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Comparative Study on Strength of Ferrocement Panels and Normal Cement Mortar Panels

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Abstract:
Ferro-cement is a type of thin walled reinforced concrete commonly consists of cement mortar reinforced with closely spaced layers of continuous and relatively small wire mesh". "Cement Mortar is a mixture of cement, sand, and water, used in building to bond bricks or stones". The project reveals the results of flexural strength and compressive strength of Normal cement mortar (NCM) cubes, panels and Ferro cement (FC) cubes, Ferro cement panels. The main objective of this experimental study is to determine the comparative strength of Ferro cement panels and cubes over Normal cement mortar panels and cubes. For each Ferro cement cubes, panels and normal cement mortar cubes, panels, nine specimens are casted (i.e. NCM cubes=9, NCM panels=9, FC cubes=9, FC panels=9) and three specimens from each are tested at age of 3days, 7days and 28days. The panels are of size (25cm X 25cm X 5cm) and cubes of standard size (7.06cm X 7.06cm X 7.06cm). Ferro cement cubes are reinforced with three layers of chicken mesh and the distance between two consecutive layers is 1.77cm. Ferro cement panels are reinforced with steel bars of diameter 8mm and chicken mesh at a height of 2.5cm. The experimental results show that flexural strength of Ferro cement panels and compressive strength of Ferro cement cubes are increased when compared to the normal cement mortar panels and cubes due to presence of "CHICKEN MESH" reinforcement.

Keywords: *Ferrocement, cement mortar, chicken mesh*

1. Introduction

Ferro cement is a thin composite material made with a cement based mortar matrix reinforced with closely spaced layers of relatively small diameter wire mesh. Over the years, applications involving Ferro cement have increased due to its properties such as strength, toughness, water tightness, lightness, ductility and environmental stability. Ferro cement may be cast in various shapes and forms even without the use of form work and are aesthetically very appealing. Due to their thinness, Ferro cement elements can be used as roofing, flooring elements to cover large spans.

1.1. Materials Used

The material used in Ferro cement consists primarily of mortar made with Portable water and aggregate and the reinforcing with steel and chicken mesh.

1.1.1. Cement

The cement shall comply an equivalent standard; the cement shall be fresh, of uniform Consistency, and free of lumps and foreign matter. It shall be stored under dry conditions for as short duration as possible. Ordinary Portland cement of grade 53 is used in the mortar matrix and to prepare control specimens.

1.1.2. Fine Aggregate

Aggregate used in Ferro cement shall be normal weight fine aggregate (sand). It shall comply with an equivalent standard. It shall be clean, inert, free of organic matter and deleterious substances, and relatively free of silt and clay.

1.1.3. Water

The mixing water shall be fresh, clean, and potable.

1.1.4. Wire Mesh

Steel wire meshes are considered as primary reinforcement. This include square woven or welded meshes, chicken (hexagonal/aviary) wire mesh, expanded metal mesh, etc. Galvanized Chicken wire mesh with a hexagonal opening of size 12mm and wire thickness of 1.2 mm was used in this study.

1.1.5. Steel Reinforcement

Skeletal rod used in the present work is HYSD bars of 8mm diameter @ 115mm c/c both in transverse and longitudinal directions. The reinforcement shall be clean and free from deleterious materials such as dust, loose rust, and coating of paint, oil, or similar substances.

1.2. Mix Design

Cement = 350Kg/m^3

Sand = 1819.96kg/m^3

Cement: sand = 1:5

W/C ratio = 0.5

1.2.1. Test Results on Materials

1. CEMENT	
Specific gravity	3.076
Normal consistency	30%
Initial setting time	40min
Final setting time	600min
2. FINE AGGREGATE	
Specific gravity	2.63
Fineness modulus	3.74
3. STEEL BARS	
Dia of bar	8mm
Yield stress	472Mpa
Ultimate strength	560Mpa
4. CHICKEN WIRE MESH	
Dia of wire mesh	1.2mm
Size of opening	12mm
Type of opening	Hexagonal
Yield stress	405Mpa
Ultimate strength	502Mpa

Table 1

Figure 1

1.3. Casting of Cubes

The cubes are made with moulds of standard dimension (7.06cmX7.06cmX7.06cm) and panels of size (25cmX25cmX5cm).

