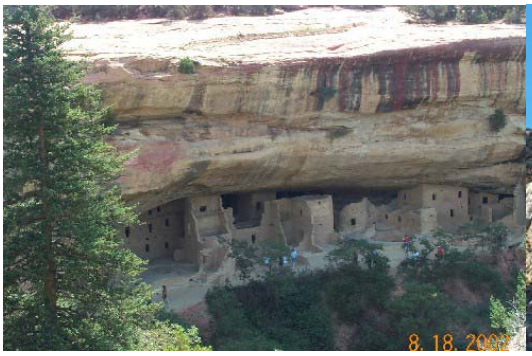


ASSOCIATION OF ENGINEERING GEOLOGISTS

"Serving Professionals in Engineering, Environmental, and Ground-Water Geology"

THE ROCKY MOUNTAIN SECTION NEWSLETTER

www.aegrms.org

MEETING DATE

THURSDAY
MARCH 10th, 2005

TIME
5:45 p.m. Social Hour
6:30 p.m. Dinner
7:30 p.m. Presentation

LOCATION
Berthoud Hall, Colorado School of Mines
1516 Illinois St.
Golden, CO 80401
See map below

COST
$20 Members
$22 Non-members
Students, Free first time, then $10

RESERVATIONS
c/o AEG Reservation Line
(303) 790-2161 x 243 or
meetings@aegrms.org
BY NOON, TUESDAY MARCH 8th

Debris Flow Remediation

Erik J. Rorem
Geobrugg North America LLC

In the fall of 2003, devastating fires ravaged the terrain in the San Bernardino Mountains above San Bernardino, CA near the mountain towns of Crestline and Lake Arrowhead, CA. These fires left the steep slopes and drainages barren of trees and ground cover, exposing soil on these slopes to erosion. Despite emergency measures to hydro seed these slopes on a massive scale and various other mitigation efforts, unusually large rainfall in December 2003 produced several large scale debris flows and many smaller debris flows that resulted in loss of life and considerable property and highway damage, as was widely reported in the national media.

Following these events, Caltrans undertook emergency measures to install a series of flexible barriers installed at multiple sites, to control debris flows that are likely in the future. The primary section of road under consideration is a section of State Route 18 commonly referred to as "The Narrows." Along this section of road, 10 distinct debris flow channels upslope from and opening onto the roadway were identified for application of these barriers.

At each site, field observations were made by Caltrans to estimate expected volumes of debris and velocities from debris flow events, broadly characterize the expected debris flow compositions, measure channel geometry and determine barrier orientations. From this information, engineers at Geobrugg were able to dimension barriers appropriate for these conditions. Dimensioning of the barriers was completed using a general design concept developed from that learned in various field testing efforts, from back-calculating forces exerted on barriers from observations of performance of barriers that had been impacted to date in actual debris flow events in the field, and from verification of the concept using a unique

computer simulation program that predicts barrier response and performance. Each site required a unique barrier design with differing barrier heights, capacities and support infrastructure.

Construction of these barriers commenced in May 2004 on a tight schedule for July completion. Due to the custom nature of the design for each site and unique materials for each, as well as a requirement for special colorization of all materials, meeting this schedule was a significant challenge but vital due to the importance of tourism in this area.

A general overview of the debris flow problem, the mitigation design process and the construction sequence for this project will be presented. A brief description of the various unique barrier types installed will be provided.

Words From the Chair

First of all, thanks to all the sponsors for Student Night. It was a great success! Also thanks to the students, Dawn Schippe and Brenda Green, for their participation and interesting presentations.

I'm looking forward to this month's presentation by Erik Rorem of Geobrugg on Debris Flow Remediation in Crestline and Lake Arrowhead, California. The talk should be very enlightening due to the recent rainfall, mudflows, and landslides in California.

If you haven't already, please log onto the website and give your thoughts and opinions on the possible AEG name change. Your input is very important to this process.

Only three more meetings left for the season. Hope to see a great turnout to finish off the year!

Opinions on AEG Possible Name Change

We're sure that most of you received the email from AEG, but we just wanted to encourage and remind you to cast your opinion on the issue.

From AEG President, David Bieber:

A name change requires a change in the AEG Constitution, which requires that a ballot be sent to the entire membership. Enactment of the change requires that two-thirds of the ballots returned within the voting period be cast in favor of the change. The AEG Executive Council and Board of Directors would like opinions from the membership regarding the name change issue. Please log onto the AEG website, go to the AEG Message Board in the Member Services section, and give us your thoughts. If there appears to be a consensus to adopt the modification to our name, then we will put it to a vote of the entire membership.

Your Business Card Here

The section is looking for companies or individuals who would like to advertise their products or services in the section newsletter and on the website. This is anything from a business card ($10/month), quarter page spread ($20/month), to a half page exposition ($40/month). If you are interested, contact Kristi Ainslie newsletter@aegrms.org.

RMS 2004-2005 Upcoming Presentations

April 14, 2005 – **Geophysical Applications for Roadway Investigations**
Khamis Haramy, Central Federal Lands Highway Division

May 12, 2005 – **Colorado Rockfall Program**
Ty Ortiz, Colorado Department of Transportation

Case Histories

The past two years, we have read about very interesting projects from Harry Siebert and Charlie Robinson. We are still looking for individuals to provide their knowledge and experience to the AEG-RMS community through case histories and articles of interest. Please contact Kristi Ainslie at newsletter@aegrms.org if you have anything you would like to share.

