Faculty of Mechanical and Manufacturing Engineering Technology

STUDY OF COMPRESSION STRENGTH OF GLASS FIBER REINFORCEMENT WITH CONCRETE

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Bachelor of Mechanical Engineering Technology (Maintenance Technology) with Honours

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A thesis submitted
in fulfilment of requirement for the degree of Bachelor of Mechanical Engineering Technology (Maintenance Technology) with Honours

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DECLARATION

I declare that this investigation entitled "Study Of Compression Strength Of Glass Fiber Reinforcement With Concrete" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....

Name :LINGESHWARA A/L MANVEERAN

Date : .....

APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of UTeM as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical and Manufacturing Engineering Technology (Maintenance Technology) with Honours. The member of the supervisory is as follows:

……

(Dr.Ahmad Fuad Bin AB Ghani)

DEDICATION

For my beloved mother and father.

ABSTRACT

The current world is undergoing the construction of a very challenging and demanding civil engineering structures. Concrete is the best as it is important and as for now it is a widely used material where it is able to retain very high strength and adequate workability characteristics. Efforts are being conducted in the field of concrete technology to create such concretes with special properties. One of the effort is by the addition of variable fibers to concrete to improve the strength aspects of concrete. Some of the generally known fibers are steel, carbon, glass and organic fibers. In the current studies, we are using alkali resistance glass fiber. Glass fiber is cost-effective where there isn't any need of extra expenditure from the total cost of concrete can be included. A total of 15 samples were prepared by varying the percentage of concrete mixes. Firstly, 3 samples of conventional concrete were tested. Then, the following test was done by adding different percentages of glass fiber to 12 more concrete samples which is 10% and 20%. Two reinforcing method used which are discontinuous fiber reinforcement (chopped) and continuous fiber reinforcement (layer) to both 10% and 20% samples respectively. The compressive capability of each samples were compared. .

ABSTRAK

Pada era dunia yang berkembang pesat ini, dunia pembinaan kini menghadapi perkembangan yang amat sukar dan cabar. Konkrit adalah sejenis bahan yang amat penting dalam pembangunan dan perbinaan. Konkrit kerap digunakan kerana ia dapat mempertahankan berat besar dan boleh memenuhi kriteria kebolehkerjaan. Usaha sedang dijalankan dalam bidang teknologi konkrit supaya dapat menghasilkan sejenis konkrit dengan kriteria istimewa. Salah satu usaha adalah dengan menambah pelbagai jenis gentian untuk menambahpulihkan kekuatan konkrit tersebut. Gentian tersebut dikenali sebagai keluli, karbon, kaca dan gentian organik. Dalam pengkajian terkini, kita akan mengunakan gentian kaca rintangan alkali. Gentian kaca adalah kos efektif kerana tiada kos pertambahan daripada kesemua kos konkrit. 15 sampel telah disediakan dengan kandungan campuran konkrit yang berbeza. Pada permulaan, 3 sampel konkrit konvensional telah diuji. Kemudian, ujian seterusnya mengunakan jumlah campuran yang lain dalam 12 konkrit yang lain. Dua kaedah pengukuhan telah digunakan iaitu gentian cincang yang diperkukuhkan dan gentian berterusan yang juga diperkukuhkan. Kaedah tersebut digunakan dalam kedua-dua sampel iaitu 10% dan 20%. Keupayaan mampatan setiap sampel telah diuji.

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Special thanks to my father, mother and siblings for their moral and financial support in completing this project as per requirement of the university syllabus. Lastly, thank you to everyone who had been to the crucial parts of realization of this project.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Concrete is a composite material broadly utilized worldwide. For an example, a stone with alluring quality and high pressure. Concrete is utilized as a structure material yet has one drawback, which implies that it has a moderately low elasticity and low protection from opening and spreading breaks and is low in pressure. Concrete twisted steel bars or prestressing ligaments are provided with specific suppositions to upgrade its impediments. It can more often than not be reinforced by pressure verification materials (Bentur,2007).

