ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

RC COLUMN STRENGTHENING BY FIBRES

M.Vinodhini [*], K.Shanthi, B.Jose Ravindraraj
[*] PG Scholar,Structural Engineering, PRIST University,Thanjavur,India.
AP,Civil Engineering, PRIST University,Thanjavur,India.
AP, Civil Engineering, PRIST University,Thanjavur,India.

DOI: 10.5281/zenodo.546341

ABSTRACT
The deterioration of concrete structures might be due to ageing, poor maintenance, corrosion due to poor environmental conditions and accidental situations like earthquakes. The need to upgrade the deteriorated civil engineering infrastructure greatly enhances with the ever increasing demands. Therefore rehabilitating and retrofitting civil engineering infrastructure has been identified as important issue to be addressed. Glass fiber is a new material consisting of closely spaced Glass and resins which is very effective in strengthening work. The basic idea is that it undergoes large strains in the neighborhood of the reinforcement and the magnitude of strain depends on the distribution and subdivision of reinforcement throughout the mass of concrete. In this book the strengthening of reinforced concrete columns using Glass fiber laminates are studied. In this study, the use of Glass fiber as an external confinement to concrete specimens is investigated. The effectiveness of confinement is achieved by comparing the behavior of retrofitted specimens with that of conventional specimen.
KEYWORDS: Deterioration of concrete, Glass and resins, Glass fiber laminates, Retrofitting.

INTRODUCTION
GENERAL
Concrete is weak in tension and has a brittle character. The concept of using fibers to improve the characteristics of construction materials is very old. Early applications include addition of straw to mud bricks, horse hair to reinforce plaster and asbestos to reinforce pottery. Use of continuous reinforcement in concrete (reinforced concrete) increases strength and ductility, but requires careful placement and labour skill. Alternatively, introduction of fibers in discrete form in plain or reinforced concrete may provide a better solution. The modern development of fiber reinforced concrete (FRC) started in the early sixties. Addition of fibers to concrete makes it a homogeneous and isotropic material. When concrete cracks, the randomly oriented fibers start functioning, arrest crack formation and propagation, and thus improve strength and ductility. The failure modes of FRC are either bond failure between fiber and matrix or material failure. Fiber reinforced concrete (FRC) is concrete containing fibrous materials which increase the structural integrity. It contains short discrete fibers that are uniformly distributed and randomly oriented. Fiber includes steel fibers, glass fibers, synthetic fibers and natural fibers- each of which lend varying properties to the concrete. In addition, the character changes with varying concretes, fiber materials, geometries distribution, orientation, and densities.

History of fiber reinforced concrete
The concept of using fibers or as reinforcement is not new. Fibers have been used as reinforcement since ancient times. Historically, horsehair was used in mortar and straw in mud bricks. In the 1900s, asbestos fibers were used in concrete. In the 1950s, the concept of composite materials came into being and fiber-reinforced concrete was one of the topics of interest. Once the health risks associated with asbestos were discovered, there was a need to find a replacement for the substance in concrete and other building materials. By the 1960s, steel, glass (GFRC), and synthetic fibers such as polypropylene fibers were used in concrete. Research into new fiber reinforced concretes continues today.

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

MATERIALS AND METHODS

Cement

53 grade of ppc is used

Steel

The steel reinforcing bars of Fe500 grade are tested under universal testing machine up to failure. The test is conducted based on IS 1786:2008 .

Water

The mixing water should be fresh, clean and potable. The water should be relatively free from organic matter, silt, oil, sugar, chloride and acidic material. It should have a pH 7 to minimize the reduction in the pH of the mortar slurry. Salt water is not acceptable, but chlorinated drinking water can be used.

Epoxy resin

Epoxy resins are excellent binding agents with high tensile strength. They are chemical preparations of the compositions which can be changed as per requirements. The epoxy components are mixed just prior to the application. The product is of low viscosity and can be injected in small cracks too. The high viscosity epoxy resins can be used for surface coating or filling larger cracks or holes. The epoxy mixture strength depends on the temperature of curing and method of applications.

Epoxy resin and Accelerator

Fiber glass

Glass fiber is commercially available in many shapes and forms. It has proven essential that not only the correct size and shape but also the correct type be used for the appropriate application.

Glass fiber types readily available include;

- E Glass
- R Glass
- D Glass
- C Glass
- AE Glass

A-glass: With regard to its composition, it is close to window glass. In the Federal Republic of Germany it is mainly used in the manufacture of process equipment.

C-glass: This kind of glass shows better resistance to chemical impact.

E-glass: This kind of glass combines the characteristics of C-glass with very good insulation to electricity.

AE-glass: Alkali resistant glass.

Generally, glass consists of quartz sand, soda, sodium sulphate, potash, feldspar and a number of refining and dying additives. The characteristics, with them the classification of the glass fibers to be made, are defined by the combination of raw materials and their proportions.

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

RESULTS AND DISCUSSION

Improvement in Concrete Properties by Glass Fibers

1) Compressive strength –Increased about 20 – 30%.
2) Tensile strength–It is improved compared to conventional concrete.
3) Flexural Strength–Increased about 25 – 30% .
4) Split Strength –Increased up to 25 – 30% .
5) Impact strength - Improved and better resistance to wear and tear.
6) Permeability - Improved permeability by inclusion of fibers.
7) Corrosion – Better resistance to atmospheric effect compared to normal concrete.

