

Optimization of Mortor for Ferrocement Concrete

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ABSTRACT

Affordable housing projects are characterized by an increasing demand mainly due to urbanization. The selection of building materials should meet the needs of local conditions to improve quality of life for the most needed ones by building new structures and/or by improving existing structures. Ferro cement as a construction material attracted considerable attention from research workers, field applicators and economists. Its property of improved homogeneity compared to Reinforced Cement Concrete (RCC) and reduced thickness made it possible to employ the material as substitute to timber, steel and asbestos cement as material. Ferro cement is supposed to be a product of low level technology. Ferro cement is ideally suited for thin wall structures as the uniform distribution and dispersion of reinforcement provide better cracking resistance, higher tensile strength to-weight ratio, ductility and impact resistance. The applications of Ferro cement structural elements are highlighted in this paper. Ferro cement is a form of reinforced concrete that differs from conventional reinforced or pre stressed concrete primarily by the manner in which the reinforcing elements are dispersed and arranged. It consists of closely spaced, multiple layers of mesh or fine rods completely embedded in cement mortar. This paper describes the various experiments conducted on Ferro cement panels in literature review and the conclusions and remarks drawn by the authors. The results obtained are going to help in the project work to investigate the behavior of Ferro cement panels for various parameters and loading. This is useful to find solutions by searching new design techniques and method of constructions.

I.INTRODUCTION

Ferro cement 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. The mesh may be made of metallic or other suitable materials.

Ferro cement is a versatile structural constructional material possessing unique property of strength and serviceability. It is made with closely-knit wire mesh and mild steel reinforcing bars filled with rich cement mortar. Welded mesh may also be used in place of reinforcing bars. The materials required for making it namely cement,

sand, wire mesh and mild steel reinforcing bars are easily available in most places. It is possible to fabricate in Ferrocement a variety of structural elements which are thin, light, and durable and possessing high degree of impermeability. Ferro cement combines the lightness of steel and mouldability of concrete and can be cast to any shape. The purpose of this thesis project is to explore and improves the Ferro cement building technique as applied to sustainable housing. Ferro cement construction refers to a specific style of steel and concrete construction. Ferrocement is a building material composed of a relatively thin layer of concrete, covering such reinforcing material as steel wire mesh. Because the building techniques are simple enough to be done by unskilled labor, Ferro cement is an attractive construction method in areas where labor costs are low. There is no need for the complicated formwork of reinforce cement concrete (RCC) construction, or for the welding needed for steel construction ,everything can be done by hand, and no expensive machinery is needed. The main difference between Ferro cement and reinforced concrete is Ferro cement is a thin composite made of cement matrix reinforced with closely spaced small diameter wire meshes instead of larger diameter rods and large size aggregates. The thickness of Ferro cement generally ranges from 25 - 40 mm. Ferro cement is an environment friendly sound technology and possesses excellent unique properties such as good tensile strength, improved toughness, water tightness, lightness, fire resistance, resistance to cracking and cost, time and material effective construction technology.

II. LITERATURE REVIEW

P.N. Balaguru et.al. The mortar matrix primarily used in Ferro cement consists of hydraulic cement and inert filler material. Portland cements generally used, sometimes blended with a pozzolan. The filler material is usually well graded sand capable of passing a 2.36 mm sieve. However, depending up on the characteristics of the reinforcing material (mesh opening, distribution, etc.); a mortar containing some small-size gravel may be used. The physical properties and microstructure of mortar depend on the chemical composition of the cement, the nature of the sand, the water-cement ratio, and the curing conditions of the finished product. Since the matrix represents approximately 95 percent of the Ferro cement volume, its properties have a great influence on the final properties of the product. There are numerous references describing in the effects of various matrix mix proportion parameters on the properties and microstructure of hydraulic cement mortars. The use of Portland cement in Ferro cement yields a composite which the matrix is considered to have some tensile strength. It appears that composite action between the matrix and the reinforcement is more pronounced in Ferrocement than ordinary reinforced concrete. The use of fibers will affect the tensile properties of the resulting matrix. Addition of short and discrete fibers of different types favorably affects the control of cracking and the capacity of the matrix to resist tensile loads.

