A Review on Application of Ferrocement Members Made of Self-Compacting Concrete

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Abstract- *This papers gives a review on Ferrocement members made of Self Compacting Concrete to be using the main objective of a civil engineer is to construct that type of structure which is able to resist against the forces for many years. It has low self-weighted, and thus gives fewer loads on the structures. In this paper, we have studied different properties of the Ferrocement & Self Compacting Concrete like tensile behavior, cracking, compression, fire resistance and impact resistance, work uniformly, without segregation and bleeding, better finishes, easier placement, thinner concrete section, no vibration, safer working environment without any application of vibration. And other techniques to remove air bubbles and honey comb, especially at the surfaces. SCC was first developed by Okamura in Japan during the year 1980. This review paper explains the history and the current scenario and the application of this method in various fields and its composition.*

Keywords- Ferrocement, cement, strength, highly workable concrete, Sustainable Development, durability, Workability, self consolidating concrete (SCC)

I. INTRODUCTION

Reinforced concrete is the most widely used construction material in present age. Ferro-cement can be considered as the origin and the first application of reinforced concrete. Ferro-cement also called as Ferrocement was invented by a Frenchman, Joseph Louis in 1848. Basically at that time Joseph wanted to create urns, cisterns and planters without the expense of kiln firing. Ferro-cement relates to type of thin reinforced concrete consisting of large amount of small diameter wire meshes distributed uniformly throughout the cross section and cement mortar. Ferro-cement is a highly versatile form of reinforced concrete possessing unique qualities of serviceability and strength which cannot be matched with any other thin construction material. Though being the oldest and first of its kind use of Ferro-cement was limited and not widely was that the production technology which was available at that time(19^{th} century) was not efficient to produce small diameter wires and meshes.

The wall thickness of ferro cement construction lies in general between 10 & 30 mm (3/8 to1-1/8 inch). Like other application of cement, a considerable amount of time may be necessary for the material to fully cure and reach its final strength.

The concept of self-compacting concrete was proposed in 1986 by professor Hajime Okamura, but the prototype was first developed in 1988 in Japan, by professor Ozawa (1989) at that University of Tokyo. During hardening, the ferro cement is kept moist, to ensure the cement is able to set and harden.

Skelton steel used kind the skeleton of the structure with the use of three to 8mm steel may be employed in tied kind or welded wire fabric. It ought to be noted that the reinforcement should be free from dirt, rust and different impurities. Steel mesh reinforcement encompass galvanized steel wire of diameter 0.5 to 1.5 millimeter spaced at 6 to 20mm center to center.

II. LITERATURE REVIEW

P. PARAMASIVAM [1] Paper gives idea about benefits of ferrocement and application to real life. Ferrocement 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. By adapting available mechanized production methods and proper choice of reinforcements it can be cost competitive in industrialized countries. Research and development works of ferrocement has resulted in several applications such as sunscreens, secondary roofing slabs, water tanks, and repair material in the building industries. The design, construction, and performance of some of these applications of ferrocement structural elements are highlighted in this paper.

M. JAMAL SHANNAG [2] The main objective of his study was to investigate the effects of combining reinforcing steel meshes with discontinuous fibers as reinforcement in thin mortar specimens. Variables were

investigated are number of mesh layers 2 and 4, transverse wire spacing, small medium and large, and the type of fiber, steel and glass. Everything else being equal, the addition of brass coated steel fibers to the matrix of ferrocement can effectively increases its flexural strength, energy absorption to failure, and significantly reduce the average crack spacing and width, and reduce the mortar
cover at ultimate load.

S. K. PATRA [3] No coded provision are available for calculation of the shear strength of ferrocement element, he has been emphasized to form different empirical formula to calculate the shear strength of ferrocement element. The shear strength of ferrocement element varies due to different layer of mesh used and the shear span to depth ratio. It is observed that stress intensity as well as cracking shear strength of plate depends upon volumetric fraction of wires.

Prof. Shriram H. Mahure (2014) [4] Had studied about the fresh and hardened properties of self-compacting concrete using Fly ash as partial replacement of cement in different percentages in addition to filler. The fresh properties have been determined by computing the slump valve, V-funnel valve and L- box value and the hardened properties are determined by computing the compressive strength, Flexural strength and split tensile strength of the specimens. It is observed that the fresh properties of concrete shows an acceptable value up to 30% replacement of fly ash and also the hardened properties of concrete is significantly improved when compared to the conventional mix.

B. H. V. Pai (2014) [5] had investigation about the self- compacting concrete where Ground Granulated Blast furnace slag (GGBS) and Silica fume (SF) is partially replaced with cement. He concluded that the flowing ability and passing ability of the concrete were satisfied with the EFNARC guidelines. He observed that the GGBS based self-compacting concrete exhibits improved mechanical properties compared to the SF based self-compacting concrete. He also analyzed that GGBS can be replaced up to 80% to achieve strength of 30Mpa.

III. OBJECTIVE OF THE STUDY

The main objective of this research work It has high level of impact and cracking resistance, toughness and ductility. The ferrocement structures are thin and light-weight compared to conventional reinforced concrete. Hence there is considerable Reduction in self-weight of the structure and saving in foundation cost. Transportation cost is also less.

IV. MATERIALS USED & METHODS

CEMENT

The Cement is affine, soft powder used as a binder because it hardens after contact with water. The Portland cement is generally used in ferrocement. The cement sand ratio for the mortar varies form 1:1.5 to 1:2.5 and water cement ratio, from 0.35 to 0.50 by weight.

