MODE II + III DELAMINATION BEHAVIOUR OF FLAX FABRIC REINFORCED POLYMER COMPOSITE

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Dedicated to

My Family

&

Special dedication to

My Wife & Children

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ABSTRACT

Flax fibres, along with a number of other natural fibres are being considered as environmentally friendly alternative of synthetic in fibre reinforced polymer composite. This paper deals with mode II & III mixed mode delamination behaviour of flax behaviour of flax fabric reinforced polymer composite experimentally. The six point bending (6PBP) test was proposed and developed to obtain mixed mode ratios (II +III). The specimens used for six-point bending plates with woven flax fabric reinforced polymer composite. The experiment result shows non-uniform distribution of GII and GIII and considerable geometric non-linearity. 6PBP testing carried out based on different parameter of dimension (type II & type III) and type of Teflon.

ABSTRAK

Serat rami (Flax) yang merupakan salah satu serat semulajadi dikategorikan sebagai serat yang mesra alam sekitar. Serat Flax adalah alternatif kepada serat sintetik polimer bertetulang. Dalam tesis ini, sifat sempadanan mod tergabung II + III untuk serat flax polimer bertetulang di kaji dengan menjalankan ujikaji makmal. 6PBP iaitu suatu keadah ujikaji yang dicadangkan dijalan kan untuk mencari mod tergabung II + III. Bahan ujikaji yang di gunakan adalah serat rami (Flax) sintetik polimer bertetulang komposit. Hasil ujikaji yang dijalankan menunjukkkan, ketidakseragaman nilai bagi ketegangan patah bagi mod II (GII) dan mod III (GIII) dan boleh diklasifikasikan sebagai geometri bukan linear. Pengujian 6PBP yang telah dijalankan di uji dengan mempelbagaikan parameter dari segi ukuran saiz bagi iaitu jenis II dan jenis III. Paramater lain yang diuji adalah dari segi jenis Teflon yang berlainan .

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LIST OF ABBREVIATIONS

6PBP	-	Six point bending plate
G	-	Energy release
DCB	-	Double cantilever beam,
MMB	-	Mixed-mode bending
UD	-	Tests on unidirectional
MD	-	Multidirectional
STB	-	Shear-torsion bending
Gj (j = I, II, III)	-	Energy release rate component
P	-	Applied Load
S	-	Span
N	-	Forces

CHAPTER 1

INTRODUCTION

1.1 Research Background

In recent days, environmental health aspects and increase in pollution have become each and every nation issue to provide better sustainable development for the public. Flax fiber along with number of other natural fibers, are being considered an environmentally friendly alternative of synthetic fibers in fiber-reinforced polymer composite. The common feature of natural fiber is much higher variability of mechanical properties [1]. This necessitates study of flax fiber particularly it employ in automotive industry, apparel, fabric, decoration and insulation.

Characterization of delamination resistance of high performance laminated composite has been subject of considerable research Delamination propagation is one of the most common degradation mechanisms of continuous fiber reinforced polymer-matrix composite material [6]. Because of laminated structure, delamination may easily occur in fiber-reinforced composites due to manufacturing defect, impact of object and high stress concentrations from geometrical discontinuity. In general, they cause a considerable reduction in crack growth resistance facture toughness.

1.2 Research Objective

The objective for this research is:

To study delamination behavior of flax-fabric reinforced composite polymer under mode II + III loading.

1.3 Problem Statements

Delamination propagation is one of the most common degradation mechanism of continuous fiber reinforced polymer-matrix composite [6]. Characteristic of delamination under basic loading mode II + III are one of the factors which determine performance of flax-epoxy polymer reinforced composites

1.4 Scope of Research

In this research brief description on delamination behaviour will be discussed. The experiment of 6PBP setting up of mode II + III under type II and III will be shown in this research. Sequence of experiment starting from materials, fabrication, sampling and testing will be shown below diagram.

