Cross Wind Flow on Trucks

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Trucks and trains can be exposed to cross winds which have the potential to overturn these vehicles. Such exposure may have a low impact on saloon cars, but can have a devastating effect on taller vehicles. Such vehicles can encounter these situations when they enter regions of open, exposed fields such as bridges or embankments or as they exit a sheltered environment, such as a tunnel. Whilst aerodynamics coefficients are readily available for most vehicles exposed to upwind flows, for "performance" reasons and usually from the manufacturers, there is far less work done for other flow situations. However from a user's perspective – road, bridge or rail designers and operators for example – the assessment of the risk level to traffic along the various sectors of their network due to cross winds is very desirable.

This is why the authors are involved in a EC CRAFT Project, WEATHER led by the SME Meteodyn [1] – Wind Early Alarm for terrestrial Transport Handling, Evaluation of Risks – which aims to develop a wind alarm system for road and rail transportations, including: (1) wind time-prediction and spatial extrapolation, (2) aerodynamic forces, (3) dynamic modeling of the vehicle response, (4) stochastic analysis for accident, (5) risk assessment over road or rail paths, considering the type of vehicle. This paper briefly introduces the overall project first and some of its achievements so far.

As part of WEATHER the University of Nottingham focuses on the CFD prediction of the flow and aerodynamic coefficients at scale 1:1 and at the wind tunnel scale. Its objectives are: (1) to validate CFD methods to compute aerodynamic coefficients on vehicles, (2) to define an efficient, robust, and optimized methodology to compute aerodynamic coefficients for a wide range of vehicles. The authors work mainly with colleagues at the Universities of Birmingham and Milan where field and wind tunnel experiments are carried out and used for validation. The paper also reports on the work done so far for the numerical simulation of cross flows over a DAF truck commonly found on Europeans roads. The simulations consider static and moving vehicles at various yaw angles. They were carried out using the SST turbulence model [2] as well as a DES approach within a framework called a "virtual wind tunnel" by the authors and which is detailed here. The simulations were run using a transient approach and most exhibit some fluctuating features.

References:

[1] www.meteodyn.com
[2] Menter, F.R.. "Two-Equation Eddy-Viscosity Turbulence Models for Engineering Applications", *AIAA-Journal*., Vol. 32, No. 8, 1994.

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