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Research Article

Flexural Behavior of Ferrocement Plates Using Iron Wire Mesh and Hand-Woven Polymer Mesh Reinforcement

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Abstract

Ferrocement is a lightweight, cost-effective structural material that is a thin mortar base reinforced by fine-diameter wire mesh and has become a popular solution in low-cost construction. The current research examines the flexural behavior of ferrocement plates reinforced with four iron mesh variants (hexagonal, woven 18-gauge, woven 20-gauge, and expanded metal mesh variants) and two hand-woven polymer mesh variants, which are polypropylene (PP) and Nylon-66. Fifty-four uniform-sized plates (250 × 550 × 12.5 mm) were reinforced with one to three layers of mesh and loaded to one point. Measured parameters were load deflection relationships, first-crack load, yield load, ultimate load, crack propagation, and modulus of rupture. Statistics show that metallic meshes are significantly superior to polymer meshes in terms of stiffness, crack management, and flexural strength. Among the metallic reinforcements, the woven 18-gauge mesh performed best, followed by the expanded metal mesh, which can be explained by the increased mesh-mortar interaction and ductile post-cracking response. On the other hand, PP and Nylon-66 meshes exhibited lower stiffness, worse bonding, and the strength declined with the number of mesh layers. These findings suggest that further attempts to create polymer meshes must focus on the optimization of mesh geometry and tensile stiffness and the strengthening of mesh-mortar interfacial bonds by surface modifications or hybrid reinforcement concepts. On balance, the current study highlights the high structural performance of iron meshes in thin ferrocement components and provides a recommendation on the development of polymer-based substitutes in load-bearing structures.

Keywords: Ferrocement, Flexural Behavior, Wire Mesh Reinforcement, Polymeric Meshes, Modulus of Rupture

Introduction

Ferrocement (FC) is a thin-walled cementitious composite with a rich mortar matrix reinforced with one or multiple layers of five or ten small-diameter wire mesh or fine rod layers rather than traditional bar reinforcement and coarse aggregates. As stated in ACI Committee 549, ferrocement can be described as a form of reinforced concrete with a thin wall, where the mortar of hydraulic cement is strengthened with layers of continuous, comparatively small-diameter mesh that can be metallic or non-metallic [1,2]. Common ferrocement components have a thickness between 10 and 50 mm, a high reinforcement surface-area-volume ratio, and diffusively distributed cracking [1,3,4].

Its low-tech method of construction, the utilization of locally sourced resources, and the low formwork have led to extensive popularization of ferrocement in cost-effective house construction, shells, water tanks, silos, boats, and repair or strengthening overlays, especially in developing countries [3–6]. FC elements have a desirable mix of characteristics that are high tensile strengths, flexural strengths divided by weights, toughness, impact resistance, water tightness, and excellent durability when well detailed [3,4,6,7]. Other recent sustainability-focused works also point to the possibility of decreasing cement use, raw-material consumption, and CO_2 emissions with the incorporation of ferrocement with other cementitious substances or industrial wastes [5,8,9].

Nevertheless, the performance of traditional ferrocement in the long term is usually controlled by the corrosion of the fine metallic meshes, which are covered by a limited amount of mortar and are susceptible to micro-cracking and external intrusion as soon as such phenomena take place [2,6,10]. As a measure to address this, a number of authors have explored coated or non-corrodible reinforcement, e.g., PVC-coated welded wire mesh, stainless meshes, glass-fiber fabrics, and polymeric meshes in place of galvanized iron (GI) mesh [7,10–13]. As an illustration, Sakthivel and Jagannathan [10] stated that the PVC-coated weld mesh panels exhibited better crack control and similar flexural strength to GI-mesh panels with increased mesh layer numbers of one to three. Udhayakumar et al. [7] also found that slabs reinforced with the PVC-coated mesh had increased impact and ductile property in comparison with slabs reinforced with GI. Qureshi et al. [11] showed that ferrocement panels with PVC plastic mesh and welded iron mesh, as well as the use of styrene-butadiene rubber (SBR) latex and polypropylene (PP) fibers, had better flexural toughness and a more ductile failure mode compared to standard ferrocement.

The flexural behavior of ferrocement slabs and beams has gained much research. The effects of panel thickness, mesh structure, the number of mesh layers, and modifying the matrices in the experimental programs on the first-crack load, ultimate flexural strength, stiffness, and ductility have been studied. The results of parametric studies on flat and folded panels, slab strips, sandwich beams, and box beams all indicate that the number of mesh layers and thickness optimization results in substantial gains in flexural strength and energy absorption [3,7,8,14,17,18]. An example is when Phalke and Gaidhankar [8] experimented on flat panels with different mesh layers and steel fibers and showed considerable improvement in ultimate strength and ductility as the mesh volume fractions increased. The study of flat ferrocement panels conducted by a PCI [9] ensured that the load-carrying capacity is increased with the panel thickness and the number of mesh layers, as well as the alteration of the stiffness and fine structure. El-Wafa and Fukuzawa [15] examined the lightweight ferrocement sandwich composite beam and proved that thin furnace strength faces with several layers of mesh reinforcement can successfully mobilize flexural capacity, even though it has reduced self-weight. Shaaban et al. [16] made a theoretical prediction of the lightweight ferrocement composite beams and demonstrated good correspondence with experimental flexural responses. Recently, Kaushik et al. [14] employed silica-fume and fiber-modified mortars in ferrocement slab panels and have reported the advancement of stiffness, less deflection, and better cracking abilities under bending.

