International Journal of Recent Engineering Research and Development (IJRERD)
ISSN: 2455-8761
www.ijrerd.com || Volume 02 – Issue 08 || August 2017 || PP. 36-40

Experimental Study on Effect of Wire Mesh Types & Pattern on Properties of Ferrocement Concrete

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Abstract: The present investigation highlights on 25 different cases of wire mesh combinations with varying types of wire mesh. It studies the effect of using varying no. of wire mesh layers and aligned horizontally, vertically and diagonally. The concrete specimens were casted with single and double layer of wire mesh.The result reveals that, flexural load of slabs with PVC-Coated weld mesh is 90% that of specimens reinforced with other types of wire mesh. While vertical orientation of PVC-Coated mesh offers 15% more compressive strength than horizontal orientation of PVC-Coated mesh.
Use of PVC-Coated wire mesh can be used effectively in ferrocement slabs, as non-corrosive reinforcement.
Keywords: Crack, Compressive Strength, Different type of wire mesh, PVC-Coated mesh, Reinforcement Orientation

1. Introduction

Alternative building materials are selected instead of conventional building materials for new construction and renovation. These materials reduce potential sources of pollutants in stormwater runoff by eliminating compounds that can leach into run off, reducing the need for pesticide application, reducing the need for painting and other maintenance. The cost of building materials used for construction such as steel, cement, brick, timber and labor are increasing day by day. Thus, it indirectly leads to increase in cost of construction which is not economical. Hence there is a need to develop or use new technology to make construction economical. Ferroconcrete is such example to be used for roofing system. This roofing system is design as a segmental element, which is very easy to cast, cure and then manually erect over the bearing walls. The strength and rigidity are developed through this roofing system and it is cost effective. Hence it is ideally suited for prefabricated construction particularly for low cost housing.

This technique was used Second World War for construction of boats. From 1960s ferrocement can be used successfully for construction of building panels. World famous Sydney Opera House (see figure 1) was constructed by ferrocement. In India, ferrocement is also used for construction of small houses, farmhouses etc.

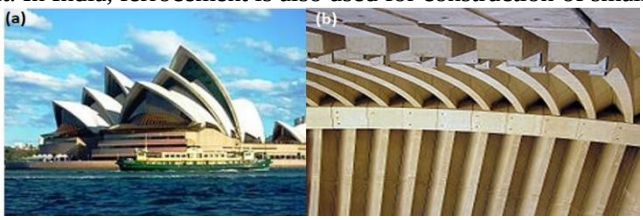


Figure 1: Sydney Opera House (a) Font view (b) Shell ribs

2. Review of Literature:

2.1 P.B. Sakthivel et.al, have made an attempt to experimentally investigate the ultimate flexural load of reinforcement slabs of size 700x200x15mm (thickness) reinforced with PVC-coated steel weld mesh, and compare the results with GI-coated steel weld mesh, by varying the no. of layers from 1-3. Ordinary Portland cement, locally available river sand and potable water have been used in preparation of cement mortar, and sand-cement ratio of 2:1 and water cement ratio of 0.43 have been used in accordance with ACI codes. The flexural load, maximum deflection, crack-pattern and crack width of ferrocement slabs reinforced have been analysed using varying PVC and GI coated weld mesh layers (1-3). Increasing the no. of mesh layers from 1-3 caused a substantial increase in flexural load as well as improvement in ducility behavior of ferrocement slabs.

2.2 Joel Galupo Opon et.al, this research is focused on a new interior floor slab system, which can be prefabricated in modular form out of ferrocement technology. Authors designed floor slab of 600x600x40mm with 8mm skeletal steels that served as connection studs with two layers of wire mesh. The slab modules were

tested to a central load using a universal testing machine (UTM). The study concluded that ferrocement is an excellent and safe technology for an interior prefabricated modular slab design and there is economic savings in the technology.

2.3 Hani H. Nassif et.al, studied the composite beams made of reinforced concrete overlaid on a thin section of ferrocement. The method of shear transfer between composite layers is examined by the author. Beam specimens with various wire meshes were tested under two-point loading system up to failure. Authors concluded that, proposed composite beam has good ductility, cracking strength and ultimate capacity.

3. Experimental Investigation

The present investigation is carried out to study "Effect of reinforcement orientation on compressive strength of PVC-coated ferrocement".The investigation highlights on 25 different combinations of orientations and layers of wire mesh reinforcement with its effect on compressive strength of PVC-coated ferrocement. The ferrocement specimens casted with single and double layers of wire mesh.In this study, PVC-coated steel weld mesh has been mainly used as the main reinforcement for ferrocement specimens. The mesh has been provided in the size of 150x150x150mm in cube moulds in single and double layer, also the mesh has been provided in the size of 550x550x25mm in slab moulds in single and double layers.The ferrocement mix was prepared with cement:sand ratio 1:2 by weight while water cement ratio adopted was 0.5 for concrete grade of M25**.**

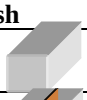
3.1 Preparation of specimens:

The different 25 designations of ferrocement with one additional control specimen.