Sumeshjain et.al.(2014) Affordable housing projects are characterized by an increasing demand mainly due to urbanization. The selection of building materials should meet the needs of local condition to improve quality of life for the most needed ones by building new structures and by improving existing structures. Ferro cement as a construction material attracted considerable attention from research workers, field applicators and economies. Its



property of improved homogeneity compared to R.C.C. and reduced thickness made it possible to employ the material as substitute to timber, steel and asbestos cement as material. Ferro cement is supposed to be a product of low level technology. Ferro cement is ideally suited for thin wall structures as the uniform distribution and dispersion of reinforcement provide better cracking resistance, higher tensile strength to weight ratio, ductility and impact resistance. The applications of Ferrocement structural elements are highlighted.

SidramappaDharane et.al. Experimental flexural behavior of Ferro cement slab and RCC slab was studied. The fourteen slab panels were casted and tested for cyclic loading. The first cracking load and collapse load along with the deflections were measured during he test for every increment of cyclic load. It was found that the first cracking load depends upon the specific surface of the reinforcement. Also the behavior of Ferro cement slab found to be more ductile as compared to RCC slab designed for same moment of resistance. The theoretical moment of resistance by using IS method and Hongestad's method was found and the results were compared with RCC slab. The efficiency ratios at cracking and collapse were found. The flexural behavior of Ferro cement slabs were found superior to RCC slab.

N. M. Kulkarniet. al.,(April 2013) Ferro cement is form of reinforced concrete that differs from conventional reinforced primarily by the manner in which the reinforcing elements are dispersed and arranged. It consist of closely spaced, multiple layers of mesh or fine rods completely imbedded in cement mortar. This paper describes the various experiments conducted on Ferro cement panels in literature review and the conclusion and remarks drawn by the authors. The results obtained are going to help in the project work to investigate the behavior of Ferro cement panels for various parameters and loading. This is useful to find solutions by searching new design techniques and method of construction Ferro cement is a highly versatile form of reinforced concrete made up of wire mesh, sand, water, and cement, which possesses unique qualities of strength and serviceability. It can be constructed with a minimum of skilled labor and utilizes readily available materials. Ferro cement is an attractive construction method in areas wherelabor costs is low. There is no need for the complicated formwork of reinforced cement concrete (RCC) construction, or for the welding needed for steel construction, everything can be done by hand, and no expensive machinery is needed. The main difference between Ferro cement and reinforced concrete is Ferro cement is a thin composite made of cement matrix reinforced with closely spaced small diameter wire meshes instead of larger diameter rods and large size aggregates. The thickness of Ferro cement generally ranges from 25 - 50 mm.

III. OBJECTIVES

Ferro cement technology has been established as environmentally friendly low cost technology. Ferro cement is a type of thin wall reinforced concrete construction where cement is reinforced with layers of continuous and relatively small diameter mesh. This report focuses on the materials, advantages, disadvantages mechanical properties, recommendations, research and development in Ferro cement. In order to achieve the aim, following objectives are identified:

- To optimize mortar mix proportion for ferrocement concrete
- To achieve structural grade makes with specific strength required for construction.
- To investigate ferrocement through different tests.
- To understand cost factor of Ferro cement panel compared with conventional materials.

IV.METHODOLOGY

1. Materials Used in Ferro cement Construction

1.1 Cement

The cement to use is usually ordinary Portland. However, rapid hardening Portland cement may be used in cold climates. Sometimes a sulphate resistant Portland cement is used, either wholly or in part mixed with ordinary Portland against sulphate attack. If the cement is used with admixtures, care should be exercised in compatibility.

1.2 Sand

The importance of good, clean, well graded sand cannot be over emphasized if one is to make the high grade impervious mortar required.

1.3 Water

Water should be potable, clean and its pH should not less than 6, free from harmful salts or foreign materials which may impair the strength and resistance of the mortar.

1.4 Skeleton Steel

Skeletal steel is often used in Ferro cement, in the form of welded wires or simple grid of steel wires, rods or stands, to form the skeleton of the structures. Mesh layers are attached around this skeleton steel.

1.5 Steel Wire Mesh

Consists of galvanized steel wires of diameter 0.5 to 2 mm, spaced at 5 to 20 mm centre to centre Welded wire mesh has hexagonal or rectangular openings

2 Properties of Ferro cement

1. It is very durable, cheap and versatile material.
2. Low w/c ratio procedures impermeable structures.
3. Less shrinkage and low weight.
4. High tensile strength and stiffness.

