DRAG EVALUATION OF TRUCK-TRAILER

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I hereby admit that I have read this thesis and it is adequate in terms of scope and quality
in accordance with the requirements of
for the degree for
Bachelor of Engineering Mechanical in Structure and Materials

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STUDY OF EVALUATION OF DRAG ACTING ON THE TRUCK TRAILER

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This report is presented as to fulfill partly of the grant requirement
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‘I confess that this study is my own work accepts the summarization and quotation that I clearly explain the resources.

Signature	:
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To family and friends

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ABSTRAK

Kajian ini merangkumi kajian terhadap hubungan antara daya seretan yang bertindak terhadap trak-treler jenis MP 130D Scania P360 dengan halaju dan permukaan bersentuhan dengan bendalir iaitu udara. Bagi mendapatkan keputusan kajian itu, kaedah ujian menggunakan terowong angin digunakan. Beberapa ujian berdasarkan pada parameter halaju dan permukaan bersentuhan dirancang dan dijalankan. Kajian ini turut mengkaji keberkesanan alat pengurang daya seretan terhadap trak-treler disamping melihat pangaruh alatan tersebut terhadap penggunaan bahan bakar serta pekali daya seretan.

ABSTRACT

This study is covered the relationship between drag force acting on truck-trailer, Scania P 360, parameter of velocity and surface of contact. For that purpose, tests using wind tunnel, MP130D Subsonic with downstream fan is performed. The parameter of the tests are depends on the wind velocity and surface of contact of the truck-trailer model. This study also investigates the effective of drag reducer device to the truck-trailer. In addition, this study also identified the effect of drag reducer devices to the fuel consumption and drag coefficient of the truck-trailer.

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A	area
C	coefficient
E	energy
F	force
G	gravity
h	height
HV	heating value
L	length
m	meter
mm	millimeters
N	Newton
Re	Reynolds number
T	temperature
v	velocity
w	width
W	work
X	distance

GREEK SYMBOL	DEFINITION
θ	Angle
ρ	Density
μ	dynamic viscosity
η	efficiency
ν	kinematics velocity

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CHAPTER 1

INTRODUCTION OF THE PROJECT

1.1 Introduction of project

Aerodynamics is a branch of dynamics concerned with studying the motion of air, particularly when it interacts with a moving object. When considering the fluid flow a submerged body, the body will surrounded by the fluid and this type of flow called ‘external flow’. The external flow of air particularly referred to ‘aerodynamics’ [3].

There are lots types of aerodynamics but in this study only focus on automotive aerodynamics.

For this study, the involvement of wind tunnel test is to evaluate the drag of a truck trailer model with scale of 1:32. Besides testing in the wind tunnel, the other test that could be used in evaluating the drag is by using the computational method or road test.

In the tunnel, the engineer can carefully control the flow conditions that affect automobile performance. Wind tunnels usually designed for a specific purpose and speed range. [14].

Lots of parameter can be evaluate using the wind tunnel test, but this study only focus on the evaluation of the drag for the tested model of automobile. The speed of wind velocity in will affect the drag act on the automobile and the more horsepower needed the greater the drag occur.

A total automobile drag can divided into two main components that are aerodynamics drag and tire drag. Both drags are influence by the speed of the automobile. However, for the aerodynamics drag, one of the factors that influencing the aerodynamics drag on the automobile is through the frontal area and the shape of the truck trailer itself.

The figure 1.1.0 shows that the differentiation between three types of truck trailer combination that causes the different effect of drag. The larger value of b, which refer to the surface of contact, then the drag occur will also increase.

Figure 1.1.a: Type of truck trailer [2]

In addition, the importance factor is the amount of gap between the truck and the trailer. This is due to a turbulent circulation occurs at the gap between the truck and the trailer. The larger the gap, the greater the disruptions to the air flow which resulting drag on the truck. This becomes more importance when encountering the crosswind condition [2].

