

EXPERIMENTAL INVESTIGATION ON FLEXURAL BEHAVIOUR OF FOLDED FERROCEMENT PANELS

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Abstract - Ferro-cement is a composite material composed of mortar reinforced with closely spaced steel rods and wire mesh layers. It is used to construct thin, hard surfaces and it can be cast in various shapes even without the use of formwork. Applications of Ferro cement have increased due to their properties such as toughness, water tightness, lightness and ductility. Due to the slenderness of these elements their performance under working loads may be affected. This experimental study describes the result of three different types of panels with varying number of wire mesh layers. The purpose of this experiment is to study the flexural behavior and the effect of folded panels as compared to flat and trough panels. From the studies, it is observed that the load carrying capacity, deformation of ultimate load and energy dissipation capacity are high in case of increasing number of wire mesh layers. Further it is observed that a reduction in crack width and increase in no of cracks indicates the delay in crack growth.

Key Words: Ferrocement, crack strength, load deflection behaviour

1.INTRODUCTION

Ferro cement, a composite material using cement, sand, water and wire mesh or galvanized steel rods, is an ideal technology for low cost construction in developing and under developed countries as well as rich countries like Singapore. It is a low cost material with excellent engineering properties and high cracking strength. Joseph Louis Lambton is considered as father of ferrocement. He constructed boats, seats, and plant pots in 1855. Pier Luigi Nervi of Italy reinvented ferrocement. Nervi first used ferrocement in a public structure in 1948 which was an exposition hall at Turin with 100 m span roof. In 1976, International Ferrocement Information Center was (IFIC) formed at Asian Institute of Technology (AIT) Bangkok. Ferrocement is gaining popularity due to its adaptable use in construction and

architecture. For developing countries with high demand of housing, Ferro cement is a best alternative for conventional construction materials. A lot of research is going on to develop Ferro cement as a substitute material for various conventional construction materials such as bricks, stones, timber, steel, concrete.

2. METHODOLOGY

1. Title selection
2. Literatures review
3. Material collection
4. Preparation of mould for folded panels
5. Casting and curing of specimen
6. Testing
7. Conclusion

3. MATERIALS USED

- Cement - 53 grade
- Sand - M - SAND
- Super plasticizer - Conplast SP430
- Water - Portable
- Skeletal steel - mild steel 6mm dia
- Wire mesh - Galvanized Chicken wire mesh with a hexagonal opening of size 12mm & thickness of 1.29 mm.

4.M- SAND -In recent years, considerable emphasis has been made by the experts in the construction industry to use Manufactured Sand (M-Sand) as River Sand resources are exhausting very rapidly. It has also been proved that Good quality M-sand can be used as an alternative construction material to River sand.

1. The shape of the m sand particles resembles with those of river sand particles. Flaky and elongated coarse particle are absent in m sand.

2. M sand is well graded and falls within the limits of grading zone II sand, grading limits specified in IS383 code.

Table -1: Properties of M- Sand

S.NO	Properties	Readings
1	Specific Gravity	2.60
2	Water absorption	20 %
3	Sieve Analysis	Under Zone II

5. OVERALL TEST RESULTS

Table-2: Properties of cement

Specimen	Method of testing	Value
cement	Specific gravity	3.15
	Fineness modulus	2%
	Initial setting time	29 minutes
	Final setting time	600minutes
	Consistency	34%

Casting of control specimen- Cement mortar cubes of size 70.6 mm × 70.6 mm × 70.6 mm are cast to test characterize the strength of the mortar mix

Table-3: Mix Design of mortar cube

Cube specimen	C/S Ratio	W/C Ratio	Super Plasticizer %	Comp strength
1	1:3	0.3	1	43.50
2	1:2	0.3	1	48.25
3	1:1	0.3	1	51.16



Geometry of the Specimens

The geometry of the panel is folded shape as shown with dimensions 1000 mm x 400 mm x 30 mm. The panels are constructed using the conventional ferrocement materials, which is composed of cement mortar and hexagonal wire mesh

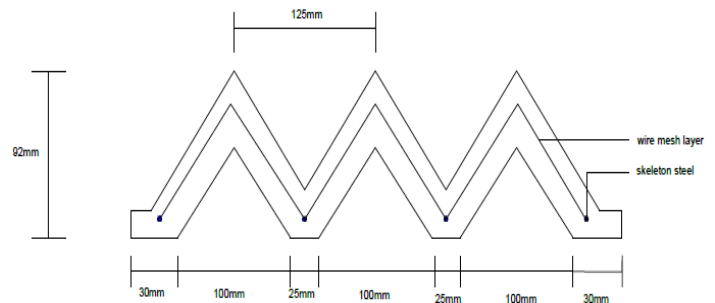


Fig-1: Ferrocement slab with single layer wire mesh



The geometry of the panel is flat shape as shown with dimensions 1000 mm x 400 mm x 30mm



Fig-2: Flat panel with mesh reinforcement



The geometry of ferrocement panel is trough shape with dimensions of 1000 mm x 400 mm x 30 mm.

