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# AN EXPERIMENTAL STUDY OF DUCTILE BEHAVIOR OF FERROCEMENT SLAB

**Mr.K.SOUNDHIRARAJAN[1], Mr.K.SUDHARSANABHARATHI[2], Mr.J.VASANTH[3], Mr.M.GUBERAN[4], Mr.V.NIRMAL[5]**

[1]*Assistant professor, Faculty of civil engineering, Gnanamani college of technology, pachal, Namakkal, Tamilnadu*

[2,3,4,5]*Bachelor of civil engineering, Gnanamani college of technology, pachal, Namakkal, Tamilnadu*

***Abstract*** : This project has been undertaken to study the role of Ferro cement slab panel with wire mesh. The impact, ductile strength and properties of the slab panel is determined, the slab panel is prepared by 1:3 cement mortar with the dimension of 1.20mx0.45mx0.025m. Three different spacing of reinforcements slabs are prepared by using 2.5mm, 5mm and 7.5mm wire mesh and one slab panel by providing chicken mesh with nominal reinforcement. The objective of the work is to minimize the size of the slab to reduce the dead load. This type of slabs are applicable for advance architectural structure. It consist of closely spaced, multiple layers of mesh or fine rods completely embedded in cement mortar. In this type of materials, strength can be increased by adding admixtures. The test is conducted in the loading frame machine by using the experimental data. Load carrying capacity and deflection curves of the slab panel are determined, then the load deflection variation and longitudinal are evaluated. Then the above data's are compared to determine the actual strength of the slab panel. Finally graph is plotted based on the test result.

**KEYWORDS:** wire meshes, chicken mesh, cement mortar, mechanical properties.

## 1.INTRODUCTION

### 1.1 General

The term ferrocement is most commonly applied to a mixture of Portland cement and sand reinforced with layers of woven or expanded steel mesh and closely spaced small – diameter steel rods rebar. It can be used to form relatively thin, compound curved sheets to make hulls for boats, shell roofs, water tanks, etc. it has be used in a wide range of other application including sculpture and prefabricated building components. The term has been applied by extension to other composite material including some containing no cement and no ferrous material. These are better referred to by terms describing their actual contents.

The term ferrocement was given to this product by its inventor in France, Joseph Monier. At the time, (1850), he wanted to create urns, planters, and cisterns without the expanse of kiln firing.

### 1.2 Definition of ferrocement

According to ACI 549R-2 ferrocement is a type of thin wall reinforced concrete commonly constructed of hydraulic cement mortar reinforced with closely spaced layers of continuous and relatively small size wire mesh. This mesh may be made of metallic or other suitable material.

Ferrocement is an innovative technology which finds multiple application in housing and construction. It derives the name from ferro meaning steel or iron and cement meaning a binder or cementitous substance.

Thus a ferrocement composite material is formed that behaves differently from conventional reinforced concrete in strength, deformation, and potential application, and thus classified as a separate and distinct material. It can be formed into thin panels or sections, mostly less than 1inch (25mm) thick, with only a thin mortar cover over the outer most layers of reinforcement.

Unlike conventional concrete, ferrocement reinforcement can be assembled into its final desired shape and the mortar can be plastered directly in place without the use of a form.

Ferrocement is cost effective, energy efficient and environmentally sound and more appropriate than conventional technology products.

### 1.3 Properties of ferrocement

Some of the basic mechanical properties of ferrocement are given below. They are,

- ✓ Ultimate strength (tensile, compressive, flexural and shear)
- ✓ First crack strength
- ✓ Fatigue strength
- ✓ Impact strength
- ✓ Crack and leakage
- ✓ Creep and shrinkage
- ✓ Durability
- ✓ Fire resistance.

### 1.4 Merits of ferrocement

- ✓ a high ratio of strength to weight comparision to reinforced concrete construction works.
- ✓ Cost effectiveness compared to RCC because of the reduction in the specimen dimension especially the thickness.

### 1.5 objective

The main objective of this present is to test the Ferro cement slab panel and to determine the ductile strength of the slab panel. Thickness of the slab panel can be reduced, no need to provide reinforcement for this members. Ferro cement slabs panel can be easily modify or prepared according to the require shape, this slabs are prepared by means of individual panels and connected together. Ferro cement slabs are mostly preferred for temporary structures, shuttering works are not necessary for this member, it can be cast in both in-site or at factory, the main advantage of this member is that the self-weight can be highly reduced. It is a economic system and relative cost of labour. Doesn't need heavy plant or machinery. Low cost of construction materials. But it needs large no of labour required. Better resistance against earthquake. Basic raw materials are readily available in most countries.

