EFFECT OF MESH OPENINGS WITH HYBRID (GLASS & RECRON) FIBRES ON MECHANICAL PROPERTIES OF FERROCEMENT ELEMENTS

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Abstract

The cracking stress, Ultimate moment, Shear Strength, First crack moment, First crack Load and corresponding Deflection of ferrocement elements in shear and flexure are the significant parameters in the design of structures made of ferrocement elements. In this project I am going to presents an experimental investigation on ferrocement elements uniformly reinforced by three different meshes, such as Hexagonal mesh, Diamond mesh, square mesh with Hybrid fibers of 1%, 2% and 3% of Glass fiber and Recron fibers. In this paper I would like to study the cracking Stress, Ultimate moment, shear strength and deflection properties of ferrocement elements by analyzing experimental data, the equations for the first-crack-stress, ultimate-moment and volume fraction have to made in this paper. Results obtained by the proposed equations have to be compared to those reported in the literature. For ferrocement and laminated cementitious composites, increasing number of mesh openings have to cast and bending test is going to conduct on those specimens. Ferrocement members can be used in the form of plates Such as for walling unit, marine structures etc. Such plates are Subjected to shear buckling hence shear resistance capacity of plate need to be verified. Various authors have studied shear behaviour on different specimens such as box beams, panels, and plates. In the present study an attempt is made to observe behavior of ferrocement rectangular plate with various mesh patterns.

Keywords: Ferrocement, Cracking stress, Bending Moment, Flexural behavior Shear Behaviour of Ferrocement Plates (SBFP), ultimate load-deflection and meshes.

I.INTRODUCTION

Generally conventional reinforced concrete members are too heavy, brittle cannot be satisfactorily repaired if any damage develops cracks or reinforcement corrodes.The above disadvantages of normal concrete forced the use of Ferro cement concretes. Ferrocement techniques though of recent origin have been extensively used in many countries. There is a growing awareness of the advantage of this technique of construction all over the world.

Ferrocement is a composite material constructed by cement mortar reinforced with

closely spaced layers of wire mesh and 1%, 2%, 3% of Glass and Recron type Hybrid fibers.The ultimate tensile resistance of ferrocement is provided solely by the reinforcement in the direction of loading. The compressive strength is equal that of the unreinforced mortar. However in case of flexure or shear analysis and design of ferrocement elements are complex and are based primarily on the reinforced concrete analysis using principle of equilibrium and compatibility

PRESENT STUDY AND OBJECTIVE

Test on simply supported rectangular plates with different percentages of hybrid fibers those are Glass and Recron fibers with meshes of different opening specimens were conducted. Al1

specimens were tested under two point loading. The tests main parameters for the plates were volume fraction reinforcement. Motor compressive strength (35N/mm^2) and shear span to depth ratio (a/d = 1, 2,3,4,5 and 6) and mix proportion 1:3 with water cement ratio 0.45.

The work is aimed to understand the behavior and strength of ferrocement plates under shear. The influence of the following variables shear span to depth ratio volume fraction of reinforcement and strength of mortar on cracking patterns modes of failure and cracking shear strength, bending, ultimate moment and first crack moment and corresponding deflection were examined.

The study is also carried on the experimental and analytical investigations of the ultimate moment capacity and the ultimate shear capacity of the plate with size of 500x150x30mm. The mode of failures and the crack patterns were also observed. Variables chosen for the investigation were the single layers of mesh with different openings and shear span to depth (a/d) ratio with 1 to 3% of individual and hybrid Glass and Recron fibers. For ultimate moment capacity shear intensity, bending and cracking stress analysis by trial and error methods based on the principles of equilibrium and strain compatibility were used. Both methods have produced satisfactory results.

The variation of shear force with a/d ratio along with different fiber percentages of single layer with two opening of mesh is examined. The experimental ultimate shear is compared with different code values (viz., AC1, BS, AC, and lS). The variation of ultimate moment of resistance and experimental shear is also examined with respect to volume fraction to and a/d. ratios. The variation of ultimate shear to the shear strength v_{cr} is observed with reference to volume fraction and different types of steel meshes are used. Those are Square mesh with 1,2mm and Hexagonal mesh with 4, 6mm and Diamond mesh with 8, 12mm opening meshes are used in this present project.

