Innovative Management System for Rock Cuts

Assessing Roadway Hazards in New Hampshire

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The New Hampshire Department of Transportation has developed a geographic information system to track and centralize statewide rock cut data, assess roadway hazard risk from rock falls, and prioritize rock cut projects according to risk-reduction and cost–benefit scenarios. The analytical capabilities of the system assist in informed decision making on where and how to spend limited construction funds.

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The New Hampshire Department of Transportation (DOT) initiated its first hazard survey of rock cuts in 1975. Since then, the program has more than doubled in size and includes four different rock fall hazard ratings. The program has developed a geographic information system (GIS) to access and analyze all the data.

Problem

New Hampshire DOT's Engineering Geology Unit stored written reports, photographs, structural data, and other information on most of the rock cuts within the state on a computer database. The inspection reports, however, were scattered. Determining the last inspection of a rock cut and what the conditions were at that time was difficult, requiring a complicated information retrieval process. Revisiting a rock cut and collecting duplicate information was easier, but time-consuming, and resulted in additional cost to the DOT.

Solution

Choosing a System

New Hampshire DOT initiated in-house research to identify how the rock cut information was used. The research indicated a need for a management system that would combine different data types with spatial information and would facilitate the tracking, retrieval, and display of information through a personal computer.

The next phase involved the development of an easily accessible and updatable data management system to combine all the data for the 380 rock cuts in the state. A GIS was chosen to house the management system because GIS increases accessibility of the data to a broader audience and provides the ability to conduct spatial analyses.

The GIS centralizes several types of data: digital photographs, new and historical text data, readings of structural data, and two-dimensional laser profiles. The digital photographs include the cut as a whole and specific problem sections within the cut. The text data include potential instabilities, recommended remedial measures, and hazard assessments.

The structural data can be viewed in text form or in the form of rose diagrams, stereonets, and density plots. The two-dimensional profiles are cross-sectional side views of a rock slope taken at selected locations with a laser-measuring device linked to a handheld computer. The profiles aid in rock cut remediation and can be input into a rock fall simulation program.

Assessing the Hazards

The GIS also contains the hazard assessment of the rock cut—a color code indicating the degree of risk for each rock cut feature. With spatial referencing, data on rock cut features can be correlated, and other data layers—roadways, topographic maps, aerial photographs, town lines, and bedrock geology maps—can show the locations of the rock cuts.

A query-building feature can be used to call up data. The answers are displayed on a map or within the current view of the GIS, providing key pieces of information for rock cut analysis and decision making.

The GIS also can be used to establish rock cut remediation priorities. The estimated cost for the recommended remediation for each rock cut can be compared with the amount of risk reduction associated with the remediation. Remedial rock cut projects can be prioritized statewide using several different risk-reduction and cost–benefit scenarios. The analytical capabilities of the GIS support informed decision making on where and how to spend limited construction funds.

Application

New Hampshire DOT uses the rock cut management system to identify rock cuts that need remediation within the limits of large roadway resurfacing and safety improvement projects. Using the four different rock fall hazard ratings, the GIS determines which rock cuts pose the greatest hazard and identifies the causes.

The potential for a rock fall event and the degree of risk to the traveling public can be computed from the information stored in the GIS. Some of the rock cut laser profiles have identified errors on the project cross-sections, which have led to plan revisions. The structural data and stereonets are used to develop specific guidance on rock cut excavations.

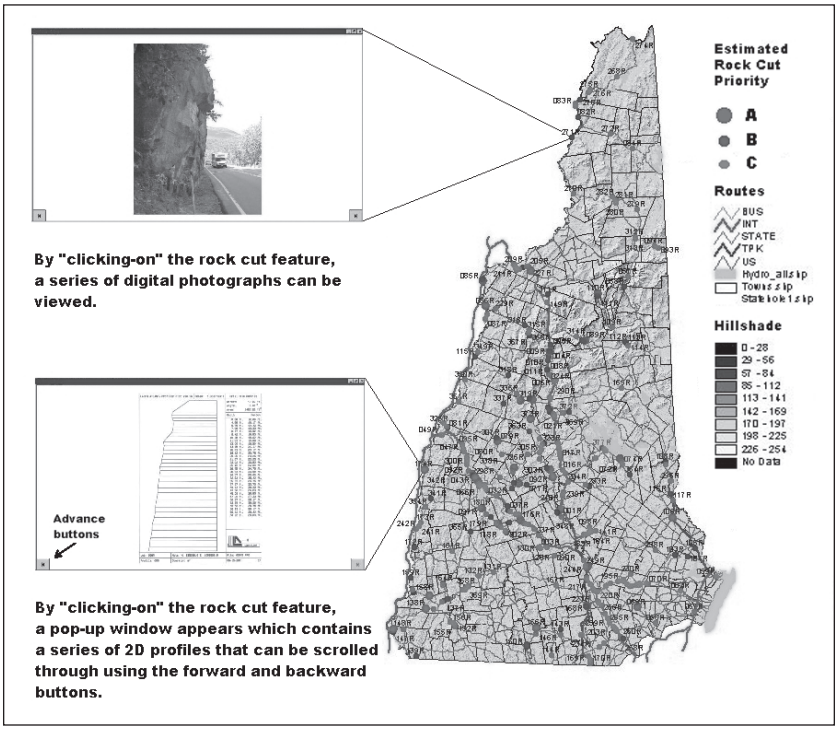
New Hampshire DOT also has used the rock cut management system to maintain rock cut inspection schedules. The GIS analyzes previous inspection dates to assure that all rock cuts are visited within a specified time. As rock cuts are inspected, the system updates the database by adding new records, leaving the previous records as historical data.

Benefits

The rock cut GIS has become a valuable asset management tool, saving time and money. Having the required information—such as past inspection records and photographs—available through the GIS saves hours every day during field inspections. The system also enhances the ability to identify and locate rock cuts that need inspection.

Rock cut work decisions are made with information from the GIS. By using information that is already available, additional visits to a particular rock cut can be reduced or eliminated. Inspection reports, structural data, and two-dimensional profiles are used to develop remedial rock slope measures and to estimate rock quantities and construction costs.

The rock cut GIS has become a valuable tool in the DOT's budgeting and planning process. Rock cut work can be prioritized, and the remedial costs associated with risk reduction can be determined, allowing the most effective use of available design and construction resources.



Screen view of New Hampshire's statewide rock cut management system.

The rock cut management system can save an estimated 2,000 work-hours and $75,000 annually. This time and money savings is comparable to a geologist's annual salary, benefits, and travel expenses for performing rock cut inspections. Through the careful collection and management of rock cut data, a limited staff can sustain a rigorous rock cut inspection schedule while performing other responsibilities and job duties.

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Suggestions for "Research Pays Off" topics are welcome. Contact G. P. Jayaprakash, Transportation Research Board, 2101 Constitution Avenue, NW, Washington, DC 20418 (telephone 202-334-2952, e-mail gjayapra@nas.edu).