AERODYNAMICS BEHAVIOUR OF PERSONA CAR USING COMPUTATIONAL FLUID DYNAMICS (CFD)

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JUDUL: **AERODYNAMICS BEHAVIOUR OF PERSONA CAR USING COMPUTATIONAL FLUID DYNAMICS (CFD)**

SESI PENGAJIAN: **2009/ 2010**

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We certify that the project entitled *Aerodynamics Behaviour of Persona Car using Computational Fluid Dynamics (CFD)* is written by *Mohd Shaifullah bin Shahruddin* . We have examined the final copy of this project and in our opinion; it is fully adequate in terms of scope and quality for the award of the degree of Bachelor of Engineering. We herewith recommend that it be accepted in partial fulfilments of the requirements for the degree of Bachelor of Mechanical Engineering with Automotive Engineering.

……………………………

Examiner Signature

AERODYNAMICS BEHAVIOUR OF PERSONA CAR USING COMPUTATIONAL FLUID DYNAMICS (CFD)

MOHD SHAIFULLAH BIN SHAHRUDDIN

Report submitted in fulfilment of the requirements
for the award of the degree of
Bachelor of Mechanical Engineering with Automotive Engineering

Faculty of Mechanical Engineering
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NOVEMBER 2009

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this project and in my opinion, this project is adequate in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering with Automotive Engineering.

Signature :
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STUDENT'S DECLARATION

I hereby declare that the work in this project is my own except for quotations and summaries which have been duly acknowledged. The project has not been accepted for any degree and is not concurrently submitted for award of other degree.

Signature :
Name : MOHD SHAIFULLAH BIN SHAHRUDDIN
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Date : 24 NOVEMBER 2009

To my beloved father mother

Shahruddin bin Ahmad
Mohaini binti Yahya

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ABSTRACT

An aerodynamic characteristic of a car is of significant interest in reducing car accidents due to wind loading and in reducing the fuel consumption. On the limitations of conventional wind tunnel experiment and rapid developments in computer hardware, considerable efforts have been invested in the last decade to study vehicle aerodynamics computationally. This report presents a numerical simulation of flow around Proton Persona car using commercial fluid dynamics software FLUENT for 2D simulation and COSMOSFloWorks for 3D simulation. The study focuses on CFD-based lift and drag coefficient prediction on the car body and the air flow pattern around the car body using Computational Fluid Dynamics (CFD) software. A three dimensional computer model of a Proton Persona was used as the base model in this study. The wind speed selected in this study ranges from 80 km/hr to 140 km/hr with increment of 20 km/hr. After numerical iterations are completed, the aerodynamic data and detailed complicated flow behaviour are visualized clearly. The drag and lift coefficient of Proton Persona have been estimated by using a mathematical equations. The pressure and velocity distributions along the surface of the car also have been analyzed. From the results obtained, it was found that highest speed occurs where the pressure is lowest, and the lowest speed occurs where the pressure is highest. Therefore it satisfies the Bernoulli's principle. In addition, the flow pattern around the model showed very similar with the previous works, emphasizing in findings.

ABSTRAK

Ciri aerodinamik sesebuah kereta adalah sangat penting dalam pengurangan kadar kemalangan kereta yang disebabkan oleh beban angin dan dalam mengurangkan penggunaan minyak. Oleh sebab terdapat had-had bagi eksperimen terowong angin konvensional dan pembangunan pantas dalam perkakasan komputer, ikhtiar yang banyak telah dilaburkan dalam dekad yang lalu untuk mengkaji aerodinamik kenderaan secara pengkomputeran. Laporan ini membentangkan satu penyerupaan berangka aliran sekitar kereta Proton Persona menggunakan perisian komersial dinamik bendalir *FLUENT* untuk simulasi 2D dan *COSMOSFloWorks* untuk simulasi 3D. Kajian itu menumpukan pada ramalan pekali daya angkat dan seretan pada badan kereta dan corak aliran udara sekitar badan kereta itu menggunakan perisian *Computational Fluid Dynamics (CFD)*. Satu model komputer tiga dimensi, Proton Persona telah digunakan sebagai model asas dalam kajian ini. Kelajuan angin yang pilih dalam julat kajian ini adalah daripada 80 km/jam hingga 140 km/jam dengan tambahan setiap 20 km/jam. Selepas iterasi berangka siap, data aerodinamik dan sifat aliran rumit yang terperinci dipaparkan dengan jelas. Pekali seretan dan daya angkat Proton Persona telah dianggarkan dengan menggunakan persamaan matematik. Pengagihan tekanan dan halaju sepanjang permukaan kereta itu juga telah dianalisis. Daripada keputusan yang diperolehi, didapati kelajuan tertinggi itu berlaku di mana tekanan terendah, dan kelajuan terendah berlaku di mana tekanan tertinggi. Oleh itu ia memuaskan prinsip Bernoulli. Seperkara lagi, corak aliran sekitar model itu menyerupai dengan kajian terdahulu, mengukuhkan lagi penemuan.

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LIST OF SYMBOLS

A	Area
C_D	Drag Coefficient
C_L	Lift Coefficient
p	Pressure
ρ	Density
v	Velocity
F_D	Drag Force
F_L	Lift Force
µ	Dynamic Viscosity
C_P	Pressure Coefficient
p_∞	Initial Pressure
v_∞	Initial Velocity
k	Turbulence kinetic energy
ε	Kinetic energy dissipation rate
τ_{ij}	Shear-stress tensor
S_{ij}	Shearing-rate tensor
σ_k	Prandtl number of the turbulence kinetic energy
	Prandtl number of the turbulence kinetic energy dissipation rate

LIST OF ABBREVIATIONS

2-D	Two Dimensional
3-D	Three Dimensional
CAD	Computational Aided Design
CFD	Computational Fluid Dynamics
DNS	Direct numerical simulation
DSM	Differential stress models
EVM	Eddy-viscosity models
FYP	Final year project
LES	Large-eddy simulation
NLEVM	Non-linear eddy-viscosity models
RANS	Reynolds-Averaged Navier-Stokes
Re	Reynold Number
RNG	Renormalization Group
RSTM	Reynolds-stress transport models
SOC	Second-order closure models