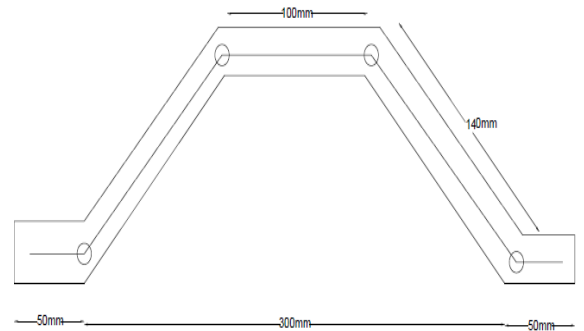


Fig -3 :trough shaped panel

Theoretical formulas

$$f_{tu} = f_{tm} + f_{ts}$$

$$f_{tm} = 0.2 (f_c')^{0.7}$$

Table 4 -Experimental Results for Folded Ferrocement panels

Specimen ID	Cracking		Ultimate		Failure	
	Load kN	Def mm	load kN	Def mm	Load kN	Def mm
FP-FD 01	9.5	3.2	21.5	10.6	17	20.4
FP-FD 02	10	3.5	28	16.7	18.5	26.2

$$f_{ts} = \alpha + \beta (V_R f_{yR})$$

$$V_R = A_{sf}/bh$$

$$f/y * I = M \text{ (calculated)}$$

where, $\alpha = 0.56$ $\beta = 0.72$

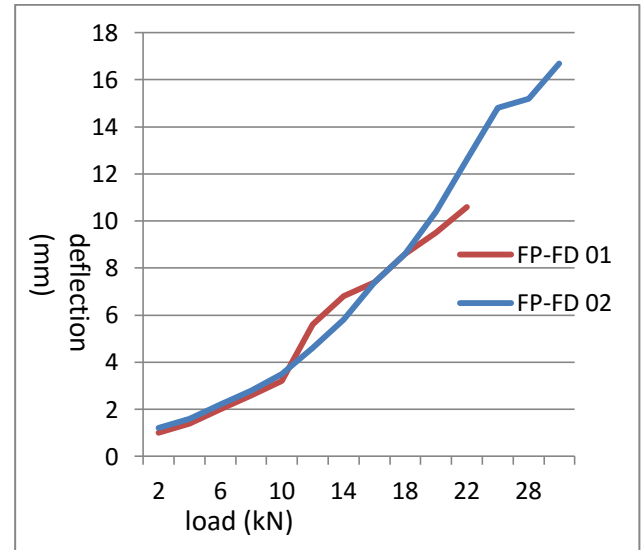
COMPARISON OF EXPERIMENTAL AND THEORETICAL MOMENT VALUE

Experimental calculation

$$\text{Bending moment} = \frac{Wl}{4}$$

Table 5 Comparison of moment value for folded Panels

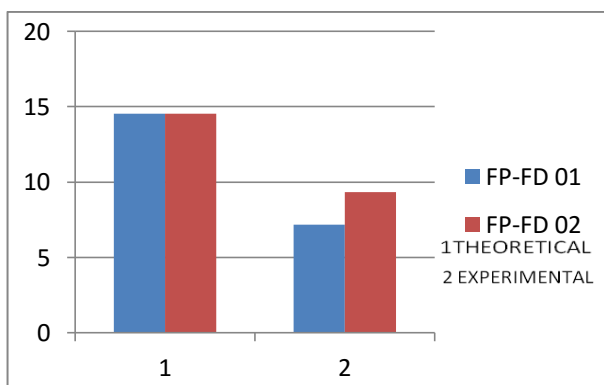
Designation of specimen	No of layers	Ultimate load	Moment(Kn-mm)		% variation
			Experimental	Theoretical	
FP-FD 01	1	21.5	7.16	14.52	0.49
FP-FD 02	2	28	9.33	14.52	0.64



Graph 2 : load deflection behaviour

Table 6 -Experimental Results for Flat Ferro cement panels

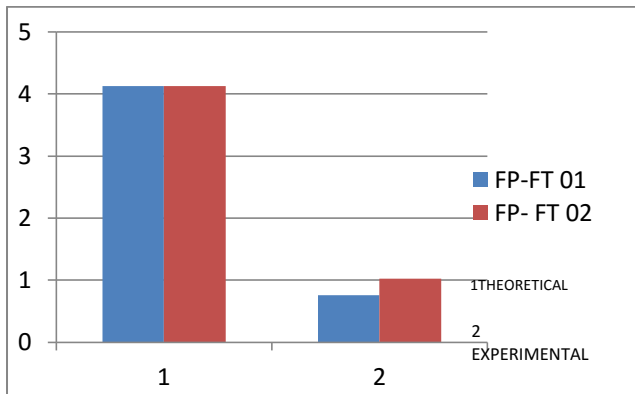
Specimen ID	Cracking		Ultimate		Failure	
	Load kN	Def mm	load kN	Def mm	Load kN	Def mm
FP-FT 01	1.4	2.4	2.3	32.6	2	45.6
FP-FT 02	2.2	15	3.4	34.5	2.8	48.6



