ISSN: 2278-4632
Vol-10 Issue-6 No. 13 June 2020

Enhancement in strength of Concrete structure by using FRP Bars

VermaPunit

Civil Engineer Anubha Chouhan and associates Indore, India

punit.verma12@gmail.com

Abstract

Fiber reinforced polymer (FRP) bars have been very widely used in civil engineering field used as a replacement of steel reinforcement because it has many better characteristics like high strength-to-weight ratio, electromagnetic neutrality, light weight, ease of handling and also have anticorrosive characteristics. However, the production technology is becoming more and more advanced and industrialized therefore FRP is now an economical and competitive structure material. According to the recent researches, this paper mainly represents advancement in the studies on concrete structures reinforced with FRP bars. These matters in this paper consist of the knowledge about the bond performance of FRP bars in concrete, Compression Behavior, ductility and flexural behavior of concrete structure reinforced with FRP bars in the past few years in the world. Although both the terms cement and concrete are used interchangeably, cement is an ingredient of concrete while concrete is a mixture of aggregates and paste. The aggregates are sand and gravel or crushed stone; the remaining paste is water and the Portland cement. FRP Reinforcing Bar is actually a structural reinforcing bar made from filaments or fibers held in a polymeric resin matrix binder. The FRP Reinforcing Bar is made from filaments or fibers held in a polymeric resin matrix binder. The FRP Bar can be made from various types of fibers such as Glass (GFRP) or Carbon (CFRP).

KeyWords

FRP Bars, Concrete Structure, Strength-to-weight ratio, Bond Performance, Compression Behavior, Flexural Behavior, and Ductility.

Introduction

History of Fiber Reinforced Composites indicates that since older times we are using composites. If we notice back in 1500 BC., Egyptians and Mesopotamian settlers made a mixture of mud and sticks to make their huts. After that in 1200 AD., Mongols made composite bow which was mainly used for military purposes. The use of this composite increased more after confinement of plastics in 1900s. The history of modern fiberglass is also can be seen. In the year 1907 the first thermosetting polymer Bakelite was introduced after it's introduction the plastic industry had grown with the rapid rate and later the plastics such as polymethyl meth acrylate, polyvinyl acetate, polyvinyl chloride, polyester, polystyrene were developed. In the year 1935, first glass fabric was introduced, and it gave rise to FRP industry. World War II (1939-1945) brought the composite industry from laboratory to industrial manufacturing. In the year 1941, Henry ford used FRP material in advanced automobile industry . "Gold Worthy" is known as the Father of composite. He made glass laminates in between 1942 and 1944. The first boat hull was manufactured in 1946 by using glass fiber. While in between 1960s and 1970s more researches done on the FRP composite. Moreover from the year 1960s the aircraft components like fairings, windscreens,

ISSN: 2278-4632
Vol-10 Issue-6 No. 13 June 2020

spoilers and floor board were started modifying with the use of FRP Composites. In 1963 W.Watt, L.N. Phillips and W.Johnson invented carbon fibers possesing extra ordinarily high potential strength. From the year 1970 the composite industry became urbanized and much more developed. In the year 1972 Group Lotus Car Ltd. patented a vacuum moulding method for manufacturing the FRP composites.In the year 1973 due point represented Aramid fibers, possessing very high impact strength. In the year 1978, Gotch explained the use of vacuum impregnation with one solid tool with silicone rubber bag . In 1980 and in 1985 he performed various experiments at different stages with silicone vacuum bag with the help of vacuum pressure. Between1980s & 1990s, manufacturing of FRP composite was more & at higher level to lessen the actual cost of manufacturing .In the year 1980 Covington and Bavmgardner promote the development of prototype fiber glass helicopter rotor blades by using filament winding. In 1982 Pultrusion process was invented by father of composite "Gold Worthy". However n the year 1982 the Indian institute of Composite material was also put up high . In the year 1985, Resin transfer molding was introduced to make the motor car bodies, laser 28 deck and in 1986 boat hulls. In 1986, Hold has provide the development of tape winding machine for the manufacturing of composite main motor blade parts. In 1987, Advance composite manufacturing center was further established to deliver composite mainly for the sectors of research and development. In the year 1988 – centrifugal casting was invented to manufacture the cylindrical pipes having very large diameters. In the year 1989 Boyce has also used the robots in the winding resin fibers specifically to show the reinforcement before the compression molding. Since the concept on Fiber Reinforced Composite manufacturing has beginned, composite industry has passed and modified over years for different processes . It may balance and coordinate four generations of composites: The first generation of composite started in 1940s with the use of Glass fiber reinforced composites, The second generation started in 1960s with the use of high performance composites, During 1970s to 1980s, in the third generation, search for fresh market in the world of composite was grown and later on after duration of 1990s, the fourth generation used the Hybrid Materials, Nano-composites.

