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EXPERIMENTAL STUDY OF RECYCLED CONCRETE AS AGGREGATE FOR STRUCTURAL CONCRETE PRODUCTION

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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: Ferro-cement, crack strength, load deflection behavior

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 ferro-cement. He constructed boats, seats, and plant pots in 1855. Pier Luigi Nervi of Italy reinvented ferro-cement. Nervi first used ferro-cement in a public structure in 1948 which was an exposition hall at Turin with 100 m span roof. In 1976, International Ferro-cement Information Center was (IFIC) formed at Asian Institute of Technology (AIT) Bangkok. Ferro-cement 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

In this section we give the steps of preparing the ferro-cement concrete. The steps involved are:

1. Material collection
2. Preparation of mould for folded panels
3. Casting and curing of specimen
4. Testing

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MATERIALS USED

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

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. There are two main reasons that M sand can be used as replaceable material for the river sand:
The shape of the m sand particles resembles with those of river sand particles. Flaky and elongated coarse particle are absent in m sand.

1. M sand is well graded and falls within the limits of grading zone II sand, grading limits specified in IS383 code. Table 1 gives the properties of M sand and table 2 gives the properties of cement

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

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 size70.6 mm × 70.6 mm × 70.6 mm are cast to test characterize the strength of the mortar mi

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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. The panels are constructed using the conventional ferro-cement materials, which is composed of cement mortar and hexagonal wire mesh

Fig. 1. Ferro-cement slab with single layer wire mesh

Fig-2: Flat panel with mesh reinforcement

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Fig 3. Experimental setup

The geometry of the panel is flat shape as shown with dimensions 1000 mm x 400 mm x30mm

Table 4 -Experimental Results for Folded Ferro cement 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

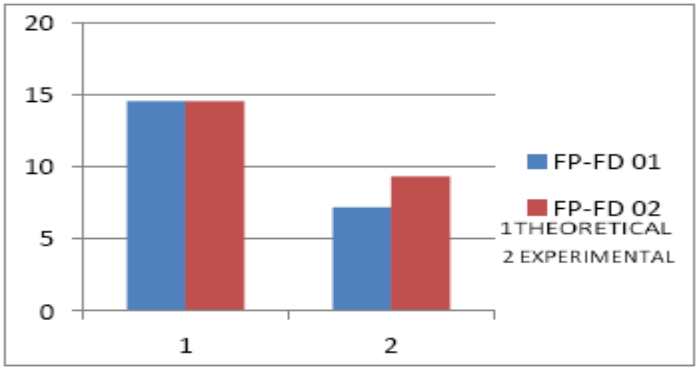
COMPARISON OF EXPERIMENTAL AND THEORETICAL MOMENT VALUE

Experimental calculation

Bending moment = 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 1 : comparison of experimental and theoretical bending moment

Fig.4 Comparison of bending moment

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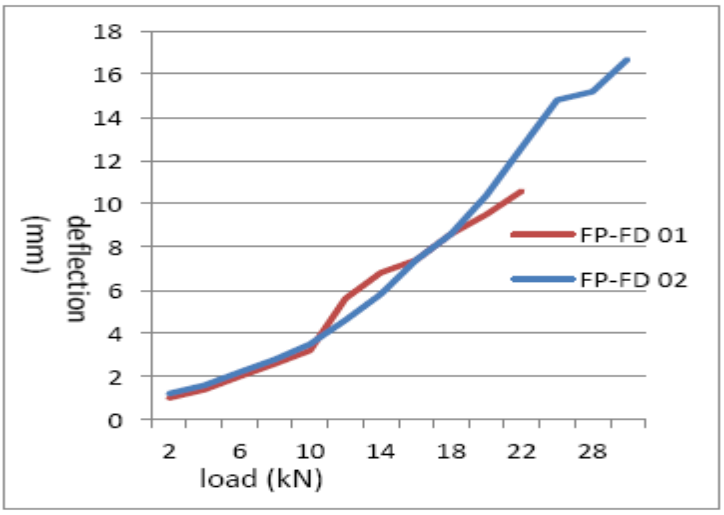


Graph 2 : load deflection behaviour

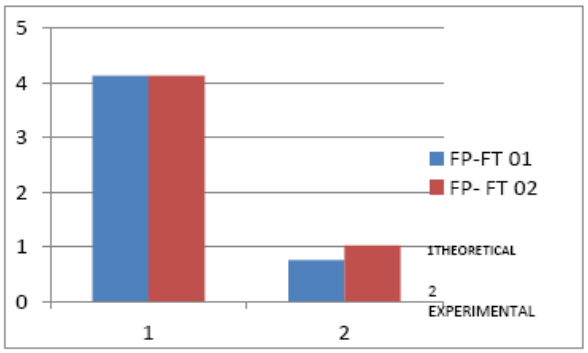
Fig.5 Comparison of Load deflection behavior

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

Table 7- Comparison of moment value for folded panel

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

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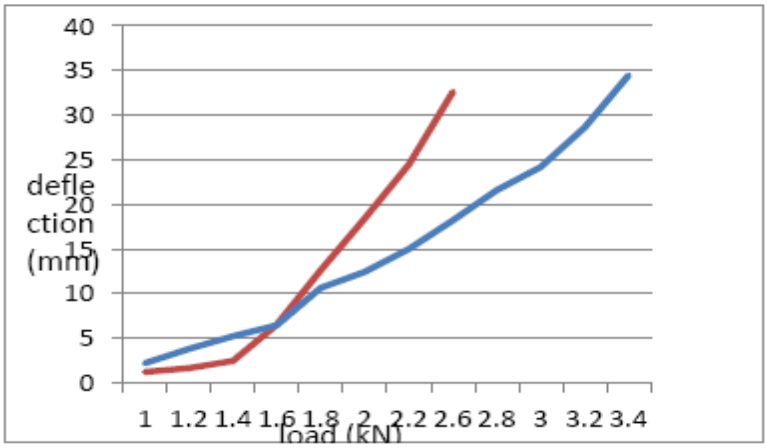
Fig.6 Comparison of bending moment for flat panels



Graph 4 : load deflection behavior for flat panels

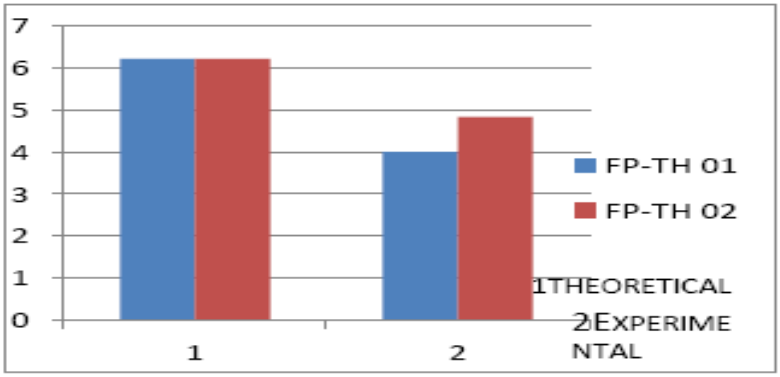
Fig.7. load deflection behavior

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

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



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

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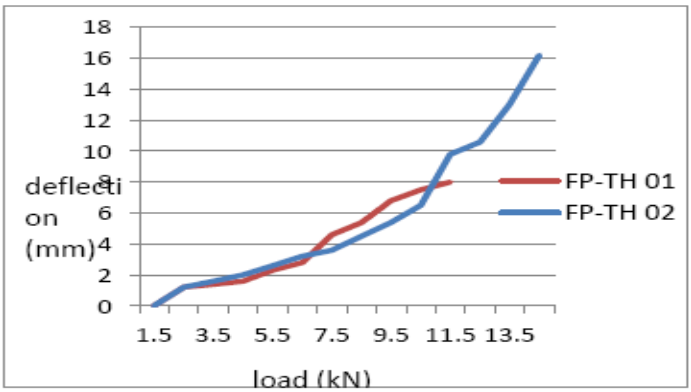
Fig.9 Comparison of theoretical pending moment



Graph 6 : load deflection behavior for trough panels

Fig.10 Load deflection behavior for trough panels

CONCLUSION

The following conclusions have been arrived from the present experimental study. In this paper, phase collection and study of literatures were done. This helps in knowing the properties of ferro-cement such as strength, toughness, water tightness, lightness, ductility and environmental stability. The initial test for materials was done and test results are presented. The entire 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.

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