Behavior and Strength of Concrete Confined by Ferro-Cement Boxes

Rajesh Biradar[1] Prof. Vaijanath Halalli[2]
[1]P.G. Student [2]Associate Professor
[1,2]Department of Civil Engineering
[1,2]P.D.A.C.E Gulbarga-585103

Abstract— The thesis presents the study on behavior and strength of concrete confined by Ferro-cement boxes under compression. A total of 24 prism specimens, which includes 6 plain concrete specimens were prepared and concentrically loaded in compression to failure. Six specimen were reinforced with Ferro-cement boxes. Another six specimens were reinforced with Ferro-cement boxes provided with longitudinal bars and hoop bars. A new set of six specimens were reinforced with longitudinal bars and hoop bars only. Since only core concrete was loaded, the height of Ferro-cement boxes was prepared shorter than core concrete to obtain gaps at both ends of specimens. After testing, the results indicate that Ferro- cement boxes offer significant enhancement in stiffness and strength.

Key words: Ferro-Cement Boxes, Concrete

I. INTRODUCTION

It is a type of thin wall reinforced concrete commonly constructed of hydraulic cement mortar, reinforced with closely spaced layers of continuous and relatively small wire mesh. The mesh may be made of metallic material. Ferro-cement composite consists of cement-sand mortar and single or multi layers of steel wire mesh. Mesh is usually 0.5-1.0mm in thickness.

Experimental and analytical works have been conducted extensively in the past on behavior of concrete confined by various types of lateral reinforcement. The confinement, as provided by the lateral reinforcement, such as hoops or ties, creates a state of multi-axial compression in the core concrete, which applies reactive pressure on concrete. This limits further deterioration of concrete and improves its ability to sustain high stresses and strain. Tests from the literature study have shown that the strength of concrete in compression are improved significantly when properly confined by suitable arrangement of reinforcement.
Ferro-cement is a highly versatile construction material, and possess high-performance characteristic, especially in cracking, tensile strength, ductility, and impact resistance could lead Ferro-cement to become one of an ideal partial substitute for the transverse reinforcement. As its reinforcement uniformly distributed in both longitudinal and transverse directions and closely spaced through the thickness of the section, the confining of core concrete with Ferro-cement will be very effective.

II. OBJECTIVES

- To study the behavior and strength of concrete confined by Ferro-cement boxes under compression.
- To study the variation in the strength of concrete by providing suitable arrangement of reinforcement.
- To increase the life of detonating columns by providing the Ferro-cement jacket.

A. Specimen Details

Specimen Sl. no	Type of specimen	Dimensions in mm	No. of specimens
1	Plain concrete	120x120x300	06
2	Plain concrete confined with Ferro-cement box	120x120x300 and 8mm Ferro cement jacket	06
3	Plain concrete with Ferro cement box and provided with 6mm longitudinal and 2mm hoop bars.	120x120x300 and 8mm Ferro cement jacket	06
4	Plain concrete with 6mm longitudinal bars and 2mm hoop bars.	120x120x300	06

Table 1:

Four number of 6 mm diameter longitudinal bars are to be provided along with 2mm diameter hoop bars for specimen no. 3 and specimen no. 4.After failure of specimen no.4, provide Ferro-cement jacket with mortar and then cured. After curing, the jacketed specimen is tested under compression testing machine. And the strength of specimen no.4 and Ferro-cement jacketed specimen are compared.

B. Results

Series	Specimen details	Load in KN	Compressive strength in N/mm^2	Average compressive strength in N/mm^2
1	Plain concrete	412.0200	28.6125	30.6562
		461.0700	32.0187	
		441.4500	30.6562	
		490.5000	34.0625	
		461.0700	32.0187	
		382.2000	26.5687	

Table 2: showing test results of series1 specimens

Series	Specimen details	Load in KN	Compressive strength in N/mm^2	Average compressive strength in N/mm^2
2	Plain concrete with Ferro-cement box	529.74	36.7875	36.5605
		480.69	33.3812	
		500.31	34.7437	
		568.98	39.5125	
		549.36	38.1500	
		529.74	36.7875	

Table 3: showing test results of series2 specimens

Series	Specimen details	Load in KN	Compressive strength in N/mm^2	Average compressive strength in N/mm^2
3	Plain concrete with Ferro-cement box and provided with 6mm longitudinal and 2mm hoop bars	559.17	38.8312	40.8749
		578.79	40.1937	
		667.08	46.3250	
		618.03	42.9187	
		588.60	40.8750	
		519.93	36.1062	

Table 4: showing test results of series3 specimens

Series	Specimen details	Load in KN	Compressive strength in N/mm^2	Average compressive strength in N/mm^2
4	Plain concrete with 6mm longitudinal and 2mm hoop bars	470.88	32.7100	36.5610
		539.55	37.4700	
		559.17	38.8300	
		441.45	30.6560	
		578.79	40.1940	
		568.98	39.5130	

Table 5: showing test results of series4 specimens

Series	Specimen details	Load in KN	Compressive strength in N/mm^2	Average compressive strength in N/mm^2
4	After failure of 4th series specimens, the specimens are provided with 8mm thick Ferro-cement jacket .	480.6900	33.3810	38.3770
		578.7900	40.1940	
		559.1700	38.8300	
		451.2600	31.3380	
		608.2200	42.2380	
		637.6500	44.2810	

Table 6: showing test results of failed series4 specimens provided Ferro-cement jacket

