INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH VOLUME 8, ISSUE 08, AUGUST 2019 ISSN 2277-8616

Flexural Behavior Of Ferrocement-LGS Composite Under Monotonic Loading

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Abstract:The main objective of this investigation is to study the flexural behavior of Ferrocement-LGS composite section when subjected to 4 point monotonic load. Ferrocement panel and LGS is connected with self-tapping screw at different spacing. 3 different spacing of 125mm, 150mm and 250mm screw connection is analyzed under flexural loading to understand the deflection behavior and moment capacity of section. Experimental study & research determine the result in terms of load-carrying capacity, central deflection, bending moment capacity, Load vs Deflection curve and failure pattern. These results will be compared with each other. Expectation from this research is that this research will be used as guidance for future research on composite system for building construction.

Index Terms: Composite section, Ferrocement, Light gauge steel, Flexural behavior of composite section, Ferrocement-LGS composite, Four point monotonic loading, Light-weight structure.

1 INTRODUCTION

New innovative construction technique is required for rapid construction of a structure having better performance than standard system and it should have better cost effectiveness when it comes to not only major projects but also for small projects. Ferrocement is a form of thin reinforced concrete structure in which a brittle cement-sand mortar matrix is reinforced with closely spaced multiple layers of thin wire mesh or small diameter rods, uniformly dispersed throughout the matrix of the composite. Ferrocement has taken a significant place among components used for construction, for its specification of durability and strength, and its small thickness, which makes it a component suitable for constructing many lightweight structures. Ferrocement appears to be an economic alternative material for roofing; however flat or corrugated roofing system is quite popular. In steel construction, there are two main families of structural members. One is the familiar group of hot-rolled shapes and members built up of plates. The other, less familiar but of growing importance, is composed of sections cold formed from steel (LGS) sheet, strip, plates, or flat bars in roll-forming machines or by press brake or bending brake operations. These are cold-formed steel (LGS) structural members. Light gauge steel section will be used for the fabrication of the ferrocement panel.The use of composite system in buildings is becoming popular due to the increase in loading capacity and stiffness. The composite construction system is increasingly used in the construction industry. Composite construction normally implies the use of steel and concrete together formed into a component in such a way that the resulting configuration works as a single unit comparable to reinforced concrete construction. The goal is to achieve a higher level of performance that would have been the case if the two materials worked separately. The design must, therefore, recognize intrinsic property distinctions and guarantee that they are correctly accommodated by the structural system. Reducing the composite elements self-weight has a significant impact in lowering the forces in those parts that support them such as the foundations. Furthermore, composite systems also offer advantages in terms of building construction speed. The design of flooring systems is regarded to have the greatest effect on the overall weight of steel buildings, particularly taller structures, and the strong demand for enhanced column spacing is becoming more important. Furthermore, the implementation of composite action was recognized as an efficient technique for improving structural performance and reducing costs. A large percentage of steel buildings are therefore designed in a composite manner. Application of composite construction system is appropriate for both private and public sector buildings like a commercial building, industrial and warehouse building, stadium, hospital, schools, housing etc.

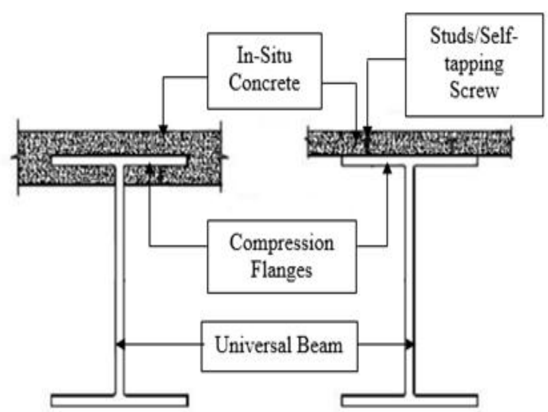

Fig. 1. General used composite section

2 OBJECTIVES

Study the parameter i.e. load-carrying capacity, deflection, bending moment capacity and failure pattern. Study the effect of different spacing of shear connector on all parameters. Comparing all the parameters of each specimen with each other.

