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Retrofitting Of RC Beam by Using Phenolics & Ferro Cement

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Abstract: Reinforced concrete components are formed to exhibit distress and get detoriated due to various factors and hence need strengthening. Ferro cement are most commonly used as retrofitting material due to their easy availability durability and their property of being cast to any shape without needing significant formwork. In this investigation we examined the performance of R.C. beam strengthened by Ferro cement, 15 beams of rectangular cross section were casted using m20 grade concrete and were tested for collapse load. Further beams were stressed up to 70%, 80% & 90% respectively. This investigation shows that up to 80% the pre-damaged beams can be strengthened using Ferro cement.

Keywords: **Ferro cement, phenolic resin, pre-damaged beams.**

I. INTRODUCTION

Concrete structures are normally designed to last long some of them do a great length of time, but some of them became unusable and are in need of restoration or repair. The result is that the number of structures needing rehabilitation has gone up sharply in recent times.

Various techniques like; plate bonding technique, concrete replacement and injection technique are used for retrofit these structures. But, Ferro cement technique is commonly used for retrofitting due to its lightness and development of finer cracks for the same steel-stress under loading.

In some studies it was found that Ferro cement technique impr33oves the mechanical properties of concrete and can also used as jacket in reinforced concrete columns. All these studies showed that Ferro cement technique provide strengthen and crack resistance concrete which is better than other concrete construction.

II. LITERATURE REVIEW

P. Paramasivamet al. (1997) [9] conducted experiments on repair and strengthening of reinforced concrete beams using ferro cement laminates attached onto the surfaces of the beams are reviewed. Investigation into the transfer of forces across the Centre ferrocement interface, the effects of the level of damage sustained by the original beams prior to repair and the results of repeated loading on the performance of the strengthened beams are discussed. The results show that Ferro cement is a viable alternative strengthening components for the rehabilitation of reinforced concrete structures.

Nassif. H. et al. **(1998) [8]** conducted experimental study on flexural behavior of an Ferro cement or concrete composite beams made of reinforced concrete over laid on a thin section of Ferro cement. The meshes were tested under two point loading system and results from the tests were compared to those from a reinforced concrete beam. The load – deflection relationship was plotted. It has been concluded that addition of a thin layer of Ferro cement to a concrete beams reinforced with square mesh exhibited better results than hexagonal mesh, increases as the number of mesh layer increase.

Conclusion:

The performance of ferrocement is completely dependent on the characteristics of the reinforcing mesh, if the mesh layer increases the strength increases and vice versa. Also conclude that ferrocement can be used as an alternative strengthening material for the reinforced concrete beams damaged.

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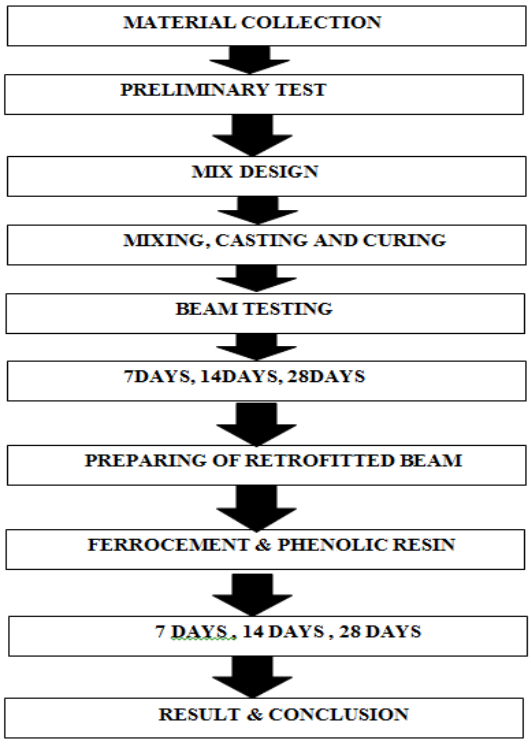
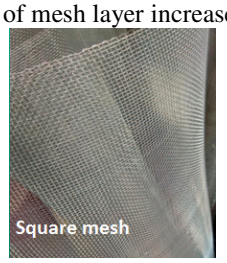
III. METHODOLOGY



1. Material collection

Phenolic resin: Phenol formaldehyde resins (PF) or phenolic resins are synthetic polymers obtained by the reaction of phenol or substituted phenol with formaldehyde. They were at one time the primary material used for the production of circuit boards but have been largely replaced with epoxy resin and fiberglass cloth, as with fire resistant & it is used as bonding agent.

Square mesh: Ferro cement to a concrete beams reinforced with square mesh exhibited better results than hexagonal mesh, increases as the number of mesh layer increase.



2. Preliminary Test on Materials

2.1 Cement

Ordinary Portland Cement(OPC) of 53 grade having specific gravity of 3.06 is used.

2.2 Fine aggregate

River sand belongs to Zone II having specific gravity of 2.61 is used.

2.3 Coarse aggregate

Crushed angular aggregate of size 20mm having specific gravity of 2.75 is used.

2.4 Water

Locally available potable water is used.