## 2. METHODOLOGY

- Literature collection
- Material properties
- Mix proportion of cement mortar
- Casting of specimens
- Testing of specimens
- Result and discussions

## 3. MATERIALS PROPERTIES

### 3.1 CEMENT

Cement OPC53 grade confirming IS 12269:1987

Minimum cement content 320kg/$m^3$

**Table 1 Physical properties of fine aggregates**

| S. No | Test for cement | Value obtained |
|---|---|---|
| 1. | Normal consistency | 26.5 % |
| 2. | Initial setting time | 30 min |
| 3. | Final setting time | 230 min |
| 4 | Specific gravity | 3.12 |

### 3.2 Sand

**Table 2 Physical properties of sand**

| S. No | Test for sand | Value obtained |
|---|---|---|
| 1. | Sand zone | Zone III |
| 2. | Specific gravity | 2.67 |
| 3. | Water absorption | 1% |

### 3.3 Wire mesh

Wire mesh is a steel rods are connected together in any form of its shape. In between the shape it can be anything like rectangle, hexagonal, triangle depend upon the uses. It resist the corrosion and it required only low maintenance. In case of more spacing wire meshes are occupy more area. Whenever, required the less thickness of member, it can be used for alternative material of reinforcement rod. In our project we used 25mmx25mm, 50mmx50mm, 75mmx75mm wire meshes are used.

### 3.4 chicken mesh

It has a spacing shape of hexagonal in netting. It is used in construction field for plastering work. It is formed by twisting wires and forming a strong structure. Due to its hexagonal shape it can resists the internal stresses. Doe to its flexibility it is used for curved structure.

**4. MIX PROPORTION OF CEMENT MORTAR**

Cement OPC 53 grade IS 12269:1987.

As per the design, the quantity of cement mortar 1:3

Cement = 7.56 kg

Sand = 22.68 kg

w/c ratio 0.45

water = 3.402 liters

**5. Testing of specimen**

**Loading frame testing**

**6.1 Slab 1 (25mx25mm)**

**Size of slab panel 1.20mx0.45mx0.025m**

**TABLE NO : 3 DEFLECTION VALUE OF SLAB 1**

| S. No | Load (KN) | Deflection (mm) | Remarks |
|---|---|---|---|
| 1 | 0 | 0 | |
| 2 | 0.3 | 0.50 | |
| 3 | 0.6 | 1.15 | |
| 4 | 0.9 | 1.96 | |
| 5 | 1.2 | 2.64 | |
| 6 | 1.5 | 3.24 | |
| 7 | 1.8 | 3.87 | |
| 8 | 2.1 | 4.65 | |
| 9 | 2.4 | 5.38 | |
| 10 | 2.7 | 5.97 | Ultimate load |
| 11 | 3 | 6.01 | |
| 12 | 3.3 | 6.05 | |
| 13 | 3.6 | 6.07 | Breaking load |

**6.2 Slab 2 (50mmx50mm) Size of slab 1.20mx0.45mx0.025m**

**TABLE NO 4 : DEFLECTION VALUE OF SLAB 2**

| S. NO | Load (KN) | Deflection (mm) | Remarks |
|---|---|---|---|
| 1 | 0 | 0 | |
| 2 | 0.3 | 1.56 | |
| 3 | 0.6 | 2.85 | |
| 4 | 0.9 | 3.8 | |
| 5 | 1.2 | 4.9 | |
| 6 | 1.5 | 5.6 | |
| 7 | 1.8 | 6.2 | Ultimate load |
| 8 | 2.1 | 6.8 | |
| 9 | 2.4 | 6.9 | |
| 10 | 2.7 | 7 | Breaking load |

**6.3 slab 3 (75mmx75mm) Size of slab 1.20mx0.45mx0.025m**

**TABLE NO : 5 DEFLECTION VALUE OF SLAB 3**

| S. No | Load (KN) | Deflection (mm) | Remarks |
|---|---|---|---|
| 1 | 0 | 0 | |
| 2 | 0.3 | 0.78 | |
| 3 | 0.6 | 1.92 | |
| 4 | 0.9 | 2.65 | |
| 5 | 1.2 | 3.64 | |
| 6 | 1.5 | 4.25 | |
| 7 | 1.8 | 4.95 | |
| 8 | 2.1 | 5.35 | Ultimate load |
| 9 | 2.4 | 5.9 | |
| 10 | 2.7 | 6.3 | Breaking load |

