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Rehabilitation of Reinforced Concrete Beams by Using Ferro Cement Jacketing

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ABSTRACT: Process of modification of existing structural members to increase their resistance of load is called retrofitting. Two techniques of retrofitting 1. Local (concrete jacketing, steel jacketing, fiber reinforced polymer sheet wrapping) 2. Global (addition of infill walls, addition of shear walls, addition of frames). Various retrofitting techniques are used in field and out of all, jacketing technique is consider as best. In this technique ferrocement are bounded to the surface of structural members to increase its strength. Ferrocement sheet are most commonly used as retrofitting material due to their easy availability, economy.

This paper represents the behaviour and strength of reinforced concrete beams strengthened with ferrocement jackets. A total 15 beams was prepared from that three specimens of beams are control beams remaining 12 beams are destressed at 50% & 60% of ultimate load and retrofitted with single and double layer of Chicken Mesh Jacketing. Study is done on the beam's failure mode.

The result of this test indicates that load carrying capacity of beam is increase after retrofitting.

KEYWORDS – Ferro cement, chicken mesh, Retrofitting, RCC beams, Jacket

I. INTRODUCTION

1.1 General :

Retrofitting is the remodelling of existing buildings to increase their functionality and robustness. For concrete structures that are susceptible to deterioration from several earthquakes, fire, bomb blasting, and chemical attacks, daily retrofitting measures are needed. The world has seen moderate to severe earthquakes on a yearly basis for the past thirty years; these occurrences cause failures and damage to concrete structures. Thus, our goal is to concentrate on a few particular techniques that could increase the vulnerability of existing reinforced concrete structures. For historical sites, earthquake-prone regions, and expensive or tall structures, it is crucial. Modern structural engineering research is focused on reinforcing and repairing ageing structures using new materials.

1.2 Chicken wire mesh: Uses to prevent cracks. Twisting two neighbouring wires at least four times creates a strong honeycomb mesh structure, which is used to create chicken mesh. As a result, it is strong and long-lasting.

1.3 Advantages =

- For plastering, chicken wire is preferable to welded wire mesh.
- The suppleness of chicken wire makes it easy to put it on curved and angled surface.
- Easy cut to your required size.

1.4 Aim: To investigate retrofitting of reinforced beams by using Ferro cement Chicken mesh Jacketing.

Objectives:

- To investigate RC beam repair utilizing Ferro cement jacketing enclosed with chicken mesh.
- To research the strength of reinforced beam.
- Comparison of test result to determine the strength of beam after Ferro cement jacketing.



II. MATERIALS AND METHODOLOGY

2.1 Materials

Cement –

- OPC53 grade (ultratech cement)
- The quality of cement checked through the test like consistency of cement, initial and final setting time of cement.

Fine aggregate –

Natural river sand is used which having specific gravity 2.75.

Coursed aggregate –

Crushed stone aggregate 20mm size used which having specific gravity 2.74.

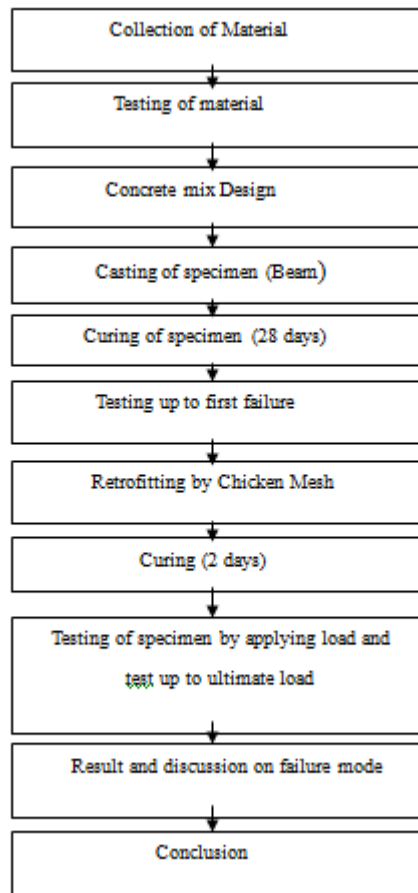
Chicken wire mesh-

- Mesh diameter - 0.78mm
- Roll length – 50mm

Steel reinforcement –

- HYSD bar of 4NOs of 8mm diameter used as main reinforcement.
- 2NOs of 6mm diameter used as stirrups.

