AERODYNAMIC STUDY OF FORMULA 1 IN SCHOOL FOR MOZAC RACING CAR

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DECLARATION

"I hereby declaration this thesis entitled

'AERODYNAMIC STUDY OF FORMULA 1 IN SCHOOL FOR MOZAC RACING CAR'

in the result of my own research except as cited in the references".

Signature	:	…………………………………….
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Date	:	24 May 2010

TO MY BELOVED FAMILY

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ABSTRACT

In this study, aerodynamics is very important characteristic that needed in the every racing car like F1 in School. Model F1 in school racing car of Sekolah Menengah Sains Muzzafar Syah (MOZAC) will be redesign for a better aerodynamics. This aerodynamics flow will generate two kind of force that is force pressure distribution and shear stress distribution over the body. For force pressure distribution, there are two types of force will be the resistance force that is drag force and lift force. Drag force is the force that against the flow and can slows the movement of the bodies that moving with certain velocity. Lift force is the force that perpendicular with flow and can lift off the moving body from ground. To analysis the drag force and lift force, there are two ways to get the result that is Computational Fluid Dynamic (CFD) analysis and Wind Tunnel Experiment.

ABSTRAK

Dalam kajian ini, aerodinamik merupakan satu perkara yang penting untuk kereta lumba ‘F1 in School. Model kereta lumba ‘F1 in School’ Sekolah Menengah Sains Muzaffar Syah (MOZAC) akan direkabentuk untuk aerodinamik yang lebih baik. Aliran aerodinamik ini akan menghasilkan dua jenis daya iaitu taburan daya tekanan dan taburan daya potongan pada sesuatu jasad. Bagi taburan daya tekanan, terdapat dua jenis daya halangan iaitu daya seretan dan daya angkatan. Daya seretan ialah daya yang melawan arah aliran dan dapat memperlahankan sesuatu jasad yang bergerak dalam sesuatu kelajuan. Daya angkat pula ialah daya yang berserenjang dengan arah aliran dan dapat menyebabkan sesuatu jasad itu terangkat dari tanah. Untuk menganalisa daya seretan dan daya angkatan, terdapat dua cara iaitu dengan menggunakan ‘Computational Fluid Dynamic’ (CFD) dan menggunakan terowong angin.

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A	=	Projected Area, m^2
C_D	=	Coefficient of Drag
C_L	=	Coefficient of Lift
C_{LF}	=	Coefficient of Lift Front Axle
C_{LR}	=	Coefficient of Lift Rear Axle
ρ	=	Density of Air, kgm^{-3}
μ	=	Air Viscosity, kg/ms
V	=	Air Velocity, ms^{-1}

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CHAPTER 1

INTRODUCTION

1.1 Introduction To The Project

The F1 in Schools Technology Challenge is a competition that opens to all secondary schools based from real Formula 1 Racing. This competition exists to introduce the student to the engineering across school and colleges all over the world. The objective of this F1 in School Technology Challenge is to give an opportunity to student to experience the latest developments in manufacturing and design technology like using CAD/CAM, CNC and CFD software. This competition is about the fastest F1 car that arrive to the finish line that others car. The car was forced to move with high velocity by pressurized Carbon Dioxide (CO_2) that the speed can exceed 70 km/h. Because of the same pressure release to all cars in the competition, all cars tenderly move with same initial speed. The resistance of its body makes the car slowly decrease the speed and make the car take more time to reach the finish line than others. The aerodynamics flow is very important in designing a racing car to reduce the drag and lift force, which is also called resistance force.

1.2 Project Background

Aerodynamics is needed to car that travels very fast like Formula 1 to reduce their drag force and to prevent to lift from ground. So, the design is very important to reduce the drag force and lift force. The model F1 that use in School Technology Challenge is designed exactly like in real Formula 1 because of its aerodynamic flow. All the part on car's body need to be designed to give nice flow around the car like the front wing, rear wing, side port and tire.

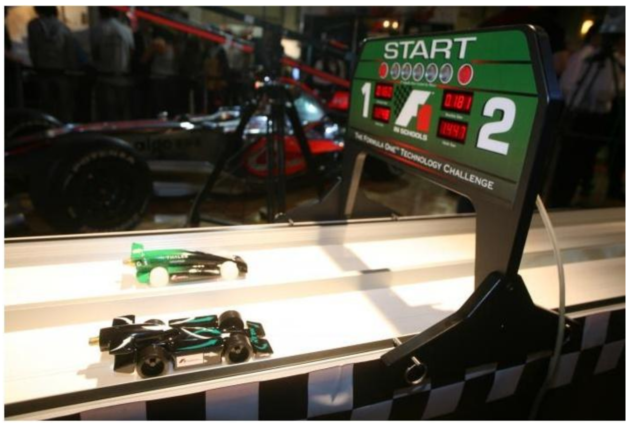

Figure 1.0 : F1 in School Competition
(Source : http://www.f1inschools.com/gallery)

1.3 Objective

The objective of this project is:

i. To study aerodynamic, coefficient of drag (C_D) and coefficient of lift (C_L) of MOZAC racing car.
ii. To propose better design of F1 in school racing car.

1.4 Scope of Study

There are some scopes to study under this project that are needed to cover like:

i. Study MOZAC's racing car 2008 – study the model of MOZAC's model racing car to analyses the design and to design new model of racing car.
ii. F1 analysis – The part of Formula 1 are analyzed to have a better design part with better aerodynamic flow.
iii. Fabricate – fabricate the model of F1 racing car with Computer Numerical Control (CNC) milling using the balsa wood that follow the rules and regulations of F1 in School.
iv. CFD analysis – test the design in computational fluid dynamics (CFD) to measure the drag and lift force. CFD also can determine the aerodynamics flow that the places have turbulence and laminar flow to get the best aerodynamics flow. The software that used in process is Gambit 2.2.30 and Fluent 6.2.16.
v. Wind tunnel analysis – conduct a wind tunnel to test and to analysis the aerodynamic of F1 model racing car of its design shape for the drag and lift force.

