Journal of Advances and Scholarly Researches in Allied Education
Vol. XV, Issue No. 2, (Special Issue) April-2018, ISSN 2230-7540

Review Paper on "Experimental Studies on Ferrocement"

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Abstract – Ferrocement is composite material of cement matrix and reinforcement having multiple layers of mesh. Ferrocement technologies are mostly used these days in many countries. These are associated with the features such as mechanical properties, advantages, design parameters, research and development, applications, and safety and economy factors. Ferrocement almost covered large scale in construction industries in many countries which gives helps to improve the GDP rate in construction sector. Though the use of ferrocement technology is at higher percentage but is does not tackled over the conventional cement and not being used at domestic level. This study deals with technicalparameters regarding the loads and deflection over an effective span by using ferrocement and self-compacting mortar (SCM) with varied w/c ratio, mix design criteria and materials which will help to overcome the difficulties and problems in construction.

Keywords: Cement, Fine Aggregate, Coarse Aggregate, Applications, Mechanical Properties.

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I. INTRODUCTION

Ferrocement is introduced by P L Nervi an Italian architect and engineer in 1940. Ferrocement has increased applications due to its properties such as strength, toughness, water tightness, lightness, ductility and environmental stability. Ferrocement can be fabricated in to any desired shape or structural configuration that is generally not possible with standard masonry, reinforced concrete or steel. Ferrocement can be cast in various shapes and forms even without the use of formwork. The thickness of ferrocement generally varies from 10 mm to 25 mm. High surface area imparts ductile characteristics to ferrocement even though mortar is weak in ductility.

Ferrocement repairs and rehabilitation can be done in reinforced concrete structures to increase its strength. Ferrocement which can be made from non – formwork construction process is an advantage over other type of repairs and strengthening techniques. It enhances the crack resistance combined with high toughness. It imposes small additional weight on the structures. This material proves to be a cost effective solution for rehabilitation and general applications. Ferrocement overlay can be used to increase the ductility of masonry columns and walls.

1.1. Future Study

Green building and sustainable development are the two main parameters which need to be focused as per environment point of view.

Advancement in concrete will minimize the need of vast additional cement production capacity and thus will leads to sustainable development at global scale.

II. LITERATURE REVIEW

Briefinformation of the research work done by researchers about topic which will help us to decide about the subject, is as given below.A number of researchers have made important contributions to the development of our understanding of the experimental studies on ferro cement.

Anisha G Krishnan1, Allzi Abraham, (September 2016)[1] The experimental study comprised of testing of three control beam specimens of dimension (200 X 300 x 1000) mm and three beam specimens with 25 mm thick ferrocement formwork. The control beams were reinforced with two numbers of 10 mm diameter bars and two numbers of 6 mm diameter bars on top and bottom with 6 mm diameter two legged stirrups at 200 mm c/c. The formwork consisted of a skeletal reinforcement of 6 mm diameter bar which provide

shape and support for the mesh and one layer of chicken mesh having 0.88 mm diameter.

Dr. P. Srichandana and Kamanuru Naga Deepika, (July 2015)[2] The present investigation aims the study on behaviour of Ferro cement slab panels using self-compacting mortar (SCM) with varied W/C ratio, fly ash replacement and incorporating polypropylene fibers. Use of SCM instead of cement mortar in ferro cement slabs plays a vital role in order to eliminate the external vibration and to overcome the difficulties and problems in the construction process.

K. Sasiekalaa and R. Malathy (November 2012)[3] This paper focuses on materials, advantages, mechanical properties, practical design parameters, recommendation, research and development in ferrocement.

M. Amala, Dr. M. Neelamegam, (February 2012)[5] The flexural properties of these Ferrocement slabs are evaluated and compared under four point static loading system using specific test setups and comparative study of the test results confirm that Ferrocement slabs made of copper slag are more effective in flexural strength and other mechanical properties. Impact strength of slab is tested and it is found that as the copper slag content is increased the kinetic energy is increased.

III. METHODOLOGY

3.1. EXPERIMENTAL WORK

3.1.1 Materials Used:-

1) Cement:

The cement used was Ordinary Portland cement (53grade) conforming to IS: 12269-1987 with a specific gravity of 3.15. Initial and final setting times of the cement were 20 min and 265 min, respectively.

2) Fine Aggregate:

Fine aggregate used for cement mortar should be properly graded to give minimum void ratio and be free from deleterious materials like clay, silt content and chloride contamination etc., Grading of fine aggregate should be such that it does not cause increase in water demand for the concrete and should give maximum voids so that the fine cementitious particles to fill the voids. Hence it is desirable to use coarser variety of fine aggregate having a high fineness modulus for making workable and strong concrete.

