



International Journal of Intellectual Advancements and Research in Engineering Computations

Experimental investigation on RC beam by using SIFCON laminate

Ms.M.Vinodhini, Dr.R.Balamurugan, Dr.R.Renganathan, Mr.H.Vijayakumar

Professor, Department of Civil Engineering, Dhanalakshmi Srinivasan Engineering College,
Perambalur, Tamilnadu, India

ABSTRACT

Slurry infiltrated fibrous concrete (SIFCON), an exceedingly improved version of conventional fibre reinforced concrete (FRC), is a unique construction material having unique properties in the areas of both strength and ductility. SIFCON being a new kind of fibre reinforced composite material, limited literature is available regarding its application as structural element. In the present study, investigations are carried out to study the behaviour of reinforced concrete beams with SIFCON laminates. Experimental programmes have to be carried out to study the behaviour of flexural and shear RC beams with precast SIFCON laminates. The concrete mixes for RC beams have to be designed to obtain a concrete grade of M20. The steel fibres used in the study were hooked end fibres having 0.5mm diameter and aspect ratio of 60. Fibre volume fraction was 7%. In this project report, the technical papers, related to high performance hybrid steel fibre reinforced concrete and regression analysis published in National and International journals have been reviewed.

Keywords: SIFCON, Flexural strength, Static loading, M20 grade of concrete.

INTRODUCTION

Nowadays natural and manmade disasters like earthquake, wind force, etc., play an important role in the behavior of structures. So the structures have to be designed in good manner, which resist blast loads, seismic and impact forces. Slurry Infiltrated Fibrous concrete possesses high strength, improved ductility, impact resistant and enhancing energy absorption capacity. So it becomes necessary to study the behavior of SIFCON. Concrete is defined as any solid mass made with the use of cementing medium the sand, gravel, cement and water. Plain concrete is strong in

devised to increase the fiber volume fraction (VF), leading for the development of Slurry Infiltrated Fibrous Concrete (SIFCON).

SIFCON is a relatively new material and can be considered as special type of fiber reinforced concrete. In two aspects, however, it is different from normal fiber reinforced concrete. They are fiber content and method of production. In FRC, the fiber content usually varies from 1% to 3% by volume, whereas in SIFCON the fiber content varies from 4% to 20%. The matrix of SIFCON consists of flowing cement mortar as opposed to regular concrete in FRC. The process of making SIFCON is also different because of high fiber content. In FRC, the fiber is added to the wet or dry mix of the concrete but compression while weak in tension. The idea of reinforcing concrete with steel bars gave rise to a new composite called, Reinforced Concrete (RC), which is capable of withstanding both compression and tension simultaneously i.e., flexure. Thus reinforced

SIFCON

Concrete is the most generally used for construction. The disadvantages of concrete are “Low Energy Absorption” and “Low Ductility”. This can be overcome by adding fibers into the concrete. A different construction techniques was

Author for correspondence:

Department of Civil Engineering, Dhanalakshmi Srinivasan Engineering College, Perambalur, Tamilnadu, India

concrete has become the most commonly used construction material. Concrete is the most commonly used construction material, consumed at a rate of approximately one ton per living being. Its popularity may be largely attributed to durability, ease of construction of various shapes and sizes.

SIFCON is prepared by infiltrating cement slurry into a bed of preplaced fiber. There are four main variables to consider when evaluating a SIFCON specimen. These variables are slurry strength, fiber volume, fiber alignment and fiber type. Each of these variables will be discussed in greater depth as they relate to individual characteristics of SIFCON specimens. Fiber orientation and size greatly affects the behavior of a SIFCON specimen. Fibers can be aligned normal to loading or parallel to loading. The ultimate strength, residual strength, ductility and energy absorption are all affected by the fiber strength. Fabrication technique and skill of workmanship greatly affects fiber orientation, while size effects make it difficult to predict in-situ SIFCON properties.

METHODOLOGY

The work flow of the project starts with the study of various literature reviews. For this is the different journals related to the proposed work are to be collected. From those collected journals the progress of the work, materials to be used are understood. After studying the properties of material the idea for using the materials and their mix design are decided.