3.1.1. For cubes

Total 225 specimen were casted, 54 numbers of cubes (150x150x150mm), 54 number of beams (600x500x150mm), 54 number of cylinder (300x150mm) for each type of mesh including 27 specimen where 9 numbers of cubes, 9 number of beams, 9 number of cylinder for Control mix were casted. The length of each mesh was 1080cm. The materials are used for orientation in cubes shown in table 1.

Table 1: Square Woven Wire Mesh

Sr. no	Designation	Orientation of mesh	Particulars
1.	M.C.S		Mortar content specimen
2.	(V1)		One mesh vertical at centre
3.	(H1)		One mesh horizontal at centre
4.	(D1)		One mesh diagonal
5.	(V2)		Two mesh vertical at equal distance
6.	(H2)		Two mesh horizontal at equal distance
7.	(D2)		Two mesh diagonally placed

3.1.2. For Slab panel

This experimental research program was also designed to evaluate the flexural behaviour of ferrocement slab sections. The primary variables are the no. of layers of wire mesh and types of wire mesh to be used in ferrocement panels. (see table 2)

Table no 2: Details of panels to be casted

Sr. no	Size of Panels	No. of Layers	No. of Panels
1.	(550x550x25mm)	1	3
2.	(550x550x25mm)	2	3

Total 24 number of slab panel (550x550x25mm) was casted where 6 numbers were casted for each type of wire mesh.The above table describes the no. of specimens to be casted for different types of wire mesh is same.

4. Results and Discussion:

In present investigation, various tests have been planned as discussed in the experimental program.

4.1. Compressive Strength, Flexural Strength and Split Tensile Strength of Ferrocement Specimens:

According to the compressive strength combine graphs are prepared and discussed the results

4.1.1. Square Wooven Wire Mesh

The below (see figure 2) indicates the combine graph of results of compression strength, flexural strength and tensile strength.

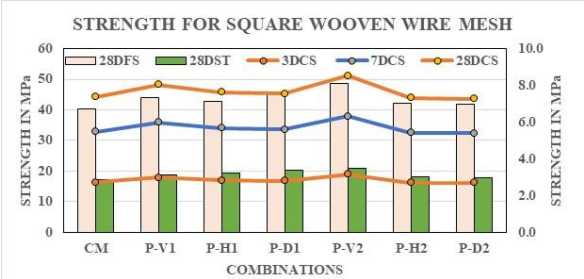


Figure 2: Strength of Square Woven Wire Mesh

According to it, the highest compressive strength is 51.19 MPa. Similarly, the highest flexural strength obtained is 8.09 MPa and tensile strength of 3.50 MPa for ferrocement specimen casted with double layer of wire mesh aligned vertically.

4.1.2 Square Welded Wire Mesh

From figure no 3, shows test results of ferrocement casted with square welded wire mesh for different orientations and no. of layers.

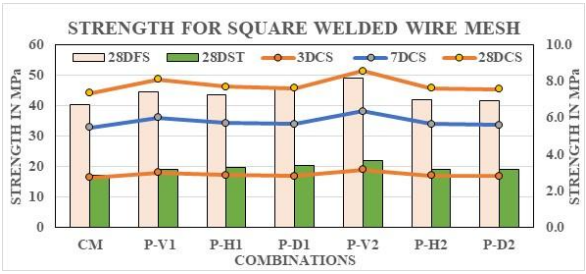


Figure 3: Strength of Square Welded Wire Mesh

The compressive strength gained is highest with 51.09 MPa, while flexural strength obtained is 8.21 MPa, and pensile strength of 3.68 Mpa. Similar to the results of previous wire mesh, the strength obtained are highest for ferrocement casted with double layer, aligning vertically.

4.1.3 Chicken Wire Mesh

The figure no 4 displays all the strength with highest compressive strength of 53.05 MPa, flexural strength of 8.57 MPa and tensile strength of 3.94 MPa. All these highest strengths are obtained for the specimen having double layer wire mesh in vertical direction.

