ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology
Vol. 2, Issue 7, July 2013

Experimental Investigation on Behavior of R.C.C Beam Retrofitted With Sisal Fibre Sheet

A.S.Jeyabharathy[1], Dr.S.Robert Ravi[2]

Assistant Professor, Dept. of Civil Engineering, PSR Engineering College, Sivakasi, Tamil Nadu, India [1]

Professor & Head,, Dept. of Civil Engineering, PSR Engineering College, Sivakasi, Tamil Nadu, India [2]

Abstract: Reinforced concrete beams are the main structural elements which lead to local failure subjected to earthquake forces. As we know during earthquake, a huge amount of energy released and hence the structural elements must have ductility behaviour and enough absorption capacity in order to avoid the loss of life and property due to earthquake force. Now a day authority insisted to incorporate the ductility code IS 13920:1993 while designing a structural elements. But we are in position to strengthen the existing structural elements which are already design by IS 456:2000 to meet the ductility requirement given by IS 13920:1993.External confinement of structural elements is one of the strengthening method. In order to utilise the local resources available in and around the area in which the structural elements are situated, the natural fibres like SISAL,VAKKA,BANANA etc.. are used make fibre sheets for retrofitting the structural element. Three reinforced concrete beam specimens were casted in which one had reinforcement detail as per code IS 456:2000(control) and another had reinforcement details as per code IS 13920:1993(control).The remaining specimen had reinforcement details as per code IS 456:2000 retrofitted with SISAL fibre sheets using epoxy resin(retrofitted). Both ends of beam were hinged. Static load was applied at the top of the beam up to a controlled load. An attempt has been made to know the performance of retrofitted specimens compared with control specimens and the results are presented in this paper.

Keywords: Beam, Retrofitting, SISAL fibre sheets, Static load

I. INTRODUCTION

Recent earthquakes have exposed the vulnerability of existing reinforced concrete beam to seismic loading. Concrete jacketing and steel jacketing were the two common methods adopted for strengthening the deficient reinforced concrete beam which results in substantial increase in the cross sectional area and the self-weight of the structure. It has poor resistance for weather attacks and is labour intensive. A new technique has emerged recently which uses fiber sheets to strengthen the beam which have a number of favourable characteristics such as ease to install, immunity to corrosion and high strength. The simplest way to strengthen the beam is to wrap fiber sheets in two orthogonal directions. An attempt has been made to carry out an investigation on behaviour of reinforced concrete beam specimens retrofitted with SISAL fiber sheets.

II. EXPERIMENTAL INVESTIGATION

The experimental program consist of testing of three reinforced concrete beam specimens identified as C1 (IS 456:2000), C2(IS 13920-1993) and C3(IS 456-2000 -retrofitted). The beam had a cross section of 200 mm x 200 mm with an overall length of 1200 mm. The beam had 3 numbers of 12mm diameter rods and 2 numbers of 10 mm diameter rods as tension and compression reinforcement. The specimens C1&C3 had vertical stirrups of 8 mm diameter bar at 140 mm c/c as per code IS 456:2000, cl.26.5.1.6. The specimen C2 had vertical stirrups of 8 mm diameter bar at 40 mm c/c. up to a distance of 400 mm from both ends as per code IS 13920:1993, cl 6.3.5 and 8 mm diameter bar at 85 mm c/c for remaining length of the beam. The concrete mix was designed for a target strength of 20 MPa at the age of 28 days. The typical view of the reinforcement detail of specimens are given in Figure.1 & Figure.2. The load carrying capacity of the beam was estimated to be 14 kN.

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology
Vol. 2, Issue 7, July 2013

