INFLUENCE OF KENAF FIBRE IN REINFORCED CONCRETE BEAM WITH CIRCULAR OPENING AT MIDSPAN

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I/We* hereby declare that I/We* have checked this thesis/project* and in my/our* opinion, this thesis/project* is adequate in terms of scope and quality for the award of the Bachelor Degree of Civil Engineering

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Tesis ini berkaitan dengan penyiasatan eksperimen terhadap prestasi rasuk konkrit bertetulang dengan pembukaan pada jarak pertengahan ditambah dengan gentian kenaf. Rasuk konkrit bertetulang dengan pembukaan menghasilkan retak yang lebih tinggi yang juga menimbulkan pesongan yang berlebihan di bawah beban perkhidmatan. Satu eksperimen telah dilakukan untuk mengkaji penggunaan potensi gentian kenaf boleh menyebabkan pengurangan ketara dalam tetulang ricih konvensional dan memenuhi keperluan untuk kekuatan dan kemuluran dengan mempertimbangkan campuran konkrit berdasarkan pecahan isipadu 0%, 1% dan 2 % kandungan gentian kenaf dalam konkrit. Natrium hidroksida digunakan untuk merawat gentian kenaf. Mampatan konkrit dan ujian lenturan dijalankan untuk mengkaji kekuatan mampatan, kapasiti beban beban, kemuluran dan penyerapan tenaga. Empat rasuk kerja eksperimen telah diuji; satu rasuk konkrit bertetulang tanpa pembukaan, satu rasuk konkrit bertetulang dengan pembukaan Vf = 0% dan dua rasuk konkrit bertetulang dengan Vf = 1% dan Vf = 2% pembukaan masing-masing. Semua lapan belas specimen kiub telah diuji sehingga gagal dalam mesin mampatan dan mendapati bahawa kekuatan mampatan merosot diikuti dengan peningkatan gentian kenaf dalam konkrit. Bagi rasuk, kapasiti penyimpanan beban maksimum menurun dalam kandungan gentian.

ABSTRACT

This thesis deals with experimental investigation on the performance of reinforced concrete beams with opening at mid-span added with kenaf fibres. Reinforced concrete beam with opening creates more cracking which also give rise to excessive deflection under service load. An attempt has been made to investigate the potential use of kenaf fibres can result in a significant reduction in conventional shear reinforcement and satisfied the requirement for strength and ductility by considering the concrete mix was based on the volume fraction of 0%, 1% and 2% of kenaf fibre content in concrete. Sodium hydroxide was used to treat kenaf fibres. Concrete compression and flexural tests were conducted for studying the compressive strength, load carrying capacity, ductility and energy absorption. Four beams experimental works were tested; one control reinforced concrete beam with no opening, one reinforced concrete beams with Vf=0% opening and two reinforced concrete beams with Vf=1% and Vf=2% opening respectively. All eighteen cubes specimen were tested until it failed in compression machine and found that the compressive strength deteriorated followed by the increasing of kenaf fibre in concrete. As for the beams, the maximum load carrying capacity decrease in fibre content.

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LIST OF SYMBOLS

NaOH	Sodium Hydroxide
P_{max}	Maximum load capacity
P_y	Load at yield
P_u	Ultimate load failure
δ_y	Deflection at yield
δ_u	Ultimate deflection
δ_{pmax}	Maximum deflection
μ	Ductility
mm	Milimeter
Vf	Volume of Fraction

LIST OF ABBREVIATIONS

FRC	Fibre Reinforced Concrete
KFRC	Kenaf Fibre Reinforced Concrete
RC	Reinforced Concrete
OPC	Ordinary Portland Cement
PVC	Polyvinyl Chloride

CHAPTER 1

INTRODUCTION

1.1 Background of Research

Research for the beams with an opening started from 1960 (Aykac, Kalkan, Dundar, & Can, 2014). Reinforced concrete structures are becoming increasingly important in construction industry (Ghernouti *et al.*, 2014). In ('Design of Reinforced Concrete Beams With Openings', 2016), based on normal construction, openings are required to accommodate where the utility allows passing through the structure like water supply, sewage, air-conditioning, electricity, telephone, and computer network. These may reduce the story heights of buildings and weight of concrete beams as it improves the demand on the supporting frame both under gravity loading which results in major cost saving (Stresses, 2014). For example, the installation system can be done by constructing the beam with opening and without adding another opening beam above the ordinary beam.