Along with these developments, scientists have started consideration of non-metallic and polymeric meshes as a major reinforcement to ferrocement. Mughal et al. described ferrocement panels reinforced with PP wire mesh and established that even though there was no consistent correlation between the number of PP mesh layers and monotonic changes in strength, thicker panels with multiple layers of PP mesh exhibited better ductility and crack distribution than thinner panels [12]. In an experimental research of thin hollow-core ferrocement slabs, which are reinforced with steel mesh, PP mesh, glass-fiber mesh, and bars, it was observed that the type and stiffness of reinforcement played an important role in flexural capacity, crack spacing, and failure mode [13]. Flexural performance that promises an improvement has also been demonstrated in hollow self-compacted ferrocement beams reinforced with GFRP bars and fiberglass mesh without corrosion of steel [18]. Other techniques used to assess the practicability of non-metallic meshes are through the use of static and impact testing of ferrocement slabs manufactured using various types of reinforcements [17]. Recently Qureshi et al. [11] have shown that with PVC plastic mesh and PP fibers incorporated into the ferrocement panels, excellent flexural strengths that can be used in lightweight housing construction were attained. Besides commercially produced polymer grids, hand-woven polymer mesh made of polypropylene and nylon can also serve as a locally flexible reinforcement method. They can be made with locally available materials and labor, have a flexible mesh aperture and weaving pattern, cost less, and rely less on imported products and yet be corrosion-free.

Although this body of work has grown, there are still few gaps. To start with, the majority of present studies are devoted to specific types of non-metallic meshes or only one type of metal mesh, without direct experimental comparisons between several types of metallic meshes and several types of polymeric meshes in the same matrix, geometry, and experimental conditions [3,7,8,12,13]. Second, although the positive effect of the increasing mesh layers is well-known in the case of metallic meshes [3,8-10], the dependence on the number of mesh layers and flexural strength in ferrocement with hand-woven polymer meshes (e.g., PP and nylon) is underquantified; even some findings indicate non-monotonic trends in connection with bonding, mismatch of stiffness, and congestion effects [11,12]. Thirdly, the effect of polymer meshes on crack initiation and propagation, yield, ultimate behavior, and modulus of rupture as compared to the most popular iron meshes at the same conditions, thickness, and span are insufficiently discussed.

The current experimental study aims to fill these gaps by studying the flexural behavior of ferrocement plates reinforced with four kinds of iron mesh, namely hexagonal, woven 18-gauge, woven 20-gauge, and expanded metal

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mesh, which are the most available and widely used reinforcement meshes in local construction practice. These are tested against ferrocement plates that are reinforced with hand-woven polypropylene (PP) and Nylon-66 meshes under the same material, geometric, and testing conditions.

The particular aims of this research are

- To determine the flexural performance (first-crack load, yield load, ultimate strength, modulus of rupture, and crack development) of ferrocement plates reinforced with four different types of iron mesh that are commonly used.
- To assess the possibility and structural performance of ferrocement plates reinforced with hand-woven PP and Nylon-66 meshes as lightweight and corrosion-free substitutes for iron meshes.
- To examine the effect of mesh layering (one to three layers) on flexural behavior and crack propagation of both metallic and polymeric reinforcement systems.

Through the explanation of the combined effect of mesh material and the number of layers on flexural performance, the work provides experimentally relevant information that can be used to design durable, lightweight ferrocement elements with traditional iron wire mesh reinforcements and new polymer mesh reinforcements.

Materials and Methods

Matrix Components

All ferrocement specimens were prepared using locally sourced Portland cement (CEM II), fine sand, and either iron wire meshes or polymer-based woven meshes. The cement was tested in the laboratory to verify its conformity with IS:12269–1987. Table 1 summarizes the measured physical properties of the cement. Table 1 presents the measured physical properties.

Table 1. Physical properties of cement

Physical Property	Result	Requirement (IS:12269–1987)
Specific Gravity	3.14	—
Standard Consistency	26%	—
Initial Setting Time	2 h	≥ 30 min
Final Setting Time	3 h	≤ 600 min
Compressive Strength (MPa)		
72 ± 1 h	15	≥ 27
168 ± 2 h	25	≥ 37
672 ± 4 h	40	≥ 53

Locally available natural sand from the Sylhet region of Bangladesh was used as fine aggregate. The sand was oven-dried prior to testing and characterized following ASTM standards. Only sand passing through a 1.18-mm sieve, as recommended by the Bangladesh National Building Code (BNBC), was used for specimen casting. Table 2 lists the measured properties.

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Table 2. Physical properties of sand

Property	Value	Test Standard
Fineness Modulus	2.21	ASTM C136
Bulk Density (kg/m³)	1590	ASTM C29
Specific Gravity	2.63	ASTM C127/C128
Water Absorption (%)	1.2	ASTM C127/C128
Effective Fineness Modulus	2.17	ASTM C136

The matrix mix ratio was maintained identical for all specimens to ensure that observed variations in flexural behavior were solely due to the reinforcement type and number of mesh layers. The mortar mix proportion used for all specimens was cement:sand:water = 1:2.5:0.45 by weight. No chemical admixtures were used in the mortar preparation. The average 28-day compressive strength of the mortar matrix, determined from 50 mm cube specimens cured under identical conditions, was 41.2 MPa.

Reinforcement

Six reinforcement configurations were used, including four iron wire mesh types and two manually woven polymer meshes (Figure 1). The selection of these materials was motivated by their availability and relevance to practical ferrocement construction.

The iron reinforcement types used were:

- Hexagonal wire mesh
- Woven wire mesh (18 gauge)
- Woven wire mesh (20 gauge)
- Expanded metal mesh

According to ACI 549 guidelines, fine rectangular or orthogonal meshes placed at 0°/90° orientation provide superior flexural performance due to improved force transfer and crack control. This principle guided the reinforcement alignment.