5. Better impact and punching shear resistance.
6. 1.4 Properties of Ferro cement Composites
7. Wire diameter 0.5 to 1.5 millimeters
8. Size of mesh opening 6 to 35 millimeters
9. Maximum use of 12 layers of mesh per inch of thickness
10. Maximum 8% volume fraction in both directions
11. Maximum 10 square inches per cubic inch in both directions.
12. Thickness 6 to 50 millimeters
13. Steel cover 1.5 to 5 millimeters

The experimental work includes the study of strength, structural behaviour and ultimate strength of Ferro cement panels. A series of experiments have been carried out to determine the various parameters. In this properties of the materials used, casting of Ferro cement Partition wall panels, and preparation of samples, testing procedure, description of the testing instrument and the geometry of the specimens. The primary variables were the thickness of panel 25mm and number of layers of meshes ranging from 2 to 4 layers. It also includes the fibres and its effect on behavior and structural properties

3.1.1 Preparation of Mortar

3.1.1.1 Fixing of mix proportion

There are 2 different proportions were prepared using cement, water, sand .For each proportion 6 cubes of size (75.6mm*75.6mm*75.6mm) and 6 cylinders for each proportion were casted and removed after 24 hours. After removal the cubes were cured in normal water for 7 days and 28 days and tested under UTM machine to determine the compressive strength and split tensile strength. Proportions were taken by trial and error method.

3.2 Procedure

3.2.1 Cutting the steel wire mesh

Steel meshes are the primary reinforcement for Ferro cement consists of galvanized steel wire of diameter 0.5 to 2 mm, spaced at 5 to 20 mm centre to centre.

3.2.2 Moulds

Wooden moulds were prepared for casting of panels to get a good finish.. The Battens are then placed on wooden platform (plywood).

3.2.3 Oiling



Mould release agents are the form of oil which gives easy and clean surface of shutter. It ensures very high quality and good kind of concrete and with the help of it concrete becomes stain free and gives it fair faced as well. The mould oil which comes in different form is beneficial for all different kind of platforms such as aluminum framework, wood, plastics framework, steel etc.

3.2.4 Mixing Of Materials

The mortar was prepared by mixing cement and sand with ratio of (1:2) and water was added to it with ratio of (0.36). Mixing of fibers with 1% of total weight of cement was calculated and used. Half of the steel fibers was added before mixing of water and half after mixing of water. After well dry mixing of ingredients, add fibers as per proportion (1% of cement quantity).

Fibers are separate after adding water so proper mixing is required.

3.2.5 Casting of Panels

The interior face of mould and base was oiled properly to get good finish. At bottom one layer of mortar was laid of thickness 7 to 8 mm and mesh was placed on it followed by another layer of mortar. The procedure continued for placing different number of layers of mesh as per mesh layer design and topmost surface is finished as per requirement.

3.2.6 Marking of Panel

For identification of various panels marking on panel was done by using paint.

3.2.7 Removal of Formwork

By removing battens panels are removes from mould after setting time i.e. 24 hours.

3.2.8. Curing

The specimens were cured for about 28 days in normal water and then kept in atmosphere in normal temperature inside the laboratory. Only clean water is used for curing. This water free from salts.

3.3 Tests Proposed

Compressive strength test

For a load bearing masonry construction, it is important to know the compressive strength requirement of masonry to withstand the load subjected on it. A masonry wall is subjected to compressive loads from floors above it and

should have sufficient strength to withstand it. So, masonry compressive strength should be enough to support the loads the loads on wall.

Split Tensile Strength

The tensile strength is an important property of concrete. There are so many researchers have been done to improve the tensile strength of concrete. Main objective of this study is to enhance the split tensile strength of Mortar as concrete and Mortar are weak in tension. With the addition of fibers in various quantities, the durability of Mortar has been increased in this experimental investigation.

CONCLUSION

After recording the results of Compressive strength test and Split Tensile Strength it was found that optimum mix proportion for mortar is 1:2.25 as cement and sand content. With the use of this proportion in ferrocement concrete the consumption of cement binder will be economized with good strengths Hence there will be a potential saving in term of material and production cost of mortor mix in construction industry.

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