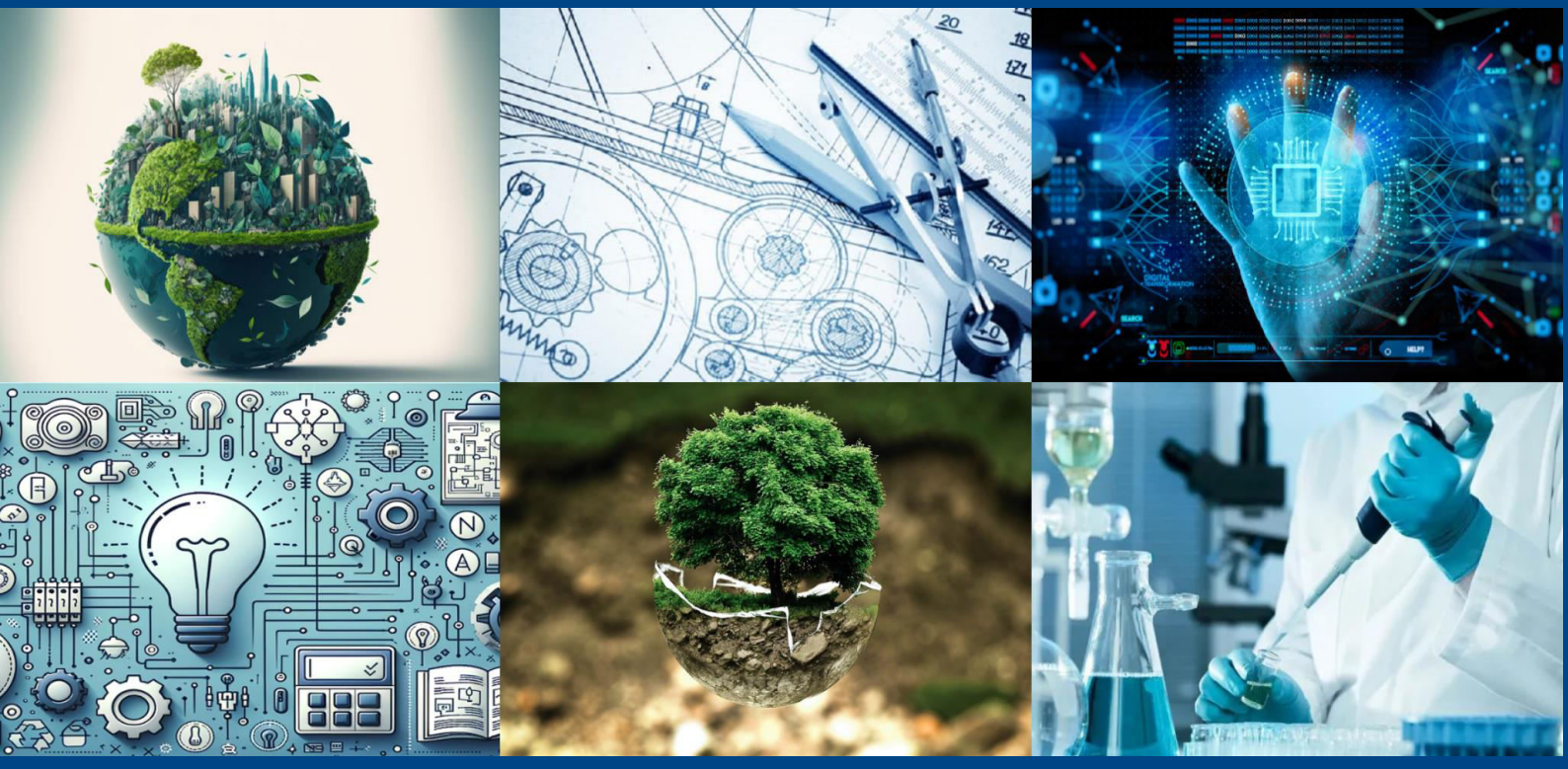
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Optimization of Ferrocement Concrete to Improve Structural Performance

