Experimental Study on Effect of Using Different Numbers of Wire Mesh Layers and Thickness Variation on the Flexural Strength of Flat Ferrocement Slab Panels

[1]Mr.Deokar A.H., [2]Shirsath M.N.

[1]Student, [2]Vice Principal

Department of Civil Engineering

G.H.Raisoni COE, Ahmednagar, India

Abstract:

The current examination portrays the consequences of testing level ferrocement boards supported with various number of wire network layer and variety in board thickness. The primary target of these exploratory tests is to consider the impact of utilizing various quantities of wire network layers and thickness minor departure from the flexural strength of level ferrocement boards and to look at the impact of fluctuating the quantity of wire network layers on the pliability and a definitive strength of this kind of ferrocement structure. In this examination, every one of the examples was partitioned into four gatherings to research the strength and conduct of ferrocement level boards exposed to two-point stacking. 24 ferrocement components were built and tried.Twenty four ferrocement elements were constructed and tested. The used number of wire mesh layers is single, two, three and four layers; also thicknesses of panels are 30mm and 40mm.

I. INTRODUCTION

1.1General: A large number of civil infrastructures around the world are in a state of serious deterioration today due to carbonation, chloride attack, etc. Moreover many civil structures are no longer considered safe due to increase load specifications in the design codes or due to overloading or due to under design of existing structures or due to lack of quality control. In order to maintain efficient serviceability, older structures must be repaired or strengthened so that they meet the same requirements demanded of the structures built today and in future. Ferrocement over the years have gained respect in terms of its superior performance and versatility**.**

What is ferrocement?

Ferrocement is a form of reinforced concrete using closely spaced multiple layers of mesh and/or small diameter rods completely infiltrated with, or encapsulated in, mortar. In 1940 Pier Luigi Nervy, an Italian engineer, architect and contractor, used ferrocement first for the construction of aircraft hangars, boats and buildings and a variety of other structures. It is a very durable, cheap and versatile material**.**

1.2Constituents of Ferrocement

1) Cement: The cement should be fresh, of uniform consistency and free of lumps and foreign matter.

2) Fine Aggregates: Normal weight fine aggregate clean, hard, and strong, free of organic impurities and deleterious Substances and relatively free of silt and clay.

3) Water: Potable water is fit for use as mixing water as well as for curing ferrocement

4) Admixture: Chemical admixtures used in ferrocement serve purposes of water reduction, with strength and reduce permeability; air entrainment, which increases resistance to freezing and thawing; and suppression of reaction between galvanized reinforcement and cement.

1.3Ferrocement Composites Have

1) Thickness 6 to 50 millimeters
2) Steel covers 1.5 to 5 millimeters
3) Ultimate tensile strength up to 34 MPa
4) Allowable tensile stress up to 10 MPa
5) Modulus of rupture up to 55MPa
6) Compressive strength up to 28 to 69MPa.

