Exploring Rapid Repair Methods for Embankment Slope Failure
Fact Sheet

Problem Statement: Recurring failures frequently happen in Texas due to extreme weather and soil conditions. The Texas Department of Transportation (TxDOT) spends millions of dollars annually to repair the embankment slope failures along the state highway system. Although some repairs show satisfactory performances, many repair attempts have shown recurring failures over a period of time.

Objective: Create a database of relevant spatial data, such as slope geometry and soil characteristics along corridors; assess and visualize slope conditions; predict slope failures; recommend rapid, resilient, and sustainable repair methods to prevent recurring failures; and develop regional slope repair and maintenance master plans.

Significance of work: A statewide survey conducted in TxDOT research project 0-6957, Synthesis on Rapid Repair Methods for Embankment Slope Failure, showed that approximately half of slope failures in Texas are recurring. TxDOT spent approximately $28.5 million in slope repairs in fiscal year 2018. Assuming an annual budget of $28.5 million for slope repairs in Texas, the implementation of the findings of this research project is expected to lead to a cost savings of $15.6 million per year. Assuming a 5 percent discount rate, the net present value of this research project is about $130 million over the next 10 years. The benefits of reduction in recurring failures go beyond reduced operational and construction costs by enhancing safety, customer satisfaction, infrastructure conditions and service life, environmental sustainability, and transportation system reliability.

Methodology: Researchers collected statewide spatial data, such as engineering soil properties, slope angles, and precipitation, for assessing the stability of slopes, and integrated the data into a geo-referenced ArcGIS database. From this data, researchers were able to develop a database of repair methods with their advantages, disadvantages, and recommended implementation practices. Researchers developed a slope failure predictive model to analyze the stability of slopes along the corridors with high recurring failures. The slope failure predictive model utilized data from the geo-referenced database to assess the slope instability. Researchers used the slope failure predictive model to generate a heat map to visualize the critical segments of the slopes along the corridors (Highly Critical: Red; Critical: Yellow; Not Critical: Green). Researchers recommended appropriate repair methods to prevent recurring failures.

User Interface: A map-based user interface visualizes the critical segments of corridors (Highly Critical: Red; Critical: Yellow; Not Critical: Green) and past slope failures. Based on the user defined criteria, such as long-term performance, impact on traffic, ease of implementation, and life-cycle costs, researchers recommended appropriate repair methods.