The mix design is followed by casting, curing of beams. Then the laminate pasted on the beam. This laminate beam is tested. The flexural test is done to measure and identify its strength. After the test, the SIFCON laminate beams are compared with conventional RC beam based on the cracks. Finally the strength of the SIFCON laminate is made higher than the conventional RC beam.

MATERIAL PROPERTIES

Cement

Care has been taken to see that the procurement made from a single batch and is stored in airtight

containers to prevent it is being affected by atmospheric, monsoon moisture and humidity. The cement conforms to 43 grades.

The ordinary Portland cement is selected for this experiment.

Course Aggregate

Machine crushed angular granite metal of maximum size of 20mm retained on 4.75mm I.S sieve conforming to IS 383-1970 was used in the present investigation. It is free from impurities such as dust, clay particles and organic matter etc. the coarse aggregate is also tested for its various properties. The rock crushed coarse aggregate

Fine Aggregate

Natural river sand is used as fine aggregate for casting conventional concrete and fiber reinforced concrete specimens.

Water

The water, which is used for making concrete should be clean and free from harmful impurities like oil, alkalis, acids etc. in general, the water which is fit for drinking should be used for making concrete.

Steel Fiber

Fibers added in concrete to improve the tensile strength, ductility and resistance to cracking. Steel fibers are used to prepare the SIFCON laminates of different thickness like 25mm and 40mm. The steel fiber used in this project is round crimped steel fibers.

Fly Ash

Fly ash is the finely divided residue resulting from the combustion of powdered coal and transported by the flue gases and collected by electrostatic precipitator. Fly ash possesses pozzolanic property. 0.5% of fly ash is added with cement slurry for preparing SIFCON laminate.

The use of fly ash in concrete for the following technical benefits:

1. Reducing bleeding and segregation
2. Improving finish ability and segregation
3. Reducing heat of hydration
4. Increasing resistance to crack
5. Increasing durability

MICRO SILICA

The silica fume is a by-product of the manufacture of silicon, ferrosilicon or the like from quartz and carbon in electric arc furnace. Silica fume can be used as partial replacement for cement. Silica fume rises as an oxidized vapour. It is further processed to remove impurities and to control particle size.

Silica fume is used in the concrete for the following reasons:

1. Improving the binding strength between the aggregates and cement matrix
2. Reducing bleeding and segregation
3. Improving finish ability and segregation
4. Increasing cohesiveness leading to excellent pump ability
5. Improving durability
6. Reducing the shrinkage cracks in the concrete

SIFCON LAMINATE

Hooked end steel fibers of 0.6 mm diameter and aspect ratio of 60 are used to cast SIFCON

laminates. Fiber volume fraction is 7%. Cement, micro silica and fly ash were used for making cement slurry with the mix proportion 1:0.2:0.5. water binder ratio was about 0.45. Laminate of size 1100 mm X 100mm X 25 mm and 1100 mm X 150 mm X 25 mm were cast for bottom face and side face and another one type of size of laminates are 1100 mm X 100 mm X 40 mm and 1100 mm X 150 mm X 40 mm also were cast for bottom face and side face respectively. Wooden moulds were used to cast the laminates. Initially the fibers were placed in the mould to its full capacity and then the cement based slurry is made to infiltrate in to the mould. The laminates were demolded after 24 hours and were cured for 28 days. This results in a high strength material for which flexural properties can be designed and predicted with much accuracy. It also offers higher energy absorption capacity and impact resistance to SIFCON. Behavior of such fiber in SIFCON laminates on reinforced beam will be studied in this project which includes flexural test.



Fig -1: Test setup

LITERATURE REVIEW

Balaji et al., (2015) explained about the article cyclic behavior of exterior beam column joints strengthened with precast slurry infiltrated fibrous concrete laminates. Beam- column joint is an important component of a RC moment resisting frame and should be designed and detailed properly, especially when the frame is subjected to seismic forces. This paper presents the

investigations carried out to study the cyclic behavior of exterior beam-column joints strengthened with SIFCON laminates. The ultimate load carrying capacity of strengthened RC and FRC beam-column joints was found to be 23% more than that of conventional RC and FRC beam-column joints respectively. In general, it is concluded that the precast SIFCON laminates can be effectively used for the strengthening of beam-column joints, which increases the load carrying

capacity, ductility and energy absorption capacity of the joints. This type of behavior is more desirable for the structures located in earthquake prone areas.