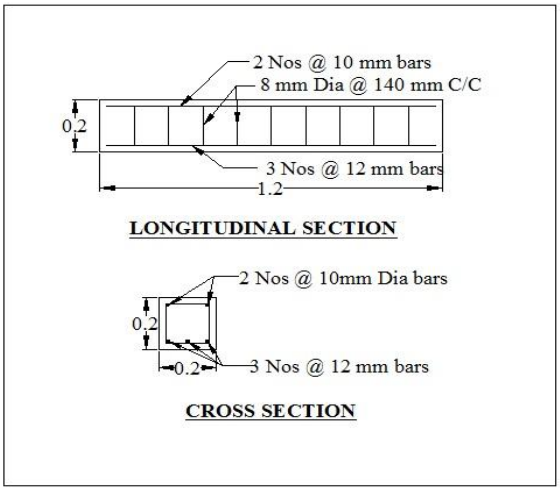

Fig. 1 Typical view of reinforcement detail of C1 & C3

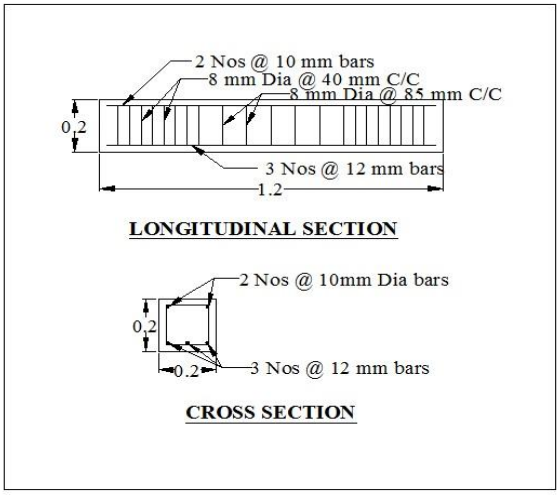

Fig. 2 Typical view of reinforcement detail of C2

III. PREPARATION OF SPECIMENS

The reinforced concrete beam specimens were cast using wooden moulds. Reinforcement was prepared and placed inside the mould. The grade of concrete used was M20. IS method of mix proportioning was adopted to arrive design mix as1:1.5:3.17 with the w/c ratio of 0.5. Concrete was mixed in a tilting type mixer machine and was properly placed and compacted. The sides of the mould were removed 24 hours after casting and the test specimens were cured in water for 28 days. Before wrapping fiber sheet, the faces of the specimen were ground mechanically to remove the laitance. All the voids were filled with putty. Then a two component primer system was applied on the concrete surface and allowed to cure for 24 hours. A two component epoxy coating was then applied on the primer coated surface and inner layer of fiber sheet and immediately wrapped over the bottom and side surface of the reinforced concrete beam. A hand roller was then applied gently over the wrap so that good adhesion was achieved between the concrete surface and allowed to cure for seven days. Another coat of the two component epoxy was applied over the inner layer of fiber sheet. Then the outer layer of wrap was applied following the same procedure and allowed to cure for a further period of seven days. Both the wrapped layers were orthogonal to each other. Figure.3, Figure.4 show the typical view of control and retrofitted specimens.

Fig. 3 Typical view of Control Specimen

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology
Vol. 2, Issue 7, July 2013

Fig. 4 Typical view of Retrofitted Specimen

IV. DESCRIPTION OF TEST PROGRAMME

The specimens C1,C2 & C3 were tested in a loading frame in the horizontal plane. Both the ends of the beam were hinged using roller plates. The point load upto 10 kN was applied at the center of beam using a hydraulic jack of 50 kN capacity and the load was measured using an electrical load cell. The deflection at the center of the beam was recorded at regular load intervals up to a control load of 10 kN. Figure.5 show the typical view of the loaded retrofitted specimen.

Fig. 5 Typical view of Specimen Retrofitted with SISAL fiber sheet

V. RESULTS AND DISCUSSION

In the case of specimen C1, first crack was formed approximately at center of the beam at a load of 7 kN. The crack widened at a load of 8 kN. Spalling of concrete occurred in the tension zone at a load of 9.5 kN. The application of the load was stopped when the load reached 10 kN for our convenience. The corresponding beam deflection was 7.59 mm. In the case of the specimen C2, first crack was formed approximately at center of the beam at a load of 8 kN. The cracks widened at a load of 9 kN. Spalling of concrete occurred in the tension zone at a load of 9.5 kN. The application of the load was stopped when the load reach 10 kN for our convenience. The corresponding beam deflection was 6.07 mm. In the case of the specimen C3, first crack was formed approximately at center of the beam at a load of 9 kN. The application of the load was stopped when the load reach 10 kN for our convenience .The corresponding beam deflection was 4.65 mm. The percentage reduction in deflection of the control and retrofitted beam specimens are given in Table.1

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology
Vol. 2, Issue 7, July 2013

Table.1 Percentage of reduction in Deflection of Control and Retrofitted specimens

Specimen ID	Deflection in mm	% reduction in deflection
C1	7.59	--
C2	6.07	20
C3	4.65	39

It is seen from the Table. 1 that the percentage reduction in deflection of the beam specimen retrofitted with SISAL fiber sheet reduces by 39%. The load deformation characteristics also improved to a larger extent in the case of wrapped specimen over the control specimen.