Polymer meshes were hand-woven using locally available polypropylene (PP) and Nylon-66 fibers, maintaining a uniform mesh opening of 12.5 mm. Manual weaving ensured consistent spacing and allowed comparison with standard iron meshes under identical geometric conditions.

(a) (b) (c) (d)

Figure 1. Types of mesh. (a) Hexagonal iron mesh, (b) Woven 20, (c) Expanded Metal Mesh (d) Woven 18

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Polymer Fibers

Polymer reinforcement was added in the shape of hand-woven nets instead of loose discrete fibers to mimic the structural role of the standard wire mesh and to overcome the issue of corrosion-related durability (Figure 2). The chemical inertness, hydrophobicity, and corrosion resistance of polypropylene (PP) fibers make them especially appropriate for thin ferrocement sections in which the mortar cover is nominal (typically 35 mm). Nylon-66 fibers are relatively high in tensile strength and flexible in nature and thus can be deformed to be compatible with the mortar matrix, but their elastic stiffness is significantly lower than steel reinforcement.

The polymer meshes were created by hand in three steps: (i) cutting and sorting fibers to the desired size; (ii) weaving the fibers by hand to create a uniform square grid with a 12.5 mm mesh hole; and (iii) fixing the woven mesh to avoid distortion during handling and casting.

The polymer meshes were not subjected to any surface treatment, including chemical coating or mechanical roughing. The meshes were used in their as-fabricated state to accurately reflect low-cost, locally produced reinforcement systems, which are usually taken up in practice. This meant that the formation of a bond between the polymer mesh and the mortar matrix was controlled more by mechanical interlocking of the woven geometry and by confinement between layers of mesh, and not by chemical bonding.

Also, the polymer meshes were not pre-tensioned or pre-stressed before or during casting. Polymer meshes were all placed under a stress-free environment, and no anchoring or tensioning devices were used, which is a realistic condition of construction. Consequently, the early part of the load-deflection response of polymer-reinforced specimens takes into account the action of fiber straightening and slack elimination before complete tensile engagement, which adds to the reduced apparent initial stiffness in comparison to steel mesh-reinforced specimens.

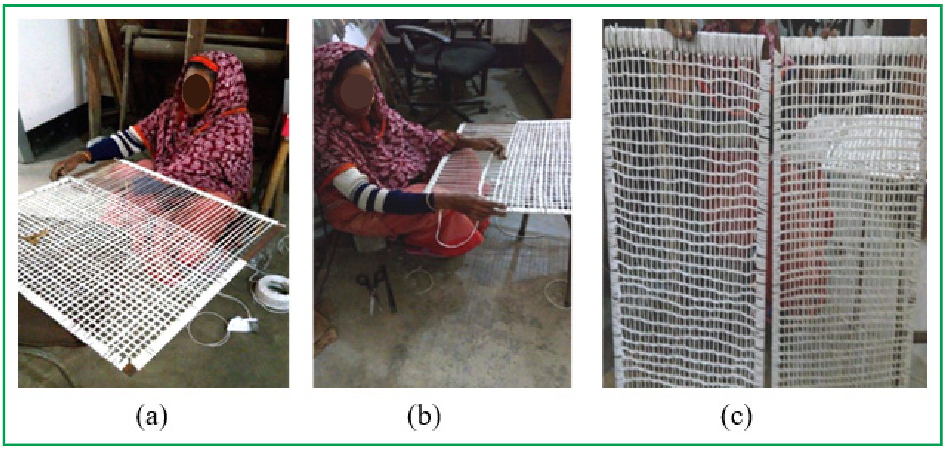

Figure 2. Polymeric reinforcement details (a) & (b) preparing the meshes, (c) prepared meshes

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Test Specimens

A total of 54 ferrocement plates were cast and divided into six series (FH, FW1, FW2, FE, FP, FN) as in Table 3, each representing a unique mesh type (Figure 3). Within each series, three subgroups were prepared containing 1-layer, 2-layer, and 3-layer reinforcement, with three replicate specimens in each subgroup. All plates were cast in identical dimensions: 250 mm × 550 mm × 12.5 mm (thickness).

Table 3. Details of test specimens

Specimen ID	Mesh Type	Layers	Panel Size
FH	Hexagonal	1–3	250 × 550 mm
FW1	Woven 18-gauge	1–3	250 × 550 mm
FW2	Woven 20-gauge	1–3	250 × 550 mm
FE	Expanded Metal	1–3	250 × 550 mm
FP	Polypropylene	1–3	250 × 550 mm
FN	Nylon-66	1–3	250 × 550 mm

Figure 3. Flexural Specimen Detail

Casting Procedure

Specimens were cast using aluminum moulds positioned on polyethylene sheets to ensure smooth finishing (Figure 4). A uniform mortar mix was prepared and placed in layers corresponding to the number of reinforcement meshes.

For 1-layer specimens:

- A 6-mm mortar layer was placed at the bottom and compacted.
- Mesh was positioned at mid-depth.
- The remaining 6-mm mortar layer was added and leveled.

For 2-layer specimens:

- A 3-mm bottom cover was created using 3-mm glass spacers.
- First mesh placed and embedded.
- A 6-mm mortar layer added.
- Second mesh placed.
- Final 3-mm cover layer added.

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For 3-layer specimens:

- The same procedure was followed, with an additional central mesh layer embedded within the internal 6-mm mortar zone.

After casting, all specimens were demoulded after 24 hours and cured in water for 28 days. Specimens were surface-dried before testing (Figure 5).