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ABSTRACT: Ferrocement is a cementitious composite reinforced with closely spaced wire mesh layers. Its structural response depends on the mortar matrix, reinforcement configuration, curing conditions, and loading arrangement. This experimental investigation compares the recorded ultimate loads of ferrocement beams containing different numbers of hexagonal galvanized wire mesh layers. The reported materials were Ordinary Portland Cement (OPC) 53 Grade, manufactured sand (M-sand) graded as Zone II, and Ground Granulated Blast Furnace Slag (GGBS) sourced from the JSW steel industry at a replacement level of 3.5% by mass of cement. The reported water-to-binder ratio was 0.50. The hexagonal galvanized wire mesh had a wire diameter of 0.75 mm and an opening size of 12 mm. Three beam specimens measuring 100 × 100 × 500 mm, containing one, two, and three mesh layers, were tested using a Universal Testing Machine after 16 days of curing under a reported two-point loading arrangement. The recorded ultimate loads were 6.0, 29.5, and 38.0 kN, respectively. The three-layer specimen recorded the highest load, 533.33% greater than the single-layer specimen. One major crack was reported in each specimen. These results are preliminary because only one specimen was tested per configuration. Replicate testing and verification of the support/loading arrangement are needed before the findings can be generalized.

KEYWORDS: ferrocement; GGBS; hexagonal galvanized wire mesh; ultimate load; beam testing; cementitious composites.

I. INTRODUCTION

Concrete is widely used in civil engineering because of its versatility and ability to resist compressive stresses. However, cementitious materials have limited tensile resistance and may crack under flexural loading. Reinforcement can help carry tensile stresses and influence crack development.

Ferrocement is a thin cementitious composite reinforced with closely spaced wire mesh. Its performance depends on matrix quality, mesh geometry, reinforcement distribution, and bond. Experimental studies have investigated the influence of mesh type and layer count on flexural load, stiffness, cracking, and energy absorption (Shannag & Bin Ziyyad, 2007; Wafa & Fukuzawa, 2010).

Ground Granulated Blast Furnace Slag (GGBS) is a supplementary cementitious material that can be used to replace part of the Portland cement. The response of GGBS-containing mixtures depends on replacement level, material properties, water-to-binder ratio, and curing age. This study focuses on the recorded ultimate loads of ferrocement beams containing one, two, and three layers of hexagonal galvanized wire mesh with a reported 3.5% GGBS replacement.

1.1 Aim and objectives

The aim was to experimentally compare the recorded ultimate loads of ferrocement beams with different numbers of hexagonal galvanized wire mesh layers. The objectives were to (i) prepare three mesh configurations, (ii) record ultimate loads, (iii) document major crack observations, and (iv) compare the recorded loads using percentage differences.

1.2 Scope

The study covers three beam specimens of 100 × 100 × 500 mm tested after 16 days of curing. Since one specimen was tested for each configuration, the results are preliminary and do not establish statistical reliability or an optimum design configuration.

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II. LITERATURE REVIEW

2.1 Wire mesh layers and flexural response

The number, type, spacing, and diameter of mesh reinforcement can influence the flexural response and crack characteristics of ferrocement elements. Shannag and Bin Ziyyad (2007) examined mesh layers and other reinforcement parameters in ferrocement specimens. Wafa and Fukuzawa (2010) investigated different reinforcement meshes and reported that mesh type and configuration affect bending characteristics, cracking, and energy absorption. These studies support the relevance of documenting mesh characteristics and testing geometry when comparing specimens.

2.2 GGBS and cementitious composites

GGBS is used as a supplementary cementitious material in mortar and concrete. Its effects depend on the material's physical and chemical properties, dosage, mixture proportions, and curing. In this investigation, the GGBS source and replacement level were reported by the researcher, but specific gravity, fineness, and chemical composition were not independently measured. Therefore, numerical values for these properties are not assigned.

2.3 Research context

Published studies have examined the flexural behaviour of ferrocement panels and beams with varying mesh layers and matrix compositions (Rathinam & Kanagarajan, 2023; El-Sayed et al., 2023). The present study provides a small-scale comparison of three hexagonal galvanized mesh configurations. Its contribution is limited to the recorded loads and observations from the tested specimens; more specimens and complete measurements are needed for stronger conclusions. Ambient temperature and exposure details will also be logged so that comparisons between mixes are fair.

III. MATERIALS AND METHODOLOGY

3.1 Materials

Cement: Ordinary Portland Cement (OPC) 53 Grade was used as the primary cementitious material.
GGBS: GGBS sourced from the JSW steel industry was used at 3.5% replacement by mass of cement. Specific gravity, fineness, and chemical composition were not independently determined and are not reported numerically.
Fine aggregate: Manufactured sand (M-sand) with Zone II grading, reported as conforming to IS 383, was used.
Water: The reported water-to-binder ratio was 0.50. This value should match the original batch records and should be applied consistently throughout the manuscript.
Wire mesh: Hexagonal galvanized wire mesh was used with a reported wire diameter of 0.75 mm and mesh opening size of 12 mm.

