Exploring Rapid Repair Methods for Embankment Slope Failure

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Problem Statement

- Recurring slope failures happen frequently in Texas due to the extreme weather and soil conditions (Hossain et al., 2017).
- The Texas Department of Transportation (TxDOT) annually spends millions of dollars to repair embankment slope failures along the state roads and highways (Shahandashti et al., 2019).
- Although some slope repairs using common repair approaches show a satisfactory performance, many repair attempts have shown recurring failures after a period of time (Shahandashti et al., 2019).

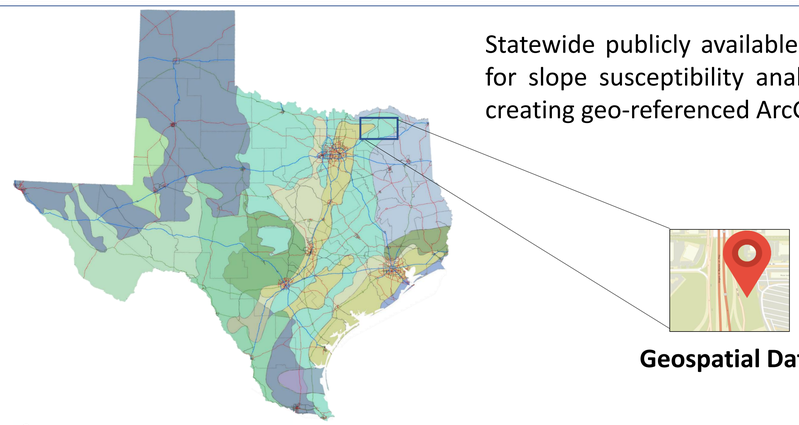
Objectives

1. Collect spatial data (e.g., slope geometry, soil characteristics) and create an ArcGIS geo-database for assessing conditions of slopes.
2. Synthesize and critically evaluate existing methods for rapid repair of embankment slope failures.
3. Develop slope failure predictive models.
4. Develop a Slope Repair and Maintenance Management System to visualize the spatial data and critical segment of the corridors.
5. Monitor slope failures, calibrate slope failure predictive models, and update the location of critical segments of the corridors.
6. Recommend rapid, resilient, and sustainable repair methods to prevent recurring failures.
7. Develop a slope repair and maintenance master plan.

Significance of Work

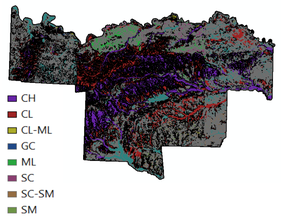
- A statewide survey showed that approximately 55% of slope failures in Texas are recurring failures (Shahandashti et al., 2019).
- TxDOT spent approximately $28.5 million in slope repair projects for the fiscal year 2018 (TxDOT, 2018).
- Assuming an annual budget of $28.5 million for slope repair projects in Texas, the implementation of the findings of the research (Shahandashti et al., 2019) is expected to lead to a cost-saving of $15.6 million per year.
- The benefits of reduction in recurring failures go beyond reduced construction and operation costs by enhancing safety, customer satisfaction, infrastructure conditions and service life, environmental sustainability, and transportation system reliability.

Methodology

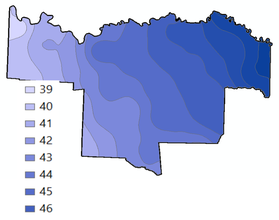


Statewide publicly available spatial data required for slope susceptibility analysis are collected for creating geo-referenced ArcGIS database.

