Screening Grade Crossing Vertical Profiles for Vehicle Immobilization Risk

Exhibit D

Recipient/Grant (Contract) Number: University of Texas Rio Grande Valley (UTRGV)/Grant No. 69A3552348340

Center Name: University Transportation Center for Railway Safety (UTCRS)

Research Priority: Networked Sensors and Sensing, Resilient Infrastructure and Systems

Principal Investigator(s): Dr. Aemal Khattak (PI, University of Nebraska-Lincoln (UNL))

Project Partners: Federal Railroad Administration (FRA) through CRISI grant

Research Project Funding: $113,980 (Federal), $56,990 (Non-Federal Cost Share)

Project Start and End Date: 11/01/2026 to 10/31/2027

Project Description: Vehicles with low underbody clearance can become immobilized on highway-rail grade crossings when abrupt changes in roadway gradient, including humps/crests and dips/sags, cause the chassis or undercarriage to contact the rail or road surface as the wheels lose traction. Although this problem is recognized, current methods for managing it remain irregular and insufficient, and there is no widely accepted, systematic framework that allows agencies to screen an entire crossing inventory to predict hang-up vulnerability without conducting field surveys at every site. The proposed research addresses this gap by developing a validated method to identify and classify crossings vulnerable to immobilizing undercarriage contact.
The research will use Federal Railroad Administration Highway-Rail Grade Crossing Incident and Crossing Inventory data to isolate geometric and operational characteristics associated with incidents in which the highway user is recorded as stalled or stuck on the crossing. Those relationships will support development of a mathematical screening framework that assigns an Undercarriage Contact Potential Score using geometric proxies such as crossing angle, number of tracks, and intersecting roadway distance. The framework is intended to identify high-priority candidates for physical inspection from thousands of inventory records, including locations without prior accident history.
To validate and calibrate the framework, the research team will select a representative sample of crossings stratified by predicted risk and collect LiDAR-based, high-resolution 3D roadway profiles. This data will be used to generate vertical alignment models and simulate the passage of standard low-clearance design vehicles to verify whether physical contact occurs. The results will then support development of tiered risk categories based on the range of vehicle characteristics susceptible to undercarriage conflict at each crossing.

USDOT Priorities: SAFETY: 1.2 Reduce surface transportation-related fatalities and serious injuries. SAFETY: 1.4 Develop improved safety management systems across transportation modes. INFRASTRUCTURE: 2.3 Improve system condition and reliability.

Outputs: This research will result in the following during the succeeding contractual year:

1. A Risk Identification and Classification Framework (technical guide) for evaluating HRGC profiles.
2. A dataset of regional crossings identified as at-risk for vehicle hang-ups for use by local stakeholders.
3. A library of LiDAR-derived vertical profiles for the study sites, serving as a dataset for future research.
4. A final report, presentations at major conferences, and publications in the form of journal articles and/or conference papers.

Outcomes/Impacts: The broader impact of this research is that it will (1) improve identification of crossings vulnerable to vehicle immobilization; (2) enable more targeted inspections and geometric interventions; (3) support more efficient use of safety resources; and (4) provide a common classification basis for roadway managers and railroad engineers.

Final Research Report: Upon completion of the project, a URL link to the final report will be provided.