Tables:

Mix design for M25 grade concrete

Cement	Fine aggregate	Coarse aggregate	Water content
425.80 kg/m3	646.41 kg/m3	1073.34 kg/m3	191.61 kg/m3
1	1.51	2.52	0.45

The mix shell designed to produce M25 grade of concrete. The design mix stipulations are:

1) Grade designation: M25
2) Type of cement: PPC 53 grade
3) Maximum nominal size of aggregate: 20 mm
4) Minimum cement content: 330 kg/m3
5) Maximum water-cement ratio: 0.40
6) Exposure condition: severe
7) Type of aggregate: crushed angular aggregate
8) Maximum cement content: 450 kg/m3

Casting of specimens

The wooden formworks required for casting the column are fitted and the required reinforcement are being tied up as per the column calculation. The formwork and reinforcement details provided are shown in the figure below. The columns are casted in Circular and square in shapes. The columns being casted includes normal Columns and Wrapped columns. The size of the column being adopted is of length (l) 0.5m, depth(d) 0.20m and thickness(t) 0.20m.Using the same design and assumed the size to also make a circular column of length (l) 0.5m, and Diameter(D) 0.15m.The columns are being casted and tested under the static loading condition. Four normal and four wrapped columns are casted for each grades and cured for 7days, 14days, 21days, 28days under laboratory conditions.

Testing of specimens

After the period of curing the specimen will be taken out from the curing tank. The first four columns determine the load carrying capacity of the each grade of the columns. The next four columns is wrapped the fiber mats to the both sides of the column by using the Epoxy resin. The fiber wrapped columns are plastering to cover the fiber mat. Cured the plastering surface for two weeks. After the curing the wrapped column will be tested.

No of days	Normal column	Wrapped column
7 days	380kN	450kN
14 days	400kN	500kN
28 days	440kN	550kN

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

CONCLUSION

In this project it is clearly noticed that the use of Glass fiber laminates appears to be a useful rehabilitative measure for the existing member at distress. It is a viable alternative material for the repair and strengthening of reinforced concrete elements. The load carrying capacity and ductility of RCC member is improved by Glass fibers. In this experimental program, eight reinforced concrete columns were casted and tested up to failure. Four RC Column is to be tested to find ultimate load of the normal specimen. The remaining four columns are to be tested to find the ultimate load of the wrapped specimen. Then the columns were rehabilitated using one layer of Glass fiber laminates with the epoxy resin. The normal columns and the wrapped columns were tested up to failure. Then the behavior of the tested columns was studied. The main objective of this experimental work was to access enhancement in load carrying capacity of the concrete columns subjected to compressive load. It has been observed that Glass Fiber Wrapping system is very effective for increasing the load carrying capacity of RC columns. Glass Fiber Wrapping System has shown enhancement in performance of RC columns however more of experimental and analytical work is needed on FRP strengthened RC structures. The flexural strength and ultimate load capacity of the beams can be improved by Glass Fibers. In this study the result shows that load carrying capacity increased on an average, 1.25 times or by 125% as compared to normal column. Also Glass fiber mat is economical since its cost is very less compared to other fiber materials and the cost for GFRP sheet (AE Glass) is only Rs.50/m2.

REFERENCES

[1] IS 10262-1982. “Recommended Guidelines for Concrete Mix Design”. Bureau of Indian Standards, New Delhi.
[2] IS 4031 Part-I “Recommended Guidelines for Test on cement” Bureau of Indian Standards, New Delhi.
[3] IS 12269-1987. “Specification for 53 Grade Ordinary Portland Cement”.
[4] Bureau of Indian Standards, New Delhi.
[5] IS 383-1970.”Specification for Coarse and Fine Agg regates from natural sources for Concrete (second revision)”. Bureau of Indian Standards, New Delhi.
[6] IS 516-1959. “Method of Test for Strength of Concr ete”. Bureau of Indian Standards, New Delhi.
[7] Sandeep G.Sawant, A. B.Sawant, M. B. Kumthekar (2013),“Strengthening of R.C.C. Beam- Using Different Glass Fiber” on Intern ational journals of emerging trends in engineering and development, Vol 5.
[8] M. Saiid Saiidi, Jessen Mortensen, and Frank Martinovic (2001), “Analysis and retrofit of fixed flared column with glass fiber reinforced plastic jacketing” on Nevada department of transportation, RDT 01-027.
[9] Vijayakumar. A, Venkatesh Babu. D.L (2011), “A sur vey of methods and techniques used for Seismic retrofitting of RC buildings” on International journal of civil and structural engineering Volume 2, No 1.
[10]. Dhanu M.N, Revathy D, Lijina Rasheed, Shanavas S (2014), “Experimental and Numerical Study of Retrofitted RC Beams Using FRP” on International Journal of Engineering Research and General Science Volume 2, Issue 3.
[11] Sandeep kumar L.S, Dr.H.N.Jagannatha Reddy, Rumina Nizar (2013), “Retrofitting of RC beams using Natural FRP wrappin g” on International Journal of Emerging trends in Engineering and Development Issue 3, Vol 5.
[12] Krishnaraju N “Design of reinforced concrete structures”
[13] Punmia B C “Design of reinforced concrete structures”
[14] Ashok k. Jain and Arun k. Jain –“design of reinforced concrete structures”