APPLICATIONS, EXAMPLES AND TRANSFER OF TECHNOLOGY

The developments in ferrocement technology over the past one and a half decade have now convincingly established that it is a highly versatile material with a great futuristic potential in the rural and urban areas. In developed countries where labour cost is high, costs can be minimized by using pre-fabricated precision components made from ferrocement. This pre-fabrication process may ultimately he the main use of the material. Ferrocement in the present state of development has found wide spread applications in diverse fields. The main applications of ferrocement reported so far are for terrestrial and marine uses, viz. roofings, wall elements, water tanks, silos, fishing vessels, pontoons and other working craft, especially in developing countries, where, fullest use can be made of local material sand cheap labour.

FERROCEMENT APPLICATION IN INDIA.

Early applications of ferrocement have been to building of boats. Its application to terrestrial structures started much later. An important development that has recently occurred is the recognition of ferrocement as a material suitable for construction in developing countries. In the last 10-15 years, ferrocement has been used for a number of structures both at laboratory/experimental level and prototype/field applications. Some of these developments that have taken place in India are briefly collected in this paper **EXPERIMENTAL INVESTIGATION**

The experimental investigation composed of casting and testing of three different type of meshes as reinforcement with addition of hybrid fibers of 1,2,3% of glass and recron fibers of Ferro cement rectangular plate size of 500x150x30mm specimens. It is aimed to prepare a rectangular type cross section of dimensions 30mm depth, 150mm width, for a length of 500mm. And then the bottom portion of the rectangular plate was first filled with the cement motor for the required thickness (30mm) their a wooden block of size 500mm x 150mm x30mm is inserted in the mould and remaining portion of the

channel section is filled with cement mortar. For the case of voided rectangular type sections the aluminum pipes of diameter 12.5mm (0.5") were used and placed at the required locations. The voids are located both in the top portion of the channel unit. Total 54 numbers of ferrocement plates are casted and tested after 28days curing period.

Fig

Ferro cement rectangular plate element

CALCULATION OF PERCENTAGE OF EFFECTIVE REINFORCEMENT:

The effective reinforcement (Rr) of the cement composite in a given direction is defined as the ratio of the area of mesh in that direction to the total area of the specimen in the same direction.

$$R_r = (25*\pi*d^2*N_L) / D*t$$

Rr = percentage of effective reinforcement

d = Diameter of wire mesh = 0.56mm for square mesh

N_L = The number of layers = 1

t = Thickness of composite (specimen)=30mm

D = c/c distance of the mesh =1mm

25 numeric is the mainly due to calculation of effective reinforcement as a percentage

RESULTS

FOR 1% GLASS FIBER OF 500X150X30mm PLATE.

Following tables are Drawn for 1% glass fiber of 500x150x30mm plate obtaining results are shown in below.

Plate model	Specimen type	1st crack load(KN) Pcr	Deflection (mm)	Ultimate load(KN)	Ultimate deflection (mm)	Volume Fraction(Vf)	Shear strength(Vcr) Mpa	% R_r	Ncr (N/mm^2)
A	KA1	5.10	0.2	6.12	0.6	0.003	4.32	0.62	4.26
	KA2	5.36	0.3	6.58	1.1	0.01	5.12	1.26	5.23
B	KB1	5.96	0.3	8.62	0.7	0.015	5.41	1.33	5.43
	KB2	6.20	0.4	11.36	1.0	0.03	6.32	1.64	6.69
C	KC1	6.30	0.2	8.97	0.9	0.025	5.24	1.66	5.12
	KC2	6.92	0.3	10.13	1.2	0.04	6.16	1.89	6.25

Table-1: Three mesh types 1 layer with different mesh openings of 500x150x30mm plate

The following graphs drawn between volume fraction and stress intensity of plate size 500x150x30mm with three meshes and 1,2,3% of Glass & Recron fiber. Each meshes having two openings. From this graph we observed that hexagonal mesh 6mm opening with 1-layer specimen can gives the best shear results. And when the volume fraction increases automatically, stress intensity also increase. But it depends on mesh opening and thickness of the mesh. If the mesh opening increases the strength will be gradually decreased.

