

An Experimental Investigation into Fluid Forces on Road Vehicles in Unsteady Flows

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Abstract : In this research, the effect of unsteady flows acting on road vehicles was experimentally investigated, using an advanced and recently introduced wind tunnel. The aims of this study were to extract the characteristics of fluid forces acting on road vehicles under unsteady wind conditions and obtain new information on drag forces in a practical on-road test. We applied pulsating wind as a representative example of the atmospheric fluctuations that vehicles encounter on the road. That is, we considered the case where the vehicles are moving at constant speed in the air, with large wind oscillations. The experimental tests were performed on the Ahmed-type test model, which is a simplified vehicle model. This model was chosen because of its simplicity and the data accumulated under steady wind conditions. The experiments were carried out with a time-averaged Reynolds number of $Re = 4.16 \times 10^5$ and a pulsation period of $T = 1.5$ s, with amplitude of $\eta = 0.235$. Unsteady fluid forces of drag and lift were obtained utilizing a multi-component load cell. It was observed that the unsteady aerodynamic forces differ significantly from those under steady wind conditions. They exhibit a phase shift and an enhanced response to the wind oscillations. Furthermore, their behavior depends on the slant angle of the rear shape of the model.

Keywords : Ahmed body, automotive aerodynamics, unsteady wind, wind tunnel test

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