TITLE: BEHAVIOUR OF FERROCEMENT COLUMNS WITH DIFFERENT LOCATION OF MESH LAYERS

Hiralal Pawar[1]

[1] *Assistant Professor, Civil Engineering, Matoshree College of Engineering and Research Center, Maharashtra, India*

ABSTRACT

Ferrocement technology are being used in construction industry due to its excellent structural behavior and cost saving. Ferrocement is suitable for the construction of precast units, manhole covers, and construction of domes, columns and beams hallow beams and curved surface roofs. Ferrocement regarded as highly versatile thin material possessing superior properties which cannot be matched by other conventional thin materials. The development and construction of structural elements in building construction is a growing trend in construction industry all over the world due to its high strength-to-weight ratio. In the present study using welded square wire mesh in ferrocement columns with different locations. At 28 days, it was found that compressive strength of ferrocement columns of different location of mesh layers especially at middle location, layers at three positions in column. Number of layers of square welded mesh were used in the columns and ferrocement cubes.

Keyword: *Compressive strength, ferrocement, strength to weight ratio, welded mesh*

1. INTRODUCTION

According to the ACI Committee 549 the definition of ferrocement is "ferrocement is a type of thin wall reinforced concrete commonly constructed of hydraulic cement mortar reinforced with closely spaced layers of continuous and relatively small size wire mesh. Balguru P.N., Parviz Soroushian present the mesh may be made of metallic or other suitable materials." Ferrocement consists of a Portland cement mortar matrix, reinforcement, admixtures, and coatings. The mortar matrix primarily used in ferrocement consists of hydraulic cement and inert filler material. Portland cement is generally used, sometimes blended with a pozzolona. The filler material is usually well-graded sand capable of passing a 2.36 mm (No. 8) sieve. The physical properties and microstructure of mortar depends on the chemical composition of the cement, the nature of the sand, the water-cement ratio and the curing conditions of the finished product. Reinforcement for ferrocement is commonly in the form of layers of continuous mesh fabricated from single strand filaments. There are most widely used wire meshes in ferrocement technology is woven wire or interlocking mesh, hexagonal mesh, expanded metal mesh. In the present study welded wire mesh are used.ThomusTamut, Rajendra Prabhu.

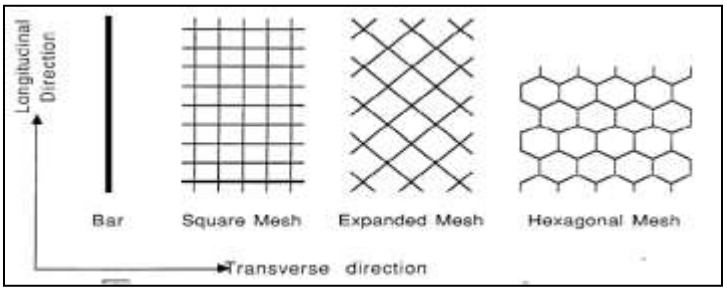

Fig-1: Types of mesh

For construction of slender column there is problem widely found from the site is buckling and shear failure because of ratio of height and width. In the present study tried to solve buckling problem and slenderness effect of the columns. In the previous research they investigated that mesh reinforcement provided along the steel bars in the ferrocement column, but in this study tried to provide mesh layers directly in three different locations. Compressive strength of columns has observed by compressive test.

2. METHODOLOGY

To achieve the desired objectives of work following specimens were cast and tested for compressive strength test of ferrocement columns with the different locations of mesh layers. To identify the type of specimen type, method of curing for the specimen, specimens were designated with special notation which is mentioned in following Table I.

Table 1: Specimens designation

Sr. No.	Designations	Type of sample	Mesh location	Curing type
1	PL mortar	Plain mortar sample	No mesh	Water curing with normal room temperature
2	FC-1	Ferrocement cubes sample 1	Mesh at middle	
3	FC-2	Ferrocement cubes sample 2	Mesh at middle	
4	CL ML	Ferrocement column with mesh at middle layer	Mesh at Center	
5	CL TL	Ferrocement column with mesh at three different location	Mesh at 1/3 rd part of column length	

2.1 Objective of the study

Following objectives were set for present investigations.

- To conduct the compressive strength test on Ferrocement
- To study the properties, such as compressive strength and deflection of ferrocement columns with different combinations of mesh.
- To conduct the study compared with those of normal ferrocement.
- To study the behavior of slender column.
- To replace of conventional column by ferrocement column.

2.2 Materials and methods

For casting of the Ferrocement column specimens, conventional cement mortar was prepared. For casting the different layers location of Ferrocement column, rich mortar was prepared. Materials used for the preparation of both Ferrocement column and Ferrocement cubes are explained below.

- **Cement:** Pozzolona Portland cement (PPC)-53 grade by IS 1489-2 (1991) was used throughout the experimentation. PPC produces less heat of hydration and offers greater resistance to attack of aggressive environment for long-term strength and enhances the durability of structures.

