

A Study on Effect of Air Resistance on Motorcycle

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Abstract – This paper deals with the study of resistance offered on moving motorcycle due to air. Air resistance plays an important role on performance of motorcycle. Performance can vary according to shapes of bodies. Air resistance affects on fuel efficiency, power output, tire wear and speed of motorcycle. To reduce the air resistance offered on vehicle by means of optimizing the shapes of body parts of the motorcycle. Aerodynamics is the key aspects in motorcycle design. The main objective is to study the various types of aerodynamics forces and moments resulting from acceleration and retardation of motorcycle.

Key Words: Air resistance, motorcycle, shapes, aerodynamics

1. INTRODUCTION

Aerodynamics is a branch of dynamics which deals with the motion of air and other gases, with the forces acting upon an object in motion through the air, or with an object which is stationary in a current of air. In effect, in motorcycle aerodynamics is concerned with three distinct parts. These parts may be defined as the motorcycle, the relative wind, and the atmosphere. An airfoil is a surface designed to obtain a required reaction from the air through which it moves.

As a consequence, a huge effort in aerodynamic optimization is important in motorcycle design today, from both a numerical and experimental point of view; however this is not the case in bicycle design, and very limited research on this topic can be found in literature. A systematic effort to measure the aerodynamic effects on motorcycles can be found in [1]. The main reason for this lack of information is probably due to the complicated shapes of motorcycles, which makes it very difficult to find important general rules applicable to different motorcycle shapes. The aerodynamic research programs are carried out by motorcycle designers usually considering single detail optimization, a comparison between different solutions and performance optimization of specific designs, but rarely find general trends. Some experimental studies concerning specific aspects were carried out by the authors: Motorcycle visor effect can be found in [3] and [4]; In [7] the authors describe an experimental set up developed to test full scale racing motorcycles in a wind tunnel; in [8] the effects of some "vortex generators" are found in order to improve the aerodynamic performances of motorcycles.

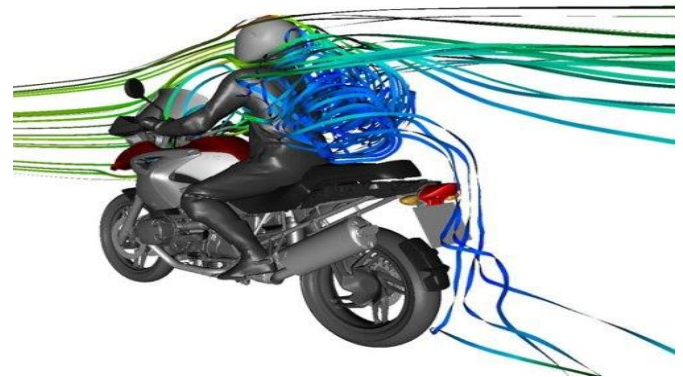


Fig -1: Vortex generation on motorcycle visor

The improvement in the performance of racing motorcycles requires the optimization of a variety of different aspects like aesthetic, ergonomics and safety with aerodynamics not the least important among them. This paper focuses on the study of the influence of the rider's position on aerodynamic performance. The basic idea is to provide the motorcycle rider with general guidelines about the optimal sitting position in order to reduce aerodynamic resistance. The experiments were carried out in a real scale open wind tunnel, in which real motorcycles were tested with their riders. The general set up of the wind tunnel was developed in accordance in figure 2

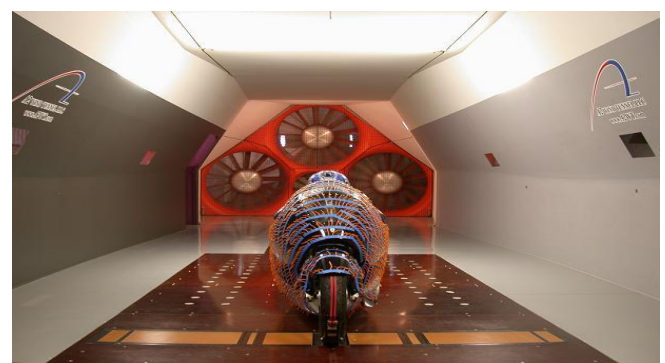


Fig -2: Real open wind tunnel with motorcycle and rider.