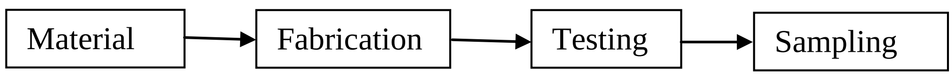

Figure 1.1 Scope of research

1.5 Theoretical Framework

This study will determine the delamination behavior of flax epoxy composite under mode II + III loading. Figure 1.1 summaries the frame work of this research.

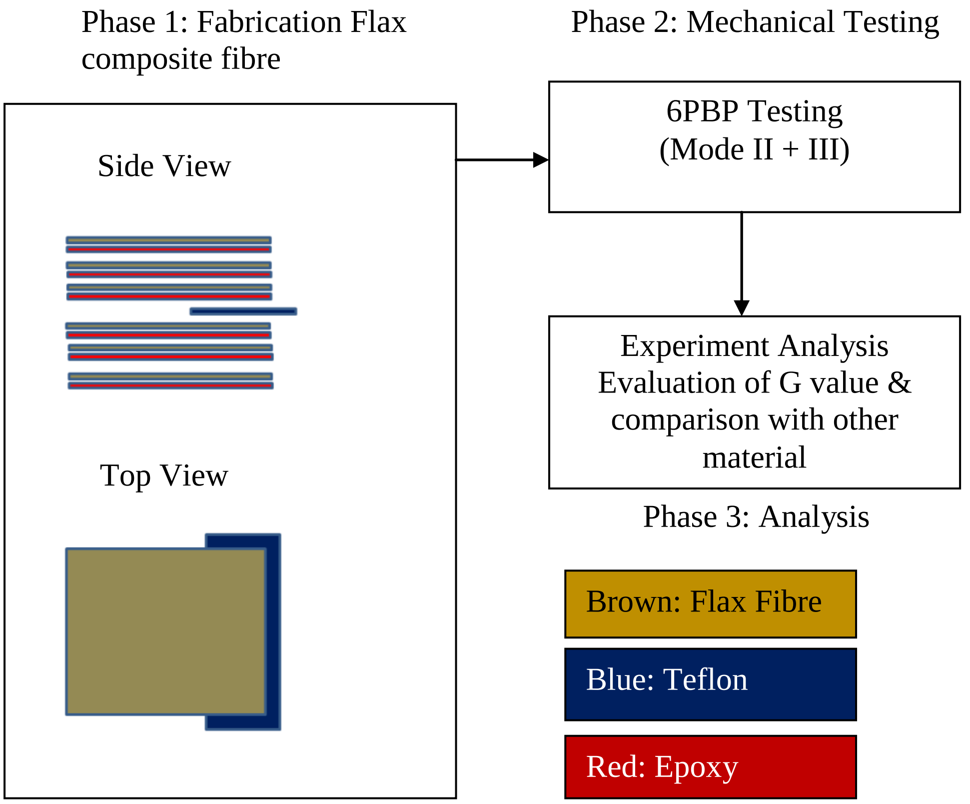

Figure 1.2 Theoretical Framework

1.6 Thesis Outline

Chapter 1 presents on the research introduction. In this chapter, the research background, problem statement, objective and scope of this study, research contribution, methodology of research and overall thesis outline has been discussed.

Chapter 2 presents the literature review related subjects concerning to the research done. In this chapter, the extensive literature review has been done on flax/epoxy composite, delamination of flax/epoxy composite and type of testing method mixed mode I+III conducted related with delamination

Chapter 3 presents methodology and experimentation of flax epoxy composite under 6PBP testing. Sets of apparatus and experiment set up elaborated in this chapter for mixed mode II + III.

Chapter 4 presents the results obtained by conducted 6PBP testing for mixed mode II + III. Resulted indicated average critical load applied for set of sample under type II and type III of 6PBP testing. Graph force against displacement been plotted, analyzed and discussed. Discussion on the delamination behavior from previous established data and research related to force and displacement been discussed and compared.

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Chapter 5 is concluding chapter. This chapter summarizes the works done in the entire research on this thesis. The directions and recommendations for future research works are also have been described in this chapter.