Glass Fiber Reinforced Concrete (GFRC) is a sort of fiber strengthened bond. Glass fiber bonds are essentially used in outside structure and as designing precast concrete. This material is great in making states of any structure and it is less thick than steel. GFRC is a kind of solid that sends fine sand, bond, different admixtures and salt safe glass strands. Glass fiber strengthened concrete composites were grown principally for the creation of slight sheet segments with a glue or mortar network and around 5% fiber substance (Majamur AJ,1968).

Glass strands are delivered through the base of a warmed platinum tank or bushing in a procedure where liquid glass is attracted the type of fibers. Typically 204 fibers are drawn in the meantime and set outside the warmed tank while cooling; they are then gathered on a drum into a strand comprising of 204 fibers.

Fiber-fortified concrete (FRC) is concrete containing stringy material which expands its basic respectability. Strands are normally utilized in cement to control

breaking due to plastic shrinkage and to drying shrinkage. They likewise diminish the permeability of cement and along these lines lessen draining of water. A few sorts of strands produce more noteworthy effect, scraped area, and break obstruction in concrete.The measure of filaments added to a solid blend is communicated as a level of the all out volume of the composite (cement and filaments), named "volume portion" (Vf). Vf typically extends from 0.1 to 3%. The perspective proportion (length/width) is determined by separating fiber length by its breadth. On the off chance that the fiber's modulus of elasticity is higher than the solid, they help to convey the heap by expanding the rigidity of the material. Expanding the perspective proportion of the fiber more often than not sections the flexural quality and sturdiness of the lattice (Brandt AM,1995).

1.2 Problem statement

Aggressive environment attacks such as sulphate attacks, chloride intake, dimensional instability, salt crystallization, and so on, cause damaging effects on the concrete. These deleterious effects deal mainly with the formation of cracks, either due to the formation of expansive products or drying-wetting cycles due to rapid expansion and shrinking. Chloride diffusion triggers steel reinforcement corrosion and initiates the formation of salt crystals in the concrete. Sulfate attack results in ettringitis and gypsum, both of which are expansive in nature.

The shrinking and expansion stresses caused by cyclic wetting and drying induce the micro cracks within the concrete structure as concrete is a brittle material. It leads to the formation of stress concentration zones in a concrete micro structure under such circumstances, even without external load or environmental effects. When the external load, differential shrinkage and environmental factors appear, the

cracks would increase and propagate further, resulting in the location of cracks and concrete failure.

Different parameters, such as water-cell ratio, porosity, density composite, interfiller contents, fibre content, orientation and length and cure effects and behavior of GFRC, as well as accuracy in the production method have different characteristics compared to traditional concrete because of its special structure. GFRC is as thin as 6 mm so that its weight is significantly lower than conventional concrete pre-casting products. The development of 3D printing technologies with fiber-reforced ink enables construction of a complete and complex structural shapes with a high degree of reliability and the use of GFRC premature, spray-up and hybrid methods. The GFRC has contributed both in terms of cost and popularity to self-cleaning environmentally friendly panels for industrial construction. Glass fiber use has gained momentum in recent years in a class that is high-performance Concrete (HPC), a class with extremely high mechanical performance, durability, workability and esthetics. International standards have been developed in Europe, America, Asia and Australasia for the design and manufacture of GFRC products. In more than 100 countries, GFRC is manufactured.

This issues triggers the idea of developing a sustainable resource which can be reinforce with concrete to produce an environmental friendly and recyclable composite. Therefore, research on glass fiber reinforcement with concrete should be done which might improves the strength and rigidity of a composite.

1.3 Objectives of study

The objectives of this study are as below:

I. To study the design aspect of GFRC with regard to compression characterization.

II. To compare compression properties of GFRC with conventional concrete.

1.4 Scope of study

The scopes of study are as stated below:

i. Concrete strength should be desirable and as required.

ii. Fibrous concrete behavior should be more than conventional concrete and therefore fibrous concrete can be used in some structural components.

iii. The effect of fibers on concrete's compressive strength.

iv. Mechanical properties such as the fiber reinforced concrete's compressive strength should be enhanced by adding fibre.

v. Determination of the mechanical properties by applying compression test (ASTM C39).

1.5 Expected results

In this investigation, the utilization of glass fiber common filaments is required to be perfect as a strengthening operator for solid composite as they may deliver more prominent effect, scraped spot, and break opposition in cement.

