CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

Fatigue crack growth (FCG) analyses of stainless steel under mode I or under axial loading with different stress ratio, R were carried out using MSC FATIGUE. Stainless steel is widely used in medical equipment, sculptures, building facades, building structures and some automotive manufacturers due to their good properties and mostly it does not stain, corrode, and rust easily as ordinary steel.

An analysis of fatigue crack growth was conducted on compact tension specimen, using MSC FATIGUE interface. A necessary solution parameter is being measured to define the condition of the analysis. Stress intensity threshold and fracture toughness are to be determine for different stress ratio, R. Stress analysis were carried out using MSC PATRAN and solved by solver MSC NASTRAN.

Stress is a parameter need to be measured in this project. Stress allows this project to get a fair comparison of the effects of a force on different samples of a material. A tensile force will stretch and, possibly, break the sample. However, the force needed to break a sample will depend on the cross sectional area of the sample. If the cross sectional area is bigger, the breaking force will be bigger. However, the breaking stress will always be the same because the stress is the force per unit area. For fatigue analysis, a different load is applied to the specimen that will give different results of life cycles before the specimen fails. Meanwhile, further analyses on FCG are required to study the crack growth behavior of stainless steel.
Different R ratio gives the different results of crack growth and stress intensity threshold and fracture toughness to be determined. As if the value nearer to the original fracture toughness of steel, it is the better or we can simply say that our analysis is rectify. When conducting the analysis, the mesh density is an important parameter that needs to be manipulated. By giving different mesh density to the boundary condition area, the higher mesh density, the accurate the results will be. The mesh density indicates the size of the elements in relation to the size of the body being analyzed. The mesh density need not be uniform all over the body. There can be areas of mesh refinement (more dense meshes) in some parts of the body. Making the mesh finer is generally referred to as h-refinement. Making the element order higher is referred to as p-refinement.

1.2 PROJECT OBJECTIVES

The main objective of this project is to analyze the fatigue crack growth of stainless steel under an axial loading with different stress ratio, R. A load is applied to the model to investigate the propagation of the crack and its behavior and the necessary parameter are to be defining the fatigue growth of steel. The second objective is to predict the life cycle of the model for stainless steel using Modified Paris Law equation of Fracture Mechanics analysis.

1.3 PROBLEM STATEMENT

Fatigue is the biggest issue in industry that cause failure in civil structure such as bridge trusses, building structures and trusses, and railway for train in city. It is still new to the industries where they facing the problem in structure failure. The studies of fatigue are still on the beginning where many factors are to be considered in designing and constructing structure such as stress ratio, stress range and mean stress. Fatigue failure also has been a critical issue in automotive industry that occur in many mechanical parts motion for example, connecting rod, crank shaft, gearing system, and mechanical tools. The study of fatigue crack growth is important in engineering sector to overcome the problem that has occurred for over a century. This is important because many engineers did not consider the fatigue failure in designing any engineering
structure. The study of fatigue crack growth will help in the engineering sector to maintain the structure for a long period of time before it fails. Therefore, it also can reduce the cost of maintenance for structure. Fatigue crack growth also leads to development of new materials that has high fracture toughness that can be used in many industries and also important to the country developments.

1.4 SCOPES OF PROJECT

The scopes of the project are:

(i) Fatigue analysis under mode I loading.
(ii) Stress analysis using MSC PATRAN and solver MSC NASTRAN.
(iii) Three different stress ratios.
(iv) The model used is standard Compact Tension (CT) specimen.
(v) Fatigue analysis using MSC FATIGUE.