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Retrofication of RC Structures Using Super Thermo Poly (STP) Sheets

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A B S T R A C T

Retrofitting is that the amendment of current systems to lead them to extra evidence in opposition to seismic activity, floor movement etc. Many of the prevailing reinforced concrete structures throughout the globe are in urgent need of rehabilitation, repair or reconstruction because of deterioration thanks to various factors like corrosion, failure of bonding between beam-column joints etc. Super thermo polymers (STP) has been accepted within the industry as a promising substitute for repairing and in incrementing the strength of RCC structures. This work presents the experimental study on strengthening of RC beam with Super thermo polymers (STP). Totally 6 RC beam specimens were casted & tested in this work. The beam dimensions considered for this study are 700 x 150 x 150 mm. Beams are tested at a interval of 7, 14, 28 days of curing. The reinforced beams were retrofitted with single layer of U- shape & fully wrapped by STP sheets on full length of the beam. The beam specimens were tested under two point loading and therefore the load-deflection behavior was observed up to failure. Also the most load, the stress strain behavior and therefore the complete crack patterns were recorded and presented.

Keywords: Floor Movement, Detorioration, Super Thermo Polymers, U-Shape, Fully wrapped.

1. Introduction

In the earlier it had been thought that concrete are going to be maintenance free Structure. Later on, this myth has proved wrong. Thanks to majority of technology structures being RCC and on account of its requirement of maintenance, quantum of such rehabilitation/strengthening work has also increased tremendously. Constant maintenance and repairing is required to reinforce the lifecycle of these structures which are deteriorated. Retrofitting of concrete element is traditionally accomplished by externally bonding steel plates to concrete. Although this system has proved to be effective in increasing strength and stiffness of concrete elements, it's the disadvantages of being vulnerable to corrosion and difficult to put in. within the last decade, the event of strong synthetic resin has led to a way which has great potential within the field of upgrading structures. Basically the technique involves gluing steelplates or Super Thermo Polymer (STP) sheets to the surface of the concrete. The sheets then act compositely with the concrete and help to hold the masses. Also recent development within the field of composite materials, along with their inherent properties, which include high specific strength good fatigue and corrosion resistance and simple use, make them a pretty alternative to the other retrofitting technique within the field of repair and strengthening of concrete elements.

1.1. Super Thermo Polymers

Super Thermo Polymer (STP) composite is defined as a polymer (plastic) matrix, either thermosetting or thermoplastic, that is reinforced (combined) with a reinforcing material with asufficient aspect ratio (length to thickness) to provide adiscernable reinforcing function in one or more directions.The installation iseasier and temporary support until the adhesive gains its strength is not required due to the low weight. They can beformed on site into complicated shapes and can also be easily cut to length on site.STP sheets possess some outstanding properties such as: resistance to corrosion, good fatigue and damping resistance, high strength to weight ratio, higher impact strength, resist stress cracking, easy fabricated, low moisture absorption, good electrical properties, good elongation, ability to present heat moderate and ability to resist against acids. STP has found an increasing number of applications in construction either as internal or as external reinforcement for concrete structures. Civil structures product of steel ferro concrete are

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normally at risk of environmental attacks that end in the initiation of an electrochemical process which finally ends up within the corrosion of steel reinforcement.

Beams are the critical members subjected to bending, torsion and shear in all type of structures. Similarly, columns are also used as various important elements subjected to axial load combined with/without bending and are used in alltype of structures. Therefore, extensive research works are being administrated throughout world on retrofitting ofconcrete beams and columns with externally wrapped by STP composites. Thus concrete beams retrofitted with Super Thermo Polymer (STP) composites so as to check the enhancement of strength and ductility, durability, effect of confinement, preparation of design guidelines and experimental investigations of those members. The thing of retrofitting of a beam in earthquake resistant frame is that, it must not deform excessively. A beam is subjected to excessive flexural stresses and shear stresses when either member reaches it's over strength capacity related to the hardened plastic hinges. The objective of the STP wrapping is to enhance the flexural strength and stiffness of deficient beams thanks to various causes. Beams are the most structural elements must be rehabilitated as and when fracture or fault is noticed.

1.2. Materials Used

Cement is that the binding material within the cement concrete. this can be employed in many engineering works where strength and sturdiness are the prime importance. Cement used for this study is that the Portland Pozzolona Cement conforming to IS 1489-1991. Sand consists of small granular or rounded particles of silica. Sand is typically used as fine aggregate in concrete mix. Both natural and artificial sand is employed for this purpose. during this the Natural river sandpassing 4.75mm IS sieve was used as fine aggregate. The properties of sand were determined by conducting tests as per IS 2386. Normal coarse aggregate of size 20mm is employed for this project. The properties of aggregate were determined by conducting test as per IS: 2386. STP may be a 100% synthetic textile fiber. it's formed by about 85% propylene.The monomer of poly propylene. Propylene is bi-product of petroleum. it's used because the after natives of plastic. Super Thermo Polymer composite has been accepted within the industry as a promising substitute for repairing and increasing the strength of RCC structures.