3.2 Material specifications

Parameter	Specification
Cement	OPC 53 Grade
GGBS source	JSW steel industry
GGBS replacement	3.5% by mass of cement
GGBS properties	Specific gravity, fineness and chemical composition not independently determined
Fine aggregate	Manufactured sand (M-sand)
Aggregate grading	Zone II, reported as per IS 383
Water-to-binder ratio	0.50
Wire mesh	Hexagonal galvanized wire mesh
Wire diameter	0.75 mm
Mesh opening size	12 mm

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3.3 Beam specimens

Specimen	Mesh layers	Length (mm)	Width (mm)	Depth (mm)
B1	1	500	100	100
B2	2	500	100	100
B3	3	500	100	100

3.4 Preparation and curing

Three beam specimens with the same reported dimensions and different mesh-layer configurations were prepared. The exact batch quantities, mixing duration, mesh placement, compaction method, demoulding procedure, and curing regime should be transcribed from the laboratory notebook if available. The specimens were reported to have been tested after 16 days of curing.

3.5 Testing arrangement

Testing was carried out using a Universal Testing Machine (UTM) under a reported two-point loading arrangement. The reported beam length was 500 mm. The loading positions were described as 150 mm from the left end to the first loading point, 200 mm between loading points, and 150 mm from the second loading point to the right end. The user confirmed that the supports were at both beam ends; for the calculations below, this is idealized as simple supports at x = 0 and x = 500 mm. The load readings are treated as total machine loads shared equally by the two loading points. These assumptions must be checked against the actual test setup and UTM arrangement before journal submission.

Parameter	Value
Testing machine	Universal Testing Machine (UTM)
Beam dimensions	100 × 100 × 500 mm
Nominal support span (assumed)	500 mm
Left end to first loading point	150 mm
Distance between loading points	200 mm
Second loading point to right end	150 mm
Curing age	16 days
Loading type	Two-point loading

IV. RESULTS AND DISCUSSION

4.1 Recorded ultimate loads

Specimen	Mesh layers	Recorded ultimate load (kN)
B1	1	6.0
B2	2	29.5
B3	3	38.0

The single-layer specimen recorded 6.0 kN, the two-layer specimen recorded 29.5 kN, and the three-layer specimen recorded 38.0 kN. The three-layer specimen therefore had the highest recorded ultimate load among the three specimens tested.

4.2 Percentage comparison

Percentage increase was calculated as: Percentage increase = $[(P_2 - P_1) / P_1] \times 100$, where P_1 is the reference load and P_2 is the comparison load.

Comparison	Calculation	Increase
Two-layer vs one-layer	(29.5 − 6.0) / 6.0 × 100	391.67%
Three-layer vs one-layer	(38.0 − 6.0) / 6.0 × 100	533.33%
Three-layer vs two-layer	(38.0 − 29.5) / 29.5 × 100	28.81%

These percentages describe differences between the three recorded values. Because only one specimen was tested per configuration, they should not be interpreted as statistically validated improvements or as a general design relationship.

4.3 Conditional bending moment and nominal bending stress

The following calculations are conditional estimates, not confirmed standard flexural-strength results. They assume simple supports at the two beam ends, loading points at x = 150 mm and x = 350 mm, and equal load division between the two loading points. If P is the total UTM load, each point load is P/2. The maximum bending moment between the two loading points is Mmax = (P/2) × 150 mm.

For the rectangular section, the elastic section modulus is $Z = bd^2/6 = (100 \times 100^2)/6 = 166{,}666.7\ mm^3$. The nominal elastic bending stress is $\sigma = M/Z$. These values should only be retained in the final paper if the assumed loading and support arrangement is verified.

Specimen	Total load P (kN)	Assumed Mmax (kN·m)	Nominal σ = M/Z (MPa)
B1	6.0	0.450	2.70
B2	29.5	2.2125	13.28
B3	38.0	2.850	17.10

Important: the stress values above are theoretical nominal elastic bending stresses calculated from the assumed geometry. They are not presented as standard flexural strength measurements. Confirm the support locations, load-cell interpretation, and whether the UTM value represents the combined load before including these values in a submitted manuscript.

4.4 Crack observation

One major crack was reported in each specimen. The available records do not specify the first-crack load, crack width, crack location, crack propagation history, deflection, or final failure mode. These parameters should be recorded in future tests to provide a more complete structural assessment.