**6.4 Slab 4 (75mmx75mm) Size of slab panel 1.20mx0.45mx0.025m**

**TABLE NO : 4 DEFLECTION VALUE OF SLAB 4**

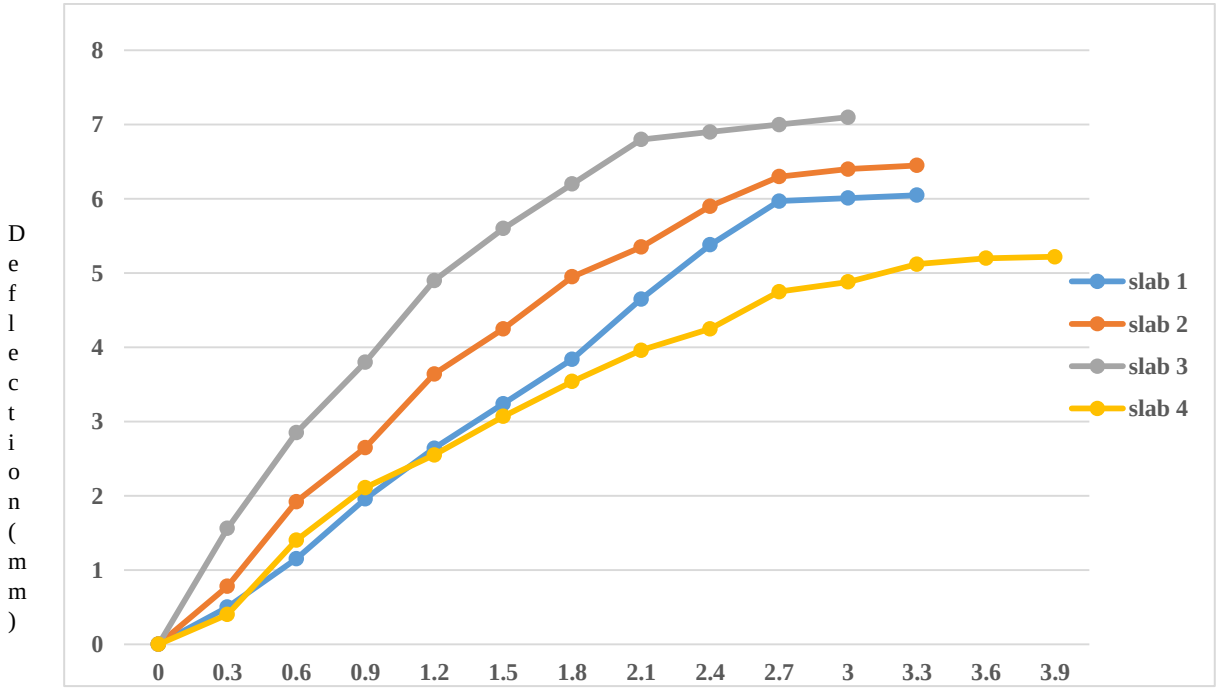
| S. NO | Load (KN) | Deflection (mm) | Remarks |
|---|---|---|---|
| 1 | 0 | 0 | |
| 2 | 0.3 | 0.40 | |
| 3 | 0.6 | 1.65 | |
| 4 | 0.9 | 2.11 | |
| 5 | 1.2 | 2.55 | |
| 6 | 1.5 | 3.07 | |
| 7 | 1.8 | 3.54 | |
| 8 | 2.1 | 3.96 | |
| 9 | 2.4 | 4.25 | |
| 10 | 2.7 | 4.75 | |
| 11 | 3.0 | 4.77 | |
| 12 | 3.3 | 4.79 | |
| 13 | 3.6 | 4.88 | Ultimate load |
| 14 | 3.9 | 5.12 | |
| 15 | 4.2 | 5.2 | |
| 16 | 4.6 | 5.25 | Breaking load |

**Failure pattern of slab**

## 7. RESULT AND DISCUSSIONS

The above experimental results shows the maximum strength resisted by the slab which is made by chicken mesh with reinforcement.

| SLAB | ULTIMATE LOAD | BREAKING LOAD |
|---|---|---|
| Slab 1 | 2.7 KN | 3.6 KN |
| Slab 2 | 2.1 KN | 2.7 KN |
| Slab 3 | 1.8 KN | 2.7 KN |
| Slab 4 | 3.6 KN | 4.5 KN |



## CONCLUSION

Based on the experimental study, following conclusion can be drawn regarding the strength behavior of ferrocement slab. From the above investigation, performance of the ferrocement slab is the high, which is having number of layers chicken mesh with reinforcement. As usual high strength given slab is, using made by reinforcement. The difference between the ultimate load and breaking load varied between the value of 50-80%. If increasing the thickness of the slab may reduce the crack formation. The strength of the slab panel depend upon the number of layers provided. From that we have conclude that, we are using the cement mortar 1:3 and the slab is gives high strength which is prepared by chicken mesh with reinforcement as per the design. That slab can resist the load 3.6KN. It means the first crack formation is called ultimate load is higher than other slabs.

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