

Application of Ferrocement as Precast Roofing System

Krishna Kumar¹, Sitender²

^{1,2} Department of Mechanical Engineering,
Ganga Institute of Technology and Management,
Kabla, Jhajjar, Haryana, India

Abstract:- Ferrocement is one of the most suitable construction materials for roofing systems. It can be cast in situ or precast form. It offers high strength, resistance against ingress/seepage of water, high crack resistance and offer solution with reduced weight and cost. Casting with or without mould is possible. Many shapes and types of roofing systems have been developed such as trough shaped, segmental shell elements, domes, bamboo F.C domes, F.C roofing has been used at large scale for housing, schools, hospital buildings, godowns etc. Single precast roofing units can be used to cover small structures. Roofing system with in between support elements can span larger roofs.

I. INTRODUCTION

Ferrocement is a form of reinforced concrete using closely spaced multiple layers of mesh and /or small diameter rods completely infiltrated with or encapsulated in mortar. In 1940 Pier Luigi Nervi, an Italian engineer, architect and contractor, used ferrocement first for the construction of aircraft hangers, boats and buildings and a variety of other structures. It is a very durable, cheap and versatile material. Ferrocement has very high tensile strength to weight ratio and a superior cracking behavior. Due to low water cement ratio an impermeable structure is produced. Ferrocement structures have high durability, less shrinkage, and low weight. Ferrocement composites have thickness 6 to 50 mm, steel covers 1.5 to 5 mm, ultimate tensile strength up to 34 Mpa, allowable tensile stress up to 10 Mpa, modulus of rupture up to 55 Mpa, Compressive strength up to 28 to 69 Mpa.

II. ADVANTAGES OF FERROCEMENT

Its basic raw material is readily available in most part of country. It can be fabricated into any desired shape; the skills for ferrocement construction can be acquired easily. Heavy plants and machinery are not involved in ferrocement Construction. It can be widely used due to low self weight, durability & versatility.

III. OBJECTIVE OF THE PRESENT WORK

This paper presents a very simple structurally sound F.C. roof which can be precast and used for smaller, medium span structures in rural areas and in urban slum development projects. Roofing technology with ferrocement precast roofing units have following unique features-Speedy installation, no shuttering required, 30 % cost saving over conventional RCC roofing, Lower dead load on walls, can be used as intermediate floor, High

strength to weight ratio, Elegant profile and uniform texture.

IV. CONSTITUENTS OF FERROCEMENT

- 1) Cement: The cement should be fresh, uniform consistency and free from lumps and foreign matter.
- 2) Fine aggregates: Normal weight fine aggregate clean hard, strong, free from organic impurities, deleterious substances and relatively free from silt and clay.
- 3) Water: Potable water is fit for use as mixing water as well as for curing ferrocement structures.
- 4) Admixtures: Chemical admixtures used in ferrocement serve various purpose like using water reduction admixtures results in increased strength and reduce permeability. Air entrainments results increase in resistance to freezing and thawing, with suppression of reaction between galvanized reinforcement and cement.
- 5) Reinforcing Mesh: The function of reinforcing wire mesh is to act as lath providing the form and to support the mortar in its green state.

V. CONSTRUCTION PROCEDURE

The whole process has been presented through 2 photo figures. The mould for such units can be prepared using masonry, steel or wood. Masonry mould is the cheapest and easiest to make. When only few units are to be produced then a soil deposit mould with cement paste lining at top is good enough. Photo 1 show making a peripheral brick on edge lining and depositing of soil in shape for mould. Soil is compacted well to form the shape if mould and the top surface are plastered using 1:4 cement sand, mortar. photograph 2 & 3 shows a thin plastic sheet laid over the mould and making skeletal cage reinforcement for the roof. Two layers of hot dip galvanized woven wire mesh of 20 g x ½ " x ½ " were provided as mesh reinforcement one at top and 2nd at bottom of cage. the casting matrix used were designed to obtain 250 kg/cm² strength at 28 days and mix used was one part of ordinary Portland cement and 2.5 parts of good quality graded sand. Water-cement ratio was maintained at 0.4. Pidiproof L.W, a waterproofing chemical from pidilite used for improving water resistance and workability of mortar. The size of roof shown was 2.5 m x 2.0 m. an orbital vibrator was used for compacting the unit. The thickness at top kept as 2.5 cm and near the edge as 3.0 cm. Produced units were used for assembling roofs of 2.5 x 4.0

m. the large areas can be covered by providing precast support beams in between. Larger units can be produced if erection facilities are available. A single unit for a one room low cost housing designed as composite unit having toilet and kithen, can also be produced. Such a system can reduce the construction time drastically.



Photo 1: Making of mould 2.5m x 2.0m



Figure 2

VI. CONCLUSION

Ferrocement technology is versatile innovative technology that can respond to the diverse economic, social and cultural need of society. Ferrocement come into widespread use in last two decades and proved to offer safe design and construction of ferrocement structures. Ferrocement precast roofing panels can economically compete with alternate materials depends on type and location of application.

The cost of such roofs comes to almost at par with G.I sheet roof when life cycle cost is considered. Several other type of roofs can also be developed and used in the field

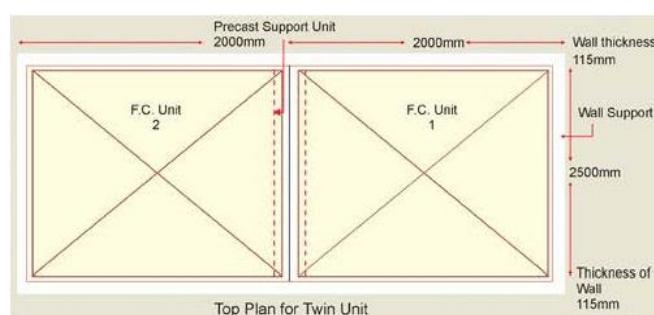


Figure 3

FUTURE SCOPE

Based on the finding and conclusions of the current study the following applications can be made with ferrocement technology

1) Housing: Ferrocement houses utilizing local materials like wood, bamboo or bush sticks as equivalent steel replacement can be constructed.

2) Marine: Ferrocement can be effectively used for various water supply structures like well casings for shallow wells, water tanks, sedimentation tanks, slow sand filters and for sanitation facilities like septic tanks, service modules and sanitary bowls.

REFERENCES

- [1] Ferrocement roofing panels for single and multiple use-technical report 7/76, SERC Roorkee.
- [2] Ferrocement roof do it yourself manual-P.C. sharma, V.S. Gopalaratnam International ferrocement information centre (IFIC0 A.I.T. Bangkok (Thailand) 1978.
- [3] ACI code -549.1R-93-Code for design, construction and repair of ferrocement.
- [4] Cohen,L.D.G. Some Experiments in design and construction with ferrocement, Transactions, Institution of the civil Engineers of Ireland,V.86,Jan.1960.
- [5] Christensen, K.A., and Williamson, R.B., Improvement in ferrocement structures, University of California,Berkely,apr.1972.
- [6] Castro,J, and Naaman, A.E.- Cement mortar reinforced with natural fibres, ACI journal,proceedings,V.78 No-1,Jan-Feb.

AUTHOR PROFILE

Krishna Kumar - M. Tech. Scholar in Civil Engineering (Structural Design) from Ganga Institute of Technology and Management, Kablana, Jhajjar, Haryana (India) affiliated to Maharshi Dayanand University, Rohtak, Haryana (India).