Figure 4. Casting stages (a) Mortar placement (b) Mesh positioning (c) Thickness control

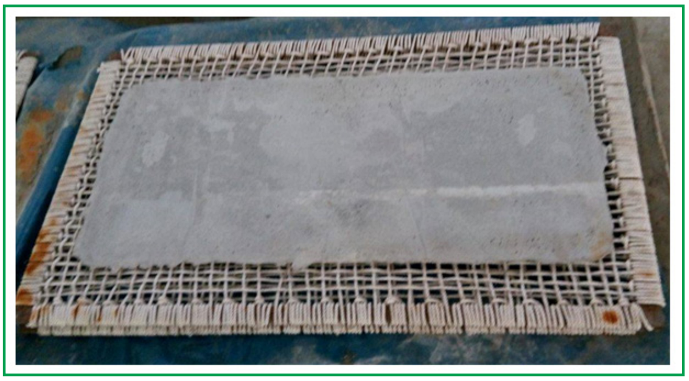

Figure 5. Completed specimen with nylon mesh

Flexure Testing Setup

Flexural testing was conducted using a specially fabricated loading frame compatible with a Universal Testing Machine (UTM). A one-point loading configuration was adopted to ensure a clear bending zone. The effective span between the bottom rollers was maintained at 275 mm.

The setup consisted of:

- Two bottom roller supports
- One central top loading roller
- Hydraulic jack connected to a proving ring for load measurement
- Dial gauges for mid-span deflection recording

Specimens were positioned with their longitudinal axis aligned to the supports, and loading was applied gradually until failure.

Test Procedure

Testing followed ASTM flexural test principles. Prior to loading, gauges were zeroed, and alignment was checked. Load increments were applied manually using the hydraulic jack.

At each increment, the following were recorded:

- Applied load
- Mid-span deflection
- Appearance of first crack
- Crack propagation pattern
- Ultimate load at failure

All specimens were tested until complete fracture occurred (Figure 6). Average width and depth of each specimen were used to calculate the modulus of rupture (R) using Equation (1), where P = ultimate load, L = span length (275 mm), b = specimen width, and d = specimen depth.

$$R = 3PL/2bd^2 \quad (1)$$

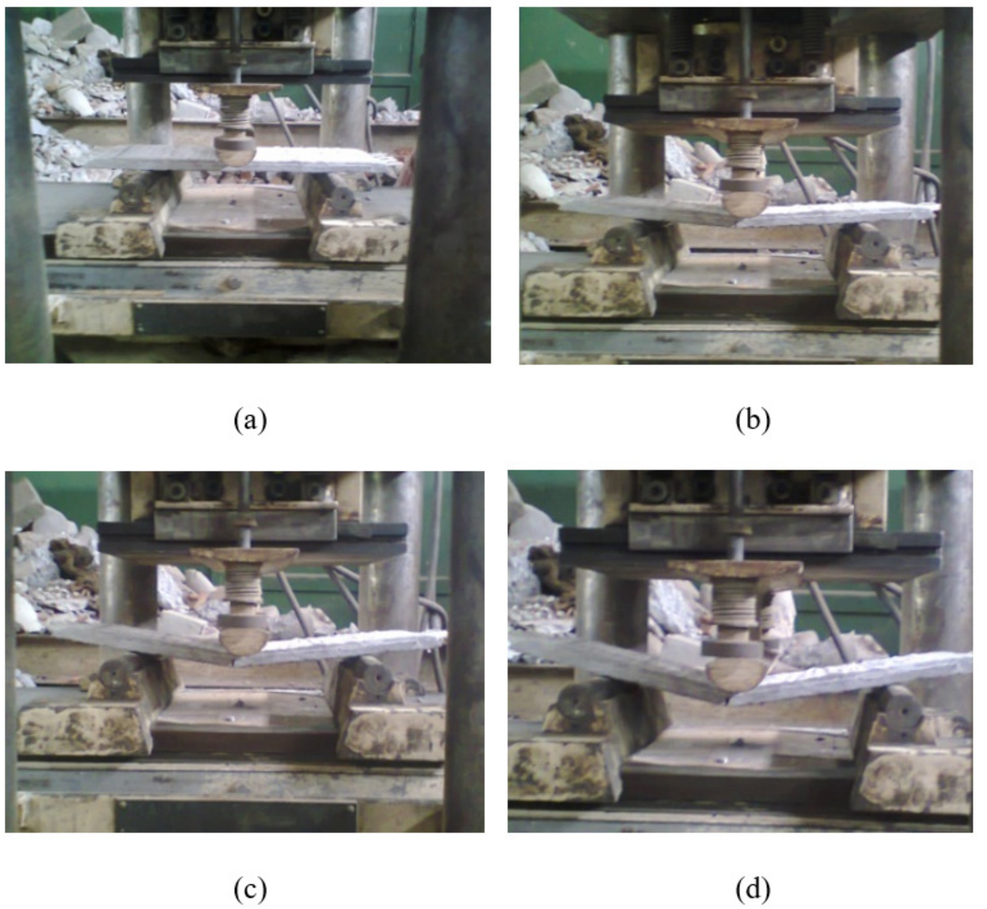

Figure 6. Flexural test method (one point load) from initial to ultimate load situation

Results And Discussion

Load-Deflection Behavior

The analysis of the strength data to determine the nature of stiffness, ductility and crack propagation considered the global load-deflection behavior. Figure 7 shows representative curves of each mesh arrangement. The sharp initial slopes of specimens reinforced with iron meshes are an indication of high flexural stiffness, with a progressive softening of the material after cracking, thus showing ductile behavior. The woven expanded metal mesh plates of 18gauge could support the load once the initial cracking occurred and created many micro cracks, with the ability to continue deflecting further before failure. This superior post-cracking response can be fundamentally attributed to the higher tensile stiffness of the steel wires, increased effective reinforcement area, and enhanced mechanical anchorage provided by the woven orthogonal geometry and the ribbed ligaments of the expanded metal mesh.