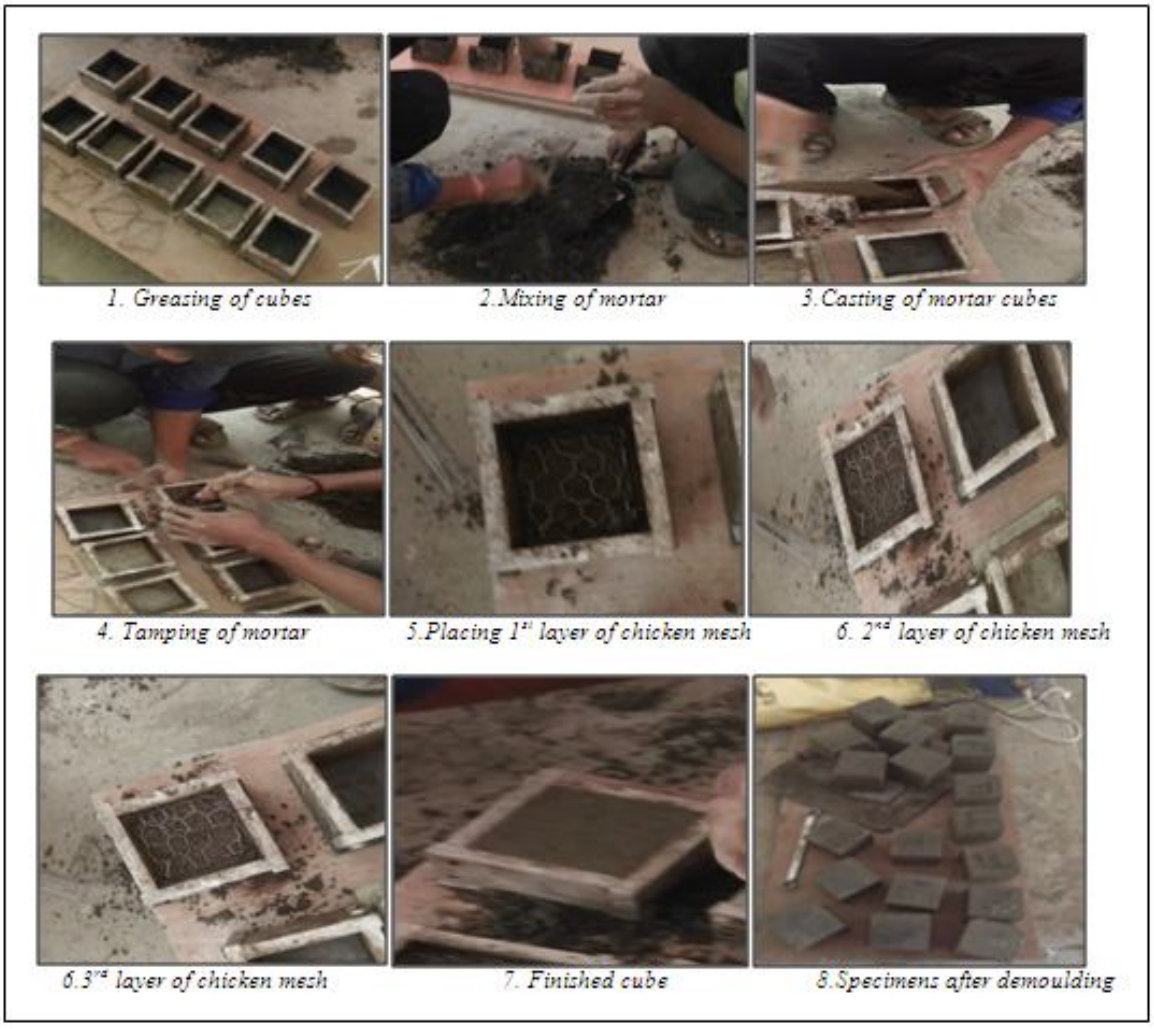

Figure 2

1.4. Casting of Panels

Figure 3

1.5. Experimental Investigation

1.5.1. Compressive Strength

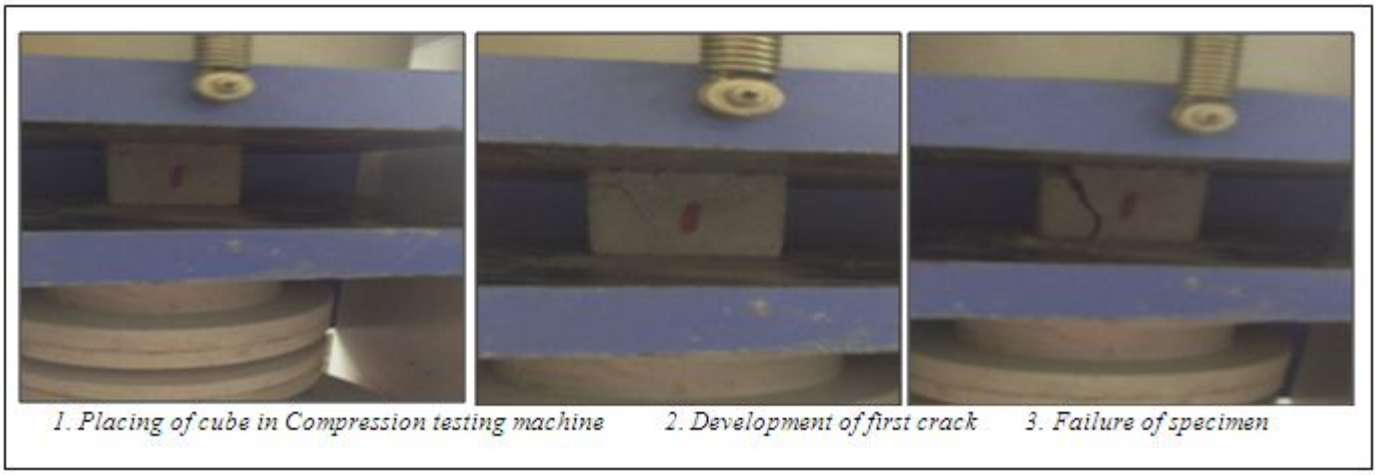

Figure 4

TYPE OF SPECIMEN	AGE ON TESTING	WEIGHT OF SPECIMEN (gms)	FAILURE LOAD (KN)	ULTIMATE STRENGTH (Mpa)
NORMAL CEMENT MORTAR	3	740	45.0	9.02
		750	43.0	8.62
		770	51.5	10.3
FERRO CEMENT	3	760	89.0	18.1
		765	92.4	18.8
		760	88.6	18.4
NORMAL CEMENT MORTAR	7	740	67.4	13.7
		760	68.1	13.8
		765	62.0	12.6
FERRO CEMENT	7	770	100.8	20.5
		750	102.3	21.2
		730	96.4	19.6
NORMAL CEMENT MORTAR	28	755	74.6	15.2
		765	72.9	14.8
		770	73.1	14.9
FERRO CEMENT	28	760	134.0	26.9
		770	136.1	27.7
		770	132.6	27.0

Table 2: Test results for Normal Cement Mortar and Ferrocement Cubes under compressive loading