III. METHODOLOGY



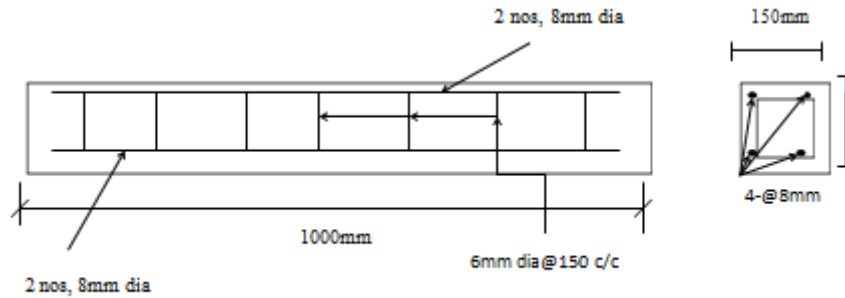


Figure1. Steel Reinforcement

2.2 Mix Proportion-

Table 1: design mix proportion (M20)

Description	Cement	FA	CA	Water
Quantity of material (kg/m ³)	438.18	599.388	1080.03	213.18
mix proportion by weight	1	1.37	2.47	0.45

2.3 casting schedule

Table: 2 Casting Schedules

Specimen (mm)	Distressing (%)	Control specimen	With jacketing	
			One	Two
Cube (150 x 150 x 150)	-	09	-	-
Beam (150x230x1200)	-	03	-	-
	50	-	3	3
	60	-	3	3
	Total specimen		24	



Fig 2. Casting of Specimen

2.4 Pre – retrofitting technique:

All other beams, with the exception of control beams C1, C2, and C3, which are loaded monotonically, are preloaded to a maximum of 50% and 60%, respectively, until the first crack does not appear. The item is visually inspected and any cracks are noted while it is being loaded. The specimen is subsequently unloaded, and a chicken mesh jacketing refit is applied.

2.5 Process of Retrofitting:

The deteriorated beams were retrofitted with Ferro cement jacketing after the initial stage of loading. Another type of ferroconcrete is Ferro cement, which is made by reinforcing cement sand mortar with a chicken wire mesh that is closely spaced. Using a hacker, the distressed beam's surface was made rougher, and wire mesh was then woven around it. Wire ties were used to tighten the mesh. As a bonding agent, a thick cement paste was used. On the surface of the beam, 20 mm of mortar was poured. The modified beams were cured in a curing tank for two days.

“The Constructrait material testing and services LLP's” Laboratory loads the beams for testing. Every specimen is subjected to the same testing process. The beams are first allowed to cure for 28 days, after which their surface is polished with sandpaper to make cracks more visible. Beams were tested using a single point loading configuration. One by one, each beam underwent testing. The aforementioned setup is used to test each of them. Throughout the test, readings of the dial gauge's deformation and the load's progressive increase are taken. The distortion is seen in the dial gauge reading. Records are kept of the load at which reading is reversed.

The deflection load points for the beams with and without chicken mesh jacketing are noted in relation to the calculated increase in load.