4.5 Discussion

Under the reported test conditions, the three-layer specimen recorded the highest ultimate load. This observation is consistent with the possibility that additional mesh reinforcement affected the load-carrying behaviour. However, the study cannot establish the mechanism or quantify a reliable reinforcement effect because only one specimen was tested for each configuration and several test details remain unverified. The results should therefore be described as preliminary.

4.6 Limitations

The limitations are: (i) one specimen per configuration; (ii) a 16-day curing age only; (iii) no independent GGBS characterization; (iv) incomplete batch-level mix quantities in the supplied records; (v) support and loading assumptions requiring confirmation; and (vi) no measured load-deflection curve or quantitative crack-width data.

V. CONCLUSION

This investigation compared three GGBS-based ferrocement beam specimens reinforced with one, two, and three layers of hexagonal galvanized wire mesh. The specimens measured 100 × 100 × 500 mm and were reported to have been tested after 16 days of curing.

The one-layer specimen recorded 6.0 kN, the two-layer specimen 29.5 kN, and the three-layer specimen 38.0 kN. The recorded load for the two-layer specimen was 391.67% higher than the one-layer result, while the three-layer result was 533.33% higher than the one-layer result and 28.81% higher than the two-layer result. One major crack was reported in each specimen.

Within the limits of this small experimental programme, the three-layer specimen showed the highest recorded ultimate load. However, one specimen per configuration is insufficient to establish a statistically reliable improvement or identify an optimum configuration. Further testing should include replicate specimens, verified loading geometry, complete batch quantities, GGBS characterization, load-deflection measurements, and detailed crack observations.

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VI. RESEARCH GAP

Previous studies have investigated the flexural behaviour of ferrocement elements by considering different wire mesh types, reinforcement configurations, and cementitious matrix compositions. However, further experimental investigation is required to understand how variations in the number of wire mesh layers influence the ultimate load-carrying capacity of ferrocement beams under specific laboratory conditions.

The present study addresses this aspect by experimentally comparing ferrocement beams reinforced with one, two, and three layers of hexagonal galvanized wire mesh. The specimens were prepared using Ordinary Portland Cement (OPC) 53 Grade, Zone II manufactured sand, and a reported 3.5% GGBS replacement by mass of cement. The comparison focuses on the recorded ultimate loads and observed major cracking in specimens with different mesh-layer configurations.

The available experimental data are limited by the absence of replicate specimens for each reinforcement configuration, load-deflection measurements, quantitative crack-width observations, and a fully verified loading arrangement. Consequently, the reliability and general applicability of the observed differences cannot yet be established. This study therefore presents a preliminary experimental comparison and highlights the need for further testing under controlled and verified conditions to improve understanding of the relationship between wire mesh layer configuration and the structural response of ferrocement beams.

REFERENCES

1. Deokar, A. H., & Shirsath, M. N. (2021). Experimental study on effect of using different numbers of wire mesh layers and thickness variation on the flexural strength of flat ferrocement slab panels. Journal of Emerging Technologies and Innovative Research, 8(5), f385–f389. https://www.jetir.org/view?paper=JETIR2105718
2. El-Sayed, T. A., Deifalla, A. F., Shaheen, Y. B., Ahmed, H. H., & Youssef, A. K. (2023). Experimental and numerical studies on flexural behavior of GGBS-based geopolymer ferrocement beams. Civil Engineering Journal, 9(3). https://doi.org/10.28991/CEJ-2023-09-03-010
3. Rathinam, K., & Kanagarajan, V. (2023). A study on flexural behaviour of ferrocement slabs using foamed concrete. International Journal of Structural Engineering, 13(1), 63–79. https://doi.org/10.1504/IJSTRUCTE.2023.126809
4. Shannag, M. J., & Bin Ziyyad, T. (2007). Flexural response of ferrocement with fibrous cementitious matrices. Construction and Building Materials, 21(6), 1198–1205. https://doi.org/10.1016/j.conbuildmat.2006.06.021
5. Wafa, M. A., & Fukuzawa, K. (2010). Characteristics of ferrocement thin composite elements using various reinforcement meshes in flexure. Journal of Reinforced Plastics and Composites, 29(23). https://doi.org/10.1177/0731684410377814
6. Bureau of Indian Standards. (2016). IS 383:2016—Coarse and fine aggregate for concrete: Specification (3rd revision). BIS



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