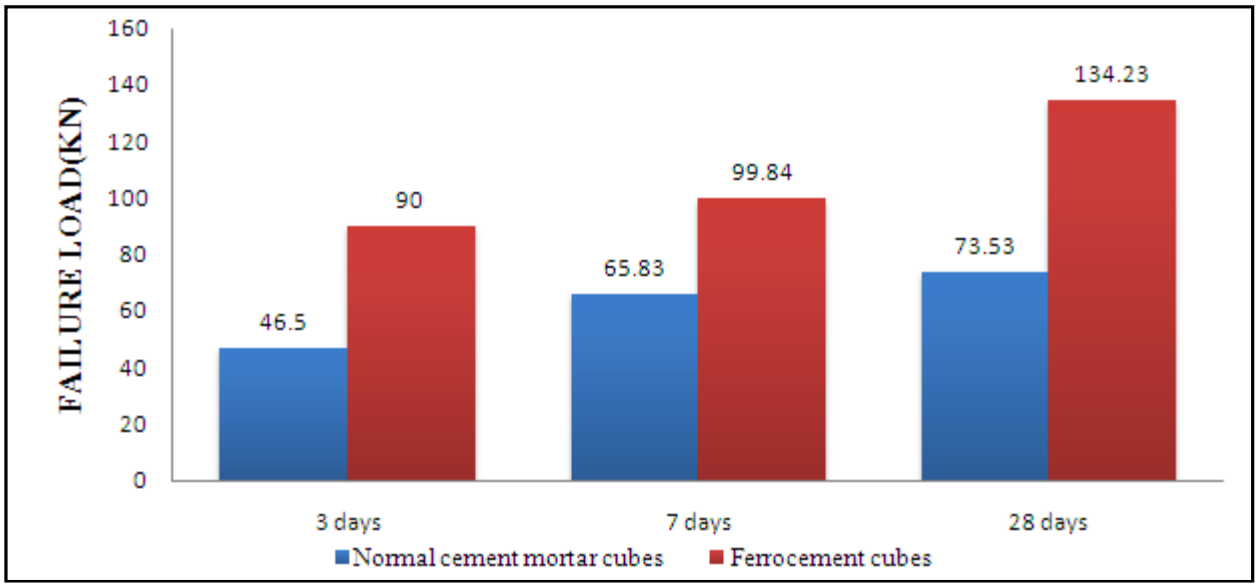

Figure 5: Comparison between average strength of Normal Cement Mortar Cubes and Ferrocement Cubes

1.5.2. Bending (Flexure)

Bending reflects the combined influence of parameters controlling both tensile and compression properties, such as mortar compressive strength, mesh type,mesh properties and mesh orientation**.**

Figure 6

Type of Specimen	Age on Testing	Weight of Specimen (GMS)	First Crack Load (KN)	Deflection Under First Crack Load(MM)	Failure Load (KN)	Deflection Under Ultimate Load (MM)	Duclity Ratio
NORMAL CEMENT MORTAR	3	6260	3.17	0.21	10.4	0.92	3.28
		6290	3.25	0.20	10.5	0.90	3.23
		6275	3.20	0.24	10.6	0.95	3.31
FERRO CEMENT	3	6525	7.10	1.30	23.5	3.10	3.31
		6510	6.50	1.43	22.5	4.10	3.46
		6660	6.50	1.17	20.5	3.60	2.89
NORMAL CEMENT MORTAR	7	6695	5.45	0.37	18.5	1.15	3.39
		6590	5.73	0.35	17.9	1.04	3.12
		6425	5.37	0.32	17.5	1.00	3.25
FERRO CEMENT	7	7315	7.90	1.45	24.5	3.10	3.10
		7535	7.35	1.57	27.2	4.50	3.70
		7460	7.73	1.50	25.3	3.25	3.27
NORMAL CEMENT MORTAR	28	6215	5.90	0.9	21.1	3.7	3.57
		6155	5.85	1.1	20.8	4.1	3.55
		6330	6.1	1.3	21.9	4.3	3.59
FERRO CEMENT	28	7410	10.5	1.7	34.67	8.0	3.30
		7350	10.8	1.77	35.15	10.0	3.25
		7455	9.5	1.85	36.00	8.5	3.78

Table 3: Test results for Normal Cement Mortar and Ferro cement Panels under flexural loading