3 METHODOLOGY

Analysis of composite section is done to find out all required parameter Compressive strength of mortar is measured for

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OPC 43 grade cement with cement : sand (1:3) with w/c ratio of 0.34 with admixture 1.2% of cement weight. IS 801:1975 and IS 800:2007 is used to determine the flexural capacity of LGS (light gauge section) C section with lip. . Macaulay's method is used to find central deflection at maximum loading and modulus of elasticity of composite section.

4 EXPERIMENTAL PROGRAM

4.1 Constituents of Ferrocement Panel and LGS

Ferrocement panel of 600mmx900mmx18mm was casted with cement-sand proportion of 1:3 and w/c ration is 0.34. Cement used for casting ferrocement panel was OPC 43 grade and crush sand of 1900kg/m^3 density was used as a fine aggregate passing through 2.36mm sieve. Admixture was added to achieve workability at low w/c ratio. Admixture added is 1.2% of cement weight. It is polycarboxylate based hyper-plasticizer admixture. Reinforcing arrangement consists of 2 layers of square welded wire mesh of 1mm dia, 20mm c/c opening and spacer rod of 4mm dia was to maintain spacing between layers of wire mesh. Spacer chair was used to provide cover to the mesh. LGS channel section with lip was used. Section property of channel section is given in figure 2. Elastic modulus of steel is E=200 x 10^3 N/mm^2 and grade of steel F_y is 500. Provision of holes in ferrocement panel for connecting panel with LGS section was done by means of driving nails in the mould before placing mortar and removed 30 minutes after the casting. Ferrocement panel is cut into the size of 200mmx900mmx18mm to meet the specimen requirement. Cut strip of ferrocement panels were connected to LGS C section at the top and bottom compression flange with self tapping screw at predefined screw spacing.

Table 1. *Test Specimen Details*

Specimen Name	Length mm	Screw Spacing mm	No of Specimens
M-125	900	125	2
M-150	900	150	2
M-250	900	250	2

(M-monotonic loading, 125-screw spacing)

Figure 2 shows the cross section of composite section and figure 3 shows arrangement of screw spacing between panel and LGS section. All the specimens will be tested and its load carrying capacity and deflection was observed.

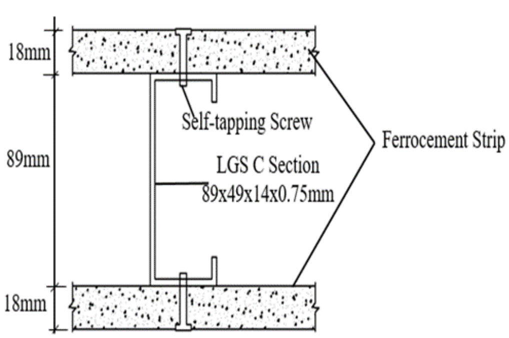

Fig. 2. Composite section assembly

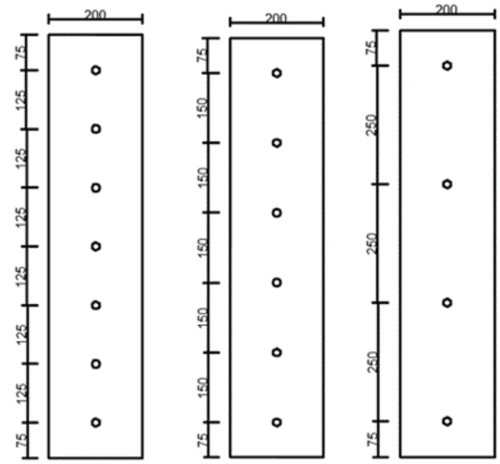

Fig. 3. Arrangement of different screw spacing

4.2 Test setup

All the specimen having same length were examined under flexural 4 point monotonic loading. Load was applied using Universal Testing Machine of 100T capacity with arrangement of 2 point load at same distance from support.