- **Fine aggregate:** The river sand was used as fine aggregate conforming to the requirement of IS 383:1970. The fine aggregates were washed and screened, to eliminate unwanted deleterious materials and over size particle. The test for determination of specific gravity of the aggregates was carried out. Particles passing through IS sieve of size 2.36 mm were used. Specific Gravity: for Sand were 2.78.

- **Reinforcement Details of Ferrocement :** It is tentatively recommended that for a given ferrocement column of size 70mm x 70mm x 850 recommended that spacing of transverse wires should not be larger than h. Furthermore, the number of layers of mesh, n, should preferably be such that, 12 number of layers of the mesh for the above sample of column and cubes of size 70mm x 70mm 70mm is given by N=0.16x70, N=12 nos.by ACI 549.

In ferrocement column 4 layers combinations of mesh layers were used at different location as per stated in above introduction.

3. RESULTS AND DISCUSSION

Following are the various result by different testing methods. Test conducted as per standard and method are described below.

3.1 Compressive Strength Test

The cubes were tested in 2000kN capacity compressive testing machine (in Figure 2) . The columns were tested in 100 tonns capacity universal testing machine (in Figure 3).

.

Fig-2: Compressive test of cube In CTM

Fig-3: Compressive test of Column In UTM

Both the mortar cubes (FC 1) and ferrocement cubes (FC 2) with combination of welded mesh due to results are as shown in following Table 2 and figure 4. Figure 4 shows Strength vs Density and also shows the strength of both ferrocement and mortar cubes are reduced to reduce the welded mesh. Figure 5 shown strength vs density of both ferrocement and mortar columns shows the density is decreases then strength also decreases and density increases by weld mesh strength also increases. In the observation there is average result of strength and density of specimens were calculated in Table 1.Since, the experimental study of this research was completed step by step. First determined results on control specimens of ferrocement cubes sample and then after completed the procedure of work of ferrocement column. As per the ACI 549R all the details about ferrocement design are followed as per standard and designed ferrocement columns. The main applications of ferrocement columns in the building to increases not only strength but also reduces the time and cost of the work. At this stage it is appropriate to identify the objectives of this research.

Table 2: The compressive strength and density of ferrocement columns and cubes with different combinations of mesh layers

Curing (Days)		**Numbers of sample tested under universal testing machine. (Mortar 1:2)**			
		FC 1		**FC 2**	
	Strength (MPa)	20.21	20.95	23.78	23.21

28		19.98	21.20	22.45	22.58
	Density (Kg/m^3)	2075.22	2068.35	2110.12	2130.20
		2074.21	2071.54	2098.30	2108.70
Ferrocement Column (Mesh layers at middle position)					
28	Strength (MPa)	CL ML Sample set 1	26.34	CL ML Sample set 2	24.87
	Density (Kg/m^3)		2180.22		2160.23
Ferrocement Column (Mesh layers three different position)					
28	Strength (MPa)	CL TL Sample 1	24.20	CL TL Sample 2	23.98
	Density (Kg/m^3)		2170.21		2198.30

