Chapter 1

INTRODUCTION

1.1 Overview

This chapter is discussed about the project background, the problem of the project, the objectives of the project and project scope.

1.2 Project Background

1.2.1 Wind Tunnel

A wind tunnel is a tool that used for aerodynamic test in order to study the effects of linear flow of air moving past a solid objects. The theory of the operation was first proposed as mean of studying vehicle in free flight. Then, the wind tunnel was reversing the usual paradigm instead of the air’s standing still and the model moving with speed through it, the same effect would be obtained if we reversed as the model is standing still and the air will move at speed past the model.

Nowadays, that direct investigation with complex equipment and special measuring techniques are used in different types of models, and for testing separate elements of these machines. There are several types of wind tunnel in order to produce flows of air that simulate the natural flow that occur outside the laboratory.
The wind tunnel types depend on the flight speed and have been divided into five ranges which is low subsonic speeds, high subsonic speeds, transonic speeds, supersonic speeds and Hypersonic speeds. Apparently, low speed wind tunnels are one type of tools in the teaching of aerodynamics or fluid mechanic. The basic test methods for large and small wind tunnel are similar which is for measuring forces, pressures and speeds. While, the main method that used in wind tunnel research which determine the success of aerodynamics and its application in technology is the testing in wind tunnel.

1.2.2 Load Balance

The aerodynamic forces and moments acting on models tested in wind tunnels can be determined indirectly by measuring the pressures at many points of the model surface. A more accurate and reliable method is the direct measurement of the forces and moments with the aid of wind-tunnel balances.

Furthermore, the main characteristic of wind tunnel balances is the number of measured components. It depends on the considered situation and this number can vary from 1 to 6 of measured components. Wind tunnel balances can be divided into two types which is balances located outside the model and test section and balances located inside the model or its supports.

For the first type balances design which is external of the model and test section, total aerodynamic forces are resolved into component with aid of various mechanism such as spring, string, weight scale and etc. This type of balances will be called mechanical balances. While, for the second type of balances which is internal design wind tunnel balances will become possible with the development of the strain gages measurement methods, this method was used during the past two decades.
Sensitivity and accuracy of the wind tunnel balances depend on the design of lever or hinges or rods. So, there are several design requirements that need to look up which is small friction during measurement displacement, high sensitivity, high accuracy of the transmission ratios of the system, rigidity of all levers or hinges or rods which is necessary for minimum distortion of the system under the action of the loads and others than mentioned. In addition, main characteristics of the wind tunnel balances are their load capacities, accuracy and how fast responses were deliver.

1.2.3 Computational Fluid Dynamics

To assist development of aerodynamic on NACA 4 digit airfoils now days, we use some software package of Computational Fluid Dynamics (CFD). The main advantage is that the results are obtained without construction of the required prototype. The major concern over a software simulation is the validity of its results. The accuracy of the obtained results cannot be guaranteed for a given study. Hence, before analyzing the results obtained from the CFD simulations, a validation study has to be carried out in order to know the specific parameters and conditions under which the software yields the most accurate results when compared to a set of established data. (Henrik D, 2008)