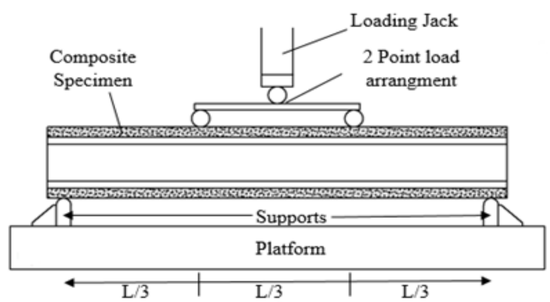

Fig. 4. Schematic arrangement of test setup

5 EQUATIONS

Following are the equations have been used to calculate theoretical data for LGS and Composite section respectively from IS codes and standard thory. Bending capacity of LGS is calculated by: $M=0.6xF_yxZ_x$ (IS 801 : 1975) Equation of Macaulay's method used is EI $(d^2y/dx^2) = -M$.

6 RESULTS AND DISCUSSION

Load carrying capacity and deflection of each specimen were tested under flexural monotonic loading. Behavior of each specimen was noted and its failure pattern was also noted.

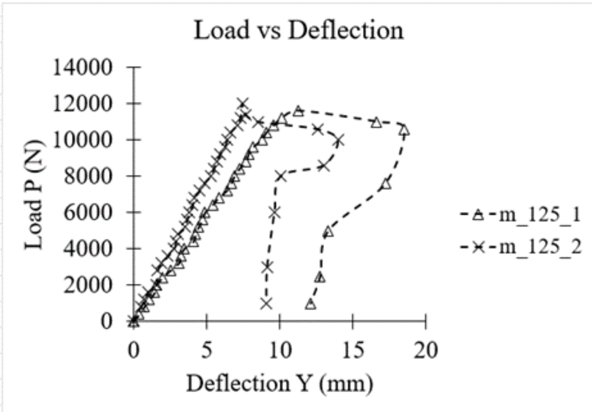

Fig. 5. Load vs Deflection curve of specimen of 125mm screw spacing

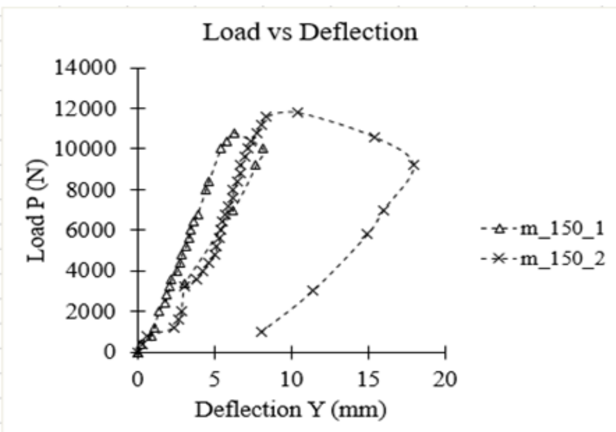

Fig. 6. Load vs Deflection curve of specimen of 150mm screw spacing

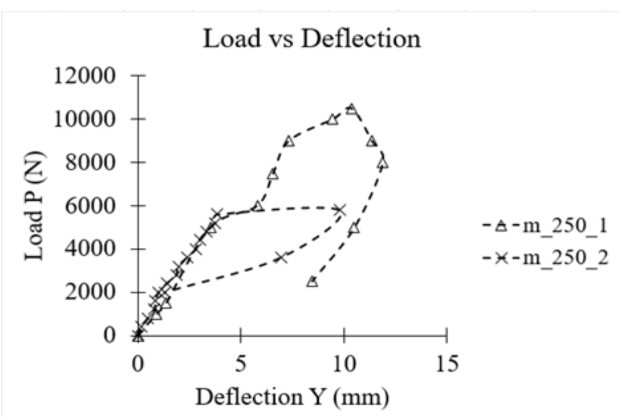

Fig. 7. Load vs Deflection curve of specimen of 250mm screw spacing

From the experimental results it is observed that load carrying capacity increases as the connection spacing decreases. All the specimens were failed due to local buckling of LGS section at the supports. No failure in ferrocement panel and connection were observed.

