CFD based performance optimisation of an HGV Cab roof deflector for maximum fuel efficiency and minimum emissions

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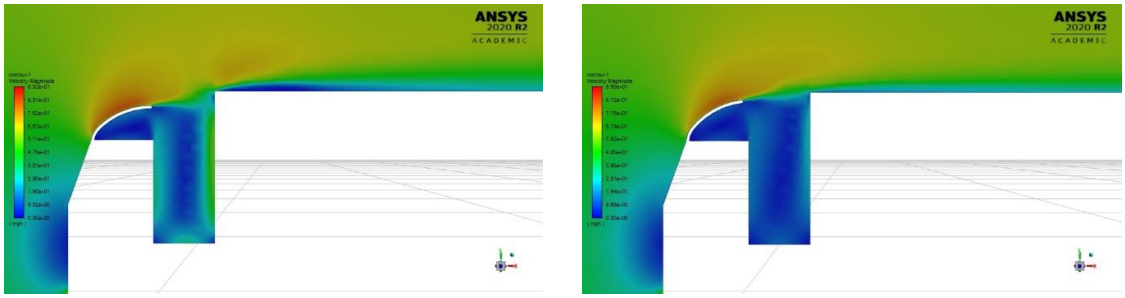
Abstract

Heavy goods vehicles, HGVs are very important for inland cargo transportation and make up 85% of the European road freight transport sector in 2018. Many aerodynamic devices have been implemented to make HGVs more aerodynamic to improve their fuel economy and reduce emissions. One such device is the Cab Roof Deflector (CRD) mounted on the HGV tractor roof that deflects the airflow over the roof of the trailer. There is usually a mismatch between the height of the tractor and that of the trailer such that the larger exposed front face of the trailer generates high drag forces and increases fuel consumption. The changing direction and velocity of both the wind and tractor-trailer, however, require further research in finding the optimum position of the CRD. This study has used Computational Fluid Dynamics (CFD) modelling technique to investigate the optimal position of the CRD for a range of tractor-trailer velocities and yaw angles. It was found that adjusting the CRD to match the height of the trailer does not provide maximum fuel saving. The findings revealed that there is no fixed optimal position of the CRD and active flow control methods are required to adjust it to the most optimum position according to varying surrounding flow conditions. It was also found that the performance of the CRD was reduced in the crosswind conditions and its optimum position was also different from the straight headwind conditions. This study has shown that an extra 7 to 13% fuel saving can be achieved by adjusting the CRD to its optimum position depending on prevailing head- and crosswinds.



(a) (b)

Figure 1 Represents velocity contour at 50mph (a) CRD lower than trailer height (b) CRD matching the flow on the trailer roof