# Investigation on Behaviour of Ferrocement Concrete Using Woven Wire Mesh

CH. Venkata Ravi Teja[1], P. Narendra Babu[2]
[1]*PG Student, Department of CE, NRI Institute of Technology, Agiripalli, A.P, India.*
[1]*Associate Professor & HOD, Department of CE, NRI Institute of Technology, Agiripalli, A.P, India*

***Abstract*—Ferro-cement, also known as ferro concrete or reinforced concrete, is a Portland cement and sand mixture that is poured on top of layers of rebar—small, tightly spaced steel rods—that are woven or stretched steel mesh. Using conventional concrete exposes it to wear and tear, spalling, cracking, and low tensile strength over time. Ferro-cement is a wonderful way to reduce these constraints of conventional concrete. These days, ferrocement sheets are most frequently utilized as retrofitting materials since they are readily available, reasonably priced, durable, and have the flexibility to be formed into any shape without requiring a lot of formwork. The current study examines the impact of wire mesh orientation on the strength of stressed beams that have been modified with ferro-cement jackets. The acquired results will demonstrate an increase in the wire mesh load carrying capability for molded cubes with ferro-cement and more layers of wire mesh. This study experiments and examines the ferro-cement's compressive strength, split tensile strength, and flexural strength in relation to conventional concrete. The findings indicate that ferro-cement with single and double layer mesh has higher percentages of compressive strength, split tensile strength, and flexural strength than ordinary concrete.**

***Index Terms*— Ferro Cement, Ferro Cement Concrete, Woven Wire Mesh, Concrete with Wire Mesh, Woven Wire.**

## I. INTRODUCTION

Ferrocement is a type of reinforced concrete, commonly constructed of hydraulic cement mortar, reinforced with closely spaced layers of continuous and relatively small size wire mesh. The mesh may be made of metallic or other substances. Ferro means iron and the metal commonly used is the iron alloy steel. It consists of closely spaced multiple layers of mesh or iron rods in cement mortar. A composite material is formed and it behaves differently from conventional reinforced concrete in strength, deformation, and potential applications. So it is classified as a separate and distinct material.

Principle objective of this project involves the mechanical properties of concrete cubes by introducing a wire mesh by varying their orientations. In the present work analysis of mechanical properties of ferro-cement is done by taking various layers of the wire mesh such as single layered and double layered.

In this study we have considered wire mesh as it is soft and malleable, abrasion resistance and high tensile strength. We have compared the mechanical properties of the normal conventional concrete with the ferro-cement concrete.

Conventional concrete when used, over time passes it is subjected to cracks, spalling, wear and tear action, low tensile strength. These limitations of traditional concrete can be brilliantly reduced by introducing ferro-cement. Ferro-cement sheets are most commonly used as retrofitting material these days due to their easy availability, economy, durability, and their property of being cast to any shape without needing significant formwork.

This study briefly explains about the comparison of mechanical properties of conventional concrete to ferro-cement concrete. Our main objective of this project include the increase in performance of concrete which includes in study of compressive strength of Ferro-cement, Split tensile strength of Ferro-cement, Flexural strength of Ferro-cement

## II. METHODOLOGY

This investigation looks at how wire mesh affects concrete's mechanical qualities, such as its compressive strength, and compares it to regular concrete. This paper presents research on the mechanical properties of ferro-cement.

The Main Objectives of the present investigation are:

- To evaluate the compressive strength of concrete cube of ferrocement and comparing with the conventional concrete cubes.
- To learn the developments in materials, production method and mechanical properties and their uses
- To study the functions of ferrocement
- To learn the importance of ferrocement and its uses

*B. Materials:*

Cement is a binder, a substance used in construction that sets, hardens and adheres to other materials, binding them together. The Cement used is of ordinary Portland Cement of 53 Grade. Natural River Sand from nearest supplier is used as a Fine Aggregate and Coarse aggregate means the aggregate which is retained on 4.75 mm sieve when it is sieved through 4.75 mm. In this Investigation 20 mm Size aggregates from nearest crusher unit are used as a Coarse Aggregate.

*C. Wire Mesh:*

Stainless steel dutch woven mesh is a kind of stainless steel filter mesh with high filter accuracy, it is also one kind of stainless steel wire mesh widely used. The characteristic of stainless steel dutch woven mesh the wire diameter and mesh count in warp and weft directions. In this method we have used the mesh size of 150 mm X 150 mm which has the opening of size 12mm.