Geospatial Data

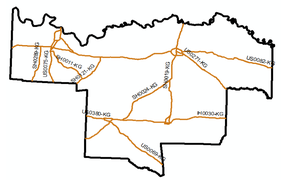


Soil Properties

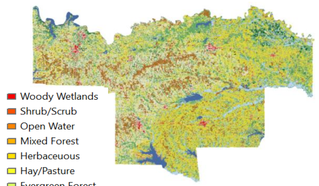


Precipitation(Inches)

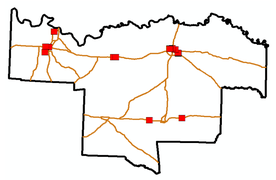
Slope Angles



Corridors

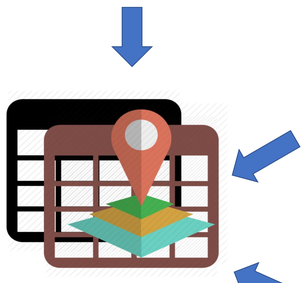


Vegetation

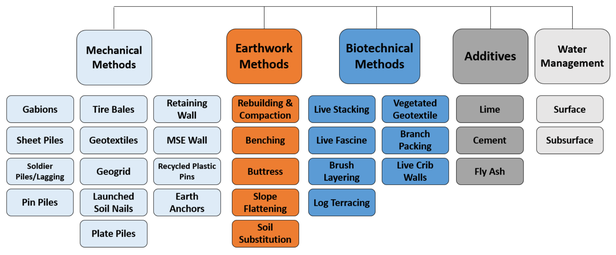


Failure Location

Data Collection

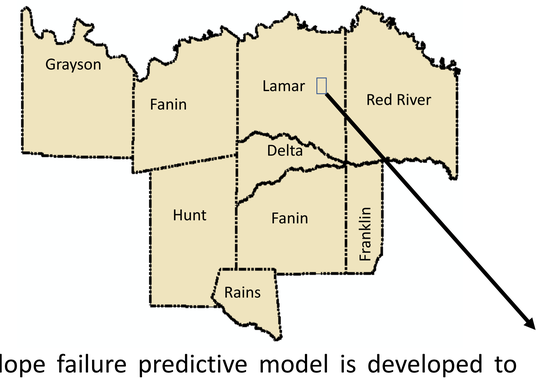


Geo-referenced Data Integration

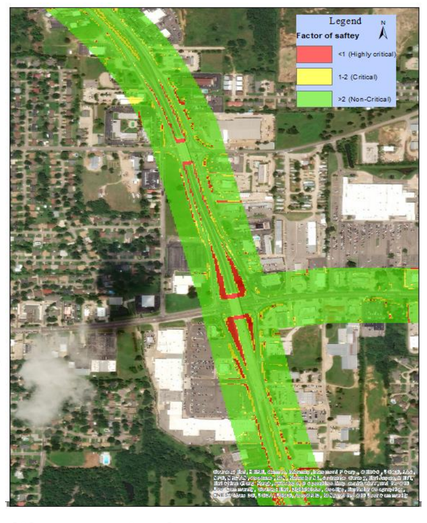


Repair methods

User Defined Criteria



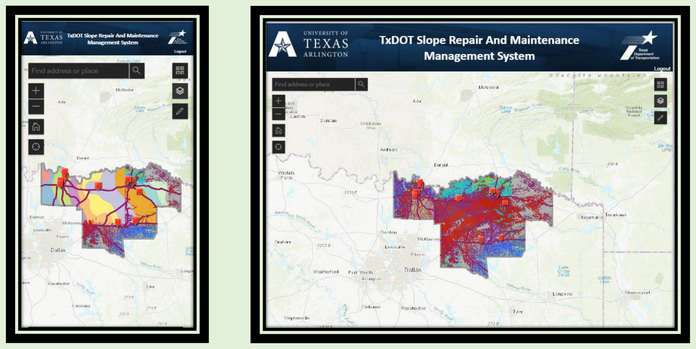
A slope failure predictive model is developed to analyze the stability of slopes along corridors. The analysis is performed in the ArcGIS environment.