Balamuralikrishnan et al., (2015) investigate the article cyclic behaviour of reinforced concrete beams retrofitted with externally bonded SIFCON laminates. The aim of the research work is to present the results of experimental and analytical studies concerning the cyclic behaviour of reinforced concrete (RC) beams retrofitted with externally SIFCON. This study presents a method for retrofitting of reinforced concrete beams to enhance the actual load carrying capacity using high performance fiber reinforced cementitious composites (HPFRCC) laminates SIFCON and which are directly bonded to the tension face at the soffit of the beam by epoxy adhesives and are tested under compression cyclic loading. The results show that the strengthened beams exhibit increased flexural strength, enhanced flexural stiffness, and composite action until failure. The numerical solution in terms of load – deflection variation for SIFCON strengthened beams exhibits a decrease by 20 percent variation with the experimental results. It shows a fairly good agreement with the experimental results.

Antony Jeyasehar et al., (2010) has reported the performance of reinforced concrete beam column joints under cyclic loading. They have used SIMCON laminates on the beam column joints with different volume fraction and aspect ratio. The energy dissipation capacities of the joints with different fractions have been compared. They have compared the experimental and numerical results shows that the strengthened beam column joint exhibited increased strength, stiffness, energy dissipation and composite failure action.

Chandran et al., (2015) explained about the article, Investigation on flexural behavior of RC beams using uni and multi-directional BFRP composites. Concrete structures are deteriorated due to environment conditions. Strengthening of existing structures are the most important challenges in the Civil Engineering. This study presents the flexural behavior of Unidirectional and Multidirectional Basalt Fiber Reinforced Polymer (BFRP) composites, strengthened with

reinforced concrete beams. For flexural strengthening of reinforced concrete beams and using M20 grade concrete and tested under two point loading. Test result indicates the stiffness of the beams is increased by increasing the number of layers. Curvature of strengthened beams are also decreased and by increasing the basalt fiber layers increase. In cracking behavior the number of cracks increase crack spacing decreased by increasing basalt fiber layers increase.

Chandran et al., (2015) from this article says about the Flexural behavior of strengthened RC beams with multi- directional basalt fiber – reinforced polymer composites. The paper describes an experimental behavior of the basalt fiber reinforced polymer composite by external strengthening to the concrete beams. The BFRP composite is wrapped at the bottom face of R.C beam as one layer, two layers, three layers and four layers. From this investigation, the first crack load is increased depending on the increment in layers from 6.79% to 47.98%. Similarly, the ultimate load carrying – capacity is increased from 5.66% to 20%. The crack's spacing is also reduced with an increase in the number of layers. Most of the strengthened beams in unidirectional BFRP showed flexure cum crushing of compression modes. The stiffness of the beams is increased by increasing the number of layers. Curvature of strengthened beams is also decreased by increasing the basalt fiber layers increase. In cracking behavior the number of cracks increase crack spacing decreased by basalt fiber layers increase.

Maheboob et al., (2015) examines the article about Comparative evaluation of different retrofitting techniques. Concrete is an important and successful material in the construction industry for a long time. It has so many applications and utilization in the construction field. From this experiment by using retrofit all beams with different techniques like HFRC, FRC, SIFCON, SIMCON, Ferro cement. Take SIMCON and cover to full beam then mortar will be applied to full beam. Take slurry infiltrated fiber concrete (steel fiber) mixed with mortar and applied over a surface of beams and same process will be done with polypropylene fiber. In Ferro cement retrofitting welded and chicken mesh is used which is cover to beams and then mortar is applied over the surfaces.

Thus it can be concluded that the concrete beam retrofitted with SIFCON yields higher flexural strength and the percentage in the flexural strength as compared to the beam without retrofitting is found to be 85.03% and the concrete beam retrofitted with Ferro cement yields higher flexural strength.