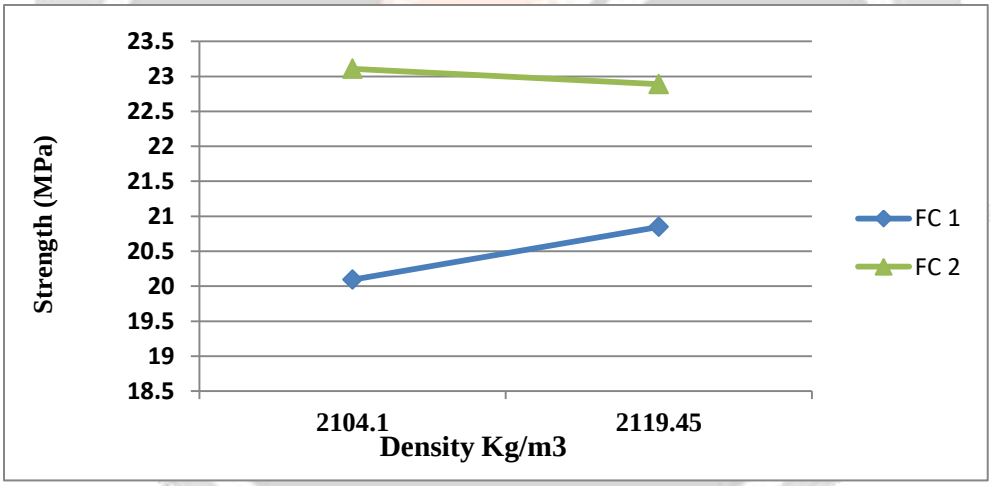

Fig-4: Density Vs Strength of Cubes

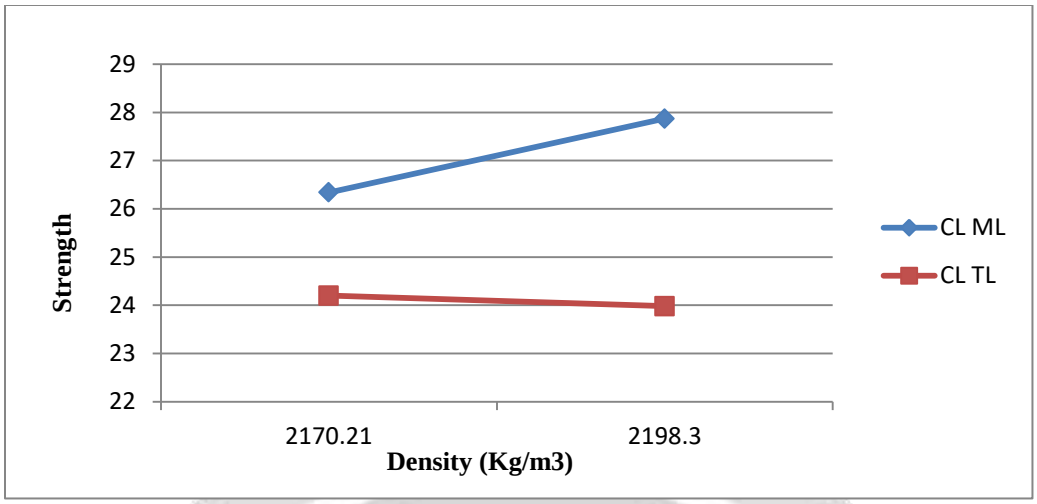

Fig-5: Density Vs Strength of ferrocement columns

The above fig. 4 shows the strength vs density of ferrocement column. From the figure it observed that if welded square mesh added in mortar cube then density increases but strength also increases. Figure 5 shows that the strength verses density of ferrocement column as per different types of specimense. It observed that if mesh layers placed at different location the strength also changed as shown in Table 2.

4. CONCLUSIONS

- From all the research experiment it conclude that if welded mesh added in rich mortar then density increases but the strength also increases.
- If weld mesh layers as per design added in mortar cubes then strength and density of cubes were increases, hence it means rich mortar with mesh layers is the ferrocrete technology. Strength increases upto 10% by adding mesh layers in cubes and also density increases 2% by weight.
- Welded mesh of layers placed In center of the column it get increase strength upto 12% as compare to three different positions of mesh in the columns.
- Density increases same 2% in the ferrocement column. If changes location and position of welded mesh I ferrocement column strength also changes.

5. ACKNOWLEDGEMENT

Many lives and destinies are destroyed due to the lack of proper guidance, directions and opportunities. It is in this respect we feel that I am in much better condition today due to continuous process of motivation and focus provided by our parents and teachers in general. The process of completion of this project was a tedious job and requires care and support at all stages. I would like to highlight the role played by individuals towards this.

I am extremely grateful to honorable principal Dr. G. K. Kharate for providing us the opportunity and infrastructure to complete the work. I am very thankful to Prof. U. P. Naik**,** Head of Department, for his kind support and faith in me. I am also thankful to all visible and invisible hands which helped us to complete this project with a feeling of success.

6. REFERENCES

[1] R, Padmavathy and S, Dharmar,. "Flexural Behavior of Flat Ferrocement Panels" International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

[2] I, Ahmad and N, Mohamad. "Structural Behaviour of Precast Lightweight Concrete Sandwich Panel under Eccentric Load".

[3] Anthony Nikem., A,Valentine. and O.A., Paul,"Thermal Behaviour and Admissible Compressive Strength of Expanded Polystyrene Wall Panels of Varying Thickness" Current Trends in Technology and Science ISSN : 2279-0535. Volume: 3, Issue : 2

[4] N.R Husein, V.C., Agarwal and A, Rawat, "An Experimental Study on Using Lightweight Web Sandwich Panel as a Floor and a Wall" International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-3, Issue-7, December 2013

[5] R, Ravindrarajah, M.J., Camporeale and C.C, Caraballo, "Flexural Creep of Ferrocement - Polystyrene Concrete Composite" ADCOMP'96, Second International Conference on Advances in Composites 1996, 18 -20 December, 1996, Bangalore, India

[6] H. F, Ezzat, N. A, Mohamed and B. S, Yousry , "Ferrocement sandwitch and cored panels for floor and wall constructions" 29th Conference on our world in concrete & structures: 25 - 26 August 2004, SingaporeArticle Online Id: 100029029The online version of this article can be found at:

[7] A, Mandlik, S.S.,Tarun, Shekhar Karade, S., Naik, and A., Kulkarni, "Lightweight Concrete Using EPS" International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

8] Ling, I. H. and Teo, D.C.L. "EPS RHA Concrete Bricks – A New Building Material" Jordan Journal of Civil Engineering, Volume 7, No. 4, 2013.

[9] ACI (1999) Committee 549R-97: "State of the art report on ferrocement", American Concrete Institute, USA.

[10] ACI (1999) Committee 549.1R-93 "Guide for design, construction and repair", American Concrete Institute, USA.

[11] IS 456:2000, "Plain and Reinforced concrete, code of practice", (fourth edition)

[12] B. N., Divekar (2012), "Ferrocement Technology-A Construction Manual", President, ferrocement society, Pune, India.