1.7 Research Methodology and Flowchart

The methodologies involved in this research have been shown in Figure 1.3. The research started with gathering and collecting literature review from different mean of reading material such as books, journals and technical papers related to delamination of flax epoxy under mixed mode II + III

The materials collected from the literature review have been extensively utilise and extracted to garner main understanding and concept in order to carry out six-point bending plate testing (6PBP) of Flax epoxy composite. Based on reviewed, more extensive study need to carry out especially for delamination of flax epoxy composite under mixed mode II + III.

Until now, since first test carried out for delamination under mode II + III, several set up of standard method has been proposed which included recently modified test method organised by the ASTM committee, but yet to achieved specific standard of mixed mode II + III.

Nevertheless, several extensive studies done by researchers to analyse of mixed mode II + III interlaminar crack growth in other polymer used as a guideline and comparison with variable parameter. In this research of flax fibre composite, experiment of variable parameters being use in term of different dimension of specimen and type of Teflon.Finally, the thesis has been concluded and future recommendation has suggested for further improvement of analysis of mixed mode II + III delamination of flax fibre.

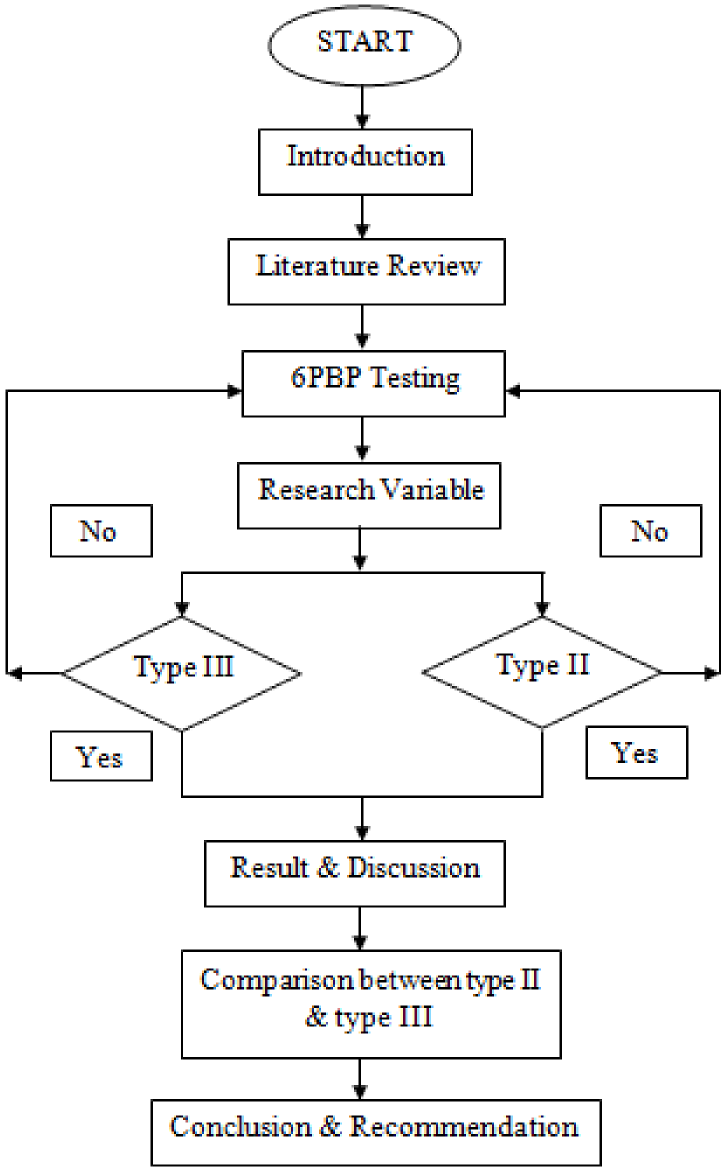

Figure 1.3 Flowchart of research

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