International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 12, pp: 428-431 www.ijaem.net ISSN: 2395-5252

A Study On Comparison Between The Strength Of Glass Fiber Reinforced Concrete And Conventional Concrete (M30 Grade)- A Review

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Date of Submission: 20-11-2021 Date of Acceptance: 05-12-2021

ABSTRACT – It is a recent advancement in the construction technology,since it is light in weight, therefore bringing economy in the construction. Steel is replaced by the glass fibre helps in avoiding structural deterioration and corrosion in reinforced concrete structures.
Keeping in mind about the global environmental conditions, many alternatives are searched to increase the strength, durability, shrinkage characteristics and serviceability of concrete.
Hence, here glass fibre is added and tests have been performed with varying percentage of 1%, 2% and 3% of cement by adding as an admixture.

KEYWORDS: Glass fibre, Light weight, Economic, Eco friendly, Compressive strength.

I. INTRODUCTION

The construction industry is revolutionizing in two major ways. One way is the development of construction techniques, such as using automated tools in construction. The other is the advancement in high-performance construction materials, such as the introduction of high strength concrete. Among these high-performance materials, fibre reinforced concrete (FRC) is gradually gaining acceptance from civil engineers. In recent years, research and development of fibres and matrix materials and fabrication process related to construction industry have grown rapidly. Their advantages over other construction materials are their high tensile strength to weight ratio, ability to be moulded into various shapes and potential resistance to environmental conditions, resulting in potentially low maintenance cost. These properties make FRC composite a good alternative for innovative construction. Their application in construction includes both upgrading existing structures and building new ones, which can apply to various types of structure, for example offshore platforms, buildings and bridges.

Concrete is the most versatile construction material of use next to water. The simplest reason for its extensive use in the construction of almost all civil engineering works is that the properties can be controlled within a wide range by using appropriate ingredients and by special mechanical, physical land chemical processing techniques. Concrete is the most widely used construction material having several desirable properties like high compressive strength, stiffness and durability under usual environmental conditions. Plain concrete possesses a very low tensile strength, limited ductility and little resistance to cracking. This shortcoming is offset by providing steel bars at appropriate locations at the time of casting the members to take up the tensile stresses and sometimes the compressive stresses if required Normally reinforcement consists of continuous deformed steel bars or pre-stressing tendons. The advantage of reinforcing and pre-stressing technology utilizing steel reinforcement as high tensile steel wires have helped in overcoming the in capacity ofconcrete in tension but the durability and resistance to cracking is not improved. These properties can be improved by the use of fibres in the concrete. It has been revealed that concrete reinforced with a permissible amount of fibre acquires better performance in compression, flexure, toughness and energy absorption, in which the degree of improvement relies on the types of fibres used.

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Experiment shave been carried out by several investigators using fibres of glass, carbon, asbestos, polypropylene etc. More over fibres also helps in restricting the growth of micro-cracks at the mortar-aggregate interface thus transforming an inherently brittle matrix i.e. cement concrete with its low tensile and impact resistances, into a strong composite with superior crack resistance, improved ductility and distinctive post cracking behaviour prior to failure.

Glass fibre–reinforced concrete (GFRC) is a type of concrete which basically consists of a cementitious matrix composed of cement, sand, coarse aggregate, water, polymer and admixtures, in which short length glass fibres are dispersed. In general, fibres are the principal load-carrying members, while the surrounding matrix keeps them in the desired location sand orientation, acting as a load transfer medium between the fibres and protecting them from environmental damage. In fact, the fibres provide reinforcement for the matrix and other useful functions in fibre-reinforced composite materials. Glass fibres can be incorporated into a matrix either in continuous or discontinuous (chopped) lengths. Glass fibres have large tensile strength and elastic modulus but have brittle stress strain characteristics and low creep at room temperature. Glass fibres are usually are usually round and straight with diameters from 0.005 mm to 0.015 mm. Different types of glass fibres are available in the market having different length, diameter and aspect ratio. In the present study alkali resistant glass fibres were used throughout the experiments. The study comprises of a comparative study of some of the properties of concrete for two different grades of concrete by varying the percentages of fibres. The aim of this study was to identify the improvement in strength characteristics of concrete with the addition of glass fibre. In the study, glass fibre is added to concrete and Plain Cement Concrete (PCC) is used as reference to study its effect on flexural, compressive and tensile strength properties and also drying shrinkage. Fibre is coated with oil so as to decrease the water absorption. Some of the advantages being observed are low-cost, low density, reasonable specific strength, good thermal insulation, reduced wear and ability to be recycled with minimal impact on environment (Majid Ali et al.,2011). Thus in addition to the enhancement in the physical properties of concrete, it turns out to be a sustainable waste management technique.

1.1 GFRC OVER CONVENTIONAL CONCRETE

•Lighter weight: With GFRC, concrete can be cast in thinner sections and is therefore as much as 75% lighter than similar pieces cast with traditional concrete. An artificial rock made with GFRC will weigh a small fraction of what a real rock of similar proportions would weigh, allowing for lighter foundations and reduced shipping cost.
•High strength: GFRC can have flexural strength as high as 4000 psi and it has a very high strength-to-weight ratio.
•Reinforcement: Since GFRC is reinforced internally, there is no need for other kinds of reinforcement, which can be difficult to place into complex shapes.
•Toughness: GFRC doesn't crack easily-it can be cut without chipping.
•Adaptability: Sprayed or poured into a mould, GFRC can adapt to nearly any complex shape, from rocks to fine ornamental details.
•Sustainable: Because it uses less cement than equivalent concrete and also often uses significant quantities of recycled materials (as a pozzolona), GFRC qualifies as sustainable.
•Cost: GFRC as a material, however, is much more expensive than conventional concrete on a pound-for-pound basis. But since the cross sections can be so much thinner, that cost is overcome in most decorative elements.

