

UTC Project Information	
Project Title	MPC-644 – Crash Modeling of High-Profile Moving Vehicles under Strong Crosswinds Based on Computational Fluid Dynamics
University	Colorado State University
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Funding Source(s) and Amounts Provided (by each agency or organization)	<p>USDOT, Office of the Assistant Secretary for Research and Technology \$60,000</p> <p>Colorado State University \$63,000</p>
Total Project Cost	\$123,000
Agency ID or Contract Number	69A3551747108
Start and End Dates	November 11, 2020 to July 31, 2024
Brief Description of Research Project	<p>The overall goal of this research project is to provide new insights and develop preliminary guidelines on improved vehicular safety performances under strong crosswind conditions. The main thrust is on investigating the variability in modeling wind loads on high-profile moving vehicles under different scenarios involving turbulent wind forcing conditions interacting with highway infrastructure (bridges, embankments, cuttings etc.) and adjacent vehicles. To do this in an effective manner, we propose an integrated study comprising of: (i) a comprehensive literature review of the state-of-the-art for modeling wind loads on moving vehicles and crash simulation under high crosswinds; (ii) novel preliminary Computational Fluid Dynamics (CFD) simulations to explore feasibility to model the wind loads on moving vehicles under different scenarios and (iii) provide preliminary modeling of single vehicle crash occurrence based on the modeled wind loads from CFD.</p>

<p>Describe Implementation of Research Outcomes (or why not implemented)</p> <p>Place Any Photos Here</p>	<p>This is a complex problem. The primary focus of the study was to investigate the flow field around a simplified geometry of a high profile vehicle. In the application field, it is apparent that additional work to determine rolling moment coefficient is needed because there is a Reynolds number dependency evident in the simplified 2D analysis of flow around a rectangular cylinder near a plane wall boundary. This work needs to include the necessary extension to 3D high-sided vehicles to assess the Reynolds number dependency. The current work only explored 2D effects and naturally excludes 3D effects. Furthermore, as follow-on work, it would be logical to explore the effects of vehicle grouping. Extension of the present process-oriented CFD study to more representative field scale simulations would allow for a realistic understanding of the variability of the local wind field and the corresponding aerodynamic loads on moving vehicles including gravitational forces.</p>
<p>Impacts/Benefits of Implementation (actual, not anticipated)</p>	<p>The overarching impact of this study is tied to improved safety guidance to mitigate crash risks for high-profile vulnerable vehicles. Our findings suggest that it is premature to assume the critical threshold of Reynolds number has been surpassed, such that the rolling moment coefficient is Reynolds number independent. This study highlights the need for previous work on quantifying rolling moment coefficients of overturning high sided vehicles to be revisited.</p>
<p>Web Links</p> <ul style="list-style-type: none"> • Reports • Project Website 	<ul style="list-style-type: none"> • MPC Final Report – Crash Modeling of High-Profile Moving Vehicles Under Strong Crosswinds Based on Computational Fluid Dynamics