In contrast, polypropylene and nylon reinforced plates had less initial slopes and a sharp drop in stiffness after crack initiation. Figure 7 shows that their curves are more brittle-descending in nature, which emphasizes a lower crack-bridging ability and less mesh-matrix interaction. Figure 7 information thus highlights the mechanical excellence of steel-based meshes and the ductility disparity between metallic and polymeric mesh systems.

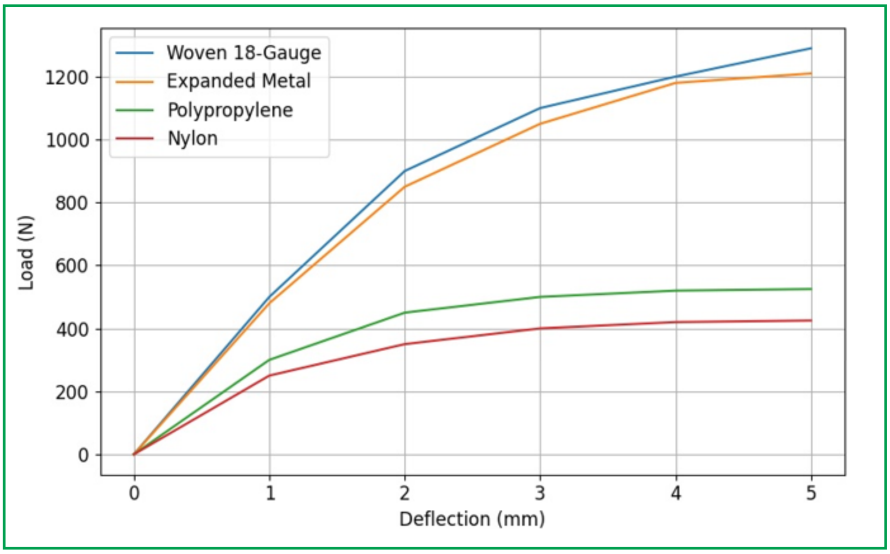

Figure 7. Deflection behavior due to load

First-Crack Load and Crack Progression

The first-crack load is a basic parameter in the design of ferrocement structures since crack control is one of the major structural roles of reinforcing mesh. The comparative values that are plotted in Figure 8 show that:

- Woven 18-gauge and expanded-metal meshes had the highest first-crack loads, thus confirming their better bonding and confinement properties.
- Hexagonal mesh was found to have moderate crack resistance, and only

slight improvements were realized when supplementary layers were added.

- Polypropylene and nylon plates exhibited significantly reduced first-crack loads; furthermore, the cracks formed were larger and more visible on their formation, supporting the conclusion of poor adhesion of mortar.

The observations made during the testing process showed that steel meshes generated a large number of closely spaced fine cracks, whereas polymer meshes generated fewer but larger cracks and failed in a more sudden way.

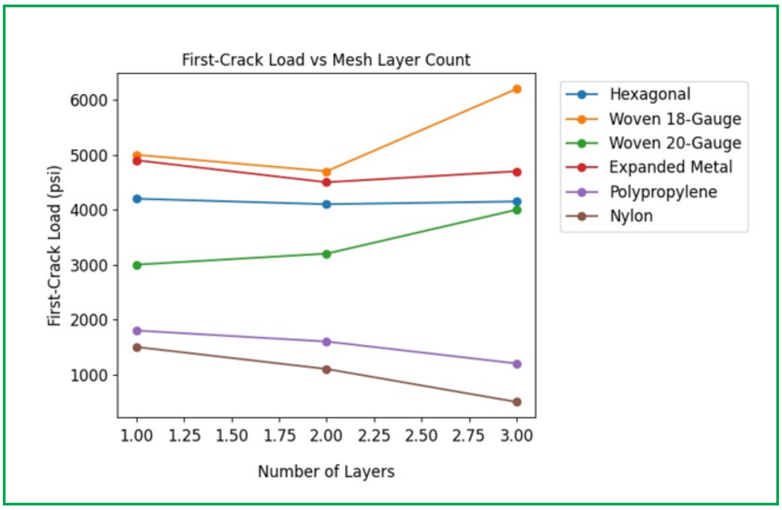

Figure 8. First-crack load at different layer count

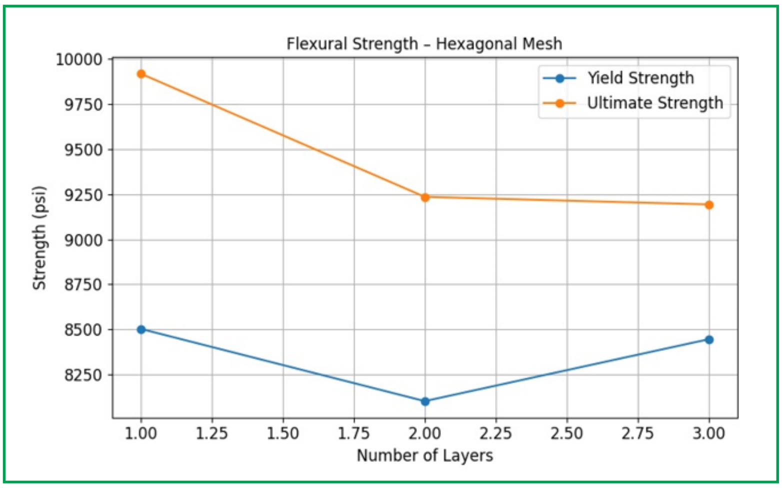

Figure 9. Ultimate flexural strength for different layers of hexagonal mesh

Yield and Ultimate Strength Trends

Performance of hexagonal mesh reinforcement

The flexural strength of plates reinforced with hexagonal meshes showed insignificant change with the three reinforcement layers. The single-layer sample had a yield strength of 8503 psi and an ultimate capacity of 9919 psi. Conversely, the two- and three-layered designs registered small reductions in final resistance, at 9235 and 9193 psi, respectively. These findings indicate that, compared to other types of iron mesh designs, the open hexagonal design does not increase mechanical interlocking as more layers are added. Therefore, increasing the ratio of reinforcement in this mesh category gives only slight changes in the bending performance. The trends of yield and ultimate strength of the FH series are shown in Figure 9.