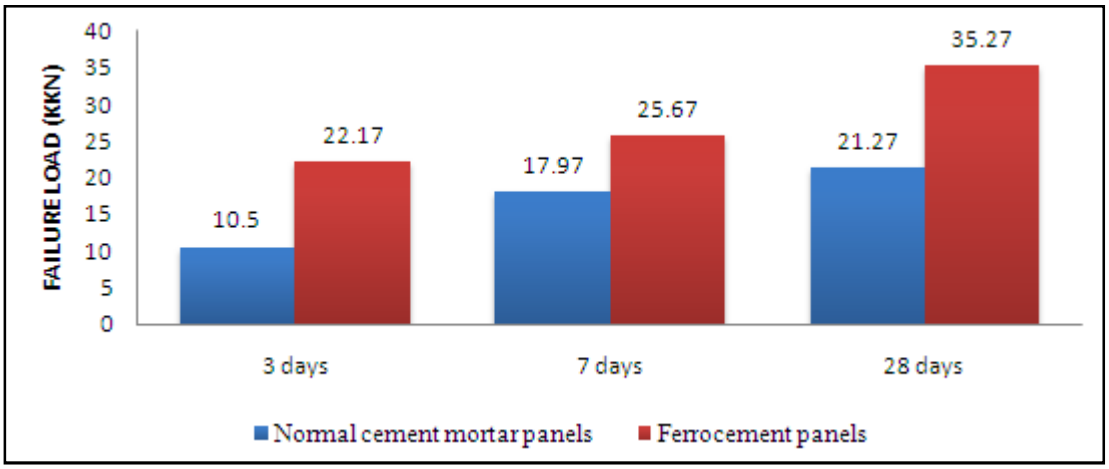

Figure 7: Comparison between average strength of Normal Cement Mortar Panels and Ferrocement Panels

2. Results

All the specimens are tested for ultimate loads. The failure loads of normal cement mortar cubes and ferrocement cubes for compression test are tabulated in Table (2) and for normal cement mortar panels and ferrocement panels for bending (flexure) test are tabulated in Table (3).The comparison between average strength of normal cement mortar cubes and ferrocement cubes is shown in Fig (5) and normal cement mortar panels and ferrocement panels is shown in Fig (7).

Results proved that ferrocement can take higher ultimate loads than normal cement mortar. Fig (5) & (7) shows that the strength of ferrocement is more than normal cement mortar and strength is increased as days goes on.

3. Conclusions

i. The compression strength of ferrocement cubes is higher than normal cement mortar cubes at the age of 28 days.
ii. The flexural strength of ferrocement panels are higher than normal cement mortar panels at the age of 28 days.
iii. The ductility ratio of ferrocement panels is higher than the normal cement mortar panels.
iv. Since ferrocement panels have a good strength than normal cement mortar panels, it can be recommended as infill.
v. Ferrocement panels have high deflection than normal cement mortar panels, so it gives enough warning before failure.
vi. Ferrocement has higher strength to weight ratio than RCC.
vii. Ferrocement structures are economical when compared to RCC structures.

4. References

i. Al-Rifaie, W.N., and Manasrah, A.A., "Ferrocement Segmented Shell Structures". Journal of Ferrocement, Vol. 31, No. 1, January 2001.
ii. B. Kondraivendhan, , "Effect of ferrocement confinement on behavior of concrete", Construction and Building Materials 23 (2009) 1218–1222.
iii. Das Gupta, N.C., Paramasivan, P., and Lee, S.L., "A Ferrocement Hyperbolic Paraboloid Shell", Journal of Ferrocement, Vol.10, No.4, October 1980, pp.273-282.
iv. Fahmy, E. H., Shaheen, Y. B. I., &Korany, Y. S. (1997b). Use of ferrocement laminates for repairing reinforced concrete slabs. Journal of Ferrocement, 27(3), 219–232.
v. Gordon B. Batson, Ronald F. Zollo , "Guide for the Design, Construction and Repair of Ferrocement''ACI 549.1R-93
vi. International Journal of Recent Trends in Engineering, Vol. 1, No. 6, May 2009
vii. International Journal of Concrete Structures and Materials Vol.8, No.1, pp.83–97, March 2014.
viii. Kalita, U.C., Nambiar, M.K.C., Borthakur, B.C., and Baruah, P., "Ferrocement Roof for Low-Cost Housing", Indian Concrete Journal July 1986, pp.177-181.
ix. Mays, G. C., & Barnes, R. A. (1995). Ferrocement permanent formwork as protection to reinforced concrete. Journal of Ferrocement, 25(4), 331–345.
x. Naaman, A. E. (1979). Performance criteria for ferrocement Journal of Ferrocement, 9(2), 75-91.