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A Review on Fiber Reinforced Concrete Using Glass Fiber Reinforced Concrete (GFRC)

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***Abstract*- Plain concrete possess very low tensile strength, limited ductility and little resistance to cracking. Internal micro cracks are inherently present in concrete and its poor tensile strength is due to propagation of such micro cracks. Fibers when added in certain percentage in the concrete improve the strain properties well as crack resistance, ductility, as flexure strength and toughness. Mainly the studies and research in fiber reinforced concrete has been devoted to steel fibers. In recent times, glass fibers have also become available, which are free from corrosion problem associated with steel fibers. The present paper outlines the experimental investigation conducts on the use of glass fibers with structural concrete. CEM-FILL anti crack, high dispersion, alkali resistance glass fiber of diameter 14 micron, having an aspect ratio 857 was employed in percentages , varying from 0.33 to1 percentage by weight in concrete and the properties of this FRC (fiber reinforced concrete) like compressive strength, flexure strength, toughness, modulus of elasticity were studied.**

***Keywords*- Fiber reinforced concrete (FRC), Ductility , Flexural Strength ,Tensile Strength.**

I. INTRODUCTION

Fiber Reinforced Concrete is a composite material consis ting of a matrix containing a random distribution or disper sion of small fibres, having a high tensile strength. Due to the presence of these uniformly dispersed fibres, the cracking strength of concrete is increased and the fibres acting as crack arresters.Fibers when added in certain percentage in the concrete improve the strain properties well as crack resistance, ductility, as flexure strength and toughness. Alkali resistant glass fibre prevents corrosion and helps improve concrete properties. Like increase ten sile strength, improve resistance to impact, increase shear strength,better water resisting properties.Glass fibers weight is much lighter than when steel is used in concrete. Good freeze-thaw resistance helps protect varying climatic conditions at marine environments in very cold countries.

Conventional concrete has the trait known as "brittle failure" because it has a semicrystalline structure, which tends to shatter on impact. This is especially dangerous when subjected to explosive force because ballistic debris is created which can create significant collateral damage. This is not the case with GRFC, as it does not experience brittle failure. The glass fiber tends to hold the material together because the fibers are dispersed randomly and lay in all directions within the material matrix. GFRC has a dramatically reduced ballistic debris profile. In this study , it is decided to experiment find out the strength and durability of the Glass Fibre Reinforced Concrete made using Portland Pozzolana Cement for assessing its suitability for Marine and Hydraulic Constructions.

Deshmukh et.al.has studied in his paper ‘Effect of Glass Fibres on Ordinary Portland cement Concrete.

1. Fibre Reinforced Concrete:

Fibre reinforced concrete is a concrete reinforced with fibres i.e. fibres are embedded during the mix of concrete. Properties such as compressive strength, flexural strength, and various other properties are improved. Fibre rein forced concrete (FRC) is a concrete made primarily of hydraulic cements, aggregates and discrete reinforcing fibres.FRC is a relatively new material.This is a composite material consisting of a matrix containing a random distribution or dispersion of small fibres, either natural or artificial, having a high tensile strength. Due to the presence of these uniformly dispersed fibres, the cracking strength of concrete is increased and the fibres acting as crack arresters.

2. Glass Fibre Reinforced Concrete:

Glass-fibre reinforced concrete (GRC) is a material made of a cementations matrix composed of cement, sand, water and admixtures, in which short length glass fibres are dispersed It has been widely used in the construction indu stry for non-structural elements, like façade panels, piping and channels. GRC offers many advantages, such as being lightweight, fire resistance, good appearance and strength. In this study trial tests for concrete with glass fibre and without glass fibre are conducted to indicate the differences in compressive strength and flexural strength by using cubes of varying sizes.

II. LITERATURE REVIEW

Yildizelet al. (2020) presented general design optimisation of glass fibre (GF)-reinforced concrete (GRC) was conducted to help professionals in producing industrial concrete facades and walls. The effects of ingredients, including paste and silica sand used as aggregate meta kaolin (MK) and GF contents, were examined in terms of their compressive and flexural strengths. Fresh concrete properties, such as workability, were investigated through fibre content tests.

Ibrahimet al. (2020) Concrete is a composite material composed mainly of water, aggregate, and cement. Often, additives and reinforcements (such as rebar) are included in the mixture to achieve the desired physical properties of the finished material. When these ingredients are mixed together, they form a fluid mass that is easily molded into shape. Over time, the cement forms a hard matrix which binds the rest of the ingredients together into a durable stone-like material with many uses. Concrete is the most widely used material in the world after water.

Rameshet al. (2020) investigated The flexural behaviour of externally bonded glass fibre reinforced polymer (GF RP)reinforced concrete (RC) beams incorporating both 'basalt' and 'polyolefin' fibres at a constant ratio of 70:30 and in several combinations of fibre volume fractions (Vf) ranging from 0–2% (at a constant increment of 0.5%), to highlight to role of strengthening and the hybrid fibres in beams.