1.2 Problem Statement of the study

Nowadays, the high fuel prices causing lots of problem to the automobile users especially to the truck trailer users. The fuel cost increasing unexpectedly and this burden the users. Theoretically, the fuel consumption is function of power required to moving the automobile (truck trailer). The horsepower required automobile to sustain a given speed that is a function of drag. Thus, as to reduce the horsepower of automobile the drag have to be reduce by evaluating the drag acting on the automobile.

1.3 Scope of the study

The scopes of this study are:

- theoretical of automotive aerodynamics
- drag on the automotive
- design of wind tunnel testing
- testing the model using wind tunnel
- collecting the data
- analyze the result

1.4 Objective of this study

The objective of this study is:

i) To evaluate drag acting on the truck trailer

ii) To study the factors that effect drag force on the truck-trailer

iii) To study the effectiveness of drag reducer device

iv) To investigate the effect of drag reducer device of fuel consumption and drag coefficient.

CHAPTER 2

LITERATURE REVIEW OF THE STUDY

2.1 Theoretical be relevant to this study

The objective of this study is to evaluating the drag that is acting on the automobile. To complete the objective of this study the theoretical study which relevant to these topics have to be understood clearly because the evaluation is depends on the understanding of the topics.

Those information can provide the idea while evaluate the drag on the vehicle tested. All those information or theory can convey the evaluation on the right line. For this study the theoretical study covered the theoretical of aerodynamics especially on automobile aerodynamics, principle of drag and lift, skin friction and pressure drag, boundary layer, and the theory of wind tunnel.

2.1.1 Theory of automotive aerodynamics

2.1.11 Introduction of aerodynamics

Aerodynamics is a branch of dynamics concern with studying the motion of air, particularly when it interacts with a moving object.

Aerodynamic problems can be identified in a number of ways. The flow environment defines the first classification criterion. External aerodynamics is the study of flow around solid objects for various shapes.

Evaluating the lift and drag on an airplane, the shock waves that form in front of the nose of a rocket or the flow of air over a hard drive head are examples of external aerodynamics. Internal aerodynamics is the study of flow through passages in solid objects. For instance, internal aerodynamics encompasses the study of the airflow through a jet engine or through an air conditioning pipe [3].

Aerodynamic problems are often solved using conservation laws as applied to a fluid continuum. In many basic aerodynamics problems, three conservation principles are used:

- The first principle is by using the Conservation of Mass:
  This principle state that matter is neither created nor destroyed. If a certain mass of fluid enters a volume, it must either exit the volume or change the mass inside the volume.

- Balance of Momentum:
  This principle is an application of Newton's second law of motion to a continuum.

- Conservation of Energy:
  Although it can be converted from one form to another, the total energy in a given system remains constant.

There are two types of aerodynamics, which is incompressible aerodynamics, and compressible aerodynamics.

- A constant density despite flowing over surfaces or inside ducts characterizes an incompressible flow. A flow can be considered incompressible as long as its speed is low. For higher speeds, the flow will begin to compress as it comes into contact with surfaces. The Mach number is used to distinguish between incompressible

and compressible flows. Subsonic flow is the example of an incompressible aerodynamics.

- According to the theory of aerodynamics, a flow is considered to be compressible if its change in density with respect to pressure is non-zero along a streamline. In short, this means that, unlike incompressible flow, changes in density must be considered.

Furthermore, that maximum 5% density change occurs at the stagnation point of an object immersed in the gas flow and the density changes around the rest of the object will be significantly lower. Transonic, supersonic, and hypersonic flows are all compressible.

2.1.12 Application of aerodynamic

Aerodynamics is important in a number of applications other than aerospace engineering. It is a significant factor in any type of vehicle design, including automobiles. It is important in the prediction of forces and moments in sailing. It is used in the design of large components such as hard drive heads.

Structural engineers also use aerodynamics, and particularly aero elasticity, to calculate wind loads in the design of large buildings and bridges. Urban aerodynamics help town planners and designers improve comfort in outdoor spaces, create urban microclimates and reduce the effects of urban pollution[3].