1.3 NEED FOR STUDY

GFRC derives its strength from a high dosage of AR glass fibre. While compressive strength of GFRC can be quite high, it's very high flexural and tensile strengths that makes it superior to ordinary concrete. Essentially the high doses of fibres carries the tensile loads and make it more flexible without cracking.
GFRC is used to make large, light weight panels that are often used as facades. So there is a reduction in total cost of material used.
So, due to its better structural properties and reduced cost with high strength we need to study its properties for further optimum use of it.

1.4 OBJECTIVES AND SCOPE

The aim of this study is to investigate the effect of glass fibre on physical properties of concrete
The objectives of this work are:

- To study the mix design aspects of the GRC.
- To check the compressive strength.
- To check the feasibility and impact on environment.
- To understand various applications of GRC.

1.5 LITERATURE REVIEW

Bhatia, 2001 studied the usefulness of fibre reinforced concrete in various civil engineering applications. Fibres include steel fibre, natural fibres and synthetic fibres each of which lends varying properties to the concrete. The study revealed that the fibrous material increases the structural integrity.

These studies made us adopt glass fibres which are easily available and cheap.

J.D. Chaitanya kumar2016, his study concluded that the addition of glass fibres at 0.5%, 1%, 2% and 3% of cement reduces the cracks under different loading conditions. It has beenobserved that the workability of concrete increases at 1% with the addition of glass fibre. The increase in compressive strength, flexural strength, split tensile strength for M-20 grade of concrete at 7 and 28 days are observed to be more at 1%. We can likewise utilize the waste product of glass as fibre.
It has been observed that there is a gradual increase in compressive strength compare to the normal concrete. The workability of concrete decreases from 1% due to the addition of fibre. The compressive strength is very high at 1% having for 7 days is 20.76N/mm2 and for 28 days is 28.46N/mm2. The tensile strength is very high at 1% having for 7 days is1.47N /mm2 and for 28 days is 2.94N /mm2.The split tensile strength is very high at 1% having for 7 days is 2.83 N /mm2 and for 28 days is 3.92N /mm2.

Eng.Pshtiwan. N. Shakor 2011, conducted trial tests for concrete with glass fibre and without glass fibre to indicate the differences in compressive strength and flexural strength by using cubes of varying sizes. He concluded that Glass fibre helped concrete to increase compressive strength until indicated limit. A limit exists to a particular percentage from glass fibre mixed with concrete because increasing itseffects on the bond of materials as is seen in the result. For 1.5% of cementitous weight the 7 days average compressive strength of concrete is maximum. At lower or higher %, about 15% to 20% reduction in strength is observed nevertheless at 28 days, the reduction in strength reduced by 5% to 10%.According to this result, increasing weight of glass fibre in normal concrete affects the cohesiveness between the particle of concrete and this results in degrading of compressive strength, flexural and tensile strength .Glass fibre does not effect on high performance concrete, if it especially contains big gradation of coarse concrete because it leaves more porosity and spaces between the particles and allows air to move between. One should take care of glass fibre during mixing with concrete. It should be not allowed to mix more than 1 minute, otherwise it will be break to tiny pieces, and it cannot be worked with.

KomalChawla, 2013 conducted experimental investigation on the use of glass fibre with structural concrete. Cem-fill anti crack, high dispersion, alkali resistance glass fibre of diameter 14 micron, having an aspect ratio 857 was employed in percentage .varying from 0.33 to1 percentage by weight in concrete and the properties of this Fibre Reinforced Concrete (FRC) like compressive strength, flexure strength, toughness, modulus of elasticity were studied. The percentage increase of compressive strength of various grades of glassfibre concrete mixes compared with 28days compressive strength is observed 37%. The percentage increase of flexure strength of various grades of glass fibre concrete mixes compared with 28days compressive strength is observed 5.19%.

C. SelinRavikumar and T.S. Thandavamoorthy 2013, conclusions drawn from the study on addition of glass fibre in concrete. With 0.5 per cent addition of fibre, the increase in the compressive strength is 13 per cent, the increase in flexural strength is 42 per cent and the increase in split tensile strength is 20 percent over conventional concrete. With 1 per cent addition of fibre, the increase in the compressive strength is 35 per cent, the increase in flexural strength is 75 per cent and the increase in tensile strength is 37 per cent. Therefore reinforcing with glass fibre contributes immensely in enhancing the compressive strength of concrete and the increase is 1.78 times that of normal concrete. From the test results, it is found that the glass fibre possesses the high flexural strength. The fire resistant test results show that there is a reduction in the compressive strength, after heating the concrete at 300C for 2 hours. Without the addition of fibre, the decrease in the compressive strength is 32 per cent over its original strength. For 0.5% addition of fibre, the decrease in the compressive strength is 25 per cent over its original strength. Similarly, with 1 per cent addition of fibre, the decrease in the compressive strength 10 per cent over its original strength.This investigation shows a higher resistance of fibre reinforced concrete to fire when compared to normal concrete. So, glass fibre concrete has a better fire resistant characterisitcs.

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