C. Graphs

Graphs showing the variation in the compressive strength

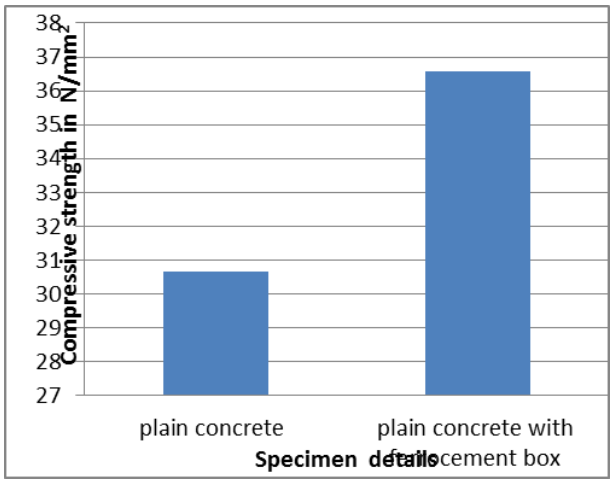

Fig. 1: showing variation in compressive strength between series 1 & 2

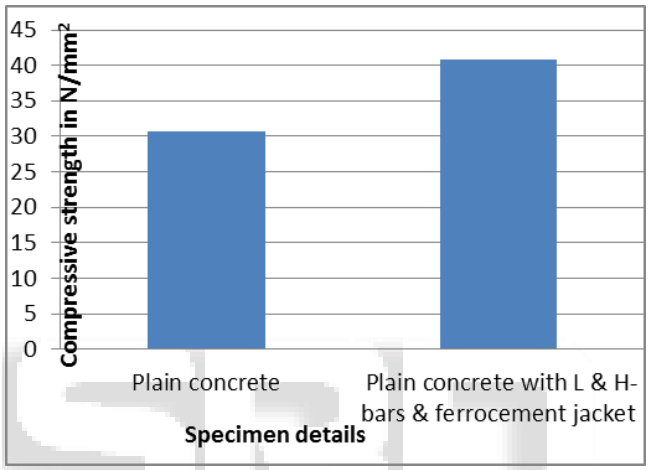

Fig. 2: showing variation in compressive strength between series 1 & 3

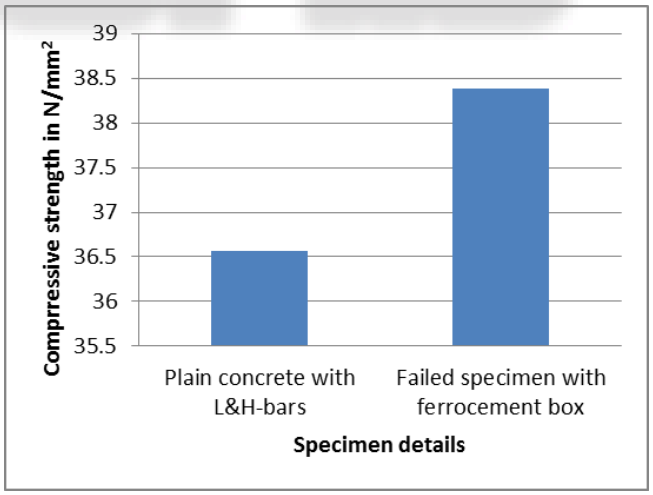

Fig. 3:(c) showing variation in compressive strength between series 4 and failed specimen provided with Ferro-cement box

III. Conclusions

The following conclusion may be drawn from the discussion of the test results presented herein based on the specimens with relatively lower strength of mortar used as matrix for Ferro-cement boxes.

1) The compressive strength of concrete is increased by 19.25% by providing Ferro-cement jacket.

2) The compressive strength of concrete is increased by 33.33% by providing Ferro-cement jacket with longitudinal bars and hoop bars.
3) The compressive strength of failed concrete specimens which is provided with longitudinal and hoop bars is increased by 4.96% after providing Ferro-cement jacket.
4) Hence Ferro-cement jacketing is suitable for increasing the life of deteorated columns.

REFERENCES

[1] A.B.M.A. KAISH,M. JAMIL, ET-AL, "Axial behavior of Ferro-cement confined cylindrical concrete specimens with different sizes", Construction and building materials 78 (2015),page number 50–59.
[2] S.U. KHAN,S.F.A.RAFEEQI , ET-AL," Strengthening of RC beams in flexure using Ferro-cement", IJST transactions of civil engineering, Vol. 37 , page no 353-365.
[3] R.PADMAVATHY, S.DHARMAR , "Study on flexural behavior of flat Ferro-cement panels", International journal of science and research (IJSR paper id: sub155576), page no. 1495-1498.
[4] ABDULLAH & KATSUKI TAKIGUCHI , "An investigation into the behavior and strength of reinforced concrete columns strengthened with Ferro-cement jackets cement & concrete composites", Vol 25 ,page no.233–242.
[5] KUMAR,G.R., "Behaviour of high strength concrete confined with Ferro-cement shell in addition to lateral ties" , Journal of Ferro-cement (31), page no.213-222.
[6] ACI COMMITTEE 549.1979,Guide for the design, construction and repair of Ferro cement (ACI 549IR-93).
[7] S.H. AHMAD AND S.P. SHAH ," Stress -strain curves of concrete confined by spiral reinforcement " , ACI journal 79-46 , page no. 484-490.
[8] NAAMAN, A.E. (2000), "Ferro-cement & laminated cementitious composites"