1.5 Problem Statement

The aerodynamics of F1 in School is very important to reduce the drag force and lift force. In this competition, there are many teams that didn't analysis the drag and lift force of their racing car because they don't have expertise on this field. The design of part on the body racing car are important because this part can make difference performance on this racing cars. Example of front wing and rear wing, these two parts are very important because these parts are to make the car don't lift off from the ground.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

For this chapter, it will discuss about F1 in School, the term of aerodynamic, fundamental of fluid mechanics, aerodynamic analysis and previous study in aerodynamic. This chapter also brings out analysis of design Formula 1 car for their aerodynamic flow.

2.2 F1 in School

'F1 in School' was piloted in United Kingdom in year 1999 and debut as a national competition on a year after that. Starting from year 2001, there are just 6 regional take place in competition in United Kingdom. Nowadays, this competition expands for 31 countries and there are 32 teams are competing for Fifth World Championship 2009 that is Bernie Ecclestone World Championship Trophy at London [3]. The wining team for the Fifth World Championship 2009 for the fastest car is 'Koni Kats' Team from Ireland with 1.020 seconds and breaks the previous world record 1.064 of team from England [4].

Figure 2.0 : Koni Kats Team winning the championship
(Source : http://www.f1inschools.com/gallery)

These racing cars firstly design in software Computer Aided Design (CAD) and then test with Computational Fluid Dynamic (CFD) to analyses their aerodynamic flow through the design. Then, the car was fabricated with Computer Numerical Control (CNC) milling. After that, the car was tested in the Wind Tunnel to analyses the real aerodynamic flow to compare with CFD analysis. The main material used in this manufactured racing car is Balsa Wood 50 × 85 × 223 millimeter [5].

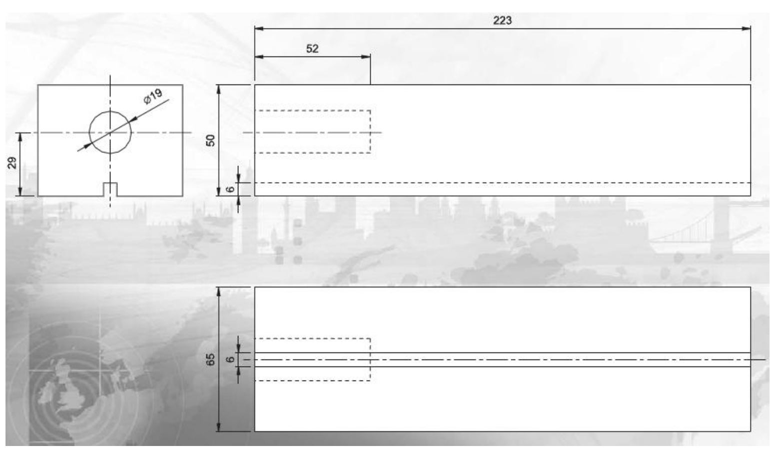

Figure 2.1 : Balsa Block Dimension (Source : Rules and Regulation 2009 World Championship Season)

For design this racing car, there are six rules and regulation have to follow. There are body and side port regulations, wheel regulations, wheel to body regulations, power plant regulations, tether line guide regulations and aerofoil regulations. Figure below show the rules compliance drawing need to follow in this competition [6].

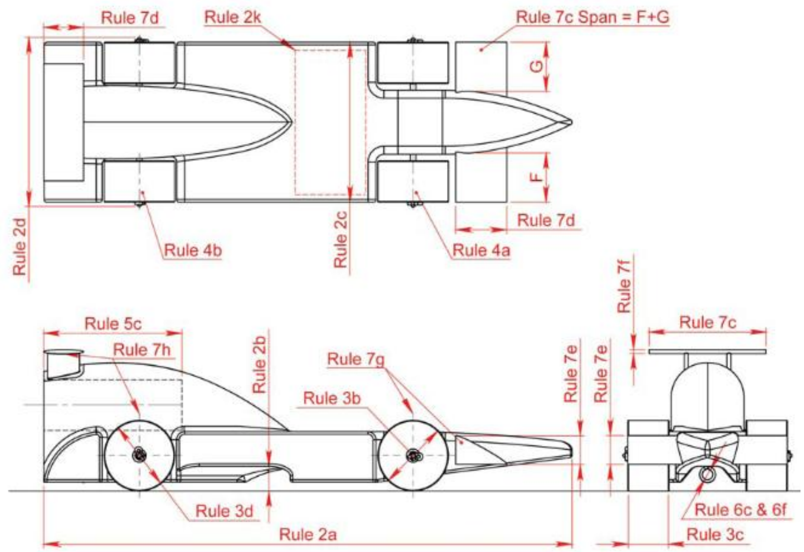

Figure 2.2 : Rules Compliance Drawing (Source : Rules and Regulation 2009 World Championship Season)

2.3 Aerodynamics

Aerodynamics can define as a flow of particle of air round a body such as airplane, car and motorcycle at low speed or high speed. An aerodynamics force will generated if there is air flow around the body. There are two types of aerodynamics force pressure distribution over the body and shear stress distribution over the body. Because of force pressure distribution over body, drag force and lift force are occurring. This is because the theory Bernoulli says that the high speed flow on the area makes low pressure on that area and low speed flow on the area makes the area have high pressure [12].