Slope Stability: Case Study using Soil Nailing

Jeff Stratmeyer
Options

- Redirect Surface Drainage
- Guardrail Upgrades
  - Relocation
  - Post Upgrades
  - Structural Support
Place fillet of asphalt 6" below final grade and 6" from face of guardrail post at a 45° angle to base.

Filter fabric to line excavation.

Select backfill to finish elevation.

Tack weld Z (stacked).

25' long W-beam guardrails to 8' long guardrail posts.
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  - Relocation
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  - Structural Support
- Class 2 Rip Rap / Gabion Baskets
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- Retaining Walls
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• Road Relocation
• Retaining Walls
• Soil Nails
CHEM-STONE™ Reactive Stain

CHEM-STONE™ Reactive Stain creates a mottled, uneven, translucent coloration effect on cementitious surfaces such as concrete overlays and conventional concrete. The natural, aged-looking coloring process is so authentic that the look rivals that of weathered stone, slate and marble.

Color is achieved when the combination of metallic salts and slightly acidic solution come in contact and react with the minerals in concrete. This color reaction results in a look so unique that it cannot be duplicated by other coloring methods.

Unlike paint, CHEM-STONE™ Reactive Stain is not a coating or film build resin. Therefore, the color becomes a permanent part of the surface which will not chip, flake or peel and only wears when the concrete surface wears.

For additional information visit us online at www.elitecrete.com

For Additional Information Please Contact:

Color samples on this sheet represent the color of the finish as viewed at 150 degrees. Humidity, light and specific light conditions can also affect the finished color. Please contact your local Chem-Stone representative for recommendations and samples.
Old Robinhood Road Soil Nails Project

Condition following several severe flooding events in the Fall of 2011
Original Condition – Post Construction July, 2011
After several significant storms – August, 2011
After Hurricanes Irene and Lee - September, 2011
SOIL NAILING
FOR
STREAM BANK STABILIZATION
Dan Svrjcek
TYPICAL REPAIR SITES

STREAM FLOW DAMAGE

• ROAD BUILT IN AND FOLLOWING FLOOD PLAIN
• MEANDER IN STREAM IS CLOSE TO ROAD
• STREAM-ROAD BANK IS STEEP
• PRIOR STORM DAMAGE WAS CUMULATIVE
• MAJOR STORM HITS
• UNDERCUT TREES AND STREAM BANKS FAIL
TYPICAL REPAIR SITES

STORM RUNOFF DAMAGE

• DAMAGE FROM TOP OF ROAD
• EROSION FROM ROAD RUNOFF
• OCCURS AT ROAD SUMP
KNPPR-S05  KNOPP ROAD
KNPPR-S05  KNOPP ROAD
REPAIR ALTERNATIVES

• EXTRA TRAFFIC BARRIER POSTS W/ RAIL WALL
• ROSGEN: ROOT WADS, ROCK VANES, PLANTINGS
• CLASS 2/3 RIP-RAP
• WALLS – CONCRETE, CRIB, GABION, IMBRICATED
• REINFORCED EARTH
• SHEET PILING W/ TIE-BACKS
• SOLDIER PILES W/ TIE-BACKS AND LAGGING
• SHORT WALL W/ CONCRETE SLAB “TIE-BACK”
• SOIL NAILS
WHAT IS SOIL NAILING?

- **HOLLOW STEEL RODS** driven into soil / rock
- Driven beyond slip plane - acts as an anchor
- **GROUT** pumped into rod
- Grout flows into space around rods
- Rod - earth system acts as MSE wall
- **DRAINAGE SYSTEM** between wall and earth
- **REINFORCED SHOTCRETE** forms the wall face
- **RIP- RAP** at base provides scour protection
SOIL NAIL WALL ENHANCEMENTS

VINE POCKETS

DYED CONCRETE
Slope Stabilization Details
Knopp Road Slide 2
Harford County, MD
Harford County Public Works

Sheet Index
1. Cover Sheet
2. General Notes
3. Typical Cross-Section and Elevation Detail
4. Self-Drilling SuperNail® Detail
KNPPR-S05 KNOPP ROAD

Construction Sequences/Work Schedule:
- Harford County or its contractor will clear, excavate, haul off excavated material, and provide traffic control.
- GSI will provide and install the specified soil nails and surface treatment per the construction documents.

Sheet Nailing of Ribs:
- GSI will mark the locations of the proposed soil nails with survey marking paints.
- The soil nails will be injected with grout. The grout will be a Type I/II or III Portland Cement. The water/cement ratio will be 0.40 to 0.60. No additional aggregate or admixtures will be added to the grout.

