Study on Flexural Behavior of Ferrocement Slab Panels

K. Muthazhagu and B. Sivagurunathan

***Abstract*— Lightweight panels find its application in the rapid – phase construction works notably in the rehabilitation of small structures. Ferro cement panels are the one belong to such family shows good characteristics in terms of its mechanical properties. As these panels accommodate reinforcement in the form of wire mesh both on transverse and longitudinal direction, it delays the failure to some extent. More over when panels are cast in trough shaped it improves flexural capacity due to increased moment of inertia. In this work two folded panels in the ratio of 1:1 mortar mix with water cement ratio of 0.3 is prepared. To obtain the workable mix super plasticizer of one percentage by weight of cement is mixed along with the mix. The number of layer of wire mesh kept over reinforcement is varied form single layer to double layer. The increase in the number of layer procrastinates the crack load significantly.**

Keywords—Trough Shape, Slab Panels, Flexural Capacity, CrackPattern, Wire mesh

I. Introduction

Ferrocement is a composite material that behaves differently from conventional reinforced concrete in strength, deformation and potential applications, and hence it is classified as a separate and distinct material. The Ferrocement implies the combination of the ferrous reinforcement embedded in the cementitious matrix. Cementitious matrix consists of cement paste blended with sand. The construction phase of Ferro cement is not labor intensive and does not require skilled labour. Initially the steel rods has to be framed according to the designed shape and size. And then meshes are surrounded over the skeletal reinforcement. The meshes maybe provided into number of layers to negotiate more loads. It must be remembered that, more the layer are accommodated, it results in the spalling of concrete; here an optimum amount of reinforcement must be provided to avoid such mishap.

Due to its light weight to high strength ratio there are plenty of applications in the construction industry. Many decades ago it was used in the construction of boats, roof of small housing units, bunkers and silos.

II. Materials

The following materials were used in the experimental methods.

A. Sand

River sand of specific gravity 2.68 was used. They are passed through the sieve size 2.36mm. well graded sand particles is preferred for the preparation of mortar.

B. Cement

Portland pozzolanic cement was used. Since the cement mortar constitutes more than 90% of the volume of the ferrocement. Its properties has great influence.

C. Water

Fresh portable water is used for the preparation of cement mortar. A water-cement ratio of 0.3. which is the minimum ratio according to the ACI 549r-97 was adopted.

D. Super plasticizer

Since the water cement ratio adopted was very low super plasticizer were added to achieve the workability. Glenium B233 was used as superplasticizer

E. Reinforcement

The skeletal reinforcement was provided both on transverse and longitudinal direction. A 6mm diameter bar was best in a trough shaped was provided along the longitudinal direction with a spacing of 100mm. four numbers of 6mm dia bars were provided along the longitudinal direction.

III. Geometry of the Panel

For the study of the flexural behavior of ferrocement slab panels trough shaped panels were prepared with the dimension of 1000mm X 350mm. The depth of the panel is 30mm. the overall height of the section is 100mm. to support the slab 85 mm rib is given. The inclined length is 90mm.

Moment of inertia directly influences the flexural capacity of the slab. Flexural rigidity is the product of Young’s modulus and moment of inertia. Modulus of elasticity is constant for reinforced cement mortar and it is the moment of inertia which can be modified to influence the flexural capacity. It is for this reason, the trough shaped panel was chosen. Trough shaped panel has higher moment of inertia than the flat panels. Moreover the breadth to depth ratio of slab panel is very small and it increases the stiffness of the panels.

In trough shaped panels, the material is situated just away from the neutral axis but in the case of flat panels the material is situated near to the neutral axis. This cause the increase in the moment of inertia. This surge in moment of inertia of trough panels was approximately 12.55 times that of the flat slab. Hence the trough shaped panel performs better in flexure than the flat shaped panels.

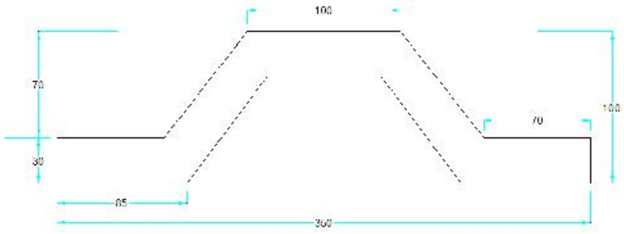


Fig. 1. Geometry of the panel

IV. EXPERIMENTAL METHODS

A. Compression test

Mortar mix with three different proportions from 1:3, 1:2, 1:1 was adopted in the casting of specimens. Mortar cubes of size 70.6 X 70.6 X 70.6 were prepared and they are tested for their compressive. The average value of the compressive strength are tabulated below

TABLE I. MIX RATIO AND COMPRESSIVE STRENGTH

Sl.No	Mix	Compressive strength(MPa)
1	1:3	44.3
2	1:2	53.6
3	1:1	60.2
w/c = 0.3	Super plasticizer = 1%	

From the compression test, it was evident that mix proportion of 1:1 produced maximum strength. Hence the same proportions was adopted in the casting of trough shaped panels.

