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SUGGESTIVE USING OF FERROCEMENT JACKETS IN RETROFITTING OF EXTERIOR RC BEAM-COLUMN JOINT

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ABSTRACT

In Moment-resistant reinforced concrete (RC) structure, subjected to seismic loads the BC-connections are recognized as one of the most vulnerable zones. Considering this vulnerability action and poor performance of beam-to-column at the joints the technique of retrofitting has been adopted. For enhancement of performance these joints by have been lined with a variety of materials such as concrete, steel, FRP, and iron cement. In the present study, the strength behavior of RCC beam-to-column external connections, initially loaded with a preset percentage of failure load and retrofitted with Ferro cement facings using two different encapsulation schemes, was investigated and presented. In the RS-I retrofit scheme, an L-shaped wire mesh is provided at the topside and bottom side of the beam-to-strut joint, while in the RS-II scheme, a wire mesh is also provided along with an L- shaped wire mesh L at the upper side and lowermost side. Always oblique to the board. Modified beam-to-column connections results were equaled to those of the controlled connection samples. The results showcased an augmentation in ultimate load and yield strength of for the reprocessed specimens. However, no enhancement in ductility was observed.

***KEYWORDS**: Jackets, Rc Beam, Column, Joint, Ferrocement*

INTRODUCTION

Concrete, as it is well recognized, is diverse in nature, stiff in behavior, with little tensile strength in comparison with its compressive strength. The utilization of steel reinforcement paves a way for upgradation of low tensile strength of concrete but not the cracks, which are tinny and not visible enough , although the dissemination of such cracks can be deferred by reinforcing steel. Countless efforts have been made to get clearance from such inadequacies of concrete by evolving two -

phase compound materials, wherein the one phase enhances the elementary properties of the additional phase and each phase is used to its best. Thousands of reinforced concrete structures deteriorate before reaching their design life. This is primarily accredited to changes in loading conditions, codal provisions, inappropriate design, defective construction, etc. Such structures demand instantaneous attention, investigation of cause of distress and proper corrective measures, so as to head back the structures to their functionality. Most vulnerable members of a Reinforced Concrete (RC) moment repelling structure are Beam-column joints which are exposed to seismic loading. When a volcanic activity occurs at a place, the comprehensive response that a structure will give is directed exclusively by the performance of these joints. This seismic activity force action in BCJ produce shear in connection. The moments, shear forces on the member terminals on respective sides of the joint staple are produced by shear stresses. Great bond stresses also have a colossal effect on the bars in joint as when bars come from beam and column the arrive into a joint. When a column is loaded axially, axial compression is produced and mutual shear stress concludes into stresses of primary tension and compression which is merely responsible for creating fissures in the transverse direction or it may crush the concrete in respective joint. For cumulative seismic commotion of structural RC-BC connection researchers have worked day and night in this field which finally resulted in utilization of materials like Fiber - Reinforced Polymers and ferrocement. These materials are utilized in retrofitting of structures and act as a peripheral shield. These materials frequently restrain the zone of the joint area, which leads to augmentation of the yield capacity, introductory stiffness and the energy overindulgence capacity considerably. Ferrocement is a substitute repairing material that has amended its effectiveness in the construction field as it is presently used to reinforce RC-structures due to its ease of application and lower cost. The resistance and axial stiffness of damaged or pre- stressed columns can easily be improved using this technique. Investigations on the effectiveness of ferrocement were carried out in the literature, so in the case of the connections of horizontal members and vertical members it was observed that no detachments were observed in the prepared reinforced concrete. Beam -to-Column connections. When equated, the upsurge in the load bearing capacity of the modified RC connections with respect to the control RC sample was observed.

OBJECTIVE

Objectives of the present study program are described as under:

1. To note down the load bearing capability of control sample and retrofitted sample of retrofitted beam-column joints.

2. Analyzing the strength performance of RCC peripheral B-C joints, which were loaded to a prefixed fraction of the critical load at the start, and then retrofitted by ferro cement jacketing via two diverse schemes of wrapping.