Fill Placement with Explosives; Cross Road, Waterford, CT; 1962

The '62 project is being upgraded to a four lane section and bike lanes, widening a grade separation structure and a full interchange due to increased traffic volumes.

The existing roadway had to be changed since a bridge over I-95 was required. The existing roadway was constructed in the 1800's on random fill that utilized will mats and corduroy pavement, crossing a peat swamp. Fill settlement occurred each year that required adding fill. An old overgrown borrow pit was within 300 feet of the north end of the project about 50 feet above the crossing. Prior to construction it was difficult to infer a peat swamp as it appeared as a wetland. Two miles to the northwest a "boulder field" with some old topsoil existed. In all probability, the channel was cut by melt water during the advance and retreat of the continental glacier that covered the area. The maximum peat depth was 55 feet for this 800-foot crossing. Test borings were made and samples tested. Water content of peat ranged from 100%-400%. The existing fill was 20' or less with near vertical slopes in the subsurface that were not stable.

A viaduct structure on pile bents was not considered because of cost. Excavation, peat disposal, and granular backfill would be cost prohibitive, as a disposal area was 20 miles from the site. Also the swamp would have been destroyed (I had hoped this would be a kettle hole). The fill and explosive placement of fill was selected.

Stability analysis used a graphical solution. Induced failure by the use of explosives and subsurface expansion of the peat required a different approach. A 1:1 slope ratio for the subsurface embankment slopes was acceptable. A fifteen-foot surcharge was used and a row of 10 on center loaded boreholes were detonated in rows parallel to the temporary toe of slope. The existing root mat was loosened by use of 4 pounds of ditching dynamite in five foot holes two feet on center detonated by propagation generating a black cloud over the work area composed of emulsified peat.

To be honest, monitoring the construction was long hours, seven days a week. Placement of the fill utilized between 50 to 300 pounds of cartridge explosive per borehole depending on depth. Verification of fill movement was by test borings. When this phase was complete a surcharge was placed on the fill to move the settlement into the secondary consolidation cycle. Post construction monitoring did not indicate unusual settlement.

A presentation was made at the New England Soils and Foundation group in Bangor, Maine the following year. Numerous requests for information were responded to and projects in Michigan, Alaska, Canada and Russia used this or a similar technique. Thanks go to Phil Keene, Engineer of Soils and Foundations, Lyle Moulton, Senior Engineer (later chair, Civil Engineering Dept., Univ. West Virginia) both the former Connecticut Highway Dept.

End Note:
Could this project be accomplished today? No-because of wetlands issues.

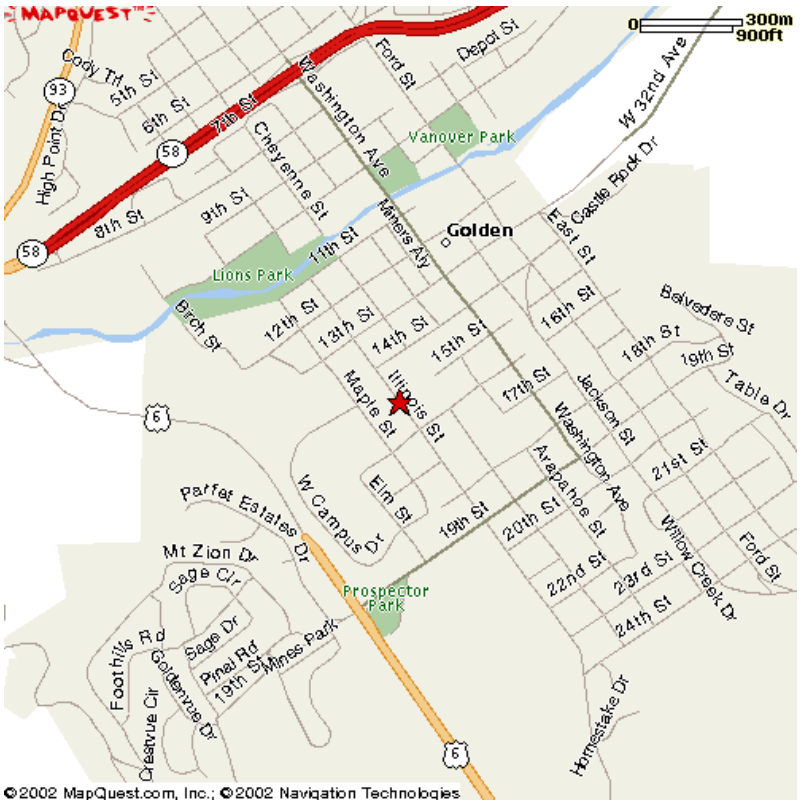
Project involved mechanics, material strength, and failure by shock initiation and granular material flow beneath the surface.

Upper level management was informed of the risk that it would not work and re-design during construction might be required.

Highly compressible material does not behave as a solid when subjected to the use of explosives. The fill placement with explosives appeared to resemble a snow avalanche. The outward movement of material to develop the 1:1 slope was a mix of granular material and peat from the verification borings. The existing fill was displaced horizontally.

Connecticut Highway Department had experience with filling over highly compressible material with a 70 % success rate.

Harry L. Siebert



COLORADO SCHOOL OF MINES – BERTHOUD HALL
1516 Illinois St.
Golden, CO 80401