1.3. Engineering Properties of Materials Used

Table 1 – Physical Properties of Materials.

Material	Engineering Properties	Results
Cement	Specific Gravity	3.13
	Fineness	6%
	Normal Consistency	33%
	Initial Setting Time	25 mins
	Final Setting TIme	582 mins
Fine Aggregate	Sieve Analysis	Zone II
	Sprcific Gravity	2.55
	Fineness Modulus	6.5%
Coarse Aggregate	Flakiness Index	6.8%
	Elongation Index	12.3%
	Specific Gravity	2.63
	Water Absorption	4.5%
	Impact Value	8.65%
	Crushing Value	7.8%
Super Thermo Polymer	Density	0.94 gm/cc
	Elongation at Break	18%
	Elasticity	Good
	Moisture Region	Nil
	Colour	Black
	Ability to Protect Heat	Moderate
	Melting Point	310 ^{0}C

2. Experimental Procedure

The moulds were prepared using steel plates. The sizes of all the specimens were identical. the scale of the specimen were 700 x 150 x 150mm. The look mix ratio was adopted for designing the beam. The beams were casted and demouldedafter in some unspecified time in the future and are allowed curing in water. They were tested on 7days, 14 days, and 28 days. The most objective of the investigation was tostudy the flexural behavior of control RC beams and retrofitted RC beams. Retrofitting is completed with single layer U-wrapping and full wrapping of STP sheets composite bonded onto the full length of the beam. Initially twelve numbers of beams were casted there in for 7 days four number of beams were casted and 2no's of beams Full-wrapped and 2no's of beams were U-wrapped & the identical procedure were followed for other eight beams also. Beams the dimensions are 700 x 150 x 150mm were casted and tested under two point load. The combo proportion of M25 gradeconcrete is cement: fine aggregate: coarse aggreate, 1:1:2 the specified quantity of materials were calculated and the concrete was mixed by hand mixed. Beams were cured for 7days, 14days, & 28days then taken out for testing. The beams after cured for required days they were took from the curing tank and dried for 3 hours and that they were washed for clear visible and also the dimensions were marked on the beams for 2 point loading and therefore the beams are tested in CTM machine. After testing the beams the cracks were repaired by using cement paste. Then the beams were cleaned using water, to reinforce the perfect bonding of composite on the beams then the caoutchouc adhesive is applied on the surface of beams. STP sheet was then placed on top of adhesive coating and also the weight was kept on top of the wrapped place for 3days.Then the retrofitted beams were again tested in CTM machine. All beams were tested under two point loads. Each beam was placed on the CTM machine in such way that, the centre of the beam and therefore the centre of the CTM machine were adjusted and aligned as a line. The effective span of the beam was 700mm; the load was distributed uniformly by means of steel roller placed on the beam along the effective span of the beam, above the roller soft-cast steel I section was placed for the distribution of load equally onthe rollers. One hydraulic jack was accustomed apply load. The load was distributed to the beam through the I-section which resulted in two point loads being applied to the specimen. The cracks patterns were observed and marked by using marker; the initial crack load and elongation of the beams were noted down. After failure the load was released slowly and also the beam comes to normal position for a few extents. The pictures of eachspecimen were taken and presented.