Pradeep et al., (2015) investigate the article about, cyclic behavior of RC beams using SIFCON sections. This SIFCON is a new method to increase the strength of concrete. SIFCON is incorporated by using some amount of steel fiber in mold to form very dense network of fiber. The network is then infiltrated with cement based slurry or mortar. In this study, the mechanical properties and flexural properties of SIFCON members are evaluated and they are compared with conventional concrete of grade M40. The cement based slurry is a composition of cement, fly ash, silica fume, Ground Granulated Blast Furnace Slag. In general it is concluded that SIFCON can be used as an effective alternative in special concreting purposes or where the concrete or conventional SFRC cannot perform as expected/required or in situations where such high strength is required. From the results obtained it is found that SIFCON members are much better than conventional concrete.

Parthiban et al., (2014) investigate the article about Flexural behavior of slurry infiltrated fibrous concrete (SIFCON) composite beams. This work reports on the experimental study concerning the flexural behavior of slurry infiltrated fibrous concrete (SIFCON) composite beams and to investigate the influence of volume percentage of SIFCON on strength and stiffness characteristics of reinforced cement concrete (RCC) and fiber reinforced concrete beams under flexural loading. The reinforced cement concrete and fiber reinforced concrete beams were casted with partial replacement with SIFCON in the tension zone. The effect of various volume of SIFCON in the beam of flexural strength was investigated. The flexural strength of plain concrete can be improved clearly by incorporating SIFCON and the addition of SIFCON in conventional concrete results in improvements in strength and ductility under static loading. The addition of SIFCON in conventional

concrete beams shows significant reduction in the no of cracks and their widths.

Regupathi et al., (2014) from this article experimentally says about Experimental Study on Behaviour of Reinforced Concrete Beams with Precast SIFCON Laminates. In the present study, investigations are carried out to study the behaviour of reinforced concrete beams with SIFCON laminates. An experimental program has been carried out to study the behaviour of flexural and shear RC beams with precast SIFCON laminates. It is corresponding to two test series has been cast and tested under cyclic loading to study the first crack load, ultimate load and the load deformation behaviour. Control specimen has withstood two cycles of loading and unloading. The maximum deflection was observed under an ultimate load. Numbers of cracks have been observed during the final failure of the specimen. This paper concludes that, the flexural strength of the SIFCON is very much higher than the conventional concrete.

Thomas et al., (2014) says about the article Strength and behavior of SIFCON with different types of fibers. The different fibers that were used in this experiment were steel fiber and polypropylene. The different fiber volume considered was 4, 5, and 6%. The tests that were conducted were flexural, compression and Split tensile test. The steel fiber used in this study was hooked end steel fibers having 1mm diameter and an aspect ratio of 50. Also, the crack width and density of specimen can be reduced by introducing polypropylene fibers. This is due to the bridging effect of polypropylene fiber. Also on comparing the density, polypropylene specimen has lower density than the specimen with steel fiber. This helps to reduce dead load of the structure.

Balamuralikrishnan et al., (2013) from this article says about the Retrofitting of Externally Bonded Thin Cement Composites. This paper presents the results of experimental and analytical studies concerning the flexural strengthening of RC beams using externally bonded High Performance Fibre Reinforced Cementitious Composites (HPFRCCs) like Slurry Infiltrated Fibre Concrete (SIFCON) and Slurry Infiltrated Mat Concrete (SIMCON). Eight beams were strengthened with bonded SIFCON and SIMCON

laminates at the bottom under virgin condition and tested until failure. Static responses of all the beams were evaluated in terms of strength, stiffness, ductility ratio, energy absorption capacity factor, compositeness between laminate and concrete, and the associated failure modes. Comparison was made between experimental results of SIFCON and SIMCON. The results show that the strengthened beams exhibit increased flexural strength, enhanced flexural stiffness, and composite action until failure. SIFCON and SIMCON laminates properly bonded to the tension face of RC beams can enhance the flexural strength substantially.