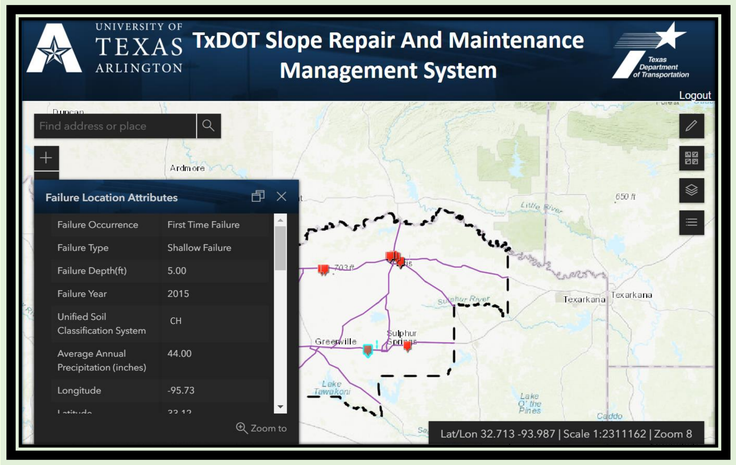
Slope Susceptibility Analysis

Recommend Slope Repair Methods

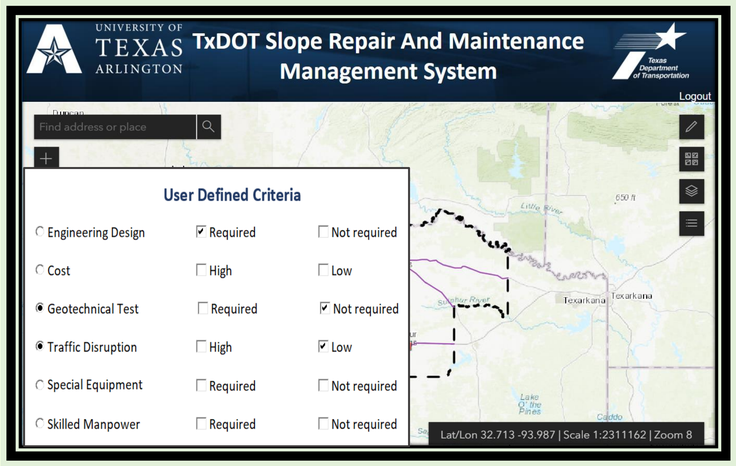
User Interface



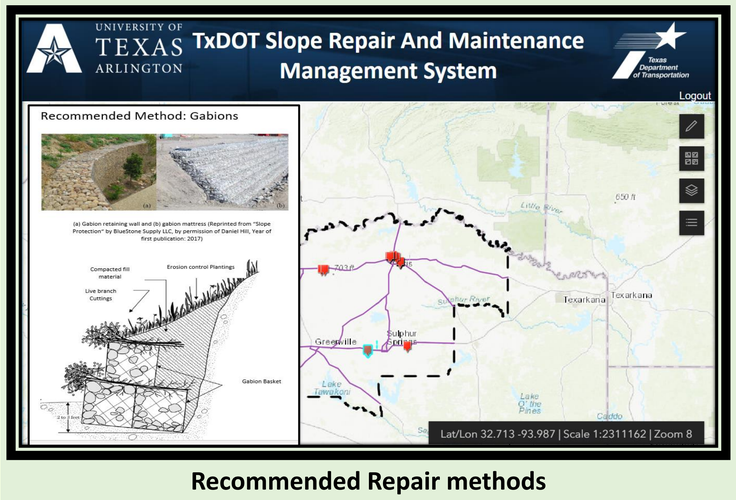
Map-based ArcGIS Interface



Slope Failure Attributes



User defined criteria for selection of Repair methods



Recommended Repair methods

References

Hossain, S., Khan, S., & Kibria, G. (2017). *Sustainable Slope Stabilization using Recycled Plastic Pins*. CRC Press.

Shahandashti, M., Hossain, S., Khankarli, G., Zahedzahedani, S. E., Abediniangerabi, B., & Nabaei, M. (2019). *Synthesis on Rapid Repair Methods for Embankment Slope Failure* (No. FHWA/TX-18/0-6957-1).