All in all, the critical improvement in different qualities may saw with the consideration of glass filaments in plain concrete. In any case, most extreme addition in quality of cement (GFRC) may discover rely on the measure of fiber content.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter deals with literature review as a key component in the undertaking of this project and requires as much information as possible in relation to that project to be collected by the research carried out. All information is taken from publications, academic articles, web resources books for this project. Details of the composite, fiber reinforced concrete and concrete test were collected during the study period for this project.

2.2 Composite

A composite is a helper material containing at any rate two materials joined at a perceptible dimension and are not dissolvable. One of the material will be the period of fortification and the other is implanted, called the framework. As strands, particles or chips, the case of strengthening stage materials might be. Instances of composite frameworks incorporate graphite-fortified epoxy and glass-strengthened cement. Advance composites can't avoid being composites used commonly used in different ventures.

Advance composites are customarily utilized composites in various enterprises. These composites utilize elite framework material, for example, epoxy and slim measurement aluminum. Precedents incorporate composites of boron/aluminum, graphite/epoxy, and Kevlar/epoxy. (Kaw, 2006).

There are a few composite sorts that are grouped by their geometry of support (Kaw, 2006):

i.Particulate composites – The particles are isotropic and submerged in grids. This composite has high quality, protection from high temperatures and protection from oxidation.

ii.Flake composite – It has a level network of support. It has a high flexural module, high opposition and ease. It can not be arranged and for restricted materials just accessible.

iii.Fiber composites – It comprises of fiber-reinforced frameworks.

iv.Nanocomposite – It is comprised of nanometer-scale materials. Properties are superior to composites of miniaturized scale.

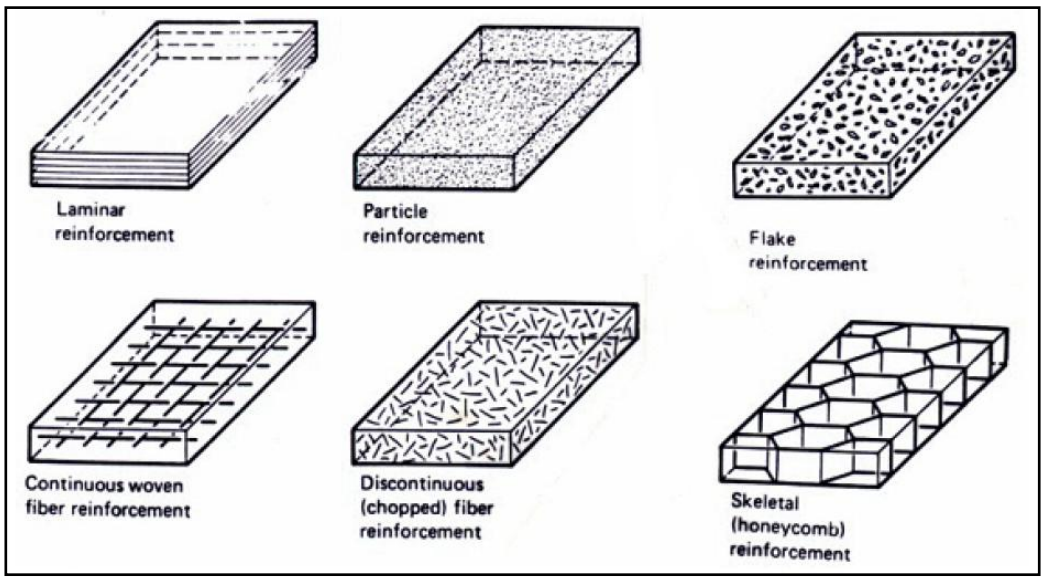

Figure 2.2.1: Schematic illustrations of some common composite strengthening.