3. Determining the effect of adopted wrapping techniques on ultimate load capacity and ductility ratio by providing RS-I, wire mesh in L profile on the upper side and bottom side of the BC-connection and in L profile at the topmost side and lower sideinclusive of wire mesh diagonally to the joint.

4.To note down the cracking patterns in control and retrofitted specimens.

5. Comparing results of retrofitted beam-column joints with those of the controlled joint.

2. Literature Review

2.1 Shannag(2016) first made innumerable mixtures of silica fume and fly ash which ended up into development of high strength mortar with flow-able properties. It was also concluded in order to repair the structures ferrocement can be quite effective.

Chalioris (2015) in his study program utilized self-compacting concrete jackets with a view to provide strength improvement to beams which were planned to have shear failure. With a suitable anchorage, the members which were updated influence the different parameters i.e; strength, ductility, distortion capacity. It is quite evident from results of experiments that Ferro-cement helps in advancing seismic enactment of BC-joint in standings of parameters like extreme horizontal load, dissipation of energy , stiffness and mutual shear strength. The shear alterations that usually occurin center of the connection are shortened for the specimens the are strengthened.

2.2 Dwivedi (2012) retrofitted the beams with ferrocement jackets and then studiedits effects on it. After observing he concluded that there was a substantial increase insafe load carrying capacity of R.C.C joints. In such situations use of ferrocement is vital as its utilization is quite flexible and can pave us a way in retrofitting techniquefor structural upgradation.

2.3 Xiong (2011) studied about the concrete columns which were rounded in crosssection inhibited by ferrocement along with steel rods (FS), with a view to enhance the compressive strength accompanied by ductility. It was concluded that when hard cement of iron was cased jointly with steel bars, the samples showed amplification in ductility, compressive strength and absorption capacity of energy than the rounded columns which were reinforced with BS or FRP.

2.4 Karayannis (2011) took reinforced concrete jackets to observe its aftermaths of retrofitting RC external BC Joints . Cyclical loading was done to BC- connections and then they were retrofitted with jacketing and then were retested again for the analogous loading arrangement. It was concluded there was a complete restoration of seismic performance of the specimens that were retrofitted and some cases were noted to have better-superiority to performance of the equivalent specimens whencomparisons were done in the preliminary stages of loading condition, since the loadcapacity and energy dissipation displayed superior values.

2.5 Nassif (2006) made a statement that for augmentation of ductility and cracking strength of a

beam can be accomplished by the addition of thin layers of ferrocement. As the number of coatings is also merely responsible for the boosting the stiffness of cracking on the compound horizontal members.

2.6 Karthika (2003) investigated about the enhancement of columns by utilization of Ferrocement. In his experimental observations it was noted that the ultimate concrete compressive strengths and failure tensions can get enhanced by the confined concretesamples. The columns that are retrofitted showcased better performance in deflection reduction and augmented the moment carrying capacity.

2. METHODOLOGY

2.1 Materials Used

2.1.1 Cement:

43 grade OPC in compliance to IS: 8112 has been utilized. The SG of cement was foundto be 3.145.The 7 day compressive strengths of standard casted cube was recorded as 35.61 MPa and after 28days C.S was recorded as 45.51 MPa.

2.1.2 Fine Aggregates

Naturally obtainable sand with in compliance to zone -III was utilized as fine aggregate. Fineness modulus was recorded as 2.08 and the specific gravity was recorded as 2.55

2.1.3 Coarse Aggregates

2.1.4

The specific gravity of coarse aggregates has been recorded as 2.66.The granular size aggregates with a size of 20 mm have been utilized for the design of mix for the beam-column connection.