Facing and Drainage System:
- Drain strips will be provided and installed between the soil nails every 6 feet along the face of the excavation. The drain strips shall be placed with the grout side against the ground. Drain strips will continue and any splice shall be made with a one-foot minimum overlap such that the flow of water is not impeded. Drain strips shall extend beyond the face of the sheeting at the downhill face.

Reinforcing Steel Placement:
- Welded wire mesh will be placed along the face of the excavation with a separation of approximately 2 inches between the wire mesh and the soil.
- No. 4 Rebar will be tied to the wire mesh. Vertical bars will extend for approximately 24 inches and the horizontal bars will be continuous with overlap splices in the sheeting.

Reinforcing Plate Placement:
- E6 x 10.5 3/4" steel reinforcing plates will be placed over the nails and fastened either with a bar nut or bar wrapping to the nail to secure the wire mesh and rebar during shotcrete placement. If the soil nails extend beyond the bar nuts or welded plate, they will be trimmed using a gas powered demolition saw.

Reinforcing Application:
- Shotcrete will be placed from the lower part of the area upwards to prevent accumulation of rebound. The nozzle will be oriented a proper distance from and approximately perpendicular to the working face so that rebound will be contained and compaction will be maximized. Cans will be taken while erasing reinforcing mesh and mesh to keep the front face of the reinforcement area during placement operations, so that shotcrete builds up behind, to ease the reinforcement and prevent voids or potholes from forming.

Reinforcing Certification:
- ACI Shotcrete Nomenclature Certification
- 10-hour Occupational Safety and Health Training Course in Construction Safety & Health
- American Red Cross Standard First Aid Training
- American Red Cross Bloodborne Pathogens Training: PBT
- OSHA 30 Hour Supervisor Training

Housekeeping:
- The site will be organized and clean of any trash or debris. All trash will be placed in a proper container and removed at the end of each work day.

Safety:
- All safety plans for lifting, hearing, dust control, PPE etc. are in place and will be followed accordingly. PPE will include safety vest, steel-toed shoes, hard hat, safety glasses, and gloves.

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<th>General Notes</th>
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GeoStabilization International
Corporation Address: PO Box 7479
Great Falls, VA 22062
P: 703.469.3333
F: 703.469.3331
www.geostabilization.com
KNPPR-S05  KNOPP ROAD

COST PROPOSALS

KNOPP ROAD       $54,880
GLENVILLE 1      $51,584
GLENVILLE 2      $48,384

TOTAL            $154,848
PERMITS & AUTHORIZATIONS

• MDE / USACE PERMITS
  – UNDER 5000 SF
• PROPERTY OWNER EASEMENTS
• ROCKS STATE PARK RIGHT-OF-ENTRY
• MARYLAND HISTORICAL TRUST
• DEER CREEK WILD AND SCENIC RIVER COMMISSION
KNPPR-05 KNOPP ROAD REPAIR
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GLENVILLE ROAD – SLIDE 1
GLENVILLE ROAD – SLIDE 1
GLENVILLE ROAD – SLIDE 1
GLENVILLE ROAD – SLIDE 1
GLENVILLE ROAD – SLIDE 1
GLENVILLE ROAD – SLIDE 1
GLENVILLE ROAD – SLIDE 2
GLENVILLE ROAD – SLIDE 2
# KNPPR-S05  KNOPP ROAD REPAIR

## FINAL COST

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<th>Description</th>
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<tr>
<td>KNOPP ROAD</td>
<td>$51,600</td>
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<td><strong>DIFFERENCE</strong></td>
<td><strong>$5,280 LESS</strong></td>
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TIMELINE

- 4/28/14  KNOPP ROAD STORM DAMAGE
- 5/13/14  MEET WITH GSI
- 5/19/14  MDE PERMIT APPLICATION
- 6/25/14  MET WITH CAMP WOMETO – NOT THEIR PROPERTY
- 6/26/14  KNOPP ROAD SITE – VERIFIED PARK ISSUE
  GLENVILLE SITES – SENT OUT EASEMENT REQUESTS
- 6/27/14  MEET WITH MDE/ CORPS IN FIELD – USE VINE POCKETS
  GLENVILLE SITES – EASEMENT REQUESTS GRANTED
- 8/1/14   GLENVILLE – HISTORICAL ISSUE – EASEMENT VOID
  MHT – DENIES USE OF SOIL NAILS
- 8/19/14  RESPONSE TO MHT COMMENTS
- 8/27/14  MHT APPROVES SOIL NAIL WALL
- 9/10/14  GSI SUBMITS PLANS
- 9/11/14  2 WEEKS ROAD CLOSURE NOTICE SENT OUT
- 9/17/14  REQUEST SENT TO GET PROJECT PLACED ON BOE AGENDA
- 9/22/14  KNOPP ROAD – PARK RIGHT-OF –ENTRY