Though these composites consist of concrete as a building material made from a mixture of broken stone or gravel, sand, cement, and water, which can be spread or poured into moulds and forms a mass resembling stone on hardening yet FRP bars proved stronger than concrete or than slabs of concrete.

That becomes a very hard building material made by mixing together cement, sand, small stones, and water. It covers specially the reinforced concrete, a concrete floor and a grey concrete building.

Although the terms **cement and concrete** often are used interchangeably, **cement** is actually an ingredient of **concrete**. **Concrete** is a mixture of aggregates and paste. The aggregates are sand and gravel or crushed stone; the paste is water and portland **cement**. While FRP Reinforcing Bar is A structural reinforcing bar made from filaments or fibers held in a polymeric resin matrix binder. The FRP. The FRP Reinforcing Bar in a more specific way is a structural reinforcing bar made from filaments or fibers held in a polymeric resin matrix binder. The FRP Bar can be made from various types of fibers such as Glass (GFRP) or Carbon (CFRP). FRP bars have a surface treatment that facilitates a bond between the finished bar and the structural element into which they are placed. FRP Bars are intended for use as concrete reinforcing in areas where steel reinforcing has a limited life span due to the effects of

ISSN: 2278-4632
Vol-10 Issue-6 No. 13 June 2020

corrosion. They are also used in situations where electrical or magnetic transparency is needed. In addition to reinforcing for new concrete construction, FRP bars are used to structurally strengthen existing masonry, concrete or wood members. Why is it innovative? FRP bars are a new type of structural material for the civil engineering community. The basic constituent materials for reinforced concrete design have changed very little in the past 100 years. Traditionally, composite materials have been used extensively in aerospace and consumer sporting goods where their high strength to weight characteristics were first exploited. Corrosion of steel reinforcement in concrete structures causes deterioration of concrete resulting in costly maintenance, repairs and shortening of the service life of structures. Government agencies throughout the world have recognized the potential benefits to society if our infrastructure can last longer and are thus funding significant amounts of research in the field of FRP's. What does FRP Change or replace? FRP bars are an alternative to steel rebar in many applications and to steel plate-bonding techniques for structural strengthening. Where and when did FRP bars originate, has it been used and is expect to be used? The concept of FRP bars has been around since the 1960's, but advances in the field of polymers, advancements in production techniques and implementation of authoritative design guidelines have resulted in a rapid increase in usage of FRP bars in the last 5 years. FRP bars have been used in a number of FHWA funded Innovative Bridge Research projects as rebar in bridge decks (photo) and in a number of seawall and marine structure projects including the rehabilitation of Dry Dock #4 at Pearl Harbor Hawaii (photo). Other uses include slurry wall construction (photo) as "soft-eye" openings for tunnel boring machines, and reinforcing for ornamental and architectural concrete of all types. A great deal of research is being performed utilizing FRP bars as structural strengthening of existing concrete and masonry members to increase flexural and shear capacity. Examples of this technique have been used to remove the posted rating of a bridge in Missouri (photo) and seismic strengthening of un-reinforced masonry walls (photo Bar can be made from various types of fibers such as Glass (GFRP) or Carbon (CFRP).

ISSN: 2278-4632
Vol-10 Issue-6 No. 13 June 2020

Conclusion

This paper deals with not only exploring different manufacturing process to produce fiber reinforced composites, but also it highlights history, recent developments and future market requirements. It has been seen, there is enormous scope in manufacturing of fiber reinforced composite which includes defense, aerospace, wind, household, toys, transportation, wind, electrical parts and so on. It is high time to aware end product users about the scope of composite in market and requirement of mass production. If we compare different manufacturing process, only 8% products are made with RTM & VARTM technology. VARTM has huge potential to manufacture critical parts with required properties at economical rate. We will work on the same concept to manufacture high quality fiber reinforced composite parts.

Acknowledgement

This paper work is carried out as a part of my recent studies and researches , under the guidance, support and coordination of Anubha solutions and their associates.

