ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)
Vol 3, Issue 2, February 2018

Use of Ferrocement as a Permanent Formwork for Beams

[1] Mohd Adnan, [2] Aadil Kotkar, [3] Md Gause, [4] Albir Singh Jabinda, [5] Kavish.G.Patwari
[1] U.G.Students, Deogiri Institute of Engineering and Management Studies, Aurangabad.
[2] Assistant Professor, Department of Civil Engineering, Deogiri Institute of Engineering and Management Studies, Aurangabad. 431005.

Abstract: **-- 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 into any desired shape or structural configuration that is generally not possible with standard masonry, reinforced concrete or steel. Temporary wooden or steel formworks are used nowadays for most of the concrete constructions. Since the cost of such formworks is a critical issue in the construction field. Hence it is essential to suggest an alternative material and technology for the formwork construction to replace the conventional materials and to reduce the cost. This study investigates the effectiveness of using ferrocement as a permanent formwork for the beams which are reinforced with single and double layers of chicken mesh. And this will also prevent the destruction of woods in many cases and hence the country will be benefited to a great extent. Therefore, this research work investigates the possibility of using such a versatile material as a permanent formwork for reinforced concrete beams.**

***Keyword*: Chicken mesh, Ferro cement, formwork, reinforced concrete.**

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 is characterized by its enhanced resistance to cracking in comparison to reinforced concrete. Cracks in ferrocement are narrower and larger in numbers. The types of wire meshes generally used in ferrocement construction are welded steel wire mesh, X8 expanded steel wire mesh and chicken mesh. 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. Temporary wooden or steel formworks are used nowadays for most of the concrete constructions. Since the cost of such formworks is a critical issue in the construction field. Hence it is essential to suggest an alternative material and technology for the formwork construction to replace the conventional materials and to reduce the cost. This study investigates the effectiveness of using ferrocement as a permanent formwork for the beams which are reinforced with single and double layers of chicken mesh. And this will also prevent the destruction of woods in many cases and hence the country will be benefited to a great extent. Therefore, this research work investigates the possibility of using such a versatile material as a permanent formwork for reinforced concrete beams. Thus, this study as proposed highly intended to harness the properties and technological advantages of ferrocement to create and design an alternative formwork for concrete that is efficient and economically beneficial.

II. LITERATURE REVIEWS

1) Mohd. Razali Abdul Kadir and Mohd. Saleh Hj. Jaafar., April 1993: In this study they do a construction project. The project involved the construction of a building to be used for storage purposes. The whole building was from ferrocement

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except the floor and the main arches which were constructed from reinforced concrete. The formwork for the main arches was an in situ permanent ferrocement formwork. The whole project was completed successfully by about 90 students in about one month working on a part-time basis. And they concluded that ferrocement permanent form work has great potentials in saving construction time and timber. It has the potential of reducing the amount of tensile steel because of the tensile strength provided by the mesh of the ferrocement form work. And also concluded that curved structures also feasible by using ferrocement technique.

2) Anisha G Krishnan, Allzi Abraham., 2013: In this study they concluded that the concrete beams incorporating permanent ferrocement formwork have high strength and crack resistance as compared to conventional reinforced concrete beams of the same dimension.

3) Bansal et al., 2008: In this study three types of wire mesh orientation such as zero degree orientation, forty five degree orientation and sixty degree orientation was used. The results revealed that the percent increase in load carrying capacity of beams retrofitted by ferrocement with zero degree, forty five degree and sixty degree wire mesh orientations. Also forty five degree orientation showed greater load carrying capacity as compared to other orientation.

4) Richelle B. Romarate, Daniel S. Mostrales., June 2015: In this study they concluded that Designed and applied procedures of the ferrocement formwork were efficient and therefore are safe to conclude that it is applicable for columns and beams.Construction procedures were developed, followed and implemented during application phase thus the new formwork system's applicability in actual is satisfactory.

5) Fahmy et al., 2014: In this study there is used of precast permanent U shaped ferrocement forms filled with different types of core materials such as conventional concrete, autoclaved aerated lightweight concrete bricks, and recycled concrete. Also she concluded that precast ferrocement formworks are applicable to use on site for beams.

6) Sandowicz, M. and Grabowski, J. 1985 : In this study they used the ferrocement technique in construction of houses and they reported saving of about 18% in the steel and about 80% in the construction time in their building projects

7) Rosenthal and F. Bljuger., January 1985: In this study reinforced concrete beam casted with skin of ferrocement and results shows the superior performance as compare to ordinary reinforced beam. Cracking moment oh this composite beam higher than of reinforced beam due to the additional flexural tensile strength contributed by the skin elements. In this composite beam cracks have only reached, at failure, 0.4 to 0.5mm as compared to twice as much in the reference beams.

III. OBJECTIVES

i) To investigate the structural effectiveness of ferrocement as permanent formwork for reinforced concrete beams.
ii) To investigate the composite behaviour of reinforced concrete beam coated with ferrocement.
iii) To study the effect of cost of construction by using ferrocement as formwork.
iv) To comprise the strength of conventional R.C.C beam and ferrocement form beam.
v) To investigate, how ferrocement formwork affects the quality of concrete.
vi)To study whether this formwork affects the speed of construction.
vii) To investigate, how ferrocement formwork is better the steel, wooden and other types of formwork.
vii) To study the practical approach of ferrocement as a permanent formwork.
viii) To carry out which formwork is best for construction of building.
ix) To understand the concept of ferrocement formwork.
x) To compare the cost of building by using conventional formwork technique & by using ferrocement formwork technique.

IV. METHODOLOGY

1 Mix design and material properties

The U shaped permanent ferrocement formwork will be made by use of mortar having proportionate concrete mix design. The mortar consisting of ordinary Portland cements and sand as well as Single and double layers of chicken mesh will be used for fabricating the U shaped permanent ferrocement formwork. The skeletal reinforcement for the U shaped ferrocement permanent formwork consisting of 6 mm diameter steel bars which provide shape and support for the mesh.

2 Preparation of test specimens

The concrete specimens will be prepared in proper proportion and water cement ratio of 0.5. Three reinforced concrete beam specimens having dimension (200 x 200 x 1000) mm will be casted and which will be taken as control beam specimens. The control beam specimens will be kept for a curing period of 28 days before testing. After that a frame is to be developed with 6 mm a diameter bar which is termed as skeletal reinforcement and it is covered with single and double layers of chicken mesh to form an open channel for the ferrocement formwork construction. The

ISSN (Online) 2456-1290

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skeletal reinforcement having single and double layers of chicken mesh then plastered with rich cement mortar to get an overall thickness of 25 mm to the ferrocement formwork. The ferrocement formworks will be kept for a curing period of 28 days.

V. COMPARISON OF RESULTS

1) Results analysed by Anisha G Krishna

Sr.no	Description	Control Beam	Beam with ferrocement Formwork having single layer of chicken mesh	Beam with ferrocement Formwork having double layer of chicken mesh
1	First crack load (KN)	171.374	190.774	210.674
2	Breaking load(KN)	196.574	256.174	320.574

2) Results analysed by Richelle B. Romarate

100x200x 2400(mm)	Applied force(KN)		Aver -age (KN)	Desig -ned capaci -ty (Knm)	Actual capacity (KN-m)
	1	2			
Conventio nal beam	34.79	47.05	40.92	10.3	14.32
Modified beam	56.71	58.89	57.8	10.3	20.23

From the above results we can conclude that the load carrying capacity of beam increases when the ferrocement is used as a permanent formwork.

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