2.3 Fiber reinforced concrete

Fiber is such a material, that reinforces. Fiber are little bits of material that have certain properties and attributes. Fiber are viewed as a structure material to improve flexural and elasticity and as a folio that could be utilized to consolidate Portland bond with concrete lattices. Fiber increment the solid's basic respectability. Because of plastic shrinkage and drying shrinkage, strands are normally utilized in cement to control breaking. It produces higher protection from effect and scraped spot. Utilizing miniaturized scale filaments gives better protection from effect. Fiber-strengthened cement (FRC) is another, inexorably significant basic material. FRC is a generally new water driven bond, totals and discrete strands composite material. The FRC framework was utilized for various purposes. Due to their inalienable advantages, filaments discover applications in structural building on a huge scale. High quality filaments, good direction, fiber volume, fiber length and fiber measurement were freely found to improve composite quality. The idea of utilizing strands as support isn't new. Horsehair was utilized in morter and straw in mud-blocks in antiquated occasions. Asbestos filaments were utilized in cement amid the 1900s. In any case, asbestos was debilitated because of wellbeing hazard location. Botson and Romualdi distributed their exemplary paper on the FRC in 1963. From that point forward, asbestos in cement was supplanted by new material like steel, glass and engineered filaments. Research on this innovation is as yet continuous. FRC is viewed as one of development designing's most noteworthy advances (Dr Atul K,1997).

A few precedents or renowned structures worked by FRC framework:

• Roman Colosseum was worked in 80 AD, utilized steed hair as auxiliary support in figure:2.3.1.

• Tipu Sultan's royal residence at Srirangpattnam has been worked with Sheep's fleece in figure:2.3.2.

• A Pueblo house worked in 1540 with straw fortification adobe block is accepted to be the most seasoned house in the USA in figure:2.3.3.

• Use of horsehair in mortar has numerous authentic references.

Figure 2.3.1: Roman Colosseum

Figure 2.3.2: Tipu Sultan’s palace

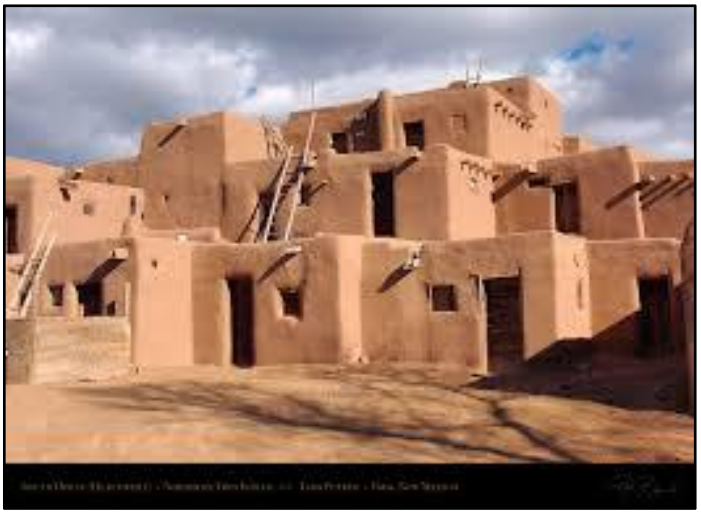

Figure 2.3.3: Pueblo house

2.3.1 Properties of FRC

When introduced with concrete, fibers give the following properties:

i. Increases concrete's tensile strength.

ii. Reduces vacuums and vacuums in air.

iii. Improves concrete's durability.

v. Give bending force compared to re-bar strength.

vi. The growth of cracks under loads is restricted.

vii. Some fibers have a greater effect, with concrete abrasion.

2.3.2 Current development in FRC

The new fiber grid was exhibited in the ongoing improvements and research (Brown J. & Atkinson T,2012):

i.High fiber volume smaller scale fiber framework.

ii. Smaller fortified composites.

iii. Polymer concrete

i. High fiber volume smaller scale fiber framework

Asbestos fiber can be supplanted. It upgrades quality and quality of effect. These highlights make it alluring for precast items like material plates, boards. Bond composites are helpful for work on fixes and renovation.

ii. Compact reinforced composites (CRC)

It is a very strong, dense and extremely expensive cement matrix. The bending force up to 260Mpa and compressive force up to approximately 200Mpa. It is as robust and can be moulded and manufactured on site as structural steel.

iii. Polymer concrete

Because of air vacuums, water vacuums, polymer concrete is porous. The latest technology for porosity reduction and strength improvement is the impregnation of monomer and subsequent polymerisation.