Elavarasi et al., (2013) says the article about Behavior of fly ash based slurry infiltrated fibrous concrete. The aim of the present work is to study the effect of fly ash and fiber content on mechanical properties of SIFCON and to arrive the optimum percentage of fly ash and fiber content. An experimental investigation was carried out to study the mechanical properties of fly ash based SIFCON by replacing cement with 10, 20 and 30% of fly ash. Fiber content in SIFCON is varied as 6, 8 and 10%. The results are compared with control specimen. It is concluded that fly ash based SIFCON were positively affected the results for every percentage replacement of fly ash. The results proved that replacement of cement with fly ash increase in the viscosity of slurry. It was observed that the viscosity can be controlled by using proper amount of super plasticizer water cement ratio of 0.45 is mainly used. Thus, SIFCON slurry having proper flow ability and filling ability properties can be produced by replacement of cement with fly ash. The results indicated that the replacement of cement with fly ash decreased the compression strength and addition of steel fibers developed marginal increase in strength.

Jayashree et al., (2013) from this article says about Dynamic response of a space framed structure subjected to blast load. This paper investigates the dynamic response of a space framed structure due to blast load. In this paper an attempt has been made to use SIFCON, a type of FRC with high fiber content as an alternative material to Reinforced Cement Concrete (RCC). SIFCON has high energy absorption capacity,

higher strength and it is highly ductile. The dynamic characteristics such as fundamental frequency, mode shapes are evaluated. The displacement time history response of frames with SIFCON and RCC due to blast load is compared. The results showed that the overall dynamic behavior of SIFCON frame is better than that of RCC frame. The fundamental frequency of SIFCON frame is about 30% more than that of RCC frame. The reduction in displacement of about 25-30 % is achieved using SIFCON.

Jayashree et al., (2013) says about this article Flexural Behaviour of SIFCON Beams. SIFCON is an exceptional type of FRC with high fibre content. This paper reports on the flexural behaviour of SIFCON-RC composite beams. Composite beam (SIFCON-RC) comprises of 2 layers with RC as the top and SIFCON as the bottom layer. To improve the strength, wear resistance and durability of the concrete a small fraction of short crimped fibres with aspect ratio 50 is used in the study. SIFCON-RC composite beam with 40% SIFCON behaves well and the load versus deflection at yield point is compared with the 100% RC beam using the software ANSYS. The results shows that on comparing the flexural strength, SIFCON is better than RC. When the volume of SIFCON increases from 20% to 100%, high flexural strength and high modulus of elasticity is achieved for 40% SIFCON. The ANSYS model of SIFCON beams exhibits similar flexural behaviour as in the experimental investigation.

Misir et al., (2013) experimentally says about the Strengthening of non-seismically detailed reinforced concrete beam-column joints using SIFCON blocks. This article aims to propose a novel seismic strengthening technique for non-seismically detailed beam-column joints of existing reinforced concrete buildings, typical of the pre- 1975 construction practice in Turkey. The technique is based on mounting pre-fabricated SIFCON composite corner and plate blocks on joints with anchorage rods. For the experimental part three 2/3 scale exterior beam column joint specimens were tested under quasi-static cyclic loading. Results showed that the control specimen showed brittle shear failure at low drift levels, whereas in the strengthened specimens, plastic

hinge formation moved away from column face allowing specimens to fail in flexure. The proposed technique greatly improved lateral strength, stiffness, energy dissipation, and ductility.

Shri et al., (2013) experimentally says about the Prediction of impact energy absorption using modified regression theory. In this study new mathematical models were proposed and developed by using a regression equation for the prediction of impact energy absorption of hybrid fibrocement slabs. Slabs were made up of self-compacting concrete (SCC) in order to minimize the external vibration work. Slabs size with varying parameters such as depth of slab, number of layers of weld mesh (2 and 3 layers bundled), and wrapping with GFRP (1 and 2 layers) along with a specified proportion (0 and 0.30%) of polypropylene fibers were cast and impact load was applied by means of a hammer and the initial and ultimate energy absorptions were evaluated. The variables used in the prediction models were the varying parameters such as number of layers of GFRP sheet, area of weld mesh and height of drop. From the test result is the percentage of polypropylene fiber increases; the strength characteristic of concrete also increases.

