# FERROCRETE ROOF SLAB SYSTEM

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**Abstract** –For roofing system different systems are adopted till yet. By using ferrocement along with some specific sized coarse aggregate thicker sections than ferrocement can be constructed. In this research study, flexural strength of ferrocrete panels is studied by application of uniformly distributed load by using jack. Also, crack pattern is also observed for one way and two way slabs. The growing housing needs, especially in developing countries, makes the search for cheap and adequate building units attractive. Ferrocrete building elements could be a viable area. Ferrocrete consist of two main components: the matrix and the reinforcement. The Matrix is hydraulic cement binder, which may contain fine aggregates, grit and admixtures to control shrinkage and set time, and increase its corrosion resistance. The beauty of ferrocrete is that it could appear in any shapes. Only imagination could limit the forms and shapes of this beautiful and cheap material. Furthermore, unskilled labour could be employed to construct its structure. Being a precast product, use of ferrocrete panel will increase the speed of construction and also make the construction of buildings feasible in bad weather conditions. The use of ferrocement panel with higher ductility will make the structure less prone to seismic damage. Increase in number of mesh layers also improves the ductile behavior of ferrocement slabs. As the material required for the construction of such panel is less, it is environment friendly. Less use of cement and steel for any section compared with RCC, with corresponding reduction in self-weight. This technique does not required any scaffolding, shuttering or a concrete mixer or a vibrator.

***Key Words***:ferrocrete roof, crack pattern, load deflection curve.

## 1.INTRODUCTION

This document shows the suggested format and appearance of a manuscript prepared for SPIE journals. Accepted papers will be professionally typeset. This template is intended to be a tool to improve manuscript clarity for the reviewers. The final layout of the typeset paper will not match this template layout Ferrocrete is a highly versatile form of reinforced concrete made up of wire mesh, sand, aggregate, water and cement, which possesses unique qualities of strength and serviceability. Over the years, applications involving Ferro cement have increased due to its properties such as strength, toughness, water tightness, lightness, ductility and environmental stability. Ferrocrete also may be cast in various shapes and forms and are aesthetically very appealing. The success of Ferro cement has been attributed to the ready availability of its component materials, the low level technology needed for its construction and relatively low cost of final products. Due to their thinness, ferrocrete elements can be used as roofing / flooring elements to cover large spans. The slenderness of these elements may adversely affect their performance under working loads. Hence, there is a need to study their

(a) first crack strength, Mcr and

(b) load-deflection behavior.

(c) Crack pattern

While (a) and (b) characterize the serviceability behavior of ferrocrete elements, it is equally important to predict their flexural strength Mu one of the ultimate limit states. A number of investigations are available for the flexural analysis and design of ferrocrete members. However Ferrocrete elements do form cracks under certain loads much smaller than the ultimate load and have a durability problem when unmodified cement mortar is used. Durability of a structure is its resistance to weathering action, abrasion, chemical attack, cracking or any other process of destruction. Corrosion of reinforcement is one of the major reasons for deterioration of ferrocrete. The corrosion of reinforcement mainly depends upon the permeability of the cement mortar. So by proper selection of chemical and mineral additives, water cement ratio of ferrocrete can be reduced. This in turn reduces the pore size, there by achieving very high strength levels and durability and the flexural moment capacity of Ferrocrete elements increases with the volume fraction of reinforcement.

**Objective and scope**

As per researches, ferrocement is used as a roofing element. But load carrying capacity is low. By introducing aggregate in ferrocement, we can increase their load carrying capacity. By this project flexural strength of roof element is to be studied. Also, load deflection curves are plotted for different conditions such as single or double mesh layer and one way or two way slabs. Crack behavior is also checked. So that it can be effectively used as a roofing element. Ferrocrete roof panels can be used as a low cost housing or not that is to bestudied.

