Breakthrough

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Recycled Plastic Offers Cost-Effective Slope Stabilization

Solution

A new and cost-effective slope stabilization technique for surficial slides has been developed for the Missouri Department of Transportation by investigators from the University of Missouri-Columbia as illustrated in Figure 1.

- The technique uses reinforcing members, manufactured from recycled plastics and other by-products, to intercept shallow sliding surfaces and provide additional resistance to maintain slope stability.
- The technique effectively stabilizes surficial slides at costs that can be substantially lower than costs for other traditional alternate stabilization measures when appropriately applied.
- The effectiveness of the technique has been demonstrated in a series of test sections installed at five different test sites chosen to evaluate the technique across a broad range of geographic and soil conditions across the state.

Motivation

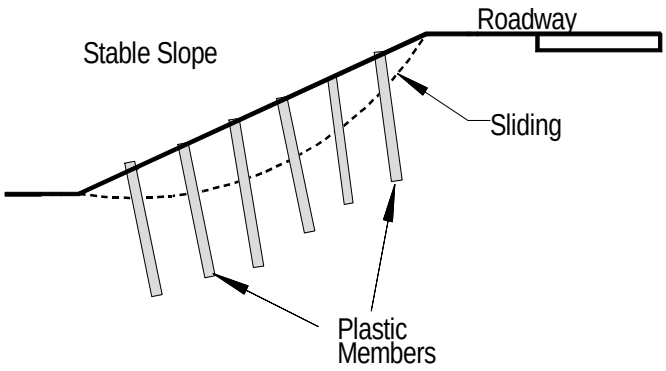

Figure 1. Illustration of stabilization of typical surficial, or "nuisance" slide, using recycled plastic reinforcement

Slope failures and landslides constitute significant hazards to all types of both public and private infrastructure. Total direct costs for maintenance and repair of landslides involving major U.S. highways alone (roughly 20 percent of all U.S. highways and roads) were recently estimated to exceed $100 million annually (TRB, 1996). In the same study, indirect costs of landslides (loss of revenue, use, or access to facilities) were conservatively estimated to equal or exceed direct costs. Costs for maintaining slopes for other highways, roads, levees, and railroads maintained by government and private agencies such as county and city governments, the U.S. Forest Service, the U.S. Army Corps of Engineers, the National Parks Service, and the railroad industry significantly increase the total costs for landslide repairs.

A significant, but largely neglected, toll of landslides is the costs associated with routine maintenance and repair of "surficial" slope failures, or "nuisance" slides, of the type shown in Figure 2. Costs for repair of such slides were not explicitly included in the above referenced study because of limited record keeping for these types of slides by most state departments of transportation. However, the authors of the TRB study conservatively estimate that costs for repair of nuisance slides equal or exceed costs associated with repair of major landslides. This estimate is supported by the Missouri Department of Transportation's (MoDOT) experience with surficial slide problems, which are estimated to cost several million dollars per year on average. Many other state departments of transportation have similar problems with similarly high, or even higher annual costs. All available evidence thus clearly indicates that the cumulative costs for repair of many surficial slides can become extremely large, despite the fact that costs for repair of individual slides are generally low.

Figure 2. Typical surficial, or "nuisance" slide, appropriate for stabilization using recycled plastic reinforcement

In addition, surficial failures often constitute significant hazards to infrastructure users (e.g. from damage to guard rails, shoulders, or portions of road surface) and, if not properly maintained, often progress into more serious problems requiring more extensive and costly repairs. Significant attention to effective management and stabilization of nuisance slides is therefore warranted so that limited maintenance funds can be applied in a manner that will produce effective stabilization at reasonable long-term costs.

Nominal Costs

Estimated costs for stabilization using recycled plastic reinforcement vary significantly with the required spacing of the reinforcing members, but in all cases costs are generally preferable, or even strongly preferable over alternative methods for long-term stabilization. Nominal costs incurred for installation of reinforcing members during the project have been approximately $20/member for materials and $20/member for installation. These costs have remained relatively consistent over the 5-year evaluation period. Based on these nominal costs, the table below provides a summary of expected costs per unit area of stabilization for several alternative stabilization patterns.

Stabilization Scheme Pattern	Nominal Unit Costs
3-ft x 3-ft	$4.50/ft^2
4.5-ft x 3-ft	$3.25/ft^2
4.5-ft x 4.5-ft	$2.00/ft^2
Range	$2.00 to $4.50/ft ^{2}

For comparison, costs for stabilization by removal and replacement of failed material, which is currently applied frequently across the state for repair of nuisance slides, is on the order of $5.50 or more depending on the availability of crushed stone or other materials suitable for these techniques. Based on this analysis, potential costs savings of 20 to 70 percent may be realized in many cases as compared to current practices.

Implementation

Based on the successful implementation of the technique at the field test sites, MoDOT and project investigators have undertaken a number of tasks to facilitate widespread implementation of the technique across the agency. These activities include: development of a design and construction guidance document to provide written documentation to aid district personnel with evaluation of applicability and with design, installation, and inspection of the technique; offering an associated ½-day short course for MoDOT personnel to educate them further on implementation of the technique; and development of an applications brief for manufacturers of recycled plastic members and contractors so those associated entities are familiar with the requirements of the technique. A draft materials specification has also been developed and submitted to AASHTO for preliminary approval so that appropriate specifications are in place to implement the technique.

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