Harish (2012) explained about the article Flexure behavior of SIFCON is relatively a new type high performance fiber reinforced concrete in which formwork moulds are filled to its capacity with fibers and the resulting fiber network is infiltrated by cement based slurry. Infiltration is usually accomplished by gravity flow. The experimental investigation is carried out to study on flexure behavior of High performance Fiber Reinforced Concrete Beam, such as SIFCON Beam, subjected to reverse cyclic loading. SIFCON possesses both high strength as well as large ductility. The aim of this present investigation is to study a new type of material, termed SIFCON. Conventional RC beams, SIFCON beams and FRC beams will be subjected to cyclic loading and the result will be compared with conventional RC beams. The test results are comparing with that of the conventional reinforced concrete beam subjected to similar loading condition. The study revealed that better performance could be derived with respect to load

carrying capacity and first crack load when subjected to reverse cyclic loading.

Jeyasehar et al., (2012) investigate the article about the Strengthening of structures by HPFRCC laminates. This paper presents the results of experimental, analytical and numerical studies concerning the flexural strengthening of RC beams using externally bonded high performance fiber reinforced cementitious composites (HPFRCCs) like SIFCON and SIMCON. Eight beams were strengthened with bonded SIFCON and SIMCON laminates at the bottom under virgin condition and tested until failure; the remaining two beams were used as control specimen. Static responses of all the beams were evaluated in terms of strength, stiffness, ductility ratio, energy absorption capacity factor, compositeness between laminate and concrete, and the associated failure modes. Comparisons were made between experimental, analytical and numerical results of SIFCON and SIMCON. From the test results it can be seen that SIMCON strengthened beams performed well in all respects when compared to SIFCON strengthened beams.

Thamilselvi (2012) says the article about Behavior of Exterior Beam Column Joints using SIFCON. An experimental investigation was conducted to study the behavior of exterior beam column joints using SIFCON and fiber reinforced concrete at the hinging regions and the results were compared with conventional Reinforced Cement Concrete joints subjected to reversed cyclic lateral loading. SIFCON and Fiber reinforced concrete specimens were provided with farther spacing of stirrups (two times than conventional) and SIFCON and Fiber reinforced Concrete were used only at the beam column joints and to a distance of 2d (two times the depth of the beam) from the joint region. The test results were focused in the aspects of strength, stiffness, and energy absorption capacity. Besides, reduced crack widths and less number of cracks were noticed in the joint region in the case of SIFCON specimens. The load carrying capacity of SIFCON specimens were found to be greater than Fiber reinforced cement concrete and Conventional specimens. The load carrying capacity of SIFCON specimen 20-50% more compared to FRC and conventional specimens respectively.

Venkatachalam et al., (2010) have studied the flexural and residual strength of SIFCON experimentally and have also obtained the optimum cross section for sandwich SIFCON beams. They have cast prisms of 100 x 100 x 400 mm to evaluate the flexural and residual strength. Prisms with layers of concrete and SIFCON, FRC and SIFCON were cast for control specimens. The authors have found flexural of concrete beam with SIFCON and FRC beam with SIFCON are higher than the conventional and FRC concrete. The use such section will effectively reduce the depth of cross section of beam. They have also found that SIFCON sections can be used in structures designed to resist impact loads. From their experimental investigation, the authors have found that the optimal cross section would probably be a SIFCON layer in extreme compression and tension zone with FRC for the remaining section.

Balamuralikrishnan et al., (2009) explained about the article, Retrofitting of RC Beams with Externally Bonded SIMCON Laminates. This paper presents the results of experimental and analytical studies concerning the flexural strengthening of RC beams using externally bonded SIMCON laminates. A total of four reinforced concrete beams were cast and tested in the laboratory over an effective span of 3000 mm. Three beams were strengthened with bonded SIMCON laminate at the bottom under virgin condition and tested until failure; the remaining one beam was used as control specimen. Static responses of all the beams were evaluated in terms of strength, stiffness, ductility ratio, energy absorption capacity factor, compositeness between laminate and concrete, and the associated failure modes. A flexible epoxy system will ensure that the bond line does not break before failure and participate fully in the structural resistance of the strengthened beams. The results show that the strengthened beams exhibit increased flexural strength, enhanced flexural stiffness, and composite action until failure.