Many factors could be necessary to strengthen and repair a structure. The use of fibre reinforced concrete (FRC) materials in flexural strengthening of reinforced concrete beams has been investigated quite extensively in the past. (Brandt, 2008)

In addition, there are possibilities concrete in cracking and crushing and act differently in compression and tension due to load applied. The behaviour of reinforced concrete beam without opening will be different with reinforced concrete beam with opening. Recent findings that the presence of an opening in the reinforced concrete beam leads to many problems in the beam behaviour such as the beam can create more cracking around the opening, reduction in the beam stiffness, increasing in deflection and decreasing in the beam strength (Al-sheikh, 2014).

Beam openings can be vary in shapes, sizes and normally located near to the supports where the shear is dominant. Hence, in order to provide chords with sufficient concrete area, openings must be located on the concrete beams to develop ultimate compression blocking flexure and sufficient depth in providing effective shear reinforcement (Stresses, 2014). The reinforcement around the opening in addition to the reduction of ultimate strength will induce greater deflections in the beam (Ahmed *et al.*, 2014).

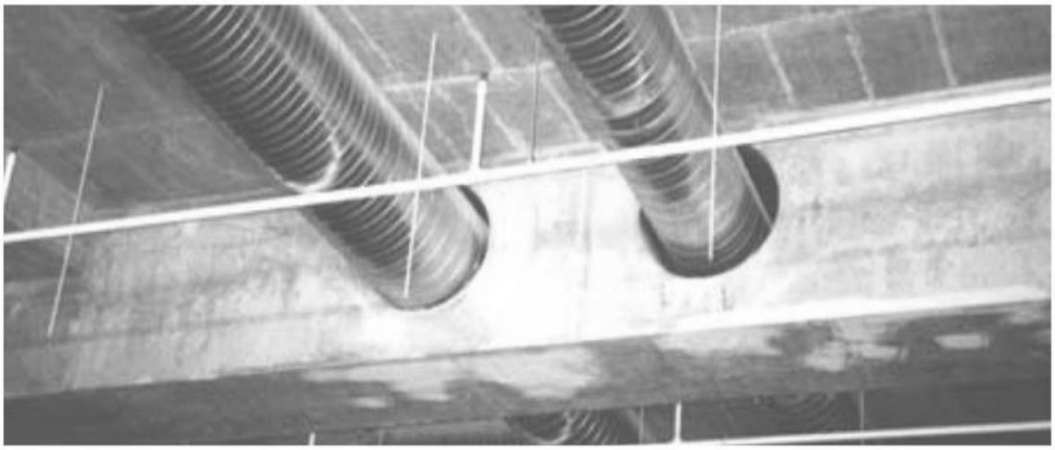

Figure 1. 1 An ordinary beam with circular openings.
Source: Yusof (2014)

1.2 Problem Statement

Behaviours of reinforced concrete still have many issues that need to be discussed in order to solve the problems. Based on the background that had been conducted, reinforced beam with opening creates more cracking because of stress concentration.

The main crack appears at the mid-span and the failure is caused by flexural cracks at the ultimate load which is quite similar to the solid beam without opening. It can also be derived that the behaviour of the beams with circular opening with diameter less than 24% of the depth of the beam is same as the solid beams without opening.

The stiffness of beams after cracking is considerably affected by openings. The reduced stiffness of the beam may also give rise to excessive deflection under service load without considering the size and location of the opening. Deflection is caused by many sources, for example loads and construction error. Deflection is usually caused by

internal loading such bending moment and axial force. Factors that will affect deflections in beam are errors in the deflection computation of flexural member, loading of flexural member, flexural stiffness and shrinkage in flexural member.

1.3 Aim and Objective

The main objective of the research is to study the different strength of beam between without opening and the effects of additional fibre in concrete beam with an opening at the centre of the beam. Different percentage amount of fibre affecting the cracking behaviour will be investigated as well. Kenaf fibre will be added into the mixture of concrete. To be specific, the further study was done by the following objectives:

i. To study the strength of the reinforced concrete beam with opening located at mid span and structural behaviour of reinforced concrete beams.

ii. To investigate the effects of the volume fraction (Vf = 0%, Vf = 1%, Vf = 2%) kenaf fibre content in concrete beam.

1.4 Scope of Study

- The dimension of the beam is 150 mm width x 400mm height x 1200 mm length.
- Six experimental work reinforced concrete beams will be conducted; two for control reinforced concrete beam, four reinforced concrete opening beam with various volume fraction of kenaf fibre.
- The opening diameter of circular shape which locate at the centre of the beam is 100mm.
- The length for kenaf fibre is 30mm each with the range 0.1mm to 3mm of diameter.
- The percentage volume fraction of kenaf fibre in concrete are Vf = 0%, Vf=1% and Vf=2%.
- For both primary and secondary bar, the reinforcement steel bar will be installed with the size of 2Y12.

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