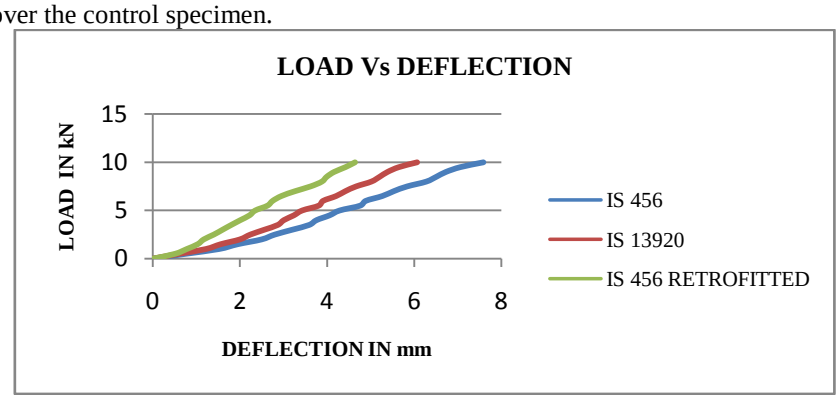

Fig 6. Load Deflection Curve For The Control and Retrofitted Specimen

VI. CONCLUSIONS

Based on the experimental investigations carried out on the control and retrofitted beam specimens, the following conclusions were drawn:

- The deflection of the beam specimen detailed as per code IS 13920-1993 was found to be 20 % lower than that of the specimen detailed per code IS 456-2000.
- The deflection of the beam specimen retrofitted with SISAL fiber sheet reduced the by 39 % compared with the deflection of specimen detailed as per code IS 456-2000.

REFERENCES

[1] Bindu K.R. and.Jaya K.P, "Performance of Exterior Beam Column Joints With Cross Inclined Bars Under Seismic Type Loading", *Journal of engineering and applied science, 2008 ,Vol 7, Pg 591-597.*

[2] Alexander G. Tsonos, "Effectiveness of CFRP Jackets and RC Jackets In Post Earthquake and Pre Earthquake Retrofitting of Beam Column Sub Assemblages", *Journal of engineering structures 2008, Vol 30, Pg 777-793.*

[3] Lakshmi G.A, Anjan Dutta,and Deb S.K, "Numerical Study of Strengthening of Beam Column Joints Under Cyclic Excitation Using FRP Composites", *Journal of structural engineering 2008,Vol 35, Pg 59-65.*

[4] Appa Roa G.,Mahajan.M and Gangaram M., " Performance of Nonseismically Designed RC Beam Column Joints Strengthen by Various Schemes Subjected to Seismic Loads", *Journal of structural engineering 2008,Vol 35, Pg 52-58.*

[5] Yousef A. Al-Salloum and Tarek H.Almusallam,"Seismic Response of Interior RC Beam Column Joints Upgrade with FRP Sheets. I: Experimental Study" *Journal of composite for construction 2007, Vol 11, Pg 575-589.*

[6] Yousef A. Al-Salloum and Tarek H.Almusallam, "Seismic Response of Interior RC Beam Column Joints Upgrade With FRP Sheets. II: Analysis And Parametric Study " *Journal of composite for construction 2007, Vol 11, Pg 590-599.*

[7] Devados Menon ,Pradip Sarkar and Rajesh Agrawal, "Design of RC Beam Column Joints Under Seismic Loading – A Review". *Journal of structural engineering 2007, Vol 33, Pg 449-457.*

BIOGRAPHY

Mr.A.S.Jeyabharathy completed his Diploma in Civil Engineering during 2002 at Arasan Ganasan Polytechnic College, He completed his B.E degree in Civil Engineering during 2005 at K.S.R.College of Engineering. He also undergone his Masters in M.Tech Structural Engineering during 2010 and pursuing his Ph.D at Karunya University. He has 3 years of teaching experience along with 1 year of industrial experience.

Dr.S.Robert Ravi completed his B.E degree in civil Engineering during 1990 at Thiagarajar college of Engineering, Madurai and completed his M.E in structural Engineering during 2004 and completed his Ph.D during Feb 2011. He has six research scholars with 22 publications. He has 13 years of teaching experience along with 7 years of industrial experience.