Kimm, Magdalenaet al. (2020) Addition of glass fibers in to concrete significantly modifies its tensile strength.The fibers are placed at desired locations and orientations by the matrix surrounding it, thereby making the fibers as principal load carrying members and also protecting them from environmental damage.Glass fibers provide resis tance to high temperature, and the ease of incorporating them into the matrix either in continuous or discontinuous lengths. In this work, carbonation test representing the durability of Glass Fiber Reinforced Concrete (GFRC) was carried out,and then experimental program determines the properties like compressive strength, split tensile strength and flexural strength of GFRC for 7 days and 28 days of curing, with percentage of fibers in ratios 0.5%, 1%,1.5%,2% and performance of GFRC at elevated temp eratures of 300°c,500°c,700°c,1000°c are compared with conventional concrete.

The results depict that, the residual compressive strength capacity of GFRC is greater than un reinforced concrete both at elevated and normal temp eratures.

Dong, Minhao et al. (2020) It has been recognized that the addition of small, closely spaced and uniformly dispersed fibres' to concrete would act as crack arrester and would substantially improve its static and dynamic properties.GFRC derives its strength from a high dosage of AR glass fibers; while compressive strength of GFRC can be increased, it is the much higher flexural and tensile strengths that make it superior to ordinary concrete. GFRC has very high tensile strength up to 1020 to 4080 N/mm2 . The alkali resistant glass fibre reinforcement in concrete shows considerable improvement in durability.

Bazli, Milad etal. (2020) presented investigation on the durability of different glass-fibre-reinforced polymer comp osites when subjected to harsh outdoor conditions, inclu ding freeze/thaw cycles, ultraviolet radiation and moisture, as well as when used with seawater sea-sand concrete for construction applications.

Jia, Daoguang et al.(2020) concluded that 7 days average compressive strength of concrete is maximum when 1.5 % of glass fibres by weight of cementitious material are used. At lower 0.11% of glass fibers or higher 2 % of glass fibers, about 15% to 20% reduction in strength is observed nevertheless at 28 days,the reduction in strength appro aches to 5% to 10%. Percentage of glass fiber of 2% gave a flexural strength of 6.15 MPa, which is 10% more than that obtained at 1.5%

Ahmed, Hemn et al. (2020)compared the strength aspects such as compressive, split tensile and flexural strength of plain and glass fiber reinforced concretes.They examined that increase in compression,flexural,and split tensile stre ngths for various grades of plain concrete at 3, 7 and 28 days are observed to be 20% to 30%, 25% to 30% and 25% to 30% respectively[4].

In 2011, P.Sangeetha, reported that increase in the percen tage of glass fiber by weight of concrete (0.1%, 0.2%& 0.3%) increases the compressive and impact strength. The percentage increase in compressive strength was reported to be up to 23%

Rezania et al. (2020) The glass fiber used is alkali resis tance glass fiber which has a cut length of 12mm and a diameter of 14 microns. The three main ingredients used to make glass are silicon dioxide(SiO2), lime (calcium oxide orCaO) and aluminum oxide (Al2O3). Changing the mix of those components and other minerals will result in significantly different glasses.E-glass (with good electrical insulation properties, hence the name) is a commonly used glass on the market.

Ou, Ya, Joseph et al. (2020) studied the ultrasonic pulse velocity behavior of high strength concrete by incor porating short discrete glass fibers into high strength concrete. They claimed that all concrete specimens were having good quality [6].

Sudarsana et al., (2011) stated that workability of glass fiber reinforced high performance concrete mixes decre ases with increase in the percentage of glass fibers.

Fawad Khan (2018) The work of different researchers on GFRC has been found on concretes cast by using foreign ingredients only. The trend of locally branded concretes manufactured by using indigenous materials found in Pakistan was still demanding a lot of research work. The current investigation was planned to explore the effects of using different percentages of glass fibres on properties of fresh and hardened concrete like workability, compressive strength, tensile strength, flexural strength and ultra-sonic pulse velocity.

S. Manivel et al (2017) In his study he focused on physical changes and spalling that takes place in concrete when exposed to high temperatures. The paper reports that cubes were exposed from 50ºc to 250ºc for 3 hours and results have depicted that the strengths got increased until the temperatures reached 50ºc and then gradually got reduced beyond 50ºc.

Chinnadurai P et al (2017) Australia has made a similar study on fiber reinforced concrete and has elevated the concrete from 400ºc to 800ºc and compared it to unrein forced concrete, from the study he has mentioned that he used both steel and basalt fibers, where on elevating to temperatures he concluded stating that the residual compressive strength capacity of steel fiber is more when compared to basalt fibers and conventional concrete at elevated and normal temperatures

III. CONCLUSION

In this study, it is concluded that the variety of Glass Fibre Concrete made with Portland Pozzolana Cement is an exce llent choice for marine and hydraulic structure constru ctions, as compressive strength, flexural strength and tensile strength increases with increase in percentage of glass fibre with respect to volume of concrete. Also since, the deterioration found for chloride resistance is found to be very less

As tensile and compressive strength increases with increase in percentage of glass fibre with respect to volume of concrete, marine and hydraulic structural elem ents can be provided with extra concrete cover supported by glass fiber, which makes it hard for elements that cause deterioration to reach the surface of steel reinforcements, preventing corrosion and increasing the life of concrete in these environments.

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