



The Ohio Department of Transportation Office of Research & Development Executive Summary Report

Landslide Hazard Rating Matrix and Database

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Problem

Landslides or embankment slope failures on highways occur for a variety of reasons, such as excessive precipitation, flooding, deterioration of soil strength over time, and adverse man-made activities. The slope failures not only affect roadways but also impact adjacent structures. Repairing slope failures may require lane closures or even detours that result in additional travel time and fuel cost as well as the diminished commercial activities in the affected area. The Office of Geotechnical Engineering (OGE) recognizes the need to develop a strategy to provide timely preventive maintenance to avoid on-set of large or catastrophic slope failures. Furthermore, with limited financial resources, the OGE is forced to make rational decisions on the priority of various landslide (slope failure) maintenance and remediation needs. The decision-making and prioritizing of maintenance/remediation plans can be executed objectively only when a framework of the landslide hazard rating system is developed, and a well developed and populated inventory of existing landslide sites is in existence.

The OGE has embarked on a broad based and far-reaching plan to develop a comprehensive Geological Hazard Management System (GHMS) to better manage data and activities related to planning, design, construction, and maintenance of both existing and new highway infrastructures that may be affected by the known geological hazards in Ohio. Geologic hazards include landslides, rockfalls, abandoned underground mines, karst, and shoreline erosion. The components of the GHMS are the following: inventory, monitoring schedule,

hazard rating matrix, cost-benefit analysis, prioritization and decision-making, new construction support, preservation of historical data, and efficient data exchange, among other requirements. This research was undertaken to develop the landslide component of the GHMS.

Objectives

Develop a field validated landslide geological hazard rating matrix

Develop field reconnaissance forms in both paper format and electronic format (window plus Arcpad)

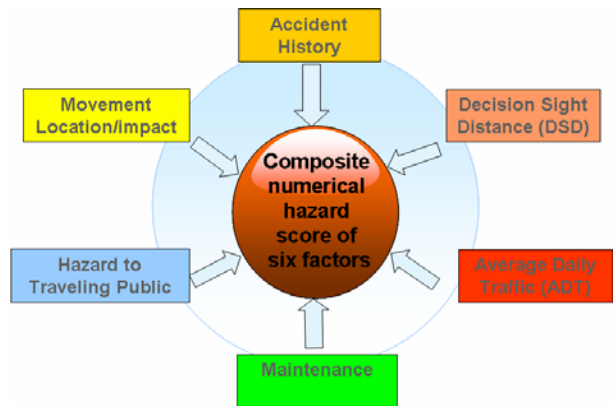
Develop and deploy a web enabled, GIS based landslide database

Develop a user’s manual and training materials for the landslide geological hazard database

Description

An extensive literature review was conducted to gain a comprehensive understanding of existing landslide geological hazard rating systems developed by national and state agencies. Based on synthesis of literature review of existing practices, ODOT in-house expert opinions, and knowledge of prevalent Ohio geological formations in landslide prone areas, the principal investigator developed the ODOT specific landslide hazard rating system, together with the field site reconnaissance form. To validate the landslide hazard rating matrix, the principal investigator has compiled a pilot database with 39 landslide sites. Statistical analysis of the pilot data set was performed to ascertain the reasonableness of the rating outcome.

A web accessible landslide database in a GIS platform was developed, pilot tested, and deployed. Full implementation of the database for full-scale data population is slated for spring 2008. A user’s manual was developed to facilitate proper use of the database. For future in-house training purposes, a set of training materials in Power Point slide presentation format was developed as well.



Conclusions & Recommendations

A landslide hazard rating matrix and a web-accessible, GIS based landslide database was developed for the OGE to manage landslides as part of a comprehensive GHMS.

The applicability of the developed landslide hazard rating matrix has been validated by statistical analysis using a pilot landslide database compiled in this research. The selection of six primary unweighted hazard parameters is shown to be capable of differentiating the hazard level of 39 landslide sites in the pilot database. As additional landslide sites are added to the database, the rating matrix could be adjusted with the possible use of weighting factors.

Implementation Potential

The OGE is already in the process of full implementation of the developed landslide hazard rating matrix and landslide database. A consultant is engaged to perform the inventory and population of the landslide database. The OGE will use the rating matrix to prioritize the fund allocation for landslide hazard remediation.

The tangible benefits from full implementation of the landslide database and landslide hazard rating matrix include: (a) elimination of excessive paper work, (b) near real-time monitoring and data management, (c) centralized information, (d) uniform data collection and reporting, (e) enhanced data sharing experiences. Furthermore, by implementing a comprehensive and systematic landslide inventory and landslide hazard rating system, the Ohio Department of Transportation can reap the benefits of cost saving due to early stage detection and pro-active remediation measures.