3. Mix Design and Batching

We designed a mix for M20 grade concrete for the following data.

a. Grade designation : M20
b. Type of cement : OPC 53 grade
c. Maximum nominal size of aggregate: 20mm
d. Minimum cement content : 320 kg/m^3
e. Maximum water-cement ratio : 0.50
f. Workability (Slump) : 100mm
g. Exposure condition : Mild
h. Method of placing : Manual
i. Degree of supervision : Good
j. Type of aggregate : Crushed angular aggregate
k. Maximum cement content : 450 kg/m^3

4. Mixing, Casting and Curing

4.1 Mixing

The mixing involves, mixing of raw material in concrete with mix proportion (M20) has to be prepared. The specimens are normal & retrofitted used for comparison purpose.

4.2 Casting

The casting involves, casting of beam of size 700mmx230mmx230mm.

4.3 Curing

Curing begins immediately after placement and finishing so that the concrete may develop the desired strength and durability. Curing processed done by gunny bags.

Fig.2 casting & curing of beam

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5. Beam Testing

5.1 Flexural Strength Test

A total of 9 beams were tested for flexural Strength including normal beam & retrofitted beam specimen. Flexural strength of 7 days, 14 days and 28 days curing were tested.

5.1.1 Flexural strength of the beam before retrofitting:

TEST	100%	90%	85%	80%	70%
7 DAYS	272KN	245KN	230KN	215KN	190KN
14 DAYS	356KN	320KN	305KN	285KN	250KN
28 DAYS	415KN	375KN	350KN	330KN	290KN

Table.1 flexural strength of beam before retrofitting

5.1.2 graphical representation of before retrofitting

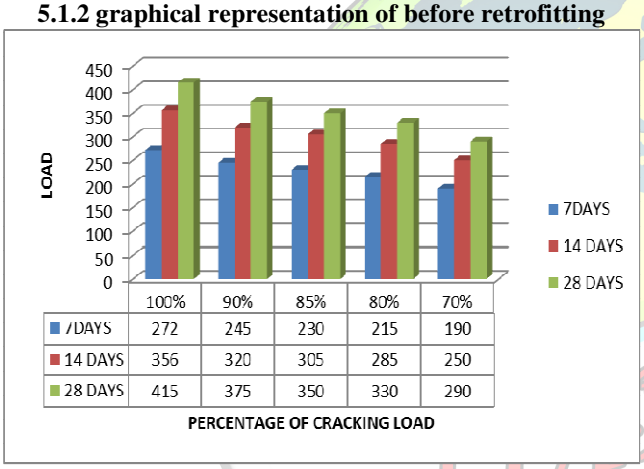

Fig.3 graphical representation of the beam before retrofitting

Fig.4 flexural strength of beam before retrofitting

6. Preparing of retrofitted beam

Fig.5 preparing of retrofitting beam

After that, normal RC beam were tested, the prepared retrofitted beam is to be conducted for testing (7 days, 14 days & 28 days).

6.1 Flexural strength of beam after retrofitting

TEST	70%	80%	85%	90%	100%
7 DAYS	180KN	150KN	148KN	142KN	140KN
14 DAYS	310KN	300KN	295KN	265KN	250KN
28 DAYS	385KN	380KN	370KN	365KN	360KN

Table.2 flexural strength of beam after retrofitted

6.2 Graphical representation of retrofitted beam

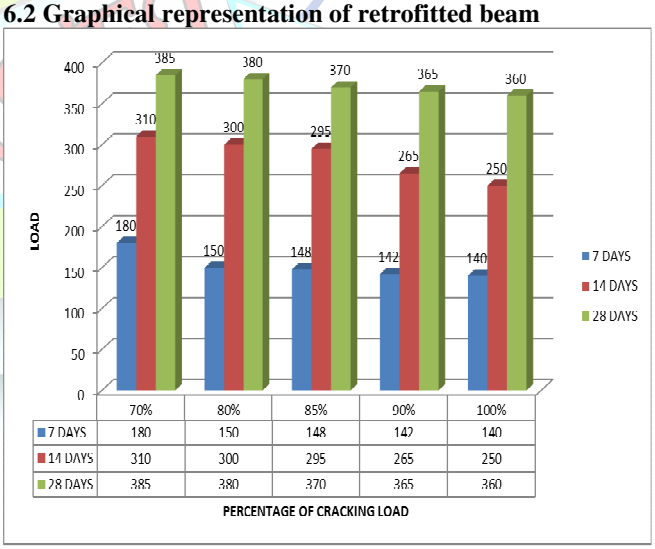

Fig.6 graphical representation of after retrofitted beam

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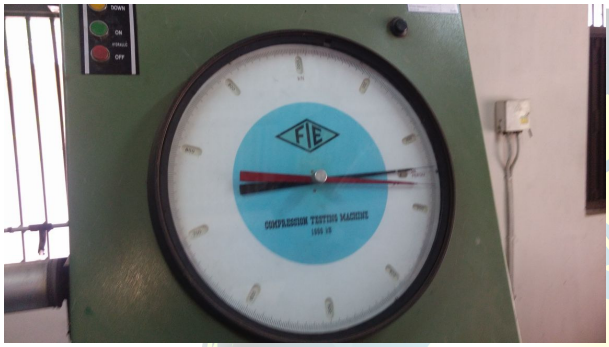

