

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 INTRODUCTION**

In this modern world, a lot of improvement and restriction was made by government in automotive industry due to environmental issue and safety of consumer (Zhao et al., 2001). From that, many automotive manufacturers prompted to come with innovation in automotive design. The authors were developed a car with lightest weight to reduce fuel consumption and higher safety level. One of solution is by introducing tailor welded blanks (TWB) in automotive manufacturing (Anand et al., 2006). Tailor welded blank is a process where two or more sheets that have been welded together in a single plane prior to forming. The sheets that be used for welded can be identical to each other or different in thickness, mechanical properties and surface coatings. For welding process, there are a lot of weld that can be used to join the sheet together such as laser welding, mash welding, electron-beam welding or induction welding. In the stamping process of automotive components, a crack appeared when the deformation of the blank exceeds a critical value predicted by forming limit curve (FLC). But the FLC of TWB cannot be obtained by the same way as that of single monolithic blanks because of the interaction between the weaker and the stronger metals. To forecast the formability of steel sheets based TWB, an application of numerical FLC carried out (Gaied et al., 2009).

As manufacturers search for low investment construction methods, affordable weight reduction applications and high performing, they have decided to choose aluminium as solution especially aluminium 5000 series, 6000 series and 7000 series (Sever et al., 2012). Due to its light weight, an aluminium structure has a few

advantages over steel for automotive applications primarily. With creative and innovative design, a vehicle that can stand noise, vibration, harshness (NVH) and have good aerodynamic can be produced especially when aluminium have high torsional stiffness with reduced mass (Davies et al., 2002). Since aluminum has greater specific energy absorption than steel, so that the equivalent energy management performance can be achieved with less weight compare to steel. Aluminum alloys tailored with proper variations of chemical configuration and processing fit many requirements, such as the non-heat treatable Al-Mg alloys used in chassis optimized for superb resistance against intercrystalline corrosion and concurrent high strength or the heat treatable AlMgSi alloys for extrusions and autobody sheet modified for improved age hardening response during the automotive paint bake cycle (Nie et al., 2004).

Since it take cost and time for try an error method, it wise to solve fatigue problem by using analysis method. There are two type of fatigue analysis that can be used known as stress life method and strain life method (Rahman et al., 2008). Stress life method is useful for life prediction of component subjected to high cycle fatigue, while strain life method can use to determine number of cycle that initiate small crack, and consider elastic plastic local stress and strain (Rahman et al., 2008). Numerous modeling techniques were implemented in the numerical analyses such as using of a non-local plastic thinning method in the heat affected zone and weld to attain mesh convergence, contact algorithm between fine and coarse meshed zones, and thickness variation in shell elements to explain the actual weld geometry (Wang et al., 2007). These methods were shown to increase the efficiency and accuracy of the numerical analyses, and are recommended for modeling of thin walled aluminium structures using shell elements.

## **1.2 PROBLEM STATEMENT**

As known from previous subchapter, TWB is popular among the automotive application due to the fuel efficient, cost and safety factor (Zhao et al., 2001). This is due to the blank that could comprised of steel for the portion which the higher strength of material properties and other lower weight and strength for the other portion of the parts (Davies et al., 2002). However there are a few problems that come out from this

type of welding. The main problem is fatigue always occur at weaker material part (Gaied et al., 2009). This problem happens because of two conditions including dissimilar materials and different thickness of materials. Of course when two types of materials weld together, the fatigue will occur first at material that has weaker properties and when similar materials weld together the thickness will become the factor. At this time, fatigue will occur at thin part first. The second problem of TWB is orientation of TWB also can affect fatigue result (Gaied et al., 2009). For example 30° of slanting and 60° of slanting will have different fatigue distribution. The proposed method is by doing simulation the part by applying forces of the dissimilar metals and orientation of TWB to estimate the critical point from the result obtained from the simulation. The suggested materials used are the aluminiums with various configurations.

### **1.3 OBJECTIVE OF PROJECT**

The objectives of project are as follows:

- i. To predict stress distribution and identify the critical location of TWB dissimilar joints.
- ii. To investigate the fatigue life of TWB joints.

### **1.4 SCOPE OF STUDY**

The scope of project is too carried out finite element based fatigue analysis on aluminium tailor welded blanks. To conduct the analysis, software that can be used such as Solidwork, MSC Patran, MSC Nastran and MSC Fatigue. First step need to do is to construct a structural modeling using Solidwork software. Finite element modeling was performed by using MSC Patran. Boundary condition and loading was stated at selected place on structural modeling. Then, finite element analysis was carried out using MSC Nastran for linear analysis. For fatigue life analysis, MSC Fatigue used after all result for linear analysis was gathered.