Performance of woven 18-gauge mesh

The overall performance of the woven 18-gauge mesh was found to be the best of all the reinforcement types investigated. The strength was significantly enhanced with the increase in the number of reinforcement layers. Ultimate strength had increased to 9,852 psi in a single-layer panel and up to 9,270 psi in a two-layer design; the highest ultimate strength was 12,972 psi in a three-layer design—the highest ultimate strength recorded during the experimental program. This sharp increase is attributed to the tightly woven orthogonal system of wires that provides better mortar bonding and crack-bridging capacity. In addition, the larger wire diameter of the 18-gauge mesh results in higher axial stiffness and tensile resistance compared to lighter meshes, increasing load transfer efficiency and delaying crack localization. The development of yield and ultimate strength of this mesh is shown in Figure 10.

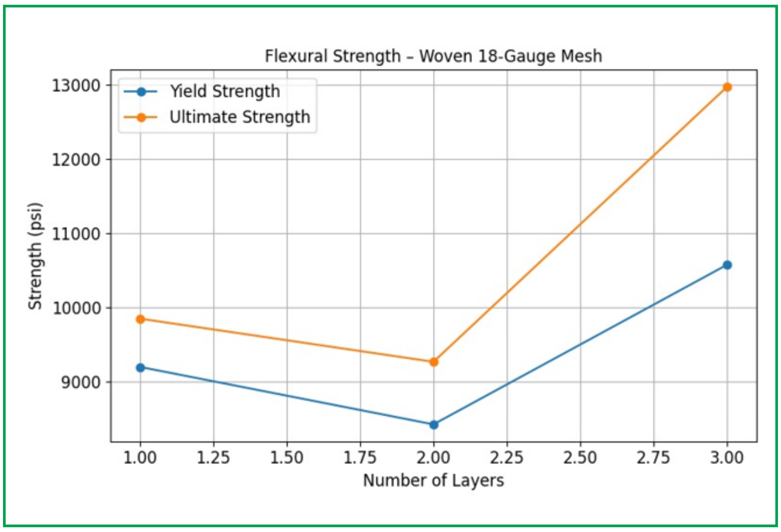

Figure 10. Ultimate flexural strength for different layers of woven 18-gauge mesh

Performance of woven 20-gauge mesh

The 20-gauge woven mesh showed a gradual and steady increase in both the yield and ultimate strength with the addition of more layers of the mesh. The ultimate strength rose by almost 46 percent between 6,130 psi on a single layer and 6,632 psi on two layers, reaching up to 8,964 psi on three layers. Although this was improved, the woven 20-gauge mesh always performed poorly compared with the heavier 18-gauge mesh, a difference that was explained by the decreasing tensile stiffness of the former and by its smaller cross-section of wire. Figure 11 shows these results.

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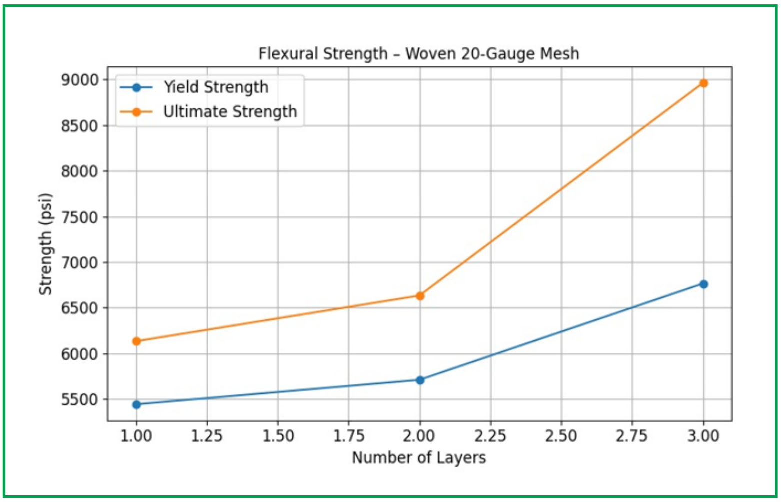

Figure 11. Ultimate flexural strength for different layers of woven 20-gauge mesh

Performance of expanded metal mesh

Expanded metal mesh was one of the most robust in the experimental program, and the single-layer plate had the highest ultimate tensile strength of 12,122 psi, the second highest of all the specimens. This high performance is attributed to the characteristic mechanical interlock inherent in the expanded metal geometry despite the single layer. The continuous ribbed strands and diamond-shaped apertures of the expanded metal mesh provide superior mechanical anchorage, larger bond surface area, and improved stress redistribution within the mortar matrix. However, the increase in the number of layers was not proportionate: a two-layered structure resulted in a slightly lower final strength of 10,699 psi, and a three-layered structure increased slightly to 11,182 psi. The nonlinearity observed indicates potential compaction problems and mortar congestion at increased reinforcement ratios. Figure 12 demonstrates the trend of the finite-element series.