3) Coarse Aggregate:

The natural broken stone (coarse aggregate) used for the study was of 20 mm size maximum. The size of aggregates bigger than 4.75mm.

d) Water:

Water is an important ingredient of concrete as it chemically participates in the reaction with cement to form the hydration product, C-S-H gel. The strength of cement mortar depends mainly from the binding action of the hydrated cement paste gel. A higher w/c ratio will decrease the strength, durability, water – tightness and other related properties. The quantity of water added should be the minimum for chemical reaction of hydrated cement, as any excess of water would end up only in the formation of undesirable voids (capillary pores) in the hardened cement paste. The strength of cement paste is inversely proportional to the dilution of the paste. Hence, it is essential to use as little paste as possible consistent with the requirements of workability and chemical combination with cement.

3.1.2 Mix Design:-

As the plan dimensions of the slabs were 600mm x 200 mm, the size of the reinforcement were kept as 590 x 190 mm to ensure a minimum cover of 5mm, when placed inside the mould. Weld mesh of 590mm x 190mm was cut and was straightened to a plane surface by pressing with fingers aided by the use of a steel hammer. The details about the slabs are given in table as follows:

Table 1:- Mix Design (www.researchgate.net)

Sr. No.	Slab ID	Size in mm			Mix Ratio	W/C Ratio
		L	B	D		
1	S11	600	200	2	1:2	0.4
2	S12	600	200	25	1:2	0.4
3	S13	600	200	25	1:2	0.4
4	S21	600	200	25	1:2	0.45
5	S22	600	200	25	1:2	0.45
6	S23	600	200	25	1:2	0.45
7	S31	600	200	25	1:2	0.5
8	S32	600	200	25	1:2	0.5
9	S33	600	200	25	1:2	0.5

3.1.3. Mixing, Compaction, Preparation of Specimen and Curing:-

The specimens cast, were left in the moulds for 24 hours. After that identification was marked on the exposed face of the specimens, the specimens were demoulded and immediately placed under water in a curing tank. The specimens were allowed to cure under water for a period of 28 days. The Ferro cement slabs along with the cubes cast from the same mortar were taken out of the curing tank at the age of 28 days and their surfaces were cleaned, for removing any salt de-posits. They were allowed to dry in room

temperature for a minimum of three hours. The actual dimensions of the specimens were accurately measured and noted. All the specimens were given a thin coat of white cement, in order to facilitate, easy detection of formation of first crack. Centre lines, load positions, support points and dial gauge positions were marked using pencil in the appropriate places.

3.1.4. Test Methods:-

The cubes of 150x150x150 mm size and cylinders of 150mm dia.300mm height were tested for compression, and split Tensile. Tests were done as per codes of Bureau of Indian Standards. The tests for compressive strength on cubes were measured at 7 and 28 days of curing.

Fig2. Test Setup (www.researchgate.com)

IV. ADVANTAGES OF STUDY

1. Ferrocement is suitable for a wide range of construction techniques, ranging from self-help construction for housing and agricultural structures, to highly prefabricated industrial processes, including precast panels for housing, pipes, channels, and curtain walls.

2. Its basic raw materials are available in most countries. At the low end, ferrocement requires a low level of technology and common labour skills. Since it is relatively light weight, it does not require heavy construction equipment or plants.

3. At the high end, ferrocement is suited for industrial construction and high levels of prefabrication, where its relative light weight compared to conventional reinforced concrete is also a benefit.

4. Ferrocement can be fabricated in any desired shape and it is particularly suitable for shells and free from shapes. It has been used for domes, boats, housing structures, and sculptures.

5. Ferrocement can be considered as an environmentally sound technology. Environmentally sound technologies protect the environment, are less polluting and use all resources in a more sustainable manner.

6. These technologies are capable of recycling more of their wastes and products and handle residual wastes in a more acceptable manner than technologies for which they substitute.

7. Ferrocement can be easily maintained and repaired after damage.

8. Ferrocement is cost effective.

V. APPLICATIONS

5.1. Marine applications

A marine application includes boats, fishing vessels, docks, cargo tugs, floatation buoys, and water or fuel tanks.

5.2. Terrestrial applications

1. Agricultural applications: Grain storage bins, silos, lining for irrigation channels, pipes, shells for fish and chicken farms and pedestrian bridges.

2. Rural energy applications: Biogas holders, biogas digesters, incinerators and panels for solar energy collectors.

3. Housing applications: Houses, community centres, museums, mosque domes, precast housing elements, wall panels, corrugated roofing sheets, sunscreens, sandwich panels, permanent form work, water tanks and repair and rehabilitation of existing housing

VI. CONCLUSION

An experimental study has been carried out in ferro cement slabs by using self-compacting mortar to avoid the requirement of skilled mason and speedy in construction. The study indicates that the ferro cement slabs by using self-compacting mortar is possible.The structures which are built by ferrocement can give resistance to loading and deflection and has safety and economy to construct.

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