	0.5
Specific gravity of sand	2.62

III. Steel Fibers

In this investigation we are using hooked ended steel fibers. Which having the following specification and figure shown below.

Table-3: Fibers specification

Notation	Aspect Ratio	Length (mm)	Diameter (mm)	Shape of fiber
SF	50.0	50	1.0	Hooked end

IV. Water

Ordinary potable water was used for mixing.

V. *Wire mesh*

Wire meshes have 0.55 mm average dia at 4.17 mm c/c) are used. The strength of wire mesh is 435.86 N/mm^2.

CASTING & TESTING OF SPECIMEN

Casting of specimens

Parameters considered in this study are, the percentage of Fibers add and mesh wires. Added fibers by 0%, 0.5%, 1% and 1.5% and mesh wires of 0 and 2 layers were considered in this study. 3 specimens were cast at a time. Fig 3, shows the dimension of specimens and using of wood moulds for casting the specimens. In each casting 3 mortar cubes 70.6 of mm side were also cast as control specimens. The specimens were white washed before testing to ensure visibility of cracks clearly.

Fig.1 Teak wood mould

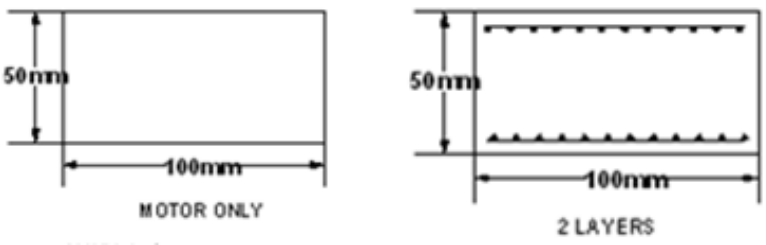


Fig 2 Cross sectional and reinforcement details of the Specimen

TESTING OF SPECIMEN

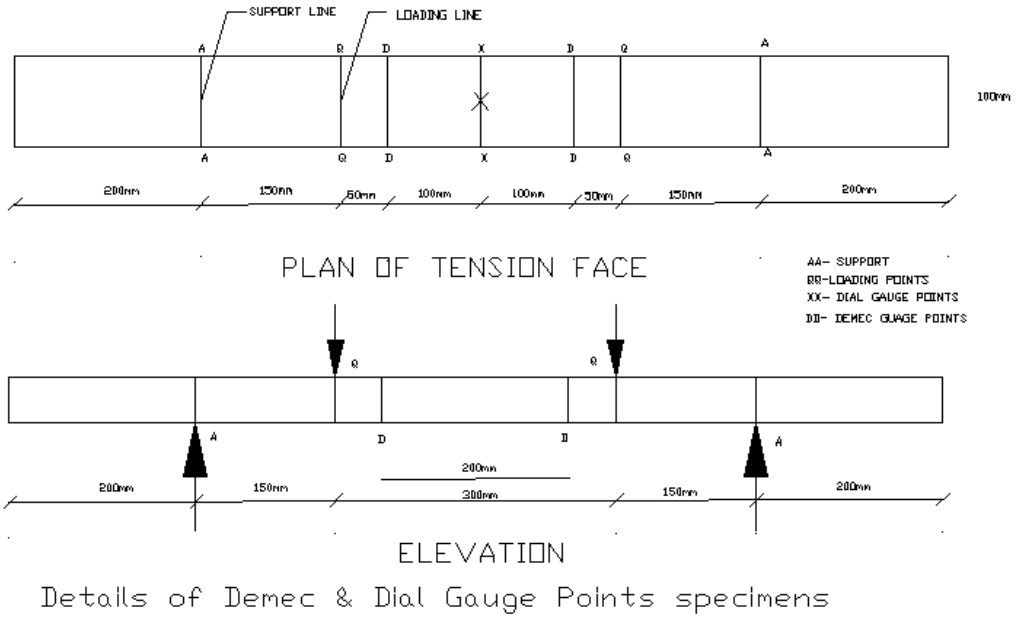


Fig 3 Details of Demec & Dial Gauge points specimens

In each set three specimens were tested under monotonic loading. Universal Testing Machine has been used for testing specimens under monotonic loading as shown in figure 4. Two points loading is used a mechanical screw jack of 100kN capacity through a distribution steel beam. 50 kN capacity proving ring is used to Applied load.

Deflections were measured at mid points and locations of these points are shown in figure 4. For measuring deflections at these points, dial gauges of 25mm range with least count of 0.01mm were used. In testing of specimens the dial gauges were reset when the deflection exceeded.

Strains on mortar surface of specimens were measured by demountable mechanical gauge. Specimens Surface strains were measured on top and bottom edges and the depth. Strains were measured on both the faces of specimen over gauge length of 200mm and least count of demec gauge was$1x10^{-5}$.

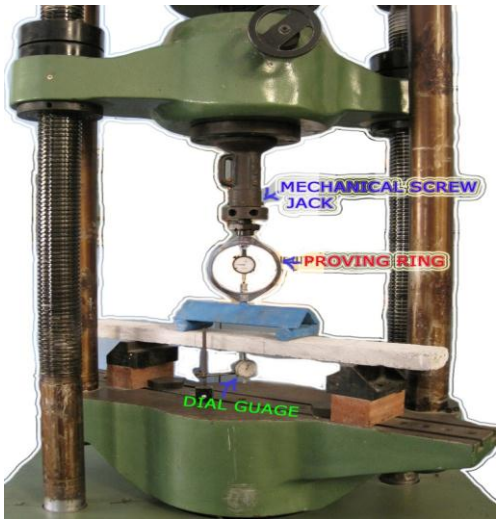


Fig 4 Specimens testing Arrangement

3. RESULT & DISCUSSION

Three Specimens Behavior of average for each percentage of fibers under monotonic load, represented by the load deflection curves Shown in fig 5.