Sharma et al., (2008) investigated the Performance characteristics SIFCON plates, SIFCON being a new kind of fiber reinforced composite material, limited literature is available regarding its application as structural elements. In the present study, experimental program was

carried out to investigate structural behavior of SIFCON slabs. Thirty slab specimens corresponding to five test series were tested to study load deformation behavior, ductility associated parameters, ultimate moment capacity and failure characteristics. The results are compared with analytical values and a good agreement is exhibited. SIFCON slabs demonstrated improved strength and ductility related properties. The failure characteristic presents multicrack behavior with densely packed cracking. An appropriate design method to evaluate ultimate moment capacity is, finally, presented.

Rao et al., (2005) investigated the Behavior of slurry infiltrated fibrous concrete (SIFCON) simply supported two- way slabs in flexure. It is recent developed construction material. The matrix consists of cement slurry or flowing cement mortar. This composite material has already been used for structures subjected to blast loading, repair of pre- stressed concrete beams and safe vaults. This paper presents the information on behavior of two-way slabs in flexure. Flexure and cyclic load tests have been conducted and compared with FRC and plain concrete slabs. Both strength and deflection characteristics have been studied. SIFCON slabs with different volume fractions of fibers have been produced and tested under uniformly distributed load. The superiority of SIFCON slabs over fiber reinforced concrete slabs and plain concrete slabs has been demonstrated. The SIFCON slab specimens behaved well in cyclic loading test. The crack width is much less in SIFCON slabs specimens than the FRC specimens.

Svermova et al., (2002) experimentally says about the Development of insitu SIFCON for connections in precast concrete and seismic resistant structures. The aim of this research was to develop slurries which produce good SIFCON but do not require to be vibrated. Slurries with different water/binder ratio and dosage of superplastiziser, limestone powder, sand and welan gum was tested. The Mini-slump test, Lombardi plate cohesion meter, J-fiber penetration test, and induced bleeding test were used to evaluate the rheology of the slurries. Finally, the compressive strength was measured. A two-level fractional factorial statistical model was used for the design

of components and for practical evaluation of the multi-parameter results. The development of self-compacting slurries with different compressive strength has practical significance since such SIFCON does not require to be vibrated. SIFCON is a material with unusual (very high performance) mechanical properties and can be used in both ordinary and new special types of construction.

CONCLUSION

From the literature review, it is clear that for strengthening purpose the RC beam by using SIFCON laminates. The idea is about casting SIFCON laminates in beam which would increase its strength than a conventional RC beam. Also how to prepare laminates and to do casting, curing,

and then pasting the laminate on RC beam, and studied about the process of using the different laminates in beam casting. The different mixed ratio of RC beam and mixed ratio of SIFCON laminates are learnt from the survey. Fiber is the main material in the SIFCON laminate which has three types. The hooked end type steel fiber is used in the proposed work to prepare the SIFCON laminates. SIFCON laminates can be pasted to the reinforced concrete members using adhesive like epoxy resin. The survey made to know how the steel fibers can be used in different forms. In some of the literature survey the steel fiber is also the mixed with RC beam. M30 grade is used in maximum work. As the strength increases with decrease in grade, M20 grade is fixed in proposed work.