Table 2.
Parameters obtained from experimental data

Parameters	Beam Specimen Designation		
	Specimen	1	2
Failure Load (N)	m_125	11600	12000
	m_150	10800	11800
	m_250	10500	5800
Max Deflection (mm)	m_125	11.24	7.42
	m_150	6.26	10.38
	m_250	10.35	9.81
Bending Moment at Max Load (N.mm)	m_125	1546657	1599990
	m_150	1439991	1573324
	m_250	1399991	773329

From Table 2, maximum bending moment capacity of specimen decreases as the connection spacing increases. Maximum bending moment capacity is observed in specimen having connection spacing 125mm.

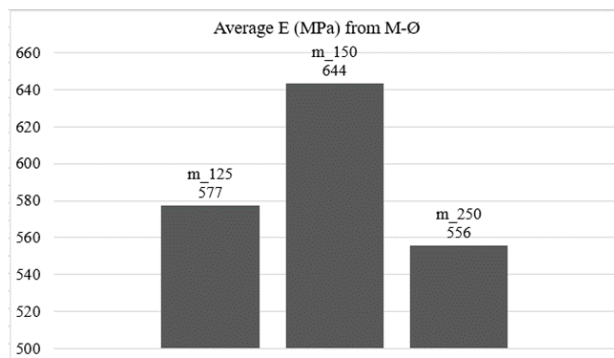

Fig. 8. Modulus of Elasticity from test data

As the modulus of elasticity is high, stiffness of material is high. But from this experiment it is seen that specimen having connection spacing 150mm have high elasticity modulus. It is seen that even if load carrying capacity of specimen of 125mm connection spacing is more, its elastic modulus 577MPa is less then specimen of 150mm connection which is 644MPa.

7 Conclusion

From the experimental results it is seen that load carrying capacity and bending moment capacity is increase as the connection spacing decreases. Load carrying capacity of M-125 specimen is more than M-150 and M-250 by 10% and 12.5% respectively.Bending moment capacity M-125 specimen is higher than other M-150 and M-250 specimen.

REFERENCES

[1] A. D. Ariyanayagam and M. Mahendran, “Experimental study of non-load bearing light gauge steel framed walls in fi re,” *J. Constr. Steel Res.*, vol. 145, pp. 529–551, 2018.

[2] B. Chalarca, D. A. Alvarez, and J. Hurtado, “Behavior of precast ferrocement walls under cyclic loading,” no. June, 2015.

[3] C. Paper, A. S. Al-nuaimi, A. W. Hago, and K. S. Al-jabri, “Flexural behaviour of ferrocement roof panels,” no. April, 2006.

[4] I. Journal, O. F. Engineering, F. Behaviour, O. F. Ferrocement, and C. Slab, “International journal of engineering sciences & research technology flexural behaviour of ferrocement composite slab,” vol. 5, no. 10, pp. 726–732, 2016.

[5] I. M. Ahmed and K. D. Tsavdaridis, “The evolution of composite fl ooring systems : applications , testing , modelling and eurocode design approaches,” *J. Constr. Steel Res.*, vol. 155, pp. 286–300, 2019.

[6] M. H. M. B. Varma, “Flexural Behaviour of Ferro Cement Panels with Different Types of Meshes Flexural Behaviour of Ferro Cement Panels with Different Types of Meshes,” no. August 2015, 2019.

[7] P. Balaji and S. A. Selvan, “PERFORMANCE VALUATION OF FERRO CEMENT SANDWICH WALL PANELS WITH DIFFERENT INFILLS,” 2018.

[8] P. Desayi, “Strength of Lightweight Ferrocement in Flexure,” vol. 13, pp. 13–20, 1991.