STUDY ON FLEXURAL BEHAVIOUR OF POLYMERMODIFIED FERROCEMENT BEAM ELEMENTS

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ABSTRACT

Ferrocement is widely used for thin wall structures because of the uniform distribution and dispersion of reinforcement which provides better cracking resistance, higher tensile strength to weight ratio, ductility and impact resistance. However, it forms minor cracks under small loads and so has a problem with durability, since cement mortar has conventionally been used as matrix for the ferrocement. Therefore, to improve the flexural behaviour and durability of ferrocement, specimens were made with modified mortars. The main objective of this paper is to study the Flexural strength for Modified ferrocement beam elements. The addition of admixtures in ferrocement improves its Flexural behaviour and Durability.

Key Words: *Ferrocement, Durability, Flexural behaviour, cracking resistance, modified mortars.*

1.INTRODUCTION

Ferrocement is a super reinforced concrete. It different from conventional concrete in that there is a higher ratio of steel to cement mortar by altering the cement/steel ratio. Ferrocement has many of the properties of steel and yet it will not rust. Mortar provides the mass and wire mesh imparts tensile strength and ductility. Compared to durability of a structure is its resistance to weathering action, abrasion, chemical attack, cracking or any other process of destruction. Corrosion of reinforcement is one of the major reasons for deterioration of ferrocement. The corrosion of reinforcement mainly depends upon the permeability of the cement mortar. So by proper selection of chemical, water cement ratio of mortar can be reduced. It has found itself in numerous applications both in the construction of new structures and repair/rehabilitation of existing structures. Therefore the authors have conducted this investigation to improve the flexural magnitude than that of conventional reinforced concrete.

2. MATERIALS

CEMENT

The cement used was ordinary Portland cement of 53 grade confirming to IS 12269-1987. The net weight of each bag was 50 kg .

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In order to have more uniformity in the results of the work, the cement used for the complete work was selected from the same lot.

FINE AGGREGATE

Manufactured is produced by reducing larger pieces of aggregate into sand-sized aggregate particles. The cost of construction can be controlled by the use of manufactured sand as an alternative material for construction. The other advantage of using M-Sand is, it can be dust free, the sizes of m-sand can be controlled easily so that it meets the required grading for the given construction.

TABLE 1- Specifications of M-Sand

PROPERTY	M-SAND	REMARKS
Shape	Cube particle	Good
Particle passing 75 micron	Presence of dust particle shall be less than 15%	Limit 3% for -uncrushed and limit 15%for crushed sand
Specific gravity	2.5-2.9	May vary
Water absorption	2-4%	Limit 2%

WATER

Water is an important ingredient of concrete as it chemically participates in the reaction with cement to form the hydration product, C-S-H gel. The strength of cement mortar depends mainly from the binding action of the hydrated cement paste gel. A higher w/c ratio will decrease the strength, durability, water tightness and the related properties. The pH value of water should be not less than 6.

POLYMER

SBR polymer is most widely used in concrete. The proportion of SBR latex, combined with low water /cement ratio produces concrete that has improved flexural, tensile, bond strength, lower modulus of elasticity and reduced permeability characteristics compared with conventional concrete of similar mix design. Compressive strength is typically unchanged. All properties of modified concrete were analyzed depending on the quantity of polymer used. Water absorption decreased with the increase of polymer/cement ratio.

Table 2.Physical properties of polymer

PROPERTIES	DESCRIPTION
Appearance	White emulsion
Specific Gravity	$1.02\pm0.02@25^{o}c$
pH value	7-10.5

MESH

Locally available woven wire mesh with an average diameter of 0.6mm,Several strands of wire taken from the mesh and tested under UTM of 100 KN capacity for tension to determine the average yield stress, the ultimate strength and modulus of elasticity.

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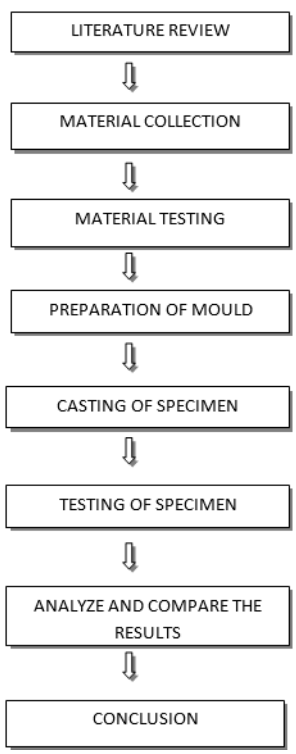
3 SKELETAL STEEL

Skeletal steel of 6mm diameter rod is used in ferrocement .It is in form of welded fabric as a grid of steel rods, strands of small diameters.Skeletal reinforcement is needed to form the shape of the structure to be built. In specimens where 2 or more layers of wire meshes are used, the additional layers were placed above the skeletal steel bars.The ultimate tensile strength of mild steel is 472 N/mm^2.

4. METHODOLOGY



5. PREPARATION OF SPECIMEN

FABRICATION OF THE REINFORCEMENT CAGE

The wire mesh gauges were cut in to the required dimensions. It is then placed over the mould and bent into the required shape. Then the 6 mm diameter skeletal steel bars were placed at the required position and were tied well together with the wire mesh to form the reinforcement cage. In specimens where 2 layers of wire meshes are used, the additional layers were placed above the skeletal steel bars. The mould is oiled well and polythene sheet is placed over it for easy removal of the specimens.