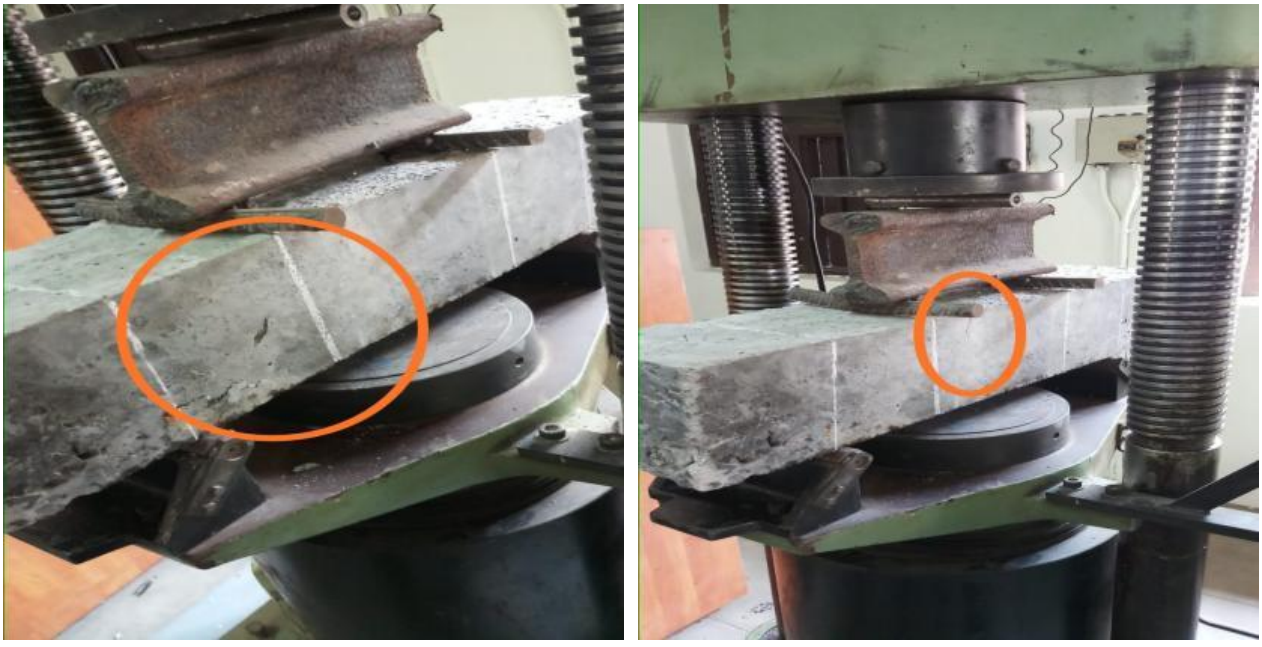

Fig. 1 - Showing the formation of cracks after testing of loads

After first crack the retrofitting process were adopted. i.e., the STP sheets were wrapped by U shaped and FULL shaped wrapping using synthetic adhesive to the full length of beam. The retrofitted beams were tested in CTM machine by two point loading. Also the complete crack patterns and the failure loadwere recorded in each test. Stress strain curves are alsopresented in this experiment. Fully wrapped beam under shows higher load carrying capacity comparing to other type of wrapping. This fig shows the rectangular beam under loading.

Fig. 2 - Showing fully wrapped beam under testing

3. Results and Discussions

The test results of experiments conducted on twelve RC beam specimens with and without STP wrapping has been presented. The beams were tested in CTM machine under two point loading till the first crack occurs. Then the beams were retrofitted using single layer U-wrapping & FULLY- wrapping of STP composites. Stress strain curves are also presented in this experiment.

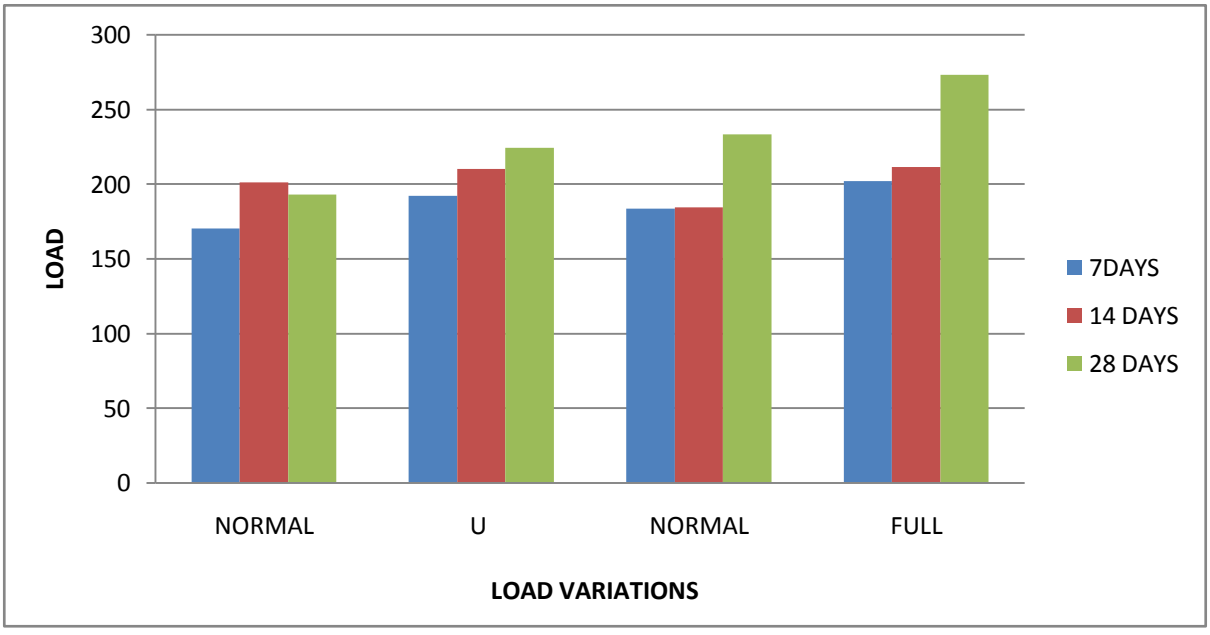

Fig. 3 - Showing load variations between Normal and Retrofitted beams

4. Conclusion

U-wrapping shows increase in strength upto 60%, and Full wrapping showing increase in strength upto 70%. The ultimate load carrying capacity of all the retrofitted beams is higher when compared to the normal beams. The stress vs strain graphs are plotted compared to normal and retrofitted beams, the retrofitted beams shows maximum values. After retrofitting all the specimens showed reduced crack, deflection at the ultimate load. The deflections of the beams are minimized due to full wrapping technique around all the four sides of the beam. Retrofitting using super thermo polymer sheets prove to be economical since its cost is only Rs.100/m2. Instead of demolishing and reconstruction of the structures, it is economical to rehabilitate the structural element using super thermo polymer sheets.

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