2.1.5 Concrete mixture

2.1.6

A grade of M20 concrete has been designed as per design procedure specified by the IS code. The material utilized in this mixture with their observed properties are mentioned above, The w/c ratio has been recorded as 0.49, however ratio 1: 1.47: 2.95(cement: sand: C.A) has been utilized . The 150 mm cubes have been prepared for the designed mix M20,and their 7 days and 28days Compressive strength has been recorded after curing it properly .The 7days and 28days was recorded as 21.52 MPa & 29.04MPa, respectively.

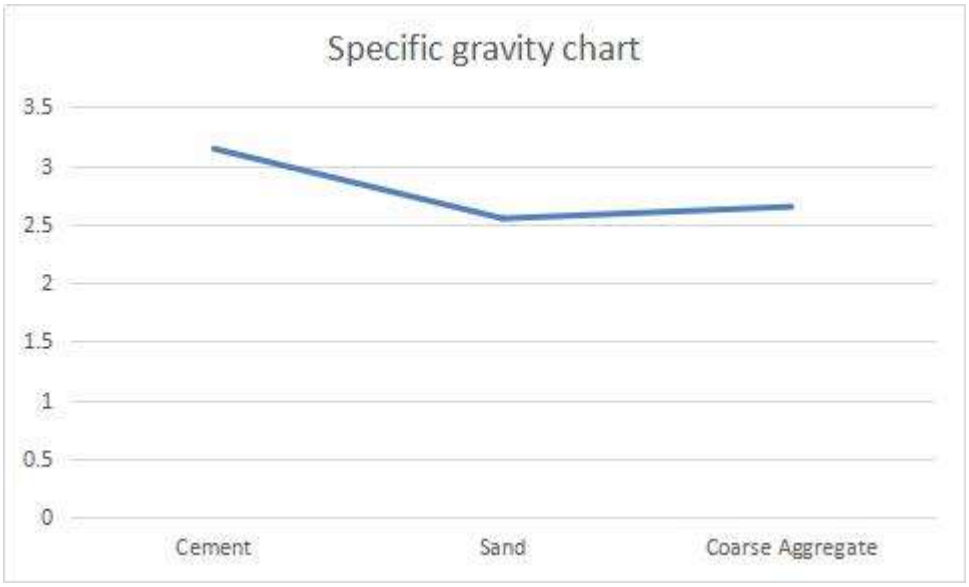

Fig 2: Specific gravity chart for cement, sand and coarse aggregate

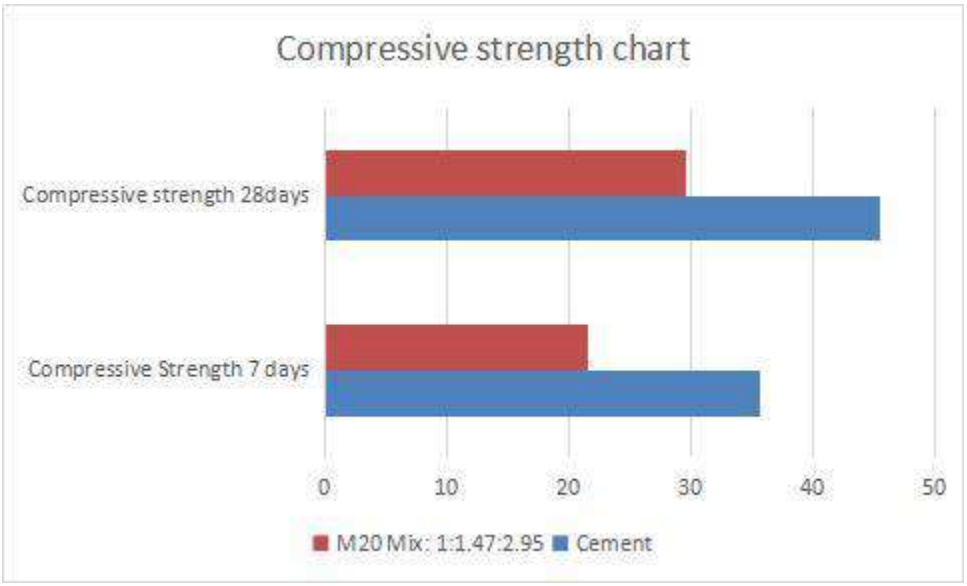

Fig 3: 7days& 28days compressive strength chart of cement and M20 concrete

3.1.5. Reinforcing steel and wire mesh

Below table presents the provisions of the bars and steel wire mesh which has beenutilized

in RS- jacketing by utilizing ferrocement.