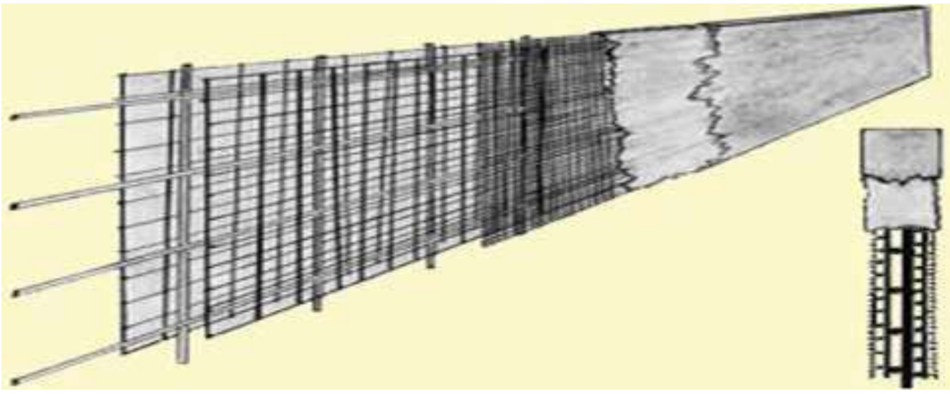

Fig-1 Typical cross section of ferrocement structure

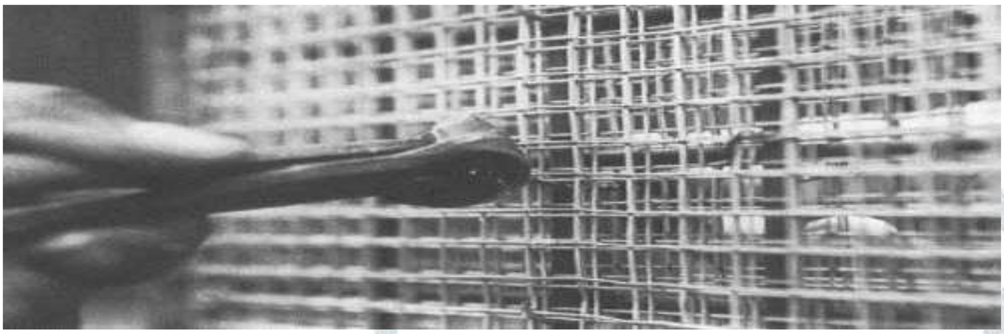

Fig- 2 Reinforcing mesh

1.4 Properties of ferrocement

The designing properties of ferrocement structure are identical to ordinary cement, and in certain applications it performs better. The rigidity of ferrocement is a consequence of the volume of support utilized in the design. Aside from the volume of support, the heading of its utilization in accordance with the power bearing and tractable pressure course is likewise significant. A ferrocement part exposed to upwards ductile pressure carries on something like straight versatile material until the primary break shows up. Breaking and at last proceeding to a point where the lattice begins to encounter yielding. Once at this stage the quantity of breaks will keep on developing with the expansion in the tractable power or stress. The particular surface space of the ferrocement part or component has been found to impact the principal break in strain, just as the width of the breaks. The most extreme pressure from the outset break for ferrocement network expansions with respect to the particular space of the component. Ferro concrete has generally great strength and protection from sway. At the point when utilized in house development in agricultural nations, it can give better protection from fire, seismic tremor, and consumption than customary materials, like wood, adobe and stone workmanship. It is offers a chance of creating a meager and light constructions. This implies it is fit for giving expense saving through the material use. Aside from the material saving, the general extra weight of the construction additionally could be decreased by utilizing ferrocement; consequently it will bring about more practical establishment plan. Ferro concrete has exceptionally high rigidity to weight proportion and a predominant breaking conduct, Low w/c proportion delivers an impermeable constructions. Ferro concrete constructions have high sturdiness, less shrinkage, and low weight.

1.5 Objective of Proposed Study

The main objective of this experimental test is to study the numbers of square wire mesh layers and effect of varying thickness of panels on the flexural strength of flat ferrocement panels, also to compare the effect of varying the number of wire mesh layers and thickness variation on the ductility and ultimate strength of these types of ferrocement structure.

The various parameters considered in this study are as follows -:

1) Effect of number of mesh layers on the flexural strength of slab panels.
2) Effect of panel thickness on the flexural strength of slab panels.
3) Effect of volume fraction on the flexural strength of slab panels.
4) To study the stress variation over the cross section of the panels.

1.7Moulds:-

Moulds were made from plywood of 16mm thickness. The moulds were fabricated in college workshop. Also before casting interior surface was oiled.

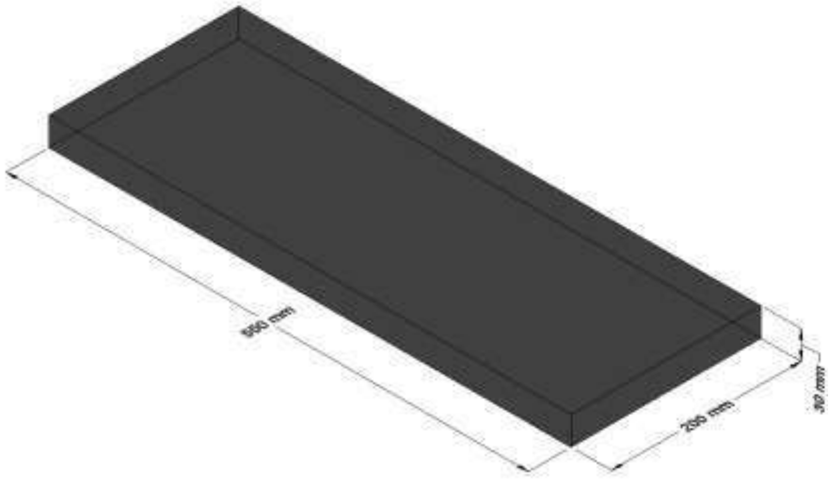

Fig-3 Dimension of panel (mm)- 550x200x30mm and 550x200x40mm

Casted panel-

Dimension of panel(mm)	Designation	Number of panel	Number of layer
550x200x30mm	E1	03	01
	E2	03	02
	E3	03	03
	E4	03	04
550x200x40mm	E1	03	01
	E2	03	02
	E3	03	03
	E4	03	04

1.6Casting

The interior faces of the moulds were oiled and then the first layer of cement mortar was poured in moulds. The first layer of mesh was laid with the cover of about 3 mm from bottom, then the mortar was placed and the other layers of meshes were also laid. After placing the mesh, pouring of the mixture continued to the level of the mould and smoothened afterward.

