

Functional Reliability of Tunnels and its Impact on Transportation Network Resilience

Grantee: Colorado School of Mines

Center Name: University Transportation Center for Underground Transportation Infrastructure

Research Priority: Improving the Durability and Extending the Life of Transportation Infrastructure

Research Project Funding: \$330,000

Project Description: Tunnels are typically one of the most critical links in a transportation network and they can greatly undermine network resilience when they lose functionality, either entirely or partially, as a result of hazardous traffic conditions, increase traffic demand, and routine maintenance, repair or retrofit. Closure or limited access of traffic tunnels is very costly and has negative impacts on the commuting public. Each tunnel owner or manager typically analyzes events that affect tunnel functionality in a case-by-case basis. This project aims at developing two fundamental products to enable this analysis, namely: 1) a tunnel operation data collection framework that can be adopted for critical tunnels across the country, and 2) a probabilistic framework for quantifying tunnel resilience (functionality loss) as conditional distribution of event type and intensity.

Outputs: This project started in August 2017. The research team has developed a framework for data collection and analysis for critical roadway tunnels in the United States to gather functionality-loss data from tunnel daily operation. The project team has held multiple meetings and visits with the Colorado Department of Transportation to discuss collaboration using the Eisenhower-Johnson Mountain Tunnel on I-70 as a test bed. The project team has acquired extensive historical operation record data from the tunnel to test the newly developed data framework. The research team plans to collaborate with an industry partner to enable collection of critical tunnel operation data through a computer-based platform. The research team also plans to conduct a survey study with department of transportation tunnel owners to identify the current status of operation data collection for tunnels. At the same time, the researchers will use critical tunnels in Colorado to conduct case studies on operational data analysis, as well as developing probabilistic framework for tunnel functionality loss analysis. The project has a very strong education and workforce development components. In Summer 2018, this Center organized two summer camps for about 30 grade school students to mentor and motivate them to pursue STEM careers, particularly in underground transportation infrastructure.

Outcomes/Impacts: The main expected outcome and impact of the research is to improve the reliability and resiliency of transportation tunnels to allow them to rapidly respond and recover from routine and extreme events that can affect their operation. This will be accomplished by developing a probabilistic framework for event-based tunnel functionality loss analysis. Using the framework, decision-making will be strengthened to enable for fast response to and recovery from events to reduce their impact, and improve tunnel robustness and resilience.



K-12 school students and their teacher, and Colorado School of Mines Researchers visiting the Eisenhower-Johnson Tunnel Operation Center.