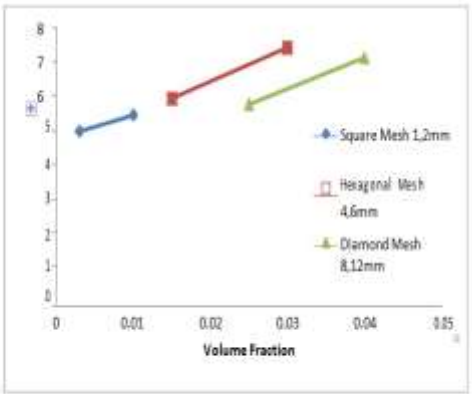

Fig1: shows 3 mesh types 1 layer with 1% GF& different mesh openings of 500x150x30mm plate.

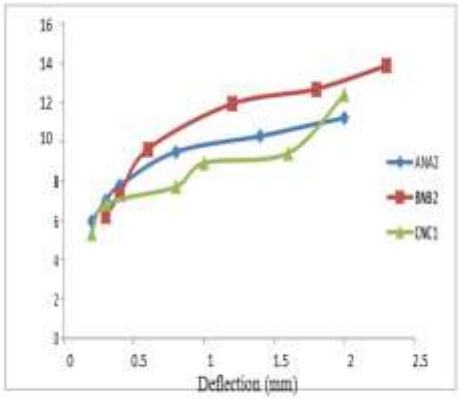

Fig 9 : It shows the load vs deflection of 1-layer with 1% GF of 500x150x30mm plate

By the effect of percentage of reinforcement three mesh types varies the shear and flexural parameters like N_{cr}, M_{ult}, P_{cr} and M_{cr}. But Hexagonal mesh 6mm opening specimens gives the best results shown in below

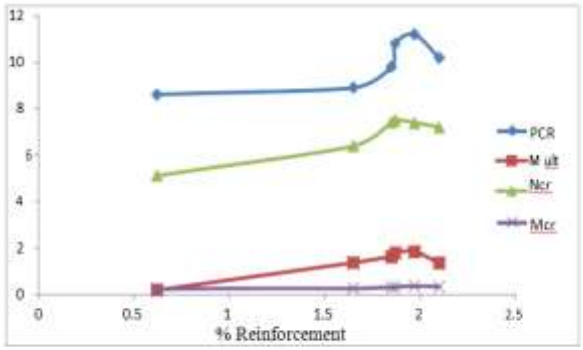

Fig: Shows the graph of Square mesh with 2mm opening specimens

CONCLUSIONS

Based on the results and observations of the experimental, the analytical study presented in this thesis and considering the relatively high variability and the statistical pattern of data. The main purpose of the present work, to check the suitability of cracking stress, ultimate moment, shear strength, first crack load, ultimate load, volume fraction and corresponding deflection of the ferrocement rectangular plate elements

From the results of number of Ferrocement specimens tested and some conclusions can be drawn as follow

1. Using three different types of meshes as reinforcing did not significantly increases the bearing capacity due to lack of confining mortar.

2. Although the reinforcement ratio was double, the increase in the bearing capacity was less than the improved associated with a smaller increase in the reinforcement ratio in the specimen reinforced with on side from bottom of plate.

3. The cracking loads slightly increased as the reinforcement volume fraction increased and the cracking loads were dependent on the mesh type and opening of the mesh.

4. The Flexural capacity of the composite plates increased with the increase of the specific surface area of the mesh.

5. The shear and flexural capacity of plates should be increased with increases the percentages of hybrid fibers 1, 2 and 3% of glass and recron fibers.

6. The rate of increase of both the cracking stress and ultimate bending moment are maximum for ferrocement contains Hexagonal mesh and are the least for the square mesh because of its hexagonal mesh having more thick and medium opening compared to squre&Diamond .

7. The load at which the load-deflection relationship started to deviate from the linearity and the extent of the plastic deformation varied with the type of steel mesh in the ferrocement plates.

8. One of the main advantage of ferrocement plates is that it can constructed with low cast housing compared to R.C.C structures.

9. And it decreases the self weight up to 20-40%. so, ferrocement structures can be used in minor structures.

10. The proposed equations for the first crack stress, first crack moment and ultimate moment of the flexural ferrocement elements are simple but provide reasonably accurate results as compared to relatively more complicated equations involving many parameters.

From these results we conclude that the ferrocement structures are cost effective and light weight structures when compared to R.C.C structures. Because, in this ferrocement plates mortar matrix was used there is no coarse aggregate content. So, it is in light weight and also it should be satisfy the strength parameters

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