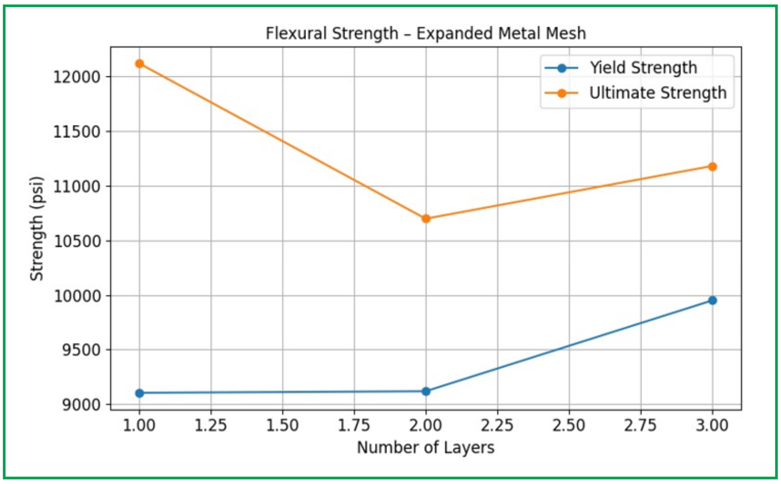

Figure 12. Ultimate flexural strength for different layers of expanded metal mesh

Performance of polypropylene mesh

The polypropylene (PP) mesh showed significantly different behavior compared to the iron meshes, as the flexural strength decreased significantly with the increase in the number of mesh layers. The ultimate strength of the plate when reinforced with a single layer of PP mesh was 5,325 psi, which then reduced to 4,732 and 2,568 psi when reinforced with two and three layers, respectively. This tendency could be explained by the relatively low rigidity of polymer fibers, reduced adhesion between fibers and the mortar matrix, and the creation of weak interfacial areas when several layers of polymer meshes are introduced. During testing, visual inspection showed partial delamination and sliding between the adjacent layers of PP mesh in multi-layer specimens at high load levels, which supports the existence of poor interfacial adhesion and poor stress transfer across layers. The resultant deterioration in performance is well depicted in Figure 13.

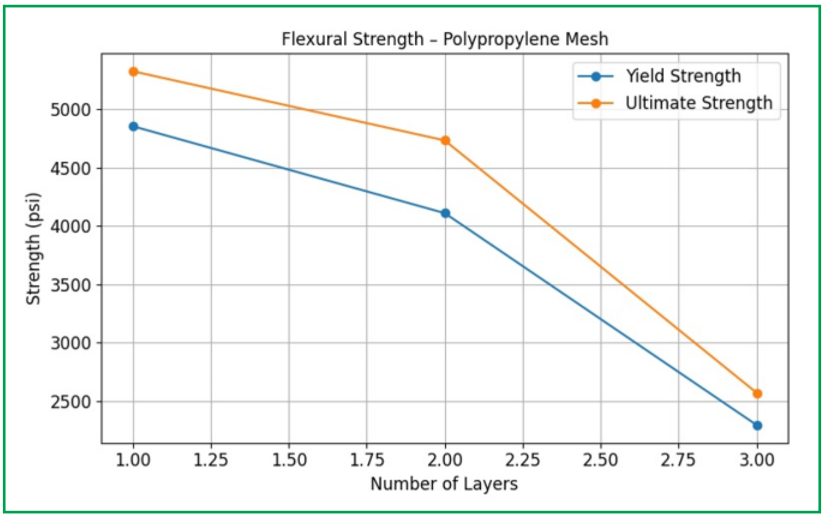

Figure 13. Ultimate flexural strength for different layers of polypropylene mesh

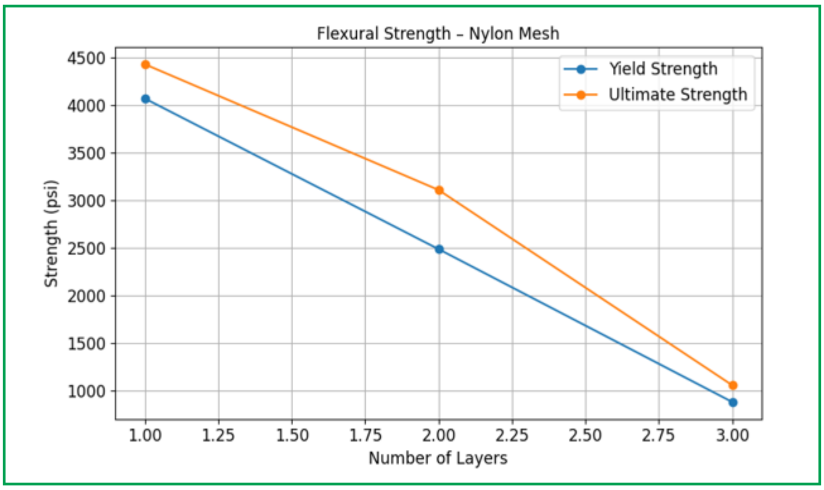

Figure 14. Ultimate flexural strength for different layers of nylon mesh

Performance of nylon-66 mesh

Among reinforcement types considered, nylon-reinforced plates exhibited the lowest flexural performance. The single-layer panel had a final flexural strength of just 4,425 psi, and the performance declined steadily as the layers increased. The three-layered nylon plate broke at only 1,055 psi, highlighting its