2. HISTORY OF MOTORCYCLE AERODYNAMICS

In the early years most of the focus regarding aerodynamics for motorcycles, was simply focused on streamlining and very much so, various concepts that were brought to light, would challenge different speed-records of the day. The idea was generally to create a teardrop shaped faring that would cover

the rider as much as possible. They also tried to manufacture the motorcycle as low and narrow as possible to reduce the frontal area. Figure 3: In early 1950's the typical "dustbin" fairing were popular as shown by Guillin Cacao's Moto Gauzy. In 1957 FIM banned these types of fairings and the "dolphin" shape quickly became the norm. [5] However, these massive fairings turned soon out to be dangerous in crosswinds and difficult when cornering. It soon became clear, that to make fast and safe motorcycles, which can go around twisting race tracks and various other considerations had to be taken into account. This tends to motorcycles with more open, yet sleek, fairings. A concept which seems to have stood the time, since the basics layout, seems to be similar to even today's machines.



Fig -3: First Dustbin Type Aerodynamic Model (1950)

3. OVERVIEW OF AERODYNAMIC FORCES AND MOMENTS

During steady state motion, the thrust produced by the engine is equated to the forces that oppose forward motion and depend mainly on three phenomena. 1. Resistance to tire rolling. 2. Aerodynamic resistance to forward motion. 3. The component of the weight force caused by the slope of the road plane. We simplify and only are taken in consideration two first forces.

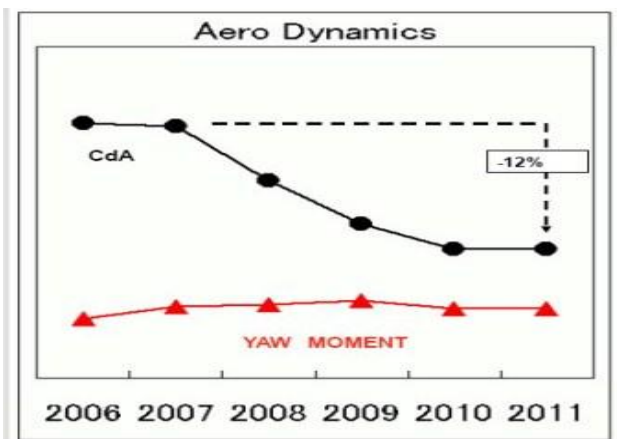


Chart -1: Amount of work done on Aerodynamics.

The drag force influences both the maximum attainable velocity and performance in acceleration. The drag force is approximately proportional to the square of the motorcycle's forward velocity and depends on the density of air, the frontal area of the motorcycle (A) and the coefficient of aerodynamic resistance.

$$F_D = \frac{1}{2} \rho \cdot C_D \cdot A \cdot V^2$$

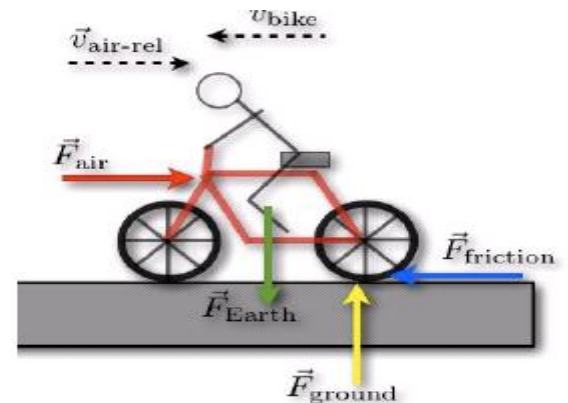


Fig -4: Various Forces Acting On Motorcycle.

4. CONCLUSIONS

Performance of motorcycle can be improved by modifying aerodynamic shape of motorcycle. By reducing coefficient of drag, improvement in the speed of motorcycle and fuel efficiency can be achieved. Atmospheric conditions also affect the drag force on motorcycle i.e. speeds of motorcycle.

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to Prof. Siddharaj Allurkar, Head of Automobile Engineering Department. Dhole Patil College of Engineering, Pune for providing their invaluable guidance, comments and suggestions.

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