B. Flexure test

As mentioned formerly, a trough shaped slab panels was preferred over the flat slab panel due to its higher moment of inertia. Two trough shaped panels were cast with a single layer of steel wire mesh in one specimen and with double layer on another.

The slabs were tested in a servo controlled actuator to study its flexural behavior. Actuator is a displacement controlled device in which the rate of displacement over the specimen is pre-defined in the software program. The actuators are coupled with the LVDT to measure the displacement. The slab were subjected to two point loading and the loads and their corresponding deflections were virtually recorded in the actuator and the load-deflection curve can be viewed as the rate of loading applied over the slab. The ultimate and cracking loads were noted for both the slabs. The first superficial crack was observed at 10kN for FS1 and at for 13.5kN FS2. The ultimate load carrying capacity doesn't increase an increasing the number of layer, but it postpones the cracking load.

Fig. 2. Flexure Test

Fig. 3. Skeletal steel with wire mesh

V. RESULTS AND DISCUSSION

The following are the results obtained from the flexural test.

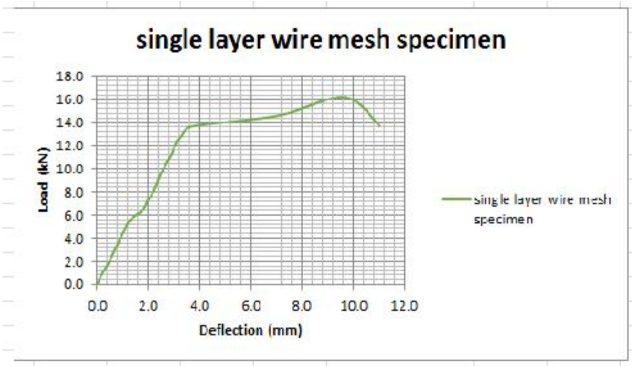
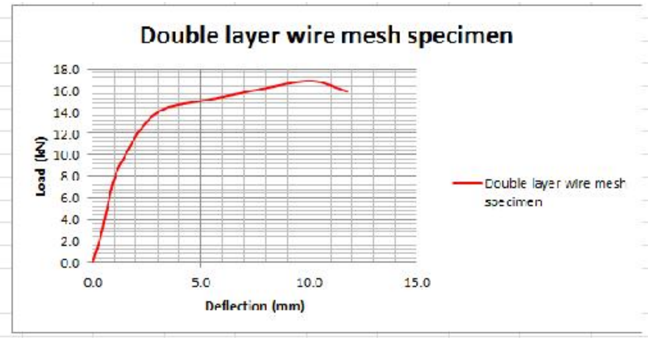
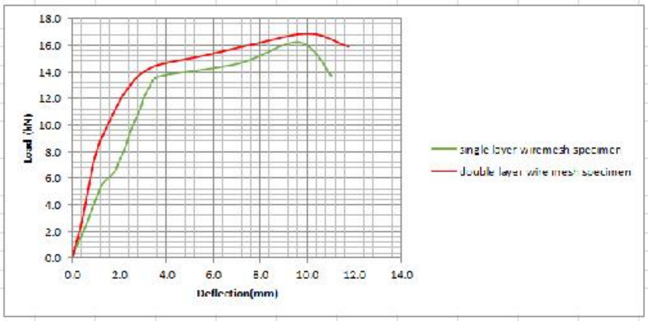


TABLE II. FLEXURE TEST RESULTS

specimen	First crack	Ultimate	
	load (kN)	Deflection(mm)	Load(kN)
Single layer wire mesh	10	9.7	16.2
Double layer wire mesh	13.5	10.1	16.9





VI. CONCLUSION

- Double layer wire mesh specimen shows good energy absorption, stiffness compared with the single layer wire mesh specimen.
- The double layer wire mesh specimen carries maximum load compared with the single layer wire mesh specimen at the initial crack.
- The presence of two layer meshes arrests the crack propagation effectively than the single layer specimen.

ACKNOWLEDGEMENT

The author would like to thank the faculties of Thiagarajar College of Engineering for their valuable suggestions in this project. The author would like to express his gratitude to his friends and family for supporting him in this research project

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