Fig .7 flexural strength test of retrofitted beam

7. Results & comparison

7.1 Comparison table of flexural strength:

MAXIMUM LOAD						
TEST	7 DAYS TEST		14 DAYS TEST		28 DAYS TEST	
	Beam test	Retrofitting test	Beam test	Retrofitting test	Beam test	Retrofitting test
100%	272KN	140KN	356 KN	250 KN	415 KN	360 KN
90%	245KN	142KN	320 KN	285 KN	375 KN	365 KN
85%	230KN	148KN	305 KN	295 KN	350 KN	370 KN
80%	215KN	150KN	285 KN	300 KN	330 KN	380 KN
70%	190KN	180KN	250 KN	310 KN	290 KN	385 KN

Table.3 comparison table of flexural strength

CHART 7.1.1: 7 Days comparison:

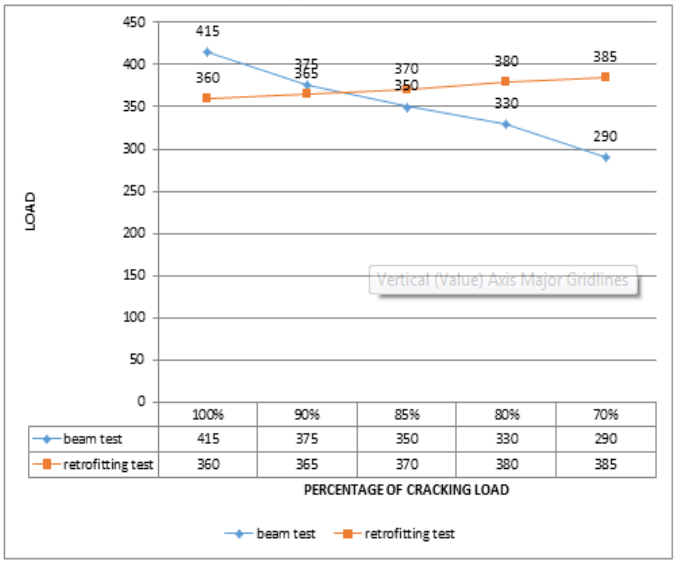

Fig.8 7 days test comparison

CHART 7.1.2: 14 Days comparison:

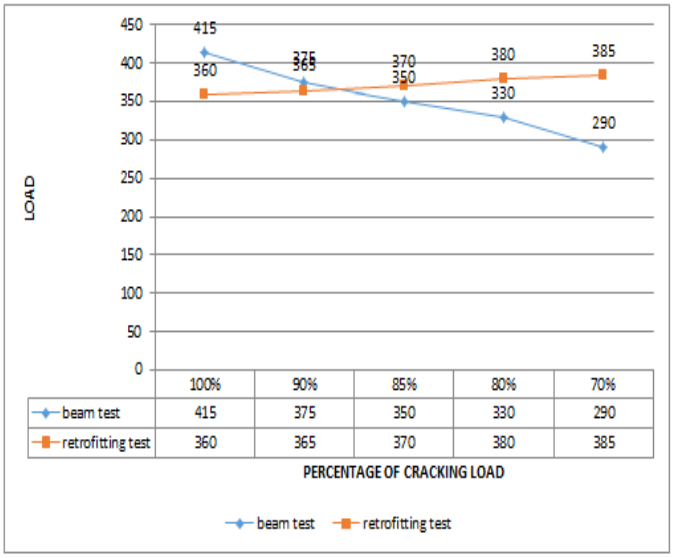

Fig.9 14 days test comparison

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CHART 7.1.3: 28 Days comparison:

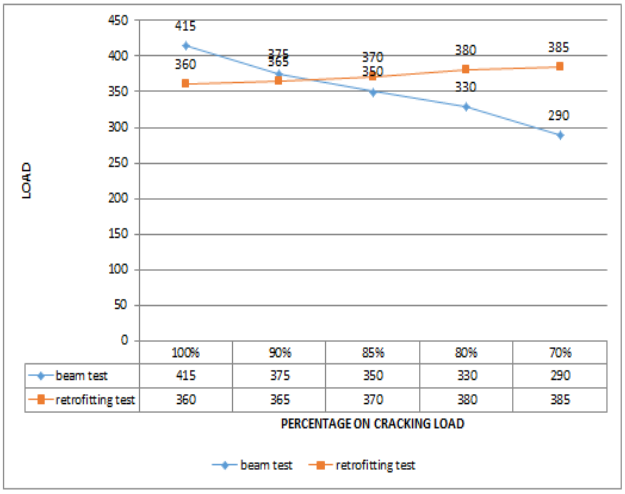

Fig.10 28 days test comparison

IV. CONCLUSION

From the experimental investigation the following results were obtained.

The strengthened beam gives higher strength when compared to the conventional concrete beam. The flexural strength of preloaded beams are higher (>70%, >80%, >85%, >90%).

Hence the existing damaged beams can be strengthened upto 83% of failure or collapse using ferrocement & phenolic resin.

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