SAND

The Sand is a granular material composed of finely divided mineral particles. Sand has various composition but is defined by its grain size. Sand grain are smaller than gravel and coarser than silt.

COARSE AGGREGATE

The Coarse aggregates refer to irregular and granular materials such as sand, gravel, or crushed stone, and are used for making concrete. CA any particles greater than o.19 inch, but generally range between 3/8 and 1.5 inches in diameter.

WIRE MESH

The wire mesh is a type of thin reinforced concrete construction, in which large amount of small diameter wire meshes uniformly throughout the cross section. The metal commonly used is iron or some type of steel, and the mesh is made with wire a diameter between 0.5mm and 1mm.

WATER

In ferrocement, the water used for mixing cement mortar should be fresh, clean and fit for construction purposes, the water of pH equal or greater than 7 and free from organic matter-silt, oil, sugar, chloride and acidic material and controlled SCC mix with 0.36 water/cementitious ratio (by weight) and 388 Liter/ m^3 of cement paste volume.

V. COMPONENTS OF FERROCEMENT & SCC

Ferrocement primarily consist of cement, sand, wire meshes and various admixtures. The main difference between reinforce concrete and ferro cement is the scale. Reinforced concrete uses large size reinforcing bar as compared to wire/meshes in ferrocement. Reinforced compared to that of the ferrocement. It does not contain large size aggregate as used in reinforced concrete only cement mortar is used. Typical cross section of ferrocement are shown in (fig.1)

With regard to its composition, self-compacting concrete consists of the same components, as conventionally vibrated normal concrete, which are cement, aggregates, water, additives and admixtures.

MORTAR COMPOSITION

Portland cement is generally used in ferrocement. But the type of cement to be selected should depend on its application where to be used and in which environment to be used. The sand to cement ratio is usually in the range of 1to 2.5 by weight and water to cement ratio is in the range of 0.4 to 0.6 by weight. In order to enhance the properties of cement be used. These minerals will also act as fine filler material.

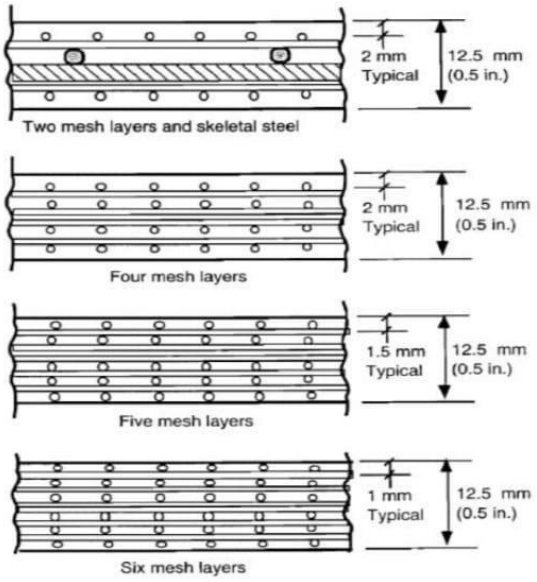

Fig. 1: Typical cross sections of Ferro-cement

MESS REINFORCEMENT

Ferrocement along with mortar uses layers of small diameter wire as reinforcement. The volume and the specific surface area of the reinforced wire are considerably higher for ferrocements as compared to that of normal reinforced concrete. Different types of wire meshes are available like woven or welded mesh, perforated sheet products and expanded metal lath. Even the shape of the wire mesh varies from square to hexagonal. All the meshes which are used as reinforcement in ferro-cement are galvanized except expanded metal mesh. Mesh made from vegetable fibers and alkali resistant glass fibers are also used.

VI. CONSTRUCTION METHOD OF FERROCEMENT

The Constituent materials of the Ferrocement are selected according to the use for which it is required. The sand to cement ratio should be between 0.35 to 0.6. the fineness of the sand particles to be used should depend on the reinforced cage to be encapsulated (opening of wire mesh).

MORTAR PLACEMENT

Mortar can be placed either by using hands or by using shot created technique. In both the process mortar is forced trough the mesh. Another technique called as Lay-out technique can also be used. The main difference between the later and the former technique is that in later mesh is placed in mortar instead of mortar in mesh. Successive layer of mesh are placed on freshly placed mortar layer.

CONSTRUCTION PROCEDURE

The mortar used should be sufficiently compacted which ensure minimum air voids present in the matrix. Construction process of Ferrocement can be carried out three methods namely:

1. Armature System
2.Closed system
3. Integrated mold system

ARMATURE SYSTEM

In this method layers of wire meshes are tied on either side around the skeleton steel which is welded to get the desired shape. They are not considered as structural reinforcement, they just add to the dead weight of structure. Skeletal steel act as spacers rods to the wire mesh reinforcement.

CLOSED MOLD SYSTEM

In this method of construction of ferrocement layers of wire mesh are tied together against the surface of the mold. These molds hold the wire mesh in position while mortar is being filled from one side. Wire mesh at 0^0 to the load applied has lesser cracking compare to the wire mesh at any other orientation.

VII. CONCLUSIONS

This study has brought out that Ferrocement offers a cost-effective and sustainable solution for a wide range of construction projects, particularly those requiring strength, durability, and versatility in design. And is an innovated material and the ready availability of materials and ease of

construction make it suitable in developing countries for housing and water & food storage structures. The standard methods of FC construction & effect of shape due to which novel forms are generated have to researched upon and benefit brought out. SCC gives good finishing as compared to ordinary concrete without any external mean of compaction.

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