CHAPTER 1

INTRODUCTION

1.1 RESEARCH BACKGROUND

Fiber reinforced polymer (FRP), also known as fiber-reinforced plastic, is a specific type of two-component composite material consisting of high strength fibers embedded in a polymer matrix. The mechanical and physical properties are clearly controlled by their constituent properties and by the micro-structural configuration. At the early stage, synthetic fibers such as carbon, glass and aramid are used in manufacturing FRP. While the fibers are mainly responsible for strength and stiffness properties, the polymeric matrix contributes to the load transfer and provides environmental protection. Matrix can be divided into two parts: thermoplastic and thermosetting. Thermoplastics are amorphous polymers, which can be modified into different shapes without changing the molecular structures at elevated temperature. Also, thermoplastics can be remolded by heating and cooling the thermoplastic repeatedly without changing the molecular structures. On the other hand, thermosetting polymers cannot be heated to reform the shape of the polymers. Due to the properties of thermosetting polymers that unable to be deformed easily, thermosets are in used to apply at most of the structural engineering applications. Compared to thermoplastic, thermosets have good thermal stability at service temperatures, good chemical resistance and display low creep and relaxation properties. The types of thermosetting resins commonly applied in the manufacture of composite plate are: polyester resin, epoxy resin and vinylesters resin (Das & Nizam, 2014).
Application of FRPs often occurred on the advance engineering structures, with their usage ranging from aircraft, helicopters and spacecraft to boats, ships and offshore platforms and to automobiles, sports goods, chemical processing equipment and civil infrastructure such as bridges and buildings (Masuelli, 2013). Due to the advantages of FRP in terms of high strength, lighter weight and easier to be applied, most of the buildings that require extra strengthening or rehabilitation will select external strengthening using FRPs instead of rebuild after demolition. The structures that in need of rehabilitation are as following (Das & Nizam, 2014) : experienced seismic reaction such as earthquakes, deterioration of concrete structures due to ageing, change in use of the building structures, such as changing from shopping outlets to parking level, and error during design stages, for example, the structures are under designed and in need of extra strengthening. Thus, this strengthening techniques retrofitted damaged structured by providing extra strengthening on it and lengthen the service period in an easy and convenient method.

1.2 PROBLEM STATEMENT

Applications of FRP are widely in used and getting popular over last decades. As mentioned before, synthetic fibers such as carbon and glass are used due to high strength-to-volume ratio, flexible and high stiffness (Dong et al., 2013). However, the production costs of synthetic fiber composite plates are not cost effective and health will be affected during the production of FRP.

Natural fibers are then become an attracting and potential materials to replace synthetic fibers recently. Several types of natural fibers are studied and carried out experiment to test on their mechanical properties. Among the natural fibers, kenaf fibre has higher tensile strength compared to other natural fibers (Ku et al., 2011). Natural fibres are preferred over synthetic fibers when high load bearing capacity is not required. Besides, natural fibers are degradable, low cost in production and harmless to health. Mechanical properties of the matrices such as tensile, flexural will be increases with the use of natural fiber reinforcing in polymer (Yan et al., 2016). Thus, the use of natural fibers will decrease the content of polymer and providing significant positive outcome than neat polymer.
In Malaysia, mengkuang leaves or *pandanus atrocarpus*, also known as screw pine in English, belongs to Pandanaceae family. There are about 600 known species for this family. Different species have different sizes and usually grow along mangroves and in local jungles. The leaves are widely used in craft industries for weaving for different products such as baskets and mats. Even the leaves yield strong fibers that can be applied on different types of handcraft items, like other natural fibers, there are too few number of researchers studying the potential of mengkuang fibers as one of the alternatives for natural fiber to fabricate FRP plate. Only a little number of journals provide information regarding the mechanical properties of mengkuang fiber. Thus, further study should be carried out to investigate the methods to improve the mengkuang fiber properties and mechanical properties of mengkuang fiber composite plate.

1.3 RESEARCH OBJECTIVES

The main aim of this research project is to study the potential use of mengkuang leaves as one of the alternatives for natural fiber to assemble as mengkuang leaves-epoxy composite plate (MLECP) for strengthening and retrofitting of reinforced concrete structures. The following are the objectives to be achieved in this study:

i. To identify the behavior of the mengkuang leaves before and after chemical treatment.

ii. To evaluate the performance of MLECP in longitudinal direction with epoxy resin in the form of different fiber-to-volume ratio.

iii. To study the structural behavior of reinforced concrete beams strengthened with MLECP at the flexural zone in terms of load deflection behavior, crack pattern and failure mode.

1.4 SCOPE OF RESEARCH

Mengkuang leaves used in this study are grown locally in Malaysia. The leaves obtained are processed and cut into strips. Mengkuang leaves were treated using alkali solution with different concentrations. The preferred alkali solution is sodium hydroxide (NaOH) with 2%, 5% and 8% and the untreated and treated mengkuang leaves were sent