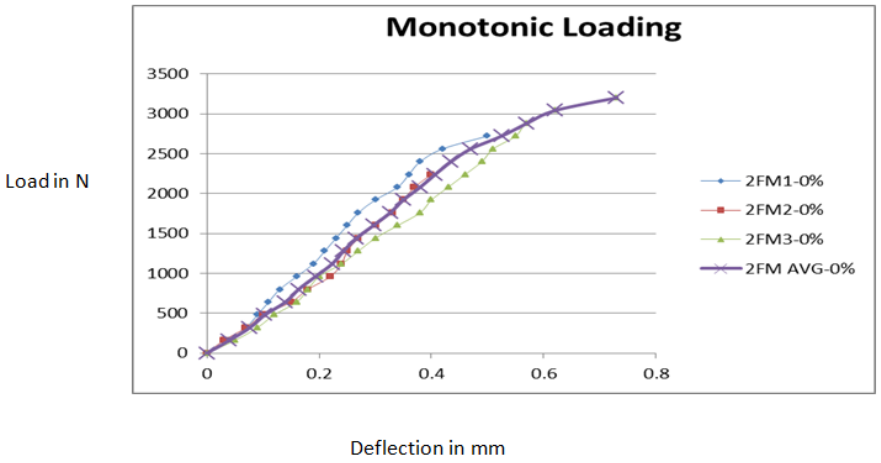


Fig 5: 2-layered Load Vs Deflection in monotonic loading (Vf=0%)

For all specimens under monotonic loading, the load deflection curves show generally three portions.

In that, the first portion is a rising portion up to ultimate load. The third portion is the post-peak portion which shows an increase in deflection with decrease in load value.

Three Specimens Behavior of average for each percentage of fibers under repeated load, represented by the load deflection curves Shown in fig 6.

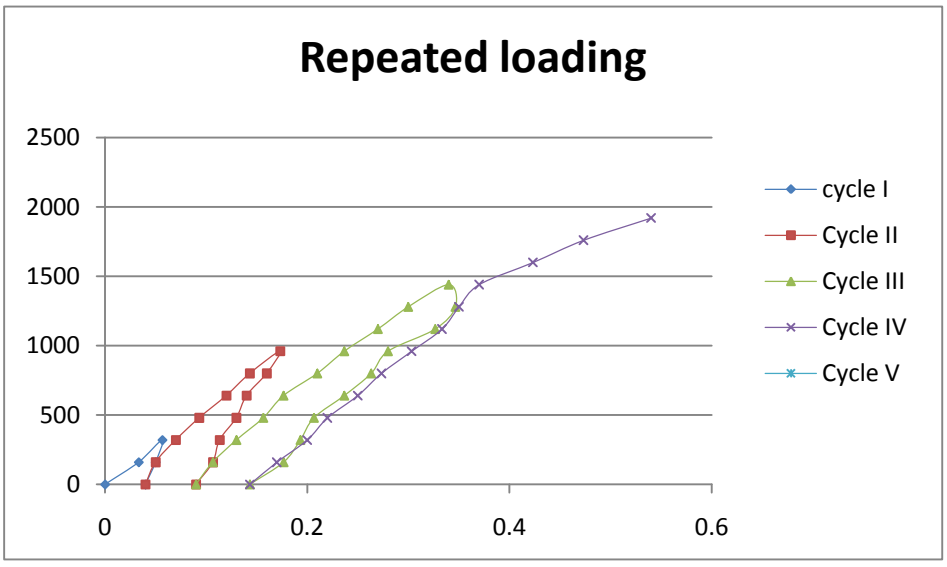


Fig 6: 2-layered Load V/s Deflection in repeated loading (Vf=0%)

In load –deflection curves for repeated loading in Fig 6, a narrow hysteresis loop has been observed between unloading and reloading curve for cycles prior to ultimate load. The ferrocement specimens with fibers have more ductility compared to RCC specimen.

Fig 7: 2 layered flexural repeated beam (Vf=0%)

Mode of Failure and Cracking of Specimens

While testing, specimens are failed suddenly on a vertical plane at the moment of the Appearance of the first crack for without reinforcement (FM-0%, FM-0.5%, FM-1%, FM-1.5 %,) Specimens. For a specimens with wire meshes, the first crack always appeared as a vertical crack when the load was applied in a direction perpendicular to the mesh layers in the specimen(parallel to the loading direction) and mostly along one of the mesh layers. When specimens reinforced with wire meshes we can observe this phenomenon.

4. CONCLUSIONS

From the above experimental investigation, the following conclusions can be drawn,

- It can be observed that, strength increase up to 10% added of fibers in the first crack and decrease with the increased percentage of fibers marginally both monotonic and repeated loading.
- Under repeated loading, Fiber reinforced ferrocement having a better behavior than reinforced concrete.
- The good moment of resistance in Fiber reinforced Light weight ferrocement beams observed.
- Fibers not only decrease crack width but also reduces the number of cracks.
- Optimum fiber content for fiber reinforced light weight ferrocement Beams is obtained 10% in flexure.

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BIOGRAPHIES

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