FLEXURAL STRENGTH OF FIBRE REINFORCED CONCRETE UNDER ELEVATED TEMPERATURE

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Specially dedicated to my beloved wife, family and friends.

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ABSTRACT

The study observes and examines the effects of elevated temperature on the fibre reinforced concrete's ability to withstand flexure loading. The fibres used are steel, synthetic and kenaf fibre. Addition of fibres into reinforced concrete may increase the ductility and cracking resistance. To explore the effects of elevated temperature, a furnace was used to heat the prepared specimens to 400°C, 600°C and 800°C. Steel fibre reinforced concrete was found to maintain some amount of flexure capacity even at 800°C, due to the high melting point, 1300°C, of the steel fibres. However, not all properties of concrete may improve with the addition of fibres. High temperature that may be due to structure usage or accidents is a concern that has to be considered when choosing the right material for reinforcing the concrete matrix. By understanding the effects of elevated temperature on the various types of fibre reinforced concrete, a better choice of fibres can be made for different structural usage.

ABSTRAK

Kajian ini memerhati dan mengkaji kesan suhu tinggi pada gentian diperkukuhkan keupayaan konkrit untuk menahan lenturan loading. Gentian yang digunakan adalah keluli, sintetik dan gentian kenaf. Penambahan gentian ke dalam konkrit bertetulang boleh meningkatkan kemuluran dan retak rintangan. Untuk meninjau kesan suhu tinggi, gentian telah digunakan untuk memanaskan spesimen bersedia untuk 400°C, 600°C dan 800°C. Gentian keluli konkrit bertetulang didapati mengekalkan sedikit kapasiti lenturan walaupun pada 800°C, disebabkan takat lebur yang tinggi, 1300°C, pada gentian keluli. Walau bagaimanapun, tidak semua sifat-sifat konkrit boleh bertambah baik dengan penambahan gentian. Suhu tinggi yang mungkin disebabkan oleh penggunaan struktur atau kemalangan adalah satu kebimbangan yang perlu dipertimbangkan apabila memilih bahan yang tepat untuk mengukuhkan matriks konkrit. Dengan memahami kesan suhu tinggi mengenai pelbagai jenis gentian konkrit bertetulang, pilihan gentian yang lebih baik boleh dibuat bagi penggunaan struktur yang berbeza.

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CHAPTER 1

INTRODUCTION

1.1 General

The most widely used material in the building industry is concrete, due to its ability to resist immense compression forces and resist abrasion. Concrete is a combination of cement, aggregates and water. Without any reinforcement, it has low tensile strength and cracks are easily formed, as it is quite brittle.

Before the invention of steel reinforcement, the concept and usage of fibres as a form of reinforcement has been present since ancient times, such as the use of straws in Egyptian mud blocks. There has been continuous research and development on the technology of using various fibres in construction till this day.

The addition of randomly scattered fibres throughout the concrete mix prevents cracks from expanding further. By increasing the ductility and tensile capabilities of the concrete, problems such as shrinkage cracks and cracks due to weathering can be captured. Thus, improving the durability of the concrete on a whole.

1.2 Problem Statement

Durability and robustness of a structure is huge a concern for the construction industry. Structures are designed to last much longer than a human lifespan. By understanding the factors affecting the lifespan of a building, engineers can continue to design and build long strong structures that will outlive their design expectations. A full concrete block could simply withstand intense heat without getting damaged. However, reinforced concrete would experience spalling, caused by the expansion of the steel reinforcement within the concrete when temperature increases.

Various types of fibres have been introduced to the concrete mix to improve its durability and tensile capacity. Some fibres may have higher resistance to fire, and some are easily flammable. The aim is to gain better understanding on the three main types of fibres used in the construction industry, primarily focusing on the effects of elevated temperature upon these fibre reinforced concrete (FRC) mixes.

1.3 Objectives

The main objectives of this study are as follows:

1. To compare the different FRC mixes under different elevated temperatures for flexure resistance.

2. To compare compression strength of the different FRC mixes without elevated temperature.

1.4 Scope

Fire resistivity or reaction towards heat of any given fibre is a very important information that governs the decision making of an engineer, during design and when specifying the materials used for construction. The focus of the study is to analyse the various FRC's ability to withstand flexural loads with the increase in temperature and compared to normal concrete without reinforcements.

The concern is the ability of the different fibres in retaining its original form and maintaining flexural stress performance within the concrete mix, when in contact with high heat. All samples are tested after 28 days of curing.

The prospect is for engineers to have more confidence with the limitations as well as capabilities of using the various fibres as additional reinforcement in construction.

The limitations of the study are as below:

a) Temperature assumed to be accurate and constant throughout the sample, in accordance to the reading on furnace temperature gauge.

b) Fibre material properties assumed to be consistent.

c) Exclusion of cost comparison.

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