## 2. METHODOLOGY

### 2.1 MIX MATERIALS

The material details are as follows:

2.1.1Cement

The cement used in this experimental work is "Ulttratech 53 grade Portland Pozzolona Cement". All properties of cement are tested by referring IS 12269 - 1987 Specification for 53 Grade Ordinary Portland cement. Specific gravity of cement was 3.15.

2.1.2. Fine Aggregate

Locally available fine aggregate used was 4.75 mm size confirming to zone II with specific gravity 2.62. The testing of sand was conducted as per IS: 383-1970.Water absorption and fineness modulus of fine aggregate was 0.10% and 3.10 respectively.

2.1.3. Grit

These are small loose particles of stone or sand. General size taken is 3/8th of mm. The source for grit is river nearby area. The normal site test to be conducted is testing of particle size. Here, the material is passed through 2.36 mm IS Sieve.

2.1.4. Water

The water used was potable, colorless and odorless that is free from organic impurities of any type.

i. Reinforcement

ii. Mesh reinforcement

2.1.4.1. Reinforcement

The ideal mesh is a 13 x 13 mm x 19 gauge (1 mm) welded mesh to BS 4482. Although meshes of 18-22 gauge can be used, 19 gauge will prove to be the best from a practical point of view. In colder, less humid climates, it may be used ungalvanised; in semi-tropical/tropical it will need to be galvanised.

2.1.4.2 . Rod reinforcement- For use in the hull shell, deck floors, bulkheads and stiffening webs or girders; ideally should be a semi-bright hard-drawn (SBHD) rod of 6 and 8 mm diameter for concrete reinforcement to BS 4482. Mild steel rod to BS 15 may also be used but in practice will require closer frame spacing or support to prevent being bent out of shape during construction and/or distortion by welding.

### 2.2 CASTING OF SPECIMENS

#### 2.2.1: Tying of Reinforcement

Total 8 slab panels are casted. For simply supported conditions all slabs are to be tested. Four slab panels are single mesh reinforced, while other four are double mesh reinforced. For tying of mesh mild steel is used. The spacing of mild steel used for tying and for absorbing handling stresses is limited to 400 mm maximum. For 1200 mm x 1000 mm x 30 mm slab, two slabs of single mesh and two slabs of double mesh are casted. Also, for 1000 mm x 1000 mm x 30 mm slab, two slabs of single mesh and two slabs of double mesh are casted. Reinforcement of chicken wire mesh with skeleton steel for rectangular slab is shown in figure 4.1.

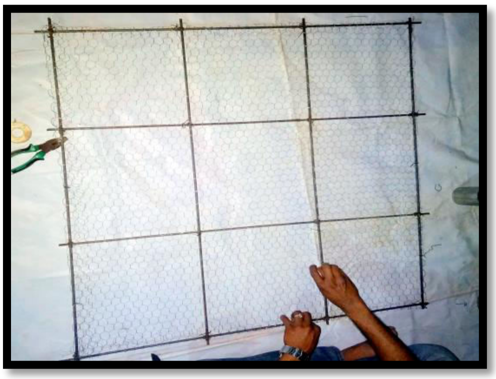

**Figure I: Tying of Reinforcement**

**2.2.2: Preparation of Formwork**

The formwork of having clear dimensions 1200mm x 1000mm x 30mm for all rectangular slab panel and 1000mm x 1000mm x 30mm for all square slab panels were prepared with flat wooden platforms as shown below in figure 4.2. Oiling was done for perfect finishing of slab panels after removal of formwork.

**Figure II : Formwork for Slab**

**2.2.3: Casting of Slab Specimens**

Ferrocrete material chosen for casting is having proportion as 1:2:0.5 (that is 1 part of cement, 2 parts of river sand and 0.5 part of Grit).The cement, sand and grit are tested as per requirements as per standard specifications. 5 mm bottom cover was provided at the time of casting. Tied reinforcement was placed in formwork and casting of all slabs done batch wise. Figure 4.3 shows mould prepared for rectangular slab.

