1. INTRODUCTION

1.1. Background

Failures occurring in structures is something greatly avoided because of their affect for various kinds of losses such as economic losses, environmental pollution, and loss of life. In 1943 (World War 2) around 2700 liberty ships produced by the United States, 400 ships experienced a failure namely fracture, of which 90 ships were considered seriously[1]. In May 1842, a train carrying 1500 people with 2 locomotives on the way to the birthday celebration of Louis Philipe king at Versailles to Paris had an accident due to the broken wheel of the train, the engine and luggage collided with each other. Approximately, more than 50 people died in this disaster [2]. The two events above are examples of failures occurring in the structure of fracture failure. Existence of fracture in the structure always begins with the presence of initial cracks and crack propagation.

Therefore, to prevent earlier occurrence of failures, it is necessary to analyze the existence of cracks in the structure, where the initial cracks can one day spread out. Crack propagation caused by load. The tip of the crack is a part that must be given special attention due to critical point which can be analyzed whether the crack spread or not. To find out the complete condition of the crack tip, the value of the stress intensity factor must be known [1]. If the value of the stress intensity factor is obtained, action in problem field can be taken to prevent the occurrence of crack propagation.

Cracks existing in structures can also branch out. In most cases, two symmetrical crack branches are created, but sometimes there is asymmetrical branching[3]. Crack branching are caused due to stress instability in the crack-tip area [4]. The different orientation of branching (geometry) cracks will have a different impact on the stress intensity factor [5]. The analysis of the effect of crack orientation will make it easier to know the conditions in each area of the crack-tip so that the impact can be anticipated properly and correctly.

Recently, several related studies have been carried out such as: stress intensity factors for hypocycloidal holes on infinite plates with boundary collocation methods [6], Calculation of stress intensity factors by the force method [7], stress intensity factors for asymmetric crack branching in field extensions using the discontinuity element crack tip displacement [8], the stress intensity factor for radial cracks on functional isotropic cylinders with approximate gradation [9], section method for the calculation of stress intensity factor [10], comparison of the value of stress intensity factors on some materials [5], stress intensity factors for some cracks in thick-walled cylinders [11], cracking problems electroelastic two-dimensional branching in various combinations of bimaterials [12], crack branching growth mechanisms in the fatigue crack growth pathway in aluminum alloy 2324-T39 [13], peridynamic models for brittle fractures and use them to investigate crack branchings in homogeneous and isotropic brittle materials [14]. However, no studies have explained the effect of crack branching with symmetric orientation on the stress intensity factor.

1.2. Problem Formulation

In designing a structure, engineer should consider how to minimize the occurrence of failures. the failures existence in direct correlation with many losses such as human losses, and economical losses. However causal factor is known, but prevent from failures are a tough proportion.

Fracture is one kind of failures frequently exist. Any fracture process involves two important thing namely initial crack and propagation. It is in good consideration to maintain crack in initiation phase because of longer life.

When the crack branched out because of instability stress, the respond occurring maybe different. It is in well consideration to know the stress intensity factor for crack branching because of unknown respond.

1.3. Objective

The purpose of this final project is:

1. To obtain the effect of various main crack length on the stress intensity factors for

various ratio of plate.

2. To obtain the effect of various crack branching length on the stress intensity factors for various ratio of plate.

3. To obtain the effect of various crack branching orientation on the stress intensity factors for various ratio of plate.

4. To obtain the effect of various ratio of plate on stress intensity factors.

1.4. Outcomes

The benefit of this final project as reference for engineer in making decision for problem related to existing of crack branching.

1.5. Assumption

Limitations of the problem in this study are:

1. Analysis is done using aluminum plate that assumed to be isotropic and homogeneous.

2. The given load is only mechanical load.

3. The plate structure is assumed to be LEFM (Linear Elastic Fracture Mechanic).

4. The length-width plate structure ratio are 200/100, 200/200, 100/200

1.6. Report Outline

The writing of this thesis consists of 5 chapters, chapter 1 is an introduction consisting of background, problem formulation, objective, outcomes, problem scope, and report outline. Chapter 2 is a literature review that discusses stress intensity factors at the crack tip. Chapter 3 contains the procedure for carrying out crack branching analysis so that the value of the stress intensity factor is obtained. Chapter 4 contains the results and discussion of the analysis of stress intensity factors. Chapter 5 is a closing consisting of conclusions.