1.6.1Mixing proportion

The blending system is significant for getting the necessary functionality. Materials were mixed manually. Fine aggregate and cement were mixed as well as fly ash. Next, the water was added gradually to the mixture, and the operation of mixing was continued until homogeneous concrete mix was obtained. Mix proportion was selected from suitable amount of ingredients in such a way to get a workable and homogeneous concrete. After sieving fine aggregates on 2.36 mm, finally a suitable mix proportion by weight was selected from a number of test investigations. The blend extent was 1:2 (Concrete: Sand) with water to solidify proportion of 0.40. the mix, crushed aggregate (passed by 2.36 mm sieve) used as 50% replacement of sand.

Comparison between RCC and Ferrocement

R.C.C	FERROCEMENT
Min Thickness– 75 mm	Thin Walled , 25-50 mm
Matrix :Cement Content	Micro-Concrete(RichCement Mortar)
R/F– Steel Bars >6mmdia , spaced apart	Continuous Fine Wire mesh dispersed throughout the body of structure
Strength– Weak intension , bond &Shear	High tensile strength, superior bond& shear strength.
Strength to Weight Ratio –In tension&Compression, Very Low.	Very High
For casting-Formwork & shuttering are quite essential.	Firmly tied wire networks go about as structures for Mortar casting..

1.6.2Curing

The test and control examples were demoulded after 24hours, and relieved by ACI 308.1.The specimens were cured for about 28days, and then left in air temperature and humidity inside the laboratory.

II. RESULT

a) Test results of the samples and flexural properties of specimens at the age of 28 days from the day of casting are presented in table (1)

Specimen and size	Panel Number	Cracking Load (N)	Ultimate Load (N)	Flexural strength at cracking load σcr ($\frac{N}{mm^2}$)	Flexural strength at ultimate load σult ($\frac{N}{mm^2}$)
E1(30mm thick)	E11	1373.4	1569.6	3.433	3.924
	E12	1373.4	1569.6	3.433	3.924
	E13	1177.2	1373.4	2.943	3.433
E2(30mm thick)	E21	1765.8	2158.2	4.414	5.395
	E22	1765.8	2158.2	4.414	5.395
	E23	1569.6	1765.8	3.924	4.414
E3(30mm thick)	E31	2354.4	2550.6	5.886	6.376
	E32	1962	2354.4	4.905	5.886
	E33	2158.2	2550.6	5.395	6.376
E4(30mm thick)	E41	2550.6	2943	6.376	7.357
	E42	2354.4	2550.6	5.886	5.886
	E43	2354.4	2746.8	5.886	6.867
E1(40mm thick)	E11	2550.6	2746.8	3.585	3.861
	E12	2354.4	2746.8	3.309	3.861
	E13	2354.4	2746.8	3.309	3.861
E2(40mm thick)	E21	2550.6	2943	3.585	4.137
	E22	2354.4	2746.8	3.309	3.861
	E23	2746.8	3139.2	3.861	4.413
E3(40mm thick)	E31	2943	3335.4	4.137	4.688
	E32	3335.4	3531.6	4.688	4.964
	E33	2943	3335.4	4.137	4.688
E4(40mm thick)	E41	2943	3335.4	4.137	4.688
	E42	3335.4	3531.6	4.688	4.964
	E43	2943	3335.4	4.137	4.688

b) Structural properties of ferrocement panels of 550 mm x200 mm dimension table (2)

Test group and Thickness (mm)	Compressive strength (28 Days) N/mm^2	Linear elastic modulus, E_1 N/mm^2 x10^3	Nonlinear elastic modulus, E_2 N/mm^2 x10^3	Avg.flexural strength at cracking load(σcr) N/mm^2	Avg.flexural strength at ultimate load(σult) N/mm^2
E1(30mm)	42.95	15.668	11.752	3.2696	3.7603
E2(30mm)	42.95	14.102	35.255	4.2506	5.068
E3(30mm)	42.95	15.668	35.255	5.3953	6.2126
E4(30mm)	42.95	15.668	70.509	6.0493	6.7033
E1(40mm)	42.95	14.868	05.947	3.401	3.861
E2(40mm)	42.95	17.842	09.912	3.585	4.045
E3(40mm)	42.95	22.303	14.868	4.3026	4.780
E4(40mm)	42.95	29.737	14.868	4.3206	4.780

III. CONCLUSION

"Based upon the trial test consequences of the ferrocement boards the accompanying ends can be expressed:"

1)"Increasing the thickness also affected the final breaking load for slab panels.

2).Therefore increasing the number of layers of wire mesh from 2 to 4 layers significantly increases the ductility and capability to absorb energy of both of the panels.

3) Increase in number of mesh layers improves the ductile behavior of ferrocement slabs.

4) Increasing the thickness also affected the final breaking load for slab panels.

5) Therefore increasing the thickness of ferrocement panels from 20 mm to 50 mm significantly increases the ductility and capability to absorb energy of both of the panels. The flexural load at first crack and ultimate load depends upon number of reinforcing wire mesh layers.

IV. REFERENCES

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