

OHIO DEPARTMENT OF TRANSPORTATION OFFICE OF GEOTECHNICAL ENGINEERING RESEARCH IMPLEMENTATION PLAN



Title: Identifying Potential Collapse Features Under Highways

State Job Number: 14700

PID Number:

Research Agency: Wright State University

Researcher(s): Paul Wolfe

Technical Liaison(s): Rick Ruegsegger

Research Manager: Karen Pannell

Sponsor(s): Tim McDonald, Gene Geiger

Study Start Date: 5/1/1998

Study Completion Date: 4/30/2003

Study Duration: 60 Months

Study Cost: \$137,144.00

Study Funding Type: 80 Federal / 20 State, ODOT SPR (2)

STATEMENT OF NEED:

There are many unmapped features under the state's roadways that threaten them with major localized collapse. The most common of these features are abandoned underground mines in the eastern part of the state and sinkholes in portions of limestone bedrock. These catastrophic failures may cause loss of life, traffic disruption and large repair expenses. Identifying roadway locations which are likely to fail would allow remedial action to prevent the future failure. Methods to locate these locations need to be inexpensive enough to allow widespread use, but focused enough to target very specific problem areas. Geophysical survey techniques have the potential for meeting these requirements. Specific geophysical techniques need to be developed, which will be effective in identifying the potential failure zones under the conditions that prevail in Ohio.

RESEARCH OBJECTIVES:

Phase I

- tested several geophysical methods at two sites with known collapse potential. The testing was conducted to determine which method, or combination of methods, was best able to detect and provide detailed subsurface information on the problem location.

Phase II

- tested the techniques developed in Phase I along a 3-mile section of highway. This test section was selected in consultation with ODOT personnel. The section was overlying abandoned underground mine workings, having some collapse potential. The selected geophysical techniques and data analysis designs from Phase I were implemented with improvements subsequently identified.

RESEARCH TASKS:

Phase 1: The geophysical methods tested were:

- seismic refraction with compressional waves.
- seismic refraction with shear waves
- fixed offset seismic reflection

- gravity
- two-dimensional resistivity imaging,
- spectral analysis of surface waves (SASW).

The seismic refraction investigations included tests of several seismic energy sources. Methods to suppress the effects of traffic noise on the data were studied. The data was analyzed to determine the experimental forms of geophysical testing to pursue in Phase II.

Phase II

- geophysical and traffic noise data were acquired along a 3-mile test section were acquired. Conditions likely to influence geophysical data that may be common to the highway margin environment were identified.
- data were processed and interpreted, and zones of good rock and zones of potential problems were identified.
- six test locations were to be identified for ODOT to conduct borings.
- results of these borings were to be interpreted jointly by project scientists and collaborators, and by ODOT personnel. These interpretive efforts were to determine the success of the geophysical surveys in locating problem zones.
- extension of the techniques to other types of potential collapse zones were to be evaluated.

RESEARCH DELIVERABLES:

A final report dated December 2002 which included: (1) the results and evaluations of the results of the various methods of the Phase I site, (2) the results and evaluations of the methods in the Phase II studies with recommendations for optimum techniques for cost-effective field implementation, and (3) boring locations for ODOT to do test borings to determine the accuracy of the Phase II geophysical interpretations of the subsurface.

RESEARCH RECOMMENDATIONS:

Seismic refraction and 2D resistivity imaging were judged to have the greatest potential for differentiating the subsurface locations of abandoned underground mine workings from those of intact rock.

PROJECT PANEL COMMENTS:

ODOT was unable to provide borings into abandoned mines beneath the Phase II testing location. This situation was due to hydraulic head conditions within the mines which the Ohio Department of Natural Resources, Division of Mineral resource Management reported had spontaneously caused a hydraulic "blowout (high-volume surface expression of groundwater impounded in the abandoned mines) along a local stream. Therefore, no subsurface investigations into the mines were possible to verify the Phase II research data.

IMPLEMENTATION STEPS & TIME FRAME

None directly resulting from this research project.

EXPECTED BENEFITS:

No significant expected benefits resulted from this research project.

EXPECTED RISKS, OBSTACLES, & STRATEGIES TO OVERCOME THEM:

No risks or obstacles will arise as the result of this research because no significant actions are to be implemented as the direct result of this research.

OTHER ODOT OFFICES AFFECTED BY THE CHANGE:

None.

PROGRESS REPORTING & TIME FRAME

None required since no significant actions are to be implemented as the direct result of this research.

TECHNOLOGY TRANSFER METHODS TO BE USED:

- Distribute copies of Final Report to District Geotechnical Engineers, District AUMIRA Coordinators, staff of the Office of Geotechnical Engineering and geotechnical consultants

IMPLEMENTATION COST & SOURCE OF FUNDING:

No implementation cost required.

Approved By: (attached additional sheets if necessary)

Office Administrator(s):

Signature: Gene Geiger Office: OGE Date: 9/21/2005

Division Deputy Director(s):

Signature: Tim McDonald Division: PM Date: 9/22/2005