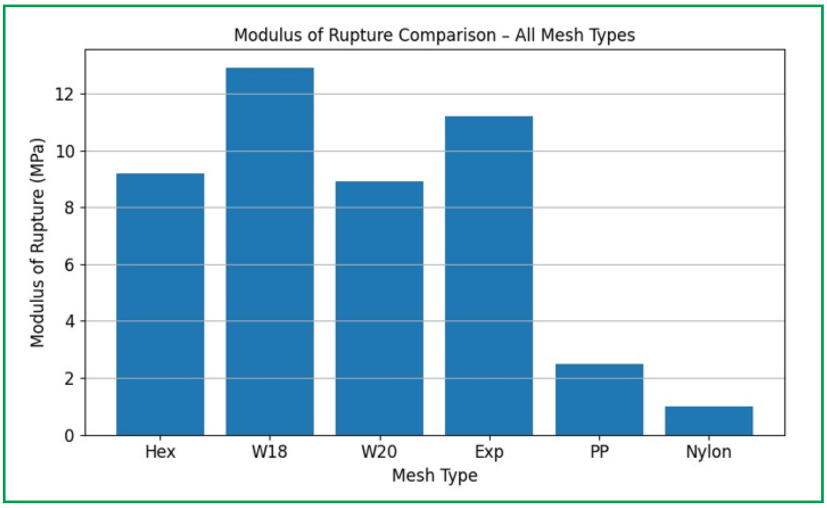

Figure 15. Modulus of rupture for different types of mesh

Table 4. Geometric and mechanical properties of reinforcement meshes used in this study

Mesh ID	Mesh type	Material	Nominal wire / strand thickness (mm)	Mesh opening (mm)	Relative mass per unit area	Effective tensile stiffness	Bond & anchorage mechanism	Expected influence on flexural behavior
FH	Hexagonal wire mesh	Steel (iron/GI)	~0.8–1.0	~12–15	Medium	Moderate	Twisted hexagonal wires provide limited mechanical interlock	Moderate stiffness and MOR; marginal improvement with added layers
FW1	Woven mesh (18-gauge)	Steel (iron/GI)	~1.2	~12	High	High	Orthogonal woven wires with large cross-section provide strong bond and crack bridging	Highest stiffness, strength, ductility, and MOR
FW2	Woven mesh (20-gauge)	Steel (iron/GI)	~0.9	~12	Medium	Medium	Orthogonal geometry but reduced wire area lowers stiffness	Moderate strength and MOR; consistently lower than 18-gauge
FE	Expanded metal mesh	Steel (iron/GI)	~1.0 (strand)	Diamond (~10–20)	High	High	Ribbed continuous strands provide superior mechanical anchorage and large bond surface area	Very high first-crack load and MOR; strong single-layer performance
FP	Hand-woven PP mesh	Polypropylene	~0.6–0.8	12.5	Low	Low	Mechanical interlock only; smooth hydrophobic surface	Low stiffness and MOR; strength decreases with added layers
FN	Hand-woven Nylon-66 mesh	Nylon-66	~0.6–0.8	12.5	Low	Very low	Flexible fibers; weak mesh–mortar interaction	Lowest stiffness, MOR, and brittle failure behavior

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significantly low rigidity and the insufficient connection between the mesh and mortar. The nylon possesses a relatively high elasticity that reduces the ability to bridge cracks significantly, thus initiating premature delamination and brittle failure. This declining pattern is shown in Figure 14.

Modulus of Rupture (MOR)

MOR values were determined on all specimens using ultimate loads. Figure 15 is a grouped bar chart that compares MOR according to mesh types. Woven 18-gauge and expanded-metal meshes provided the most superior values of MOR, which allows affirming their great tensile resistance and effective composite action. Polymer mesh MOR values were much lower, and this was in line with their poor structural performance. These observations are consistent with the mechanical properties of the reinforcement materials summarized in Table 4, where the higher tensile strength, stiffness, and surface geometry of woven 18-gauge and expanded metal meshes explain their superior composite action and flexural resistance.

The median final compressive strength (MOR) results achieved with ferrocement plates reinforced with woven 18-gauge and expanded metal mesh are just comparable and in some cases even higher than the results achieved in previous investigations on conventional ferrocement panels of the same thickness (10-15 mm). The reported MOR values of conventional GI-mesh ferrocement panels are generally in the range of 6 to 10 MPa, depending on the density of the mesh and layering [3, 7, 8]. The improved MOR of the current study is due to the improved mesh geometry, reinforcement stiffness, and mesh placement.

Conclusion

The flexural response of the ferrocement plates with four types of the iron mesh and two types of the hand-woven polymer mesh was studied in the present study under strictly the same experimental conditions and under the order of reinforcement. The results indicate that specimens reinforced with the use of iron mesh had consistently been superior to those reinforced with the use of polymer mesh in terms of first-crack load, yield strength, ultimate strength, and modulus of rupture. Among the metallic reinforcements, 18-gauge mesh, which was simultaneously woven, displayed the highest flexural strength and greatest strength augmentation with an increase in the number of mesh layers, which can be credited to its dense orthogonal structure and effective bond that developed with the mortar matrix. Extended metal mesh also proved to have a significant flexural resistance, especially in single-layered ones, though further reinforcement layers produced incrementally smaller improvements as reinforcements grew congested and compaction started to occur. Polypropylene hand-woven meshes and Nylon-66 hand-woven meshes, on the other hand, exhibited less stiffness and flexural capacity, and performance decreased with an increase in the number of layers and were also associated with less tensile stiffness, a weaker mesh-mortar interfacial bond, and the formation of fewer but larger cracks leading to a more brittle post-cracking regime. Crack patterns were also observed as further support for the fact that metallic meshes create finer, uniformly distributed cracking as typical of ductile behavior and polymer meshes offer limited control of cracks. On the whole, these findings highlight the fact that traditional iron meshes, especially woven 18-gauge and expanded metal meshes, still have a greater degree of performance in thin ferrocement components where strength, ductility, and control of cracks are key performance standards.

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Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Author Contributions

Rubaiyet Hafiza: conceptualization, methodology, investigation, data curation, formal analysis, and writing – original draft. **Md. Saniul Haque Mahi:** supervision, validation, writing- reviewing and editing.

Data Availability Statement

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this manuscript, generative AI tools were used only to improve language clarity and grammar. The authors reviewed and edited all AI-assisted content and take full responsibility for the accuracy, originality, and integrity of the manuscript.

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