References

[1] Prof. R. Velmurugan, composite materials, Module II - Manufacturing Techniques, Dept. of Aerospace Engg., Indian Institute of Technology, Madras, Retrieved February 2017, from http://www. nptel.ac.in/courses/101106038/mod02lec01.pdf

[2] Dr.John summerscales, Manufacturing concepts for volume production of large composite components, International Symposium on Composite Materials with Textile Reinforcement for use in Building Construction and Related Applications 18 (1990), volume 3, 387-394.

[3]B.J. Yang, S.K. Ha, S.H. Pyo, H.K. Lee, Mechanical characteristics and strengthening effectiveness of random-chopped FRP composites containing air voids, Composites: Part 62 (2014) 159–166.

[4] Tim Palucka and Bernadette Bensaude.(2002, October 19)Composites Overview, history of recent science & Technology, Retrieved February 2017, from http://authors.library. caltech.edu

ISSN: 2278-4632
Vol-10 Issue-6 No. 13 June 2020

[5] L.C. Hollaway, A review of the present and future utilization of FRP composites in the civil infrastructure with reference to their important in-service properties, Construction and Building Materials 24 (2010) 2419–2445.

[6] Rahman, M. A., Parvin, F., Hasan, M., & Hoque, M. E. (2015). Introduction to manufacturing of natural fibre-reinforced polymer composites. In Manufacturing of Natural Fibre Reinforced Polymer Composites (pp. 17-43).

[7] Todd Johnson. (2016, August 22)History of composites, the evaluation of light weight composite material, Retrieve February 2017, from http://composite.about.com.

[8] Fransisko G. Roosenboom, Building the future with FRP composites FRP composite sandwich elements as an all-in-one building skin, 2014

[9] Huntsman International LLC. (2001- 2017) Wet Lay-Up Moulding Processes Retrieved February 2017, from http://www.huntsman.com/advanced_materials

[10] Manufacturing of Composite, Department of Aerospace Engineering, AE681 composite Materials, Retrieved February 2017, from https://www.google.co.in.

[11] Composite material and manufacturing by society of manufacturing Engineering, Retrieved January 2017, from www.sme.org

[12] Molded Fiberglass Companies, (2016) Moulding process, Retrieved February, 2017, from http://www.moldedfiberglass.com

[13] US Department of Energy (2015 February 15) Advance Composite material and their Manufacturing Technology Assessment. Retrieved February 2017, from https://energy.gov/ sites/prod/files2015 /02/ f19/ QTR% 20Ch8%20-%20Composite%20Materials%20 and %20Manufacture%20Feb-13- 2015.pdf

[14] H. Hernández-Morenoa, B. Douchin, , F. Collombet, D. Choqueuse,and P. Davies, Influence of winding pattern on the mechanical behavior of filament, Composites Science and Technology, March 2008, Volume 68, Issues 3-4, Pages 1015-1024.

[15] Lucintel (2016, December 14) Growth Opportunities in the Indian Composites Market: 2016-2021 Trends, Forecast, and Opportunity Analysis, Retrieved February 2017, from http://www.lucintel.com/indian_composites_market_2016_2021.aspx

[16] Dr. Inderdeep Singh (2013, January 7) Module – 5 Polymer Matrix Composites: Processing Index Retrieved February 2017, from http://textofvideo. nptel.iitm.ac.in/112107086/.

[17] American Composites Manufacturers Association (2017) Compression moulding process Retrieved February 2017, from http://www.acmanet.org

[18] Advance Material in Transport Aircraft Structure, Summary of Methods used to Manu- facture PMCs Retrieved February 2017, from http://courses.washington.edu /mengr450 /Manufacturing.pdf

ISSN: 2278-4632
Vol-10 Issue-6 No. 13 June 2020

[19] ICEP (2017) Indian Composites Industry Outlook Retrieved February 2017, from http:// icerpshow.com/about-icerp/indian-composites-industry-outlook/ 10 1234567890‘’“” ICRAMMCE 2017 IOP Publishing IOP Conf. Series: Materials Science and Engineering 330 (2018) 012107 doi:10.1088/1757-899X/330/1/012107

[20] Soumitra Biswas, Atul Mittal & G Srikanth. (2009) Composites: A Vision for the Future Retrieved February 2017, from http://www.tifac.org.i

[21]Sanjay K. Maunder. (2001, December 27) Composite manufacturing material, product and process engineering, Retrieved February 2017, from https://www.crcpress.com. 9 1234567890‘’“” ICRAMMCE 2017 IOP Publishing IOP Conf. Series: Materials Science and Engineering 330 (2018) 012107 doi:10.1088/1757-899X/330/1/012107

