CHAPTER 1

INTRODUCTION

1.1 Background of Study

Due to the awareness of community toward the environmental problem, it led to thinking the use of natural materials instead of manmade materials. Synthetic fiber is one of the manmade materials which has been commonly used to repair and strengthened the reinforced concrete beams. The contribution brought by the usage of synthetic fiber greatly enhanced the strength of RC beam. However, the aftermath of it toward environmental impact is undeniable. Take for example, some pollutants emitted during the manufacturing of carbon fiber such as hydrogen cyanide, ammonia, volatile organic compounds and greenhouse gases not only create dangerous to human health but also cause to global warming. Natural fibers are fibers that are not synthetic or manmade, sourced from plant, animal and mineral source. The application of natural fiber in reinforced composite has increased progressively which intend to replace manmade composite fiber. The main advantages of natural fiber compared to manmade synthetic fiber such as low cost, low weight, less damage to processing equipment, improved surface finish of moulded parts composite, good relative mechanical properties, abundant and renewable resources (Yousif et al., 2012). However, the mechanical strength of natural fiber is not strong as manmade composite fiber and it needs several of treatments to achieve a comparable strength to composite fiber. Bamboo grows abundantly in Asia and South Africa and has not been explored thoroughly to its extent especially in Asian countries. The economic value, light weight, high specific strength and non-hazardous nature of bamboo fibers prove that it has potential to replace the costly and non-renewable fibers in composite materials.

Thermoset composites are based on thermoset resins, consisting of one fully cross-linked network. During composite production, these resins transform from a liquid to a solid state by cross-linking with a catalyst. The most common thermoset resins are epoxy, polyester, polyurethane and phenolics. The choice of type of resin has a big influence on the composite production method. Polyester resins combined with fiberglass reinforcements have been the building blocks of the composites industry for decades. These formulations provide low cost, ease of handling, quick cure, and high strength to create a wide variety of composite parts in countless applications.

Web opening in floor beams is to provide building installation service like utility pipes, sewage, water supply lines, electricity and air conditioning duct etc. Normally, a circular or rectangular opening was cut in the web of I-section or H-section beams and placed underneath the soffit of beam. However, beam with web opening has caused a potential failure mode which would not happen in a solid beam.

1.2 Problem Statement

Synthetic fibers are man-made fibers manufactured from the research and development of the petrochemical and textile industries. Synthetic fibers like carbon fiber, ceramic fiber and glass fiber, it can use in concrete can perform well in the alkaline environment of concrete which lead to deterioration. However, synthetic fibers can cause high damage to the environment due to its manufacturing process originated from petrochemicals. Chemicals used to produce synthetic fiber such as sodium hydroxide and carbon disulphide are derived from resources like oil and gas which are not renewable, they take massive energy to produce it and indirectly cause to a high cost of manufacturing. In addition, synthetic fiber can cause acute irritation to respiratory tract, skin and eyes. Another issue is the opening in the web of beam, the introduction of an opening vary the stress distribution within the member and also influences its collapse behaviour. Due to the loss of a particular section on the web, it causes a reduction in the shear resistance of beams. In general, the presence of web opening leads to increase of the cracking risk and decrease the ultimate strength of beam.

1.3 Objectives

The main objectives of this research study are as follows:

i. To study the physical, thermal and mechanical properties of bamboo fiber reinforced composite.
ii. To determine the behaviour of RC beams in flexure and shear under un-strengthened and strengthened conditions using bamboo fiber reinforced composite-polyester plate in terms of load-deflection and crack pattern.

1.4 Scope of Study

Generally, this section was classified into two parts, which were BFRC-polyester plates and reinforced concrete beams.

A total five Bamboo Fiber Reinforced Composite (BFRC) -polyester plates were fabricated with an equal dimension of 120 mm x 15 mm x 450 mm (W x H x L). The effect of fiber volume ratio (0 wt %, 10 wt %, 20 wt %, 30 wt %, and 40 wt %) on the mechanical properties of the composite is determined through tensile test (ASTM D790-03) and flexural test (ASTM D3039). Besides that, Fourier Transform Infrared Spectroscopy (FTIR) and Thermogravimetric Analysis (TGA) were conducted to study the physical properties and thermal properties of BFRC-polyester plate respectively.

A total of six reinforced concrete beams were cast and tested under four-point loading test. All the beams were cast by using ready mixed concrete with a characteristic strength of 30 MPa at 28 days. A total of six beams which include two solid beam which acted as control beam, two beams with un-strengthened and strengthened in term of flexure behaviour, two beams with un-strengthened and strengthened circular openings respectively. The circular opening considered in this study has a diameter of 120 mm. All six RC beams had the similar dimension with 120 mm in width, 300 mm in height and 1500 mm in length. The beams were simply supported at both ends, which is 100 mm from the end of the beam. Besides that, two concentrated point loads were applied on top of the beam which is located 500 mm from both ends of the beam.