Fig 5.1 Trapezoidal shape specimen

Table 5.1 Designation of the Trapezoidal section

Specimen Designation	% of polymer	No of layers	V_{RL}(%)	S_{RL} per mm
1	0	1	1.30	0.17
2	2	2	1.52	0.20

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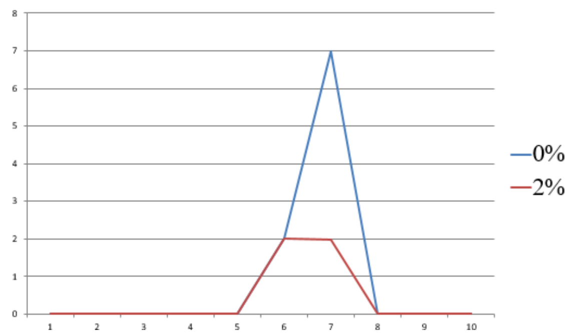

Fig 5.1 Moment Value Comparison for trapezoidal elements

CHANNEL SECTION

Fig 5.2 Channel section specimen

Table 5.2 Designation of the channel section

Specimen Designation	% of polymer	No of layers	V_{RL}(%)	S_{RL} per mm
1	0	1	1.30	0.17
2	2	2	1.52	0.20

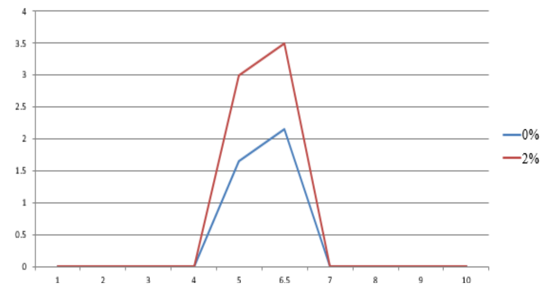

Fig 5.3 Moment Value Comparison for channel elements

CORRUGATED SHAPE

Fig 5.3 Channel shape specimen

Table 5.3 Designation of the channel section

Specimen Designation	% of polymer	No of layers	V_{RL}(%)	S_{RL} per mm
1	0	1	1.30	0.17
2	2	2	1.52	0.20

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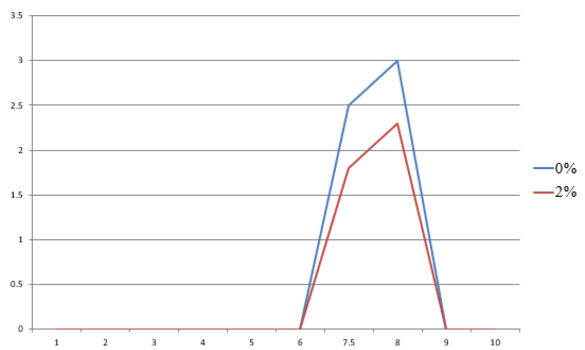

Fig 5.3 Moment Value Comparison for corrugated elements

PREPARATION OF CEMENT MORTAR

The cement mortar consists of cement to sand in the ratio 1:2 by weight and the water cement ratio used was 0.5by weight. In the case of polymer modified mortar specimens the polymer was added at the mixing stage of cement and sand. Then the prepared mortar was used to fabricate the ferrocement specimens.

5.5. PLASTERING WITH CEMENT MORTAR

The cement mortar (Ferrocement model code,2001) was placed over the reinforcement cage on the mould and was pressed well into the wire mesh. Adequate care was taken to maintain 3mm cover throughout. This process was continued till to arrive at the required thickness of the specimen .The specimen is removed from the mould after 2 days of curing with wet gunny bags. The prepared specimens were subjected to curing for 28 days by ponding water in it.

6. CONCLUSION

In this phase we studied the literature reviews and the material collections are done. This was helps to find the properties of materials by checking the quality. In general, the ferrocement layers showed good stiffness, ductility and impact. The polymer modification resulted in the development of large number of finer cracks rather than a fewer number of wider cracks in normal ferrocement specimens. The flexural loads at first crack and ultimate loads depend on number of reinforcing mesh layers used in ferrocement. There is increase in strength with change in orientation of mesh from 90º to 45º.Increase in number of mesh layers also improves the ductile behaviour of ferrocement slabs. As all the test results values are comes under the IS code provisions.

7. FURTHER STUDY

1. Optimum cross sections of 2m length Channel, Trapezoidal and Corrugated shaped elements were casting, and satisfying the requirement of strength, serviceability and minimum cost.
2. Cross sections have been tested under third point loading. The test results were used to obtain the engineering properties and behaviour of ferrocement specimen.
3. Equations were proposed for predicting the first crack load for the Channel, Trapezoidal and Corrugated shaped specimens. The proposed equation was comparing with the test results.

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The polymer modification resulted in the development of large number of finer cracks rather than a fewer number of wider cracks in normal ferrocement specimens. A method was proposed to predict the ultimate load in the case of Channel , corrugated and Trapezoidal elements. Predicted values of ultimate load were compared with the experimental values.

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