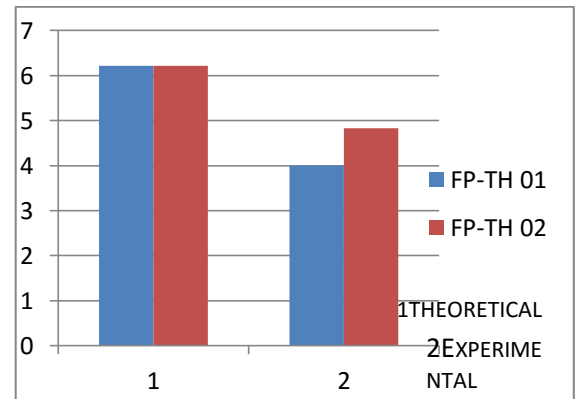
Graph 1 : comparison of experimental and theoretical bending moment

Table 7- Comparison of moment value for folded panels

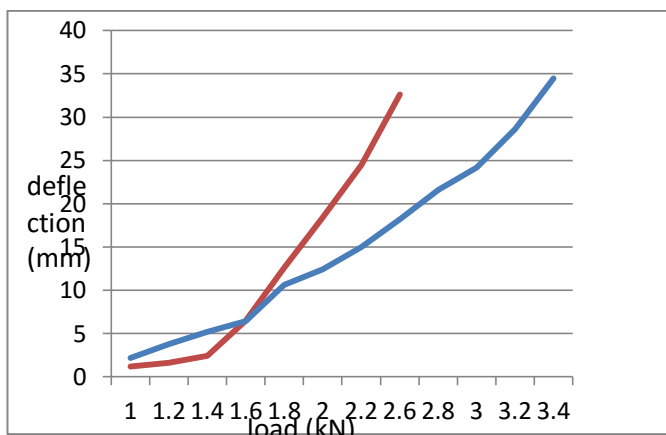
Designation of specimen	No of layers	Ultimate load	Moment(Kn-mm)		% variation
			Experimental	Theoretical	
FP-FT 01	1	2.3	0.76	4.13	0.18
FP-FT 02	2	3.4	1.02	4.13	0.24



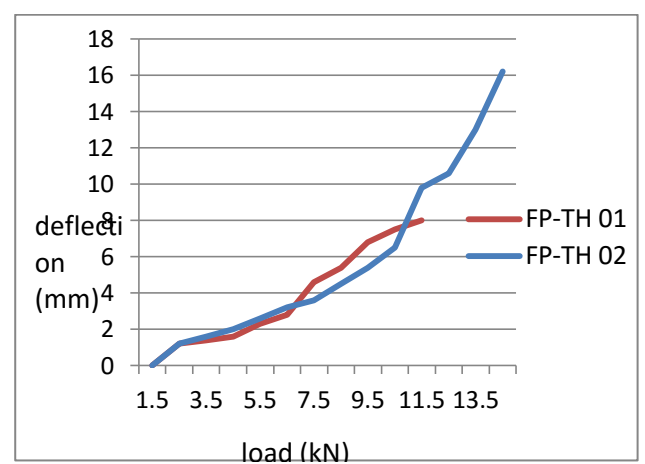
Graph 3 : comparison of experimental and theoretical bending moment for flat panels



Graph 5 : comparison of experimental and theoretical bending moment for trough panels



Graph 4 : load deflection behavior for flat panels



Graph 6 : load deflection behavior for trough panels

Table 8 -Experimental Results for Trough ferro cement panels

Specimen ID	Cracking		Ultimate		Failure	
	Load kN	Def mm	load kN	Def mm	Load kN	Def mm
FP-TH 01	6.5	2.8	12	8	9.5	17.8
FP-TH 02	8.5	4.5	14.5	16.2	10.5	25

6.CONCLUSION

From the present experimental study the following conclusions are arrived.

- In this phase collection and study of literatures were done.This helps in knowing the properties of ferrocement such as strength, toughness, water tightness, lightness, ductility and environmental stability.
- In this study the initial test for materials were done and test results are presented . All the test conducted in this phase are as per IS code .All the values that are obtained are within the permissible limits as per IS code.

Table 9- Comparison of moment value for folded panels

Designation of specimen	No of layers	Ultimate load	Moment(Kn-mm)		% variation
			Experimental	Theoretical	
FP-FT 01	1	2.3	0.76	4.13	0.18
FP-FT 02	2	3.4	1.02	4.13	0.24

- Folded and flat shaped ferrocement panels were prepared for testing . The testing for flexural behaviour of ferrocement panels will be done at after 28 days of curing

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