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STRENGTHING OF RC COLUMNS

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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 fiber, Strengthening, Rehabilitating, Retrofitting.

INTRODUCTION

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.

MATERIALS AND METHODS

1) Steel Fibers: These fibers are generally used for providing concrete with enhanced toughness and post-crack load carrying capacity. Typically loose or bundled, these fibers are generally made from carbon or stainless steel and are shaped into varying geometries such as crimped, hooked-end or with other mechanical deformations for anchorage in the concrete. Fiber types are classified within ACI 544 as Types I through V and have maximum lengths ranging from 1.5” to 3” (30 – 80 mm) and can be dosed at 10 to 100 lbs/yd (6 to 67 kg/m3). Straight, crimped, twisted, hooked, ringed, and paddled ends. Diameter range from 0.25 to 0.76mm.

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2) Micro-synthetic fibers: These fibers are generally used for the protection and mitigation of plastic shrinkage cracking in concrete. Most fiber types are manufactured from polypropylene, polyethylene, polyester, nylon and other synthetic materials such as carbon, aramid and other acrylics. These fiber types are generally dosed at low volumes ranging from 0.03 to 0.2% by volume of concrete – 0.5 to 3.0 lbs/yd (0.3 to 0.9 kg/m3).

3) Macro-synthetic fibers: This newer class of fibers has emerged over the past 15 years as a suitable alternate to steel fibers when dosed properly. Typical materials include 3 polypropylene and other polymer blends having the same physical characteristics as steel fibers (length, shape, etc.), These fibers can be dosed from 3 to 20 lbs/yd (1.8 to 12 kg/m3).

4) Glass Fibers: GFRC (Glass Fiber Reinforced Concrete) has been predominantly used in architectural applications and modified cement based panel structures. Straight. Diameter ranges from 0.15 to 0.5mm (may be bonded together to form elements with diameters of 0.7 to 3mm).

5) Cellulose Fibers: Manufactured from processed wood pulp products, cellulose fibers are used in a similar manner to micro-synthetic fibers for the control and mitigation of plastic shrinkage cracking.

6) Natural Fibers: Not typically used in commercial applications of fiber reinforced concrete, natural fibers are used to reinforce cement based products in applications around the world and include materials such as coconut, sisal, jute and sugarcane. These materials come in varying lengths, geometries and material characteristics. Wood, asbestos, cotton, bamboo, and rock wool. They come in wide range of sizes.

7) PVA Fibers: Poly-vinyl alcohol fibers are synthetic made fibers that when used at higher volumes, can alter the flexural and compressive performance of concrete.

8) Specialty Fibers: This classification of fibers covers materials not described above and generally pertains to newly manufactured or specified materials not common to the above categories.

9) Steel & Micro / Macro blends: A recent development in the field of fiber reinforced concrete that has emerged in the marketplace has been the combination or blending of steel and / or macro-synthetic fibers with various types of micro-fibers to help control plastic shrinkage cracking (ie: micro-synthetics) while at the same time providing concrete with enhanced toughness and post-crack load carrying capacity achieved only with the use of steel and macro-synthetic fibers. These fibers are typically dosed at the prevailing.

10)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 .The test results are represented in the table below. **11) 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.

12) 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.

13) 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.

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FIGURE

Epoxy resin and Accelerator

TESTING SETUP

CUBE AT COLLAPSE STAGE

RESULTS AND DISCUSSION

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.

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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/m^2.

Tables: Test result of square columns

No of days	Normal column	Wrapped column
7 days	380kN	450kN
14 days	400kN	500kN
21 days	410kN	510kN
28 days	440kN	550kN

Test result of circular columns

No of days	Normal column	Wrapped column
7 days	350kN	430kN
14 days	380kN	450kN
21 days	410kN	510kN
28 days	450kN	550kN

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.

REFERENCES

BOOKS:

1. Krishnaraju N “Design of reinforced concrete struct ures” Punmia B C “Design of reinforced concrete structure s”
2. Ashok k. Jain and Arun k. Jain –“design of reinforc ed concrete structures”

ISSN: 2277-9655
Impact Factor: 3.785

CODE BOOKS:

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". Bureau of Indian Standards, New Delhi.
4. IS 383-1970."Specification for Coarse and Fine Agg regates from natural sources for Concrete (second revision)". Bureau of Indian Standards, New Delhi.
5. IS 516-1959. "Method of Test for Strength of Concr ete". Bureau of Indian Standards, New Delhi.

JOURNALS:

1. 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.
2. 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.
3. 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.
4. 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.
5. 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.