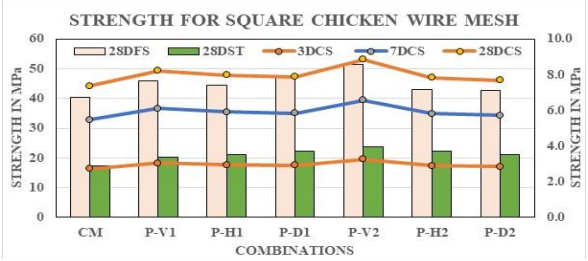


Figure 4: Strength of Chicken Wire Mesh

4.1.4 PVC – Coated Wire Mesh

For PVC – Coated wire mesh, the highest strength for compression test obtained is 54.29 MPa, flexural strength with 8.78 MPa and tensile strength of 4.04 MPa. For the above wire mesh similar to others, all these higher strengths are obtained for the ferrocement specimens casted with vertically aligned double layered PVC – Coated wire mesh(see figure 5)

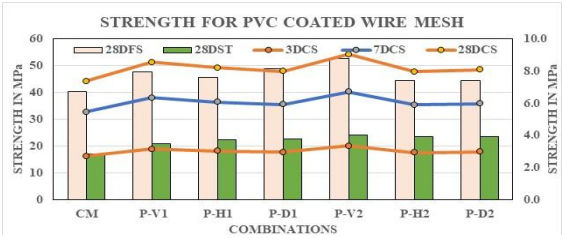


Figure 5: Strength of PVC- Coated Wire Mesh

4.2. Slab Panel Strengths

4.2.1. Square Woven Wire Mesh

The strength of ferrocement slab panels are shown in above graph. From the above graph, the compressive strength is highest i.e 44.43 MPa for slab panel having single layer of wire mesh, higher flexural strength. (see figure 6)

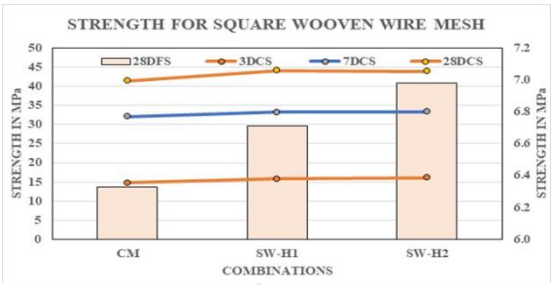


Figure 6: Strength of Square Woven Wire Mesh

4.2.2. Square Welded Wire Mesh

The graph plotted above gives the compressive strength of 45.65 MPa, flexural strength of 7.09 MPa. All these strengths are obtained for the slab panels casted with double layer wire mesh at equal distance. (see figure 7)

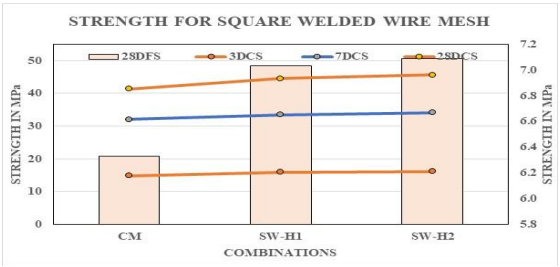


Figure 7: Strength of Square Welded Wire Mesh

4.2.3 Chicken Wire Mesh

For the above wire mesh, 46.79 MPa is the highest compressive strength, 7.14 MPa flexural strength.(see fig 8)

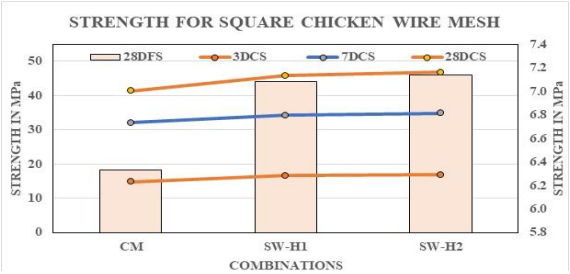


Figure 8: Strength of Chicken Wire Mesh

4.2.4 PVC – Coated Wire Mesh

The graph plotted above gives the compressive strength of 47.38 MPa, flexural strength of 7.35 MPa. All these strengths are obtained for the slab panels casted with double layer wire mesh at equal distance. (see figure 9)

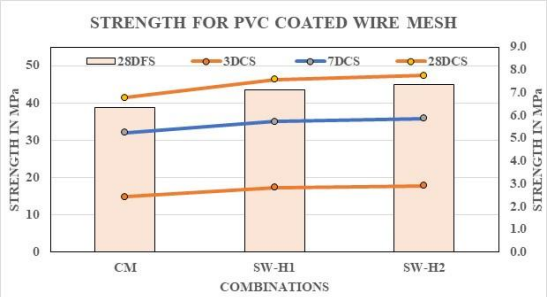


Figure 9: PVC – Coated Wire Mesh

3. Conclusion:

Based upon the test results of the experimental study undertaken, the following conclusions may be drawn:

a. It can be concluded that, there was highest increase in compressive strength, flexural strength and tensile strength of ferrocement specimen when the wire mesh was provided in double layer along with vertical orientation for all the varying types of wire mesh.

b. Increase in number of mesh layers also improves the ductile behavior of ferrocement slabs.

c. Since ferrocement slabs using PVC coated mesh reinforcement is corrosion-free and also capable of withstanding high flexural loads, this study recommends its effective use in roof slabs / terraces, repair and renovation works of open terraces and canal lining works.

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Author Profile

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