Table1: Specifications of steel bars and steel wire mesh used

S. No.	Bar dia/ mesh wire	Grade of Steel	Yield Strength (N/mm2)	Critical Strength (N/mm2)	Elongation at failure (%)
i	10mm	Fe415	445.54	509.21	15.51
ii	8mm	Fe415	559.51	634.14	20.31
iii	6mm	Fe250	442.41	612.69	32.89
iv	2.4mm	Fe250	400.01	511.27	2.53

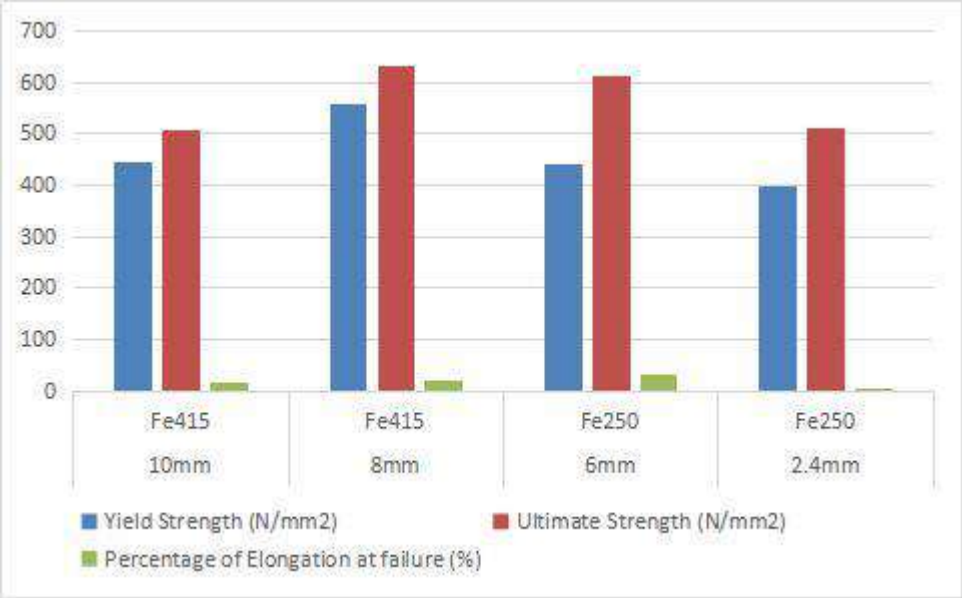

Fig 4: Yield strength, ultimate strength&% elongation of failure of wire meshand different grades of steel

CONCLUSIONS

- The load-bearing capacity of RS for B-C connections fo r RS1 & RS2 techniques issignificantly amplified in

association to the control B-C connection.

- Specimens with diagonally wound wire mesh show the greatest improvement in theirbreaking strength

- There is also an increased performance load with both types of processing; however, the increase in yield strength is more pronounced for diagonally wound wire mesh specimens.

- The ductility ratio of the modified sample is lower than that of the control samples and also it is worth mentioning that the D.R of those samples where diagonal wire mesh is wound is lesser than those samples where the wire mesh is wound only in L-shape

FUTURE SCOPE

The ferro-cement retrofit technique is an important technique is usually consider when reinforcing RC parts or in the construction phase itself. There are many RC buildings in India that are in verge of losing their strength due to many factors such as aging of building, corrosion of materials, building alterations due to improper design. There are also unexpected environmental factors such as natural disasters and earthquakes hitting aplace and the Indian government should take this into account and consider the early adoption of such techniques.

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