**Figure III : Casting of Slab Panel**

**2.2.4: Curing of Specimens**

All the casted specimens were cured for 28 days with the help of gunny bags. After curing specimens were removed and made ready for white wash. Casted specimens for curing of both rectangular and square slab are shown in figure 4.4.

**Figure IV : Casted Specimens**

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**2.2..5: Applying White Wash to Slab Panels**

White wash was applied to all slab panels for clear revelation of yield line pattern after testing.

**2.3 EXPERIMENTAL WORK ANDTEST**

Four slabs are of rectangular dimensions of 1200mm × 1000mm and the thickness 30mm and remaining four are square slabs of dimensions 1000mm x 1000mm and 30mm thickness with single and double layer of mesh in combination.All are identically loaded with uniformly distributed load.

**Table I:** Schedule of Casting and Testing of Specimens:

| Sr. No. | Support type | Total No. of specimen |
|---|---|---|
| 1 | Simply supported rectangular slab | 3 |
| 2 | Simply supported square slab | 3 |
| 3 | Simply supported rectangular slab (Double mesh) | 3 |
| 4 | Simply supported square slab (Double mesh) | 3 |
| Total number of specimens | | 12 |

**Test procedure:**

For testing of slab panels frame was made by using ISMC100 section. The arrangement was made as shown below. Slab specimen were placed above the frame over that wooden blocks of size 50mm x 50mm x 50mm spread at appropriate distances for both square and rectangular slab panels to distribute the load uniformly on slab. Center lines were marked using plumb bob. The channel section of ISMC100 were placed in three layers over the wooden blocks alternately each layer orthogonal to each other and for fixity of slab, angle section ISA 50 X 50 X 6 was used above the slab panel. Jack was supported on three layers of channel sections, above that proving ring placed to calibrate the jack which supports the wooden member of length 54 inches and diameter 6 inches placed below the beam junction to transfer the beam reaction to slab and distribute evenly. Dial gauge was adjusted at bottom of slab center to note the deflection readings.

**Photo No.V.**Test Setup for Load Application on Slab

**2.4TEST RESULTS:-**

Following table II gives values of load at first crack and values of load at failure crack for both rectangular and square slab with single mesh and double mesh reinforcement.

**Table II: Summary of Test Results**

| SN | Slab Type | Sample No. | Load at first crack (kN) | Deflection at first crack (mm) | Load at failure crack (kN) | Deflection at failure (mm) |
|---|---|---|---|---|---|---|
| 1 | Simply supported rectangular single mesh | 1 | 30.50 | 18.25 | 51.00 | 25.50 |
| | | 2 | 29.50 | 15.10 | 53.50 | 26.15 |
| | | 3 | 32.75 | 13.28 | 49.00 | 27.00 |
| 2 | Simply supported square single mesh | 1 | 28.50 | 6.95 | 42.00 | 18.00 |
| | | 2 | 27.50 | 7.15 | 41.00 | 19.00 |
| | | 3 | 29.00 | 8.10 | 40.25 | 18.15 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 3 | Simply supported rectangular double mesh | 1 | 33.50 | 7.24 | 59.00 | 19.55 |
| | | 2 | 32.50 | 5.99 | 60.50 | 18.30 |
| | | 3 | 34.00 | 9.11 | 58.93 | 17.98 |
| 4 | Simply supported square double mesh | 1 | 31.50 | 6.45 | 51.50 | 15.97 |
| | | 2 | 32.00 | 6.90 | 52.50 | 14.87 |
| | | 3 | 31.30 | 7.90 | 50.00 | 14.25 |

## 3. CONCLUSIONS

Ferrocrete roof system consists of locally available materials. With respect to load deflection behavior, rectangular slabs carry more load as compared to square slab. Also, double layered slab can carry more load than single mesh slabs. Deflection is increasing very fastly with respect to loads. Also coarse aggregate is not there and no removal of formwork, it low cost technique.

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