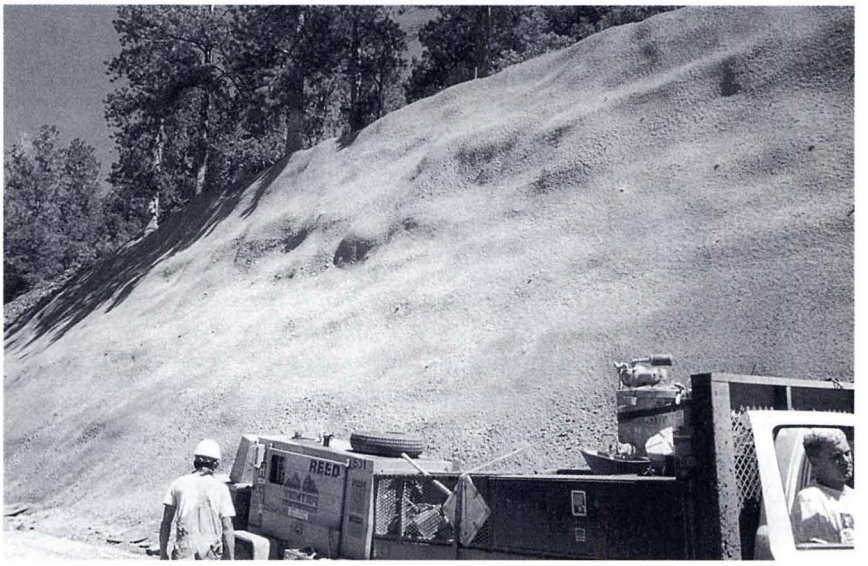
Shotcrete Expands Gambling in Colorado



The old mining towns of Central City and Black Hawk, Colorado have enjoyed legalized limited stakes gambling for the past eight years. Not coincidentally, property values are at their highest levels ever. Commercial developers wanting to get in on the action continue to search for possible sites for casinos and resorts. The high price of "traditional" real-estate has led to an unusual solution. The developers have started to cut away at the steep slopes that surround the towns and put casinos and resorts where mountains once stood. But cutting away mountains leads to conditions of instability, for which corrective measures must be taken.

The owners of the Black Forest Inn in Black Hawk wanted to expand their parking area and faced the task of moving an estimated 214,000 m^3 (280,000 yd^3) of rock. As the waste was removed, after blasting the side of the mountain, benches were created on which stabilization and scaling crews worked . Rock-bolt holes were then drilled into the excavated portion of the mountain. and 27.5 MPa (4000 psi) portland cement grout was pumped into the holes. "The grout is critical," explains Bill Roberts, project superintendent with Yenter Companies, "because it supports the bolts which support the mass. No part of the bolt can be resting on rock. We expect to force grout out of the hole when we insert the bolt." To be fully cured, the grout needs to set up for a period of three to seven days.

With the bolts installed, scaling crews begin hanging wire mesh over the bolt ends, which will serve to hold and reinforce the shotcrete facade. As they proceeded along the wall of rock,

geotextile drain boards were installed to prevent the buildup of water between the wall and the shotcrete. The geotextile material filters out everything except the water, which is channeled to the base of the wall. It is critical that water not pool up behind the shotcrete because it can will adversely affect long term durability and aesthetics.

After a double layer of mesh and the drain boards were in place, the bolts were plated and nutted, which helped to pull the mesh tight. Crews were then ready to begin the process of applying shotcrete, which sealed the rock and help prevent erosion. The shotcrete mixture included 15% fly ash which gave it a sticky quality. The shotcrete mix was pumped to a special shotcrete nozzle where compressed air was introduced. The addition of compressed air gave the concrete velocity and high compressive strength.

"The shotcrete has a minimum thickness of 6 in. (150 mm)," says Roberts. "The mesh gives the shotcrete something to cling to and serves as steel reinforcement." When the shotcrete had cured, it could be stained to blend in with the surrounding terrain. Black Hawk ordinances required that staining be done all areas that were visible to the public.

Another stabilization project, Hidden Valley, is located off I-70, near Idaho Springs, Colorado. The job consisted of a 7.5 m (25 ft.) high cut that was stabilized through the use of nails and shotcrete, nominally 6 in. (150 mm) thick. The stabilization project has allowed the Colorado Department of Transportation to widen and reduce curve radii through the windy I-70 stretch. The stabilized cut was approximately 1,200 m^2 (13,000 ft^2), and ranges from 300 mm to 7.5 m (1 ft. to 25 ft.) in height. Approximately 190 m^3 (250 yd^3) of shotcrete mix was used for the construction of the wall.

A third project was to remove a failing tunnel that was used by the Burlington Northern Santa Fe Railroad. A total of 765,000 m^3 (1,000,000 yd^3) was excavated. The excavation was 27.5 vertical meters (90 ft.) by 300 linear meters (1000 ft.) The total area shotcreted was 33,260 m^2 (358,000 ft^2) with a nominal 150 mm (6 in.) thickness. Approximately 5,080 m^3 (6,650 yd^3) of shotcrete were used, with the maximum production for a single day reaching 1,300 m^2 (14,000 ft^2) of shotcrete.