International Congress
Motor Vehicles & Motors 2012

SUSTAINABLE DEVELOPMENT OF AUTOMOTIVE INDUSTRY

Proceedings of Papers

October 3rd - 5th, 2012
Kragujevac, Serbia

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International Congress Motor Vehicles & Motors 2012

Kragujevac, October 3th-5th, 2012

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Branimir Milosavljević[1]
Radivoje Pešić[2]
Jovanka Lukić[3]
Saša Babić [4]

AERODYNAMIC RESISTANCE IMPACT ON MOTOR VEHICLE FUEL ECONOMY

ABSTRACT: If we analyze vehicle dynamics, most influential factors can be categorized as road load. One of them general has a lot of influence on modern engineering approach and trucks aerodynamics. Aerodynamic forces that interact with the vehicle caused by air resistance, increase dynamic response of soil, lateral forces, moments galloping, meandering and rolling as well as noise. As a result of good control and optimization of these elements, there is savings in fuel consumption and better car handling. This paper presents the basics of quality aerodynamic vehicle design and what this approach has on the total potential savings in fuel consumption.

KEYWORDS: Car aerodynamics, drag coefficient, fuel consumption

INTRODUCTION

The first country who introduced legal norms for fuel consumption of motor vehicles was the United States. These regulations provided that each manufacturer or importer had additional costs per vehicle if its power was higher than allowed one. As Japan has similar legal norms, a growing number of countries are making similar way. The present legal documents in Europe such as R-84 and R-101 define only the method for determining average consumption for its labeling and comparison with other vehicles. Air resistance is most important component of aerodynamic force and is specifically expressed in normal and high-speed car.

AERODYNAMIC AIR FORCE RESISTANCE

Aerodynamic drag force is determined by the formula [1]:

$$F_{aero} = 0.5 \cdot \rho \cdot C_D \cdot A_f \cdot (V_x + V_{wind})^2 \tag{1}$$

where: ρ – mass density of air, C_d – aerodynamic drag coefficient, A_f – vehicle frontal area (projection area in the direction of movement), $V_x = \dot{x}$ – longitudinal speed of the vehicle, and V_{wind} – wind velocity (positive when the wind flows from the opposite direction of the vehicle and vice versa).

The size of frontal area is 79-84% of total area (width and height obtained by a passenger car) (Wang 2001). According to Wang the relationship between mass and frontal area (for vehicles with mass in the range of 800-2000 [kg]) is given by equation [1]:

$$A_f = 1.6 + 0.00056 \cdot (m - 765) \tag{2}$$

[1] *Branimir Milosavljević, College of Applied Mechanical Engineering Trstenik, e-mail: lenka1809@gmail.com*
[2] *Radivoje Pešić, Ph. D., Prof., Faculty of Engineering, University of Kragujevac, Serbia,* e.mail: *pesicr@kg.ac.rs*
[3] *Jovanka Lukić, Ph. D., Prof., Faculty of Engineering, University of Kragujevac, Serbia, e.mail: lukicj@kg.ac.rs*
[4] *Saša Babić, College of Applied Mechanical Engineering Trstenik, e-mail: babicsf@nadlanu.com*