Figure3. Process of Retrofitting



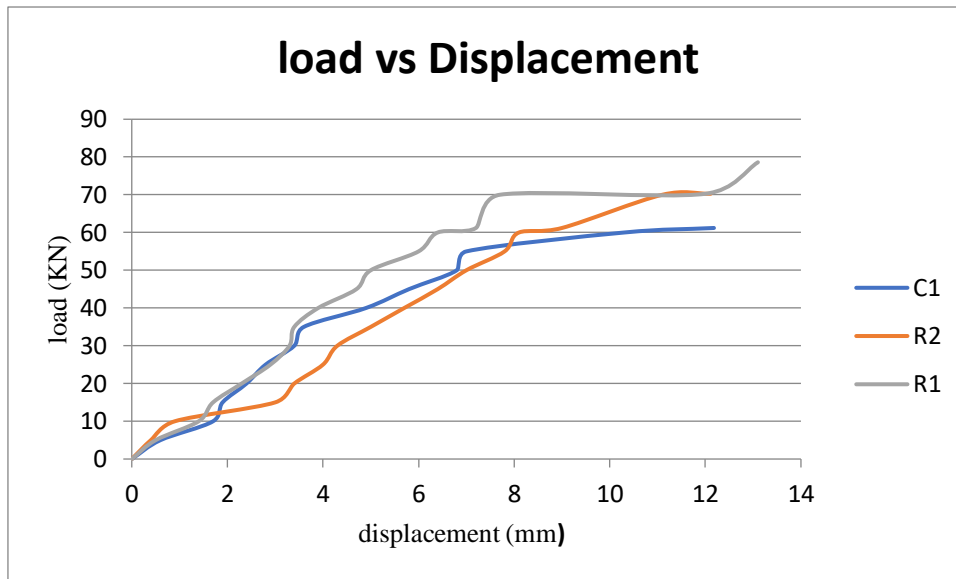
IV. RESULTS AND DISCUSSION

Table 3.Ultimate Load And Displacement Of Beams

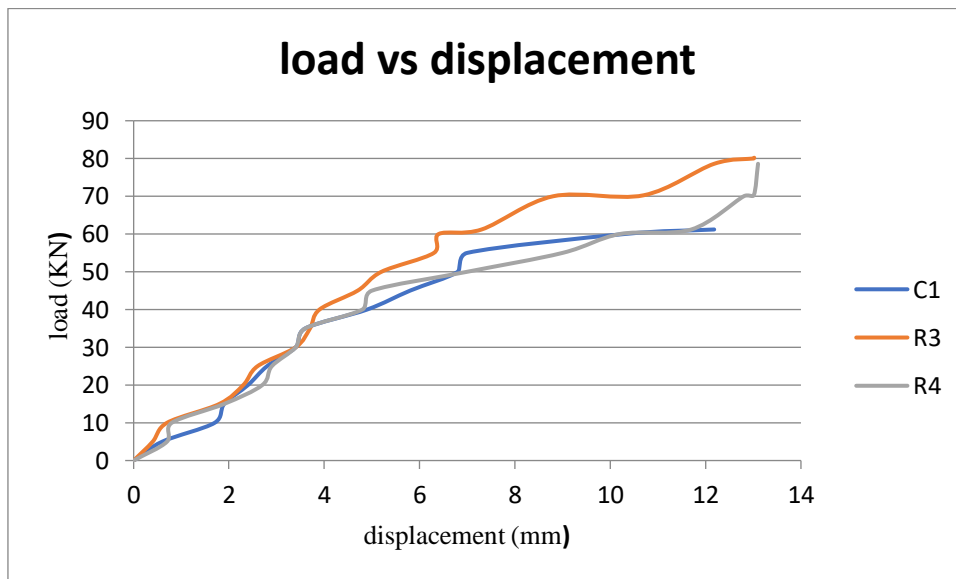
Type of beam	Beam designation	First crack load (KN)	Ultimate load (KN)	Displacement (mm)
Controlled beam	C1	24.26	61.20	12.18
	C2	23.75	63.70	14.26
	C3	23.00	65.40	14.20
Beam distressed up to 50% ultimate load and wrapped with single layer chicken mesh	R1	29.36	79.75	13.1
	S1	30.60	79.89	14.13
	T1	29.40	80.04	13.02
Beam distressed up to 60% ultimate load and wrapped with single layer chicken mesh	R2	29.10	70.26	12.11
	S2	29.46	71.18	12.30
	T2	30.00	70.71	13.11
Beam distressed up to 50% ultimate load and wrapped with double layer chicken mesh	R3	30.35	80.21	13.02
	S3	31.20	81.26	13.12
	T3	31.35	79.45	13.10
Beam distressed up to 60% ultimate load and wrapped with double layer chicken mesh	R4	29.10	78.60	13.10
	S4	28.15	78.40	12.12
	T4	30.20	77.30	12.18

4.2 Discussion:

R1, R2 beams were refitted with a single layer of chicken mesh after being 50% and 60% distressed, respectively. Under a single point load, control beams were loaded. At a load of 23 KN, the first crack was seen. At a load of 65.40 KN and displacement of 14.20 mm, the controlled beam failed. The ultimate load



Graph 1. load vs Displacement curve for beam C1, Retrofitted beam R1, R2 wrapped with single layer



Graph 2. load vs Displacement curve for beam C1, Retrofitted beam R3, R4 wrapped with Double layer

measured by retrofitting beams R1 and R2 is 79.75 KN and 70.26 KN, respectively, and the first crack is 29.36 KN, 29.10 KN. We noted that the beam's maximum load carrying capacity has increased. R3, R4 beams were refitted with a double layer of chicken mesh after being 50% and 60% KN. The ultimate load measured by retrofitting beams R3 and R4 is 80.21 KN and 78.60KN, respectively, and the first crack is 30.35 KN, 29.10 KN. We noted that the beam's maximum load carrying capacity has increased.

V. CONCLUSION

1. According to test results, comparable reinforced concrete beam repaired with the same jackets and preloaded up to 50% and 60% of their ultimate load carrying capacities exhibited a 25% and 11% improvement in load bearing capacity, respectively, above control beams.
2. The load-bearing capability of a given structure is increased by jacketing it with chicken wire mesh.
3. Ferro cement jacketing can be retrofitted to various structural materials to reinforce them since it gives the beam an acceptable amount of strength.
4. The present RC structure's strength can be increased.



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