REFERENCES

- [1]. Arun Aniyar Thomas and Jeena Mathews, "Strength and behavior of SIFCON with different types of fibers", *International Journal of Civil Engineering and Technology*, 15, 2014, 25-30.
- [2]. Antony Jeyasehar C and Balamuralikrishnan R. "Strengthening of structures by HPFRCC laminates", *Asian Journal of Civil Engineering*, 13, 2012, 29-42.
- [3]. Antony Jeyasehar C. and Ravichandran K., "Cyclic behavior of beam column joint retrofitted with SIMCON laminates", *Asian Journal of Civil Engineering Journal*, 3, 2010, 533-544.
- [4]. Balamuralikrishnan R., "Cyclic behavior of reinforced concrete beams retrofitted with externally bonded SIFCON laminates", *Asian Journal of Civil Engineering*, 16, 2015, 1063-1075.
- [5]. Balamuralikrishnan R. and Antony Jeyasehar C, "Retrofitting of Externally Bonded Thin Cement Composites", *Journal of Advanced & Applied Sciences*, 1(1), 2013, 20-29.
- [6]. Balamuralikrishnan R. and Antony Jeyasehar C, "Retrofitting of RC Beams with Externally Bonded SIMCON Laminates", *The Open Civil Engineering Journal*, Vol.3, pp. 34-40.
- [7]. Balaji S and Thirugnanam G. S. "Cyclic Behavior of Exterior Beam-Column Joints Strengthened with Precast Slurry Infiltrated Fibrous Concrete Laminates", *Journal of Civil Engineering and Technology*, 4, 2015, 65-69.
- [8]. Chandran A and Muthuramu K.L., "Investigation on Flexural Behavior of RC Beams Using Uni and Multi-directional BFRP Composites", *Research Journal of Applied Sciences, Engineering and Technology*, 10, 2015, 1062-1029.
- [9]. Chandran A and Neelamegam M., "Flexural behavior of strengthened RC beams with multi-directional basalt fiber - reinforced polymer composites", *Research Journal of Applied Sciences, Engineering and Technology*, 19, 2015, 45-58.
- [10]. Balamuralikrishnan R. and Antony Jeyasehar C. "Retrofitting of Externally Bonded Thin Cement Composites", *Journal of Advanced & Applied Sciences*, 1, 2013, 20-29.
- [11]. Elavarasan D., Saravananaraja Mohan K. and Sibi Chander Manavalan, "Behavior of fly ash based slurry infiltrated fibrous concrete", *Asian Journal of Applied Science*, 2013, 1-5.
- [12]. Harish R, "Study on flexure behavior of slurry infiltrated fibrous concrete (SIFCON)", *International Journal of Computer & Organization Trends*, 2, 2012, 29- 46.
- [13]. Jayashree S., Rakul Bharatwaj R. and Helen Santhi M. "Dynamic response of a space framed structure subjected to blast load", *International Journal of Civil and Structural Engineering*, 4, 2013, 98-105.

- [14]. Jayashree S.M, Rakul Bharatwaj R and Helen Santhi M., “Flexural Behavior of SIFCON Beams”, *International Journal of Engineering Research & Technology*, 2, 2013, 1-6.
- [15]. Maheboob M and Kashinath B.R. “comparative evaluation of different retrofitting techniques”, *International Journal of Engineering Research and technology*, 3, 2015, 145-151.
- [16]. Misir I.S and Kahraman S. “Strengthening of non- seismically detailed reinforced concrete beam–column joints using SIFCON blocks”, *Indian Academy of Sciences*, 38, 2012, 69-88.
- [17]. Pradeep T and Sharmila S., “Cyclic behavior of RC beams using SIFCON sections”, *International Journal of Innovative Research in Engineering and Technology*, 4, 2015, 9172-9177.
- [18]. Parthiban K., Saravanaramohan K. and Kavimukilan G. “Flexural behavior of slurry infiltrated fibrous concrete (SIFCON) composite beams”, *Asian Journal of Applied Science*, 4, 2014, 232-239.
- [19]. R.Regupathi R., Mathiyalakan R., Balasundaram V and Selvanarayanan G., “Experimental Study on Behavior of Reinforced Concrete Beams with Precast SIFCON Laminates”, *International Journal of Advanced Information Science and Technology*, 32, 2014, 22-27.
- [20]. Sharma H. K. and Singh V.P., “Performance characteristics SIFCON plates”, *Journal of Civil Engineering and Technology*, 8, 2008, 149-154.
- [21]. Sudarsan Rao H. and Ramana N. V., “Behavior of slurry infiltrated fibrous concrete (SIFCON) simply supported two-way slabs in flexure”, *Indian Journal of Engineering and Materials Sciences*, 12, 2005, 427- 433.
- [22]. Svermova L. and Bartos P. J. M., “Development of insitu SIFCON for connections in precast concrete and seismic resistant structures”, *Asian journal of Civil Engineering*, 2, 2002, 553 -559.
- [23]. Thamilselvi P. “Behavior of Exterior Beam Column Joints using SIFCON”, *International Journal of Engineering Research & Technology*, 1, 2012, 1-5.
- [24]. Thirugnanam G.S., Govindan P. and Seturathnam A., “Ductile behavior of SIFCON structural members”, *Journal of Structural Engineering*, 28, 2001, 27-32.