Table -1: Properties of Cement

| Property | Result |
|---|---|
| Specific Gravity | 3.12 |
| Soundness of Cement | 1.5 mm |
| Fineness of Cement | 275 $m^2/kg$ |
| Normal Consistency | 28% |

Table -2: Properties of Aggregate

| Material | Specific Gravity | Bulk Density | Water Absorption |
|---|---|---|---|
| Fine Aggregate | 2.62 | 1620 $Kg/m^3$ | 0.5% |
| Coarse Aggregate | 2.43 | 1700 $Kg/m^3$ | 1.5% |

## III. MIX DESIGN

In this project, the mix shall be designed to produce the required grade of concrete having the designated workability, and characteristic compressive strength, as per IS 10262-2019.

Table -3: Mix Quantities as Per IS 10262 – 2019

| Mix | Cement ($Kg/m^3$) | FA ($Kg/m^3$) | CA ($Kg/m^3$) | Water (Lit) |
|---|---|---|---|---|
| Normal Concrete | 383 | 1202 | 621 | 153 |
| Sample 1 (1 Wire Mesh) | 383 | 1202 | 621 | 153 |
| Sample 2 (2 Wire Mesh) | 383 | 1202 | 621 | 153 |

## IV. RESULTS AND DISCUSSIONS

*A. workability (Slump):*

Concrete slump test is to determine the workability or consistency of concrete mix prepared at the laboratory or the construction site during the progress of the work. Concrete slump test is carried out from batch to batch to check the uniform quality of concrete during construction. The Average Slump Value of the concrete is shown in Table 4.

Table -4: Workability of Concrete

| S.NO | W/C Ratio | $H_1$ | $H_2$ | Slump in mm |
|---|---|---|---|---|
| 1 | 0.45 | 300 | 240 | 60 |

Fig. 1 Slump Cone Test

*B. Compressive Strength:*

The compressive strength of hardened concrete is considered one of the most important properties and is often used as an index of the overall quality of concrete. By using compression test machine we can calculate the compression strength. No of tests conducted in the lab on different percentages of concrete on 7, 14 and 28 days.

Table -5: Compressive Strength of Concrete

| Age | Compressive Strength (N/mm$^2$) | | |
|---|---|---|---|
| | Nominal Mix | Single Mesh | Double Mesh |
| 7 Days | 18.60 | 20.20 | 22.00 |
| 14 Days | 26.50 | 27.00 | 29.50 |
| 28 Days | 31.20 | 32.80 | 33.50 |

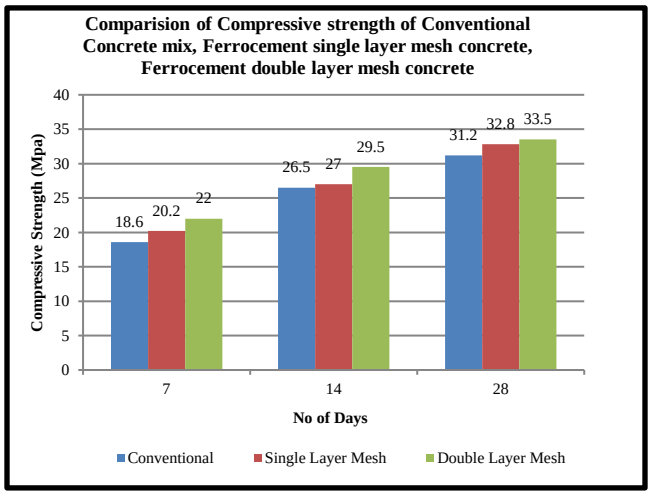


Fig. 2 Variation of Compressive Strength

*B. Split Tensile Strength:*

The Split Tensile Strength of concrete can be analyzed by casting Cylinders of Size 200 mm X 100 mm

**Table -6:** Split Tensile Strength of Concrete

| Age | Split Tenslie Strength (N/mm$^2$) | | |
|---|---|---|---|
| | Nominal Mix | Single Mesh | Double Mesh |
| 7 Days | 1.90 | 2.10 | 2.95 |
| 14 Days | 2.52 | 3.10 | 3.64 |
| 28 Days | 3.55 | 3.94 | 4.20 |

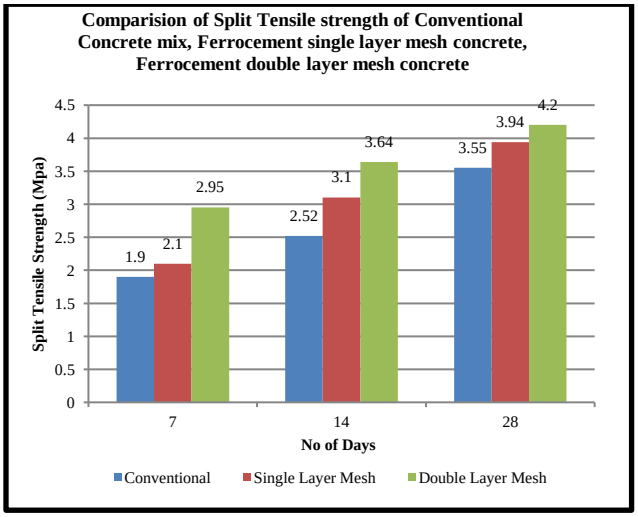


Fig. 3 Variation of Split Tensile Strength

*C. Flexural Strength:*

The Flexural Strength of concrete can be analyzed by casting Beams of Size 750 mm X 150 mm X 150 mm.

**Table -7:** Flexural Strength of Concrete

| Age | Flexural Strength (N/mm$^2$) | | |
|---|---|---|---|
| | Nominal Mix | Single Mesh | Double Mesh |
| 7 Days | 4.82 | 5.58 | 6.40 |
| 14 Days | 5.80 | 6.62 | 7.54 |
| 28 Days | 8.45 | 9.20 | 10.65 |

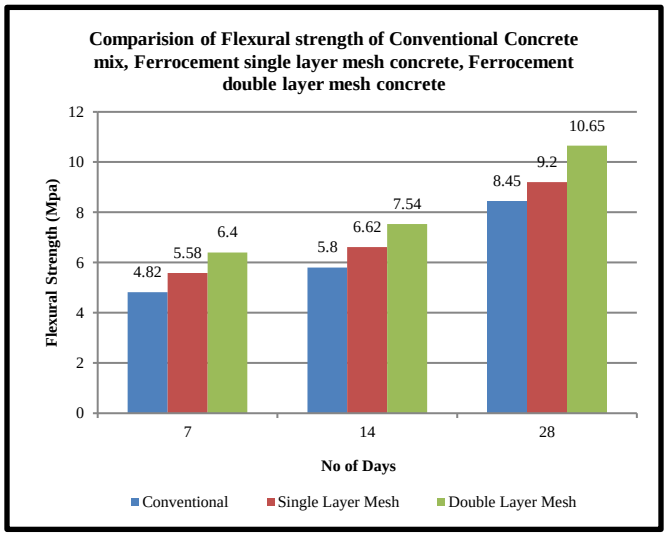


Fig. 4 Variation of Flexural Strength

Fig. 5 Cube Specimens after Casting

## V. CONCLUSIONS

Based on the limited study carried out on the strength behavior of Ferrocement the following conclusions are drawn.

1. At all the cement cube samples; there is gradual increase in compressive strength, tensile strength and flexure strength from 7 days to 14 days. However there is significant increase in compressive strength from, tensile strength and flexure strength 14 days to 28 days.
2. At 7, 14, 28 days test when we compare the obtained compressive strength, tensile strength and flexure strength of all the 3 samples i.e. Conventional Concrete, Ferrocement Single layer mesh Concrete, Ferrocement Double layer mesh Concrete we could find the strength of Ferrocement Double mesh Concrete is increased.
3. The percentage increase of compressive strength of Conventional concrete to Single layered mesh ferrocement is increased by 4.87%.
4. The percentage increase of compressive strength of Single layered mesh ferrocement to double layered mesh ferrocement is increased by 2.08%.
5. The percentage increase of compressive strength of Conventional to double layered mesh ferrocement is increased by 6.8%.
6. The percentage increase of split tensile strength of Conventional concrete to Single layered mesh ferrocement is increased by 9.89%.
7. The percentage increase of split tensile strength of Single layered mesh ferrocement to double layered mesh ferrocement is increased by 6.19%.
8. The percentage increase of split tensile strength of Conventional to double layered mesh ferrocement is increased by 15.4%.
9. The percentage increase of flexure strength of Conventional concrete to Single layered mesh ferrocement is increased by 8.15%.
10. The percentage increase of flexure strength of Single layered mesh ferrocement to double layered mesh ferrocement is increased by 13.6%.
11. The percentage increase of flexure strength of Conventional to double layered mesh ferrocement is increased by 20.6%.

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