AN EXPERIMENTAL INVESTIGATION ON FERROCEMENT BY USING LATEX

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ABSTRACT

The ferrocement is a cementitous thin-wall composite structural material comprising of cement mortar matrix uniformly distributed throughout its cross section. The uniform distribution and dispersion of reinforcement in ferrocement composite provide better cracking characteristic high tensile strength, ductility and impact resistance. Ferrocement has high tensile strength to weight ratio and superior cracking behaviour in comparison with conventional reinforced concrete. Hence it is an attractive material for thin wall structure. Ferrocement construction in early 70's was labour intense and particularly suitable for rural application in developing countries. This does not require heavy plants or machinery and being a low-level, the construction skills can be fairly acquired quickly. Accordingly, considerable research effort was directed towards the use of ferrocement in low cost rural housing and agriculture compatible with indigenous traditions and materials. The main objective of this study is to alleviate shortage and high cost of skilled labour mechanized production and proper choice of reinforcement are used to ensure cost competitiveness and speed of construction.

Keywords:

Ferrocement, flexural properties, ductility, static load, deflection, structural use.

1. Introduction:

The concept of reinforced mortar by closely spaced fine wire mesh was used for boat building construction by Lambot in 1849.Subsequently in 1940's; Nervi promoted the use of ferrocement in civil engineering structures. Since then ferrocement has been studied extensively by various research group and gained wide acceptance only in 1960's.There has been wide spread use of ferrocement applications in agriculture and housing throughout the world including North and south America, east European and Asia-pacific countries

2. Materials used:

The properties and types of constituent materials used in ferrocement construction are shown in table1.1. Although meshes of glass and vegetable fibres have been used the most common form involves steel and it is this type that is described in this paper. The cement mortar matrix should be designed for appropriate strength and maximum denseness and impermeability, with sufficient workability to minimize voids. The use of sharp fine grade sand as aggregate together with ordinary Portland cement is generally adequate, despite the low covers employed. This is due to comparatively high cement content in mortar matrix.

2.1 Cement:

Portland Pozzolanic Cement (PPC, Fly ash based) of grade 53 was used throughout the project. The cement conforms to the IS 1489:1991 (part 1) code. The initial setting time of cement as specified by the manufacturer was 30 minutes Impact.

Table 1.1: Properties and type of constituents

MATERIALS	RANGE
WIRE MESH:	
Diameter of wire (Φ)	$0.5 \leq \Phi \leq 1.5$mm
Type of mesh	chicken wire or square woven or welded
Size of mesh opening(S)	$6 \leq S \leq 25$mm
Volume fraction (V_R) of reinforcement	$2\% \leq V_R \leq 8\%$ in both directions.
Specific surface (S_R) of reinforcement	$0. \leq S_R \leq 0.4\%mm^2/mm^3$ in both
Elastic modulus (E_R)	140 - 200 N/mm^2
Yield strength (σ_{Ry})	250 - 460 N/mm^2
Ultimate tensile strength (σ_{Ru})	400 - 600 N/mm^2
SKELETAL METAL:	
Type	Welded mesh, steel bars, strands.
Diameter (d)	$3mm \leq d \leq 10mm$
Grid size (G)	$50mm \leq G \leq 200mm$
Yield strength	250 - 460 N/mm^2
Ultimate tensile strength	400 - 600 N/mm^2
MORTAR COMPOSITION:	
Cement	any type of Portland cement(depending upon
Sand to cement ratio(S/C)	$1 \leq S/C \leq 3$ by weight
Water cement ratio(W/C)	$0.35 \leq W/C \leq 0.65$ by weight
Gradation of sand	5mm to dust with no more than 10%

2.2 Fine aggregate:

Ordinary river sand passing through sieve of size 2.36 mm was used for this project. The sand was ensured that it was dry. The fineness modulus of sand is 2.68.

2.3 latex

Latex is a stable dispersion of polymer microparticles in an aqueous medium. It is found in nature, but polymerizing a monomer such as styrene that has been emulsified with surfactants.

3. Experimental Investigations

The Cube specimens of size 70 mm x 70 mm x 70 mm are cast and cured for 3 days, 7 days and 28 days. For each day of testing, 3 cubes are casted.

3.1 Mix Proportions and Water-cement Ratio

S. No	Batch	Materials		
		Cement	Sand	W/C Ratio
1	A	1	1	0.41
2	B	1	2	0.47
3	C	1	3	0.575

3.3.1 Batch A

The details of specimens and ultimate load of individual specimens of Batch A are tabulated in Table 3.2. The average compressive strength and the strength development curve are given in Table 3.3 and graph 3.1. The average compressive strength of 3, 7 and 28 days are 13.44, 19.92 and 39.78 N/mm^2 respectively.

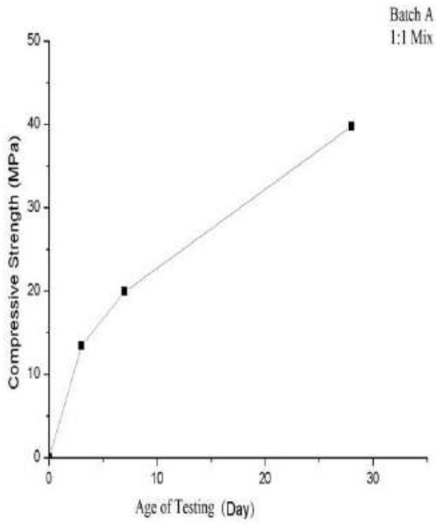
Table 3.2: Ultimate Load of mortar specimens of Batch A

Batch A - Mortar Cube - 3 Days				
Specimen	1	2	3	Average
Weight (grams)	742	797	782	773.67
Ultimate Load (KN)	72	59.6	66	65.867
Batch A - Mortar Cube - 7 Days				
Weight (grams)	779	754	765	766
Ultimate Load (KN)	86.2	110	96.6	97.6
Batch A - Mortar Cube - 28 Days				
Weight (grams)	763.5	761	766	763.5
Ultimate Load (KN)	191.2	224	169.6	194.93

Table 3.3: Compressive Strength of mortar specimens of Batch A

S.No	**Days**	**Compressive Strength** (MPa)
1	0	0
2	3	13.44
3	7	19.92
4	28	39.782

Graph 3.1: Compressive Strength Development Curve for Batch A Mortar



3.3.2 Batch B

The details of specimens and ultimate load of individual specimens of Batch B are tabulated in Table 3.4. The average compressive strength and the strength development curve are given in Table 3.5 and graph 3.2. The average compressive strength of 3, 7 and 28 days are 21.50, 26.89 and 33.32 N/mm^2 respectively.

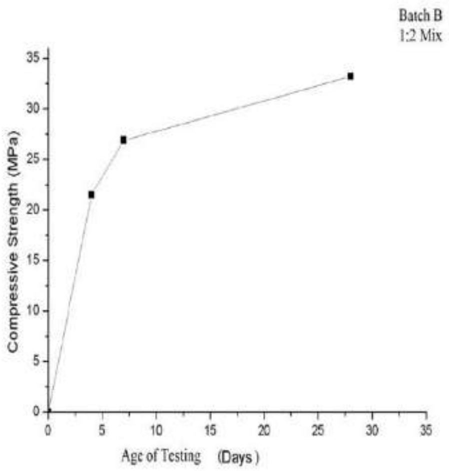
Table 3.4: Ultimate load of mortar specimens of Batch B

Batch B - Mortar Cube – 3 Days				
Specimen	1	2	3	Average
Weight (grams)	738	741	735	738
Ultimate Load (KN)	109	111	96	105.33
Batch B - Mortar Cube - 7 Days				
Weight (grams)	778	778	758	771.33
Ultimate Load (KN)	174.4	117.6	103.2	131.73
Batch B - Mortar Cube - 28 Days				
Weight (grams)	734	722	740	732
Ultimate Load (KN)	162	161.6	164.8	162.8

Table 3.5: Compressive Strength of mortar specimens of Batch: B

S.No	Days	**Compressive Strength**(MPa)
1	0	0
2	3	21.50
3	7	26.89
4	28	33.22

Graph 3.2 : Compressive Strength Development Curve for Batch B Mortar



3.3.3 Batch C:

The details of specimens and ultimate load of individual specimens of Batch C are tabulated in Table 3.6. The average compressive strength and the strength development curve are given in Table 3.7 and graph 3.3. The average compressive strength of 7 and 28 days are 11.15 and 20.07 N/mm^2 respectively.

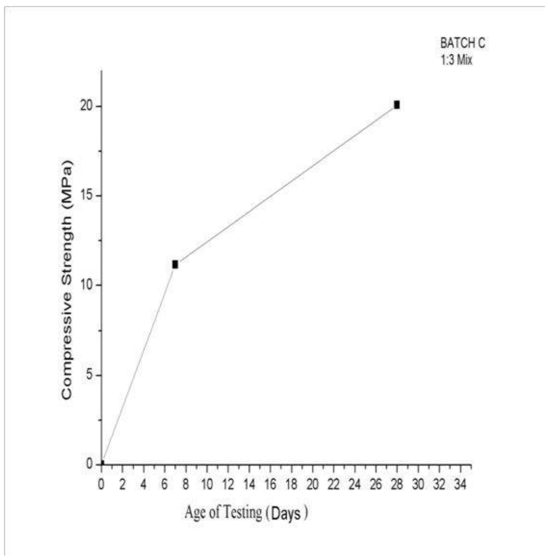
Table 3.6: Ultimate Load of mortar specimens of Batch C

Batch C - Mortar Cube - 3 Days				
Specimen	1	2	3	Averag
Weight (grams)	775	784	765	774.67
Ultimate Load (KN)	69.6	55.6	38.8	54.67
Batch C - Mortar Cube - 7 Days				
Weight (grams)	762	755	718	745
Ultimate Load (KN)	124.	72.8	45.6	81
Batch C – Mortar Cube – 28 Days				
Weight (grams)	772	769	763	768
Ultimate Load (KN)	124	104	119.2	115.73

Table 3.7: Compressive Strength of mortar specimens of Batch C

S.No	Days	Compressive Strength(MPa)
1	0	0
2	7	11.15
3	28	20.07

Graph 3.3 : Compressive Strength Development Curve for Batch C Mortar



Conclusion :

- After committing various trail tests, we achieved the grade.
- In the present study of concrete mix was developed with an idea that properties of concrete would be improved by using latex.

Reference :

- M.S.Shetty, "Concrete Technology, Theory and Practice", S.Chand and Company Limited
- "Guide for the Design, Construction and Repair for Ferrocement – ACI 549.1R-93". Report by ACI Committee 549.
- Neelamegam.M, Ohama.Y, Demura.K, Suzuki.S, and Shira.A, "Flexural Behaviour of Polymer-Ferrocement with Various Polymer Mortars as Matrices". The International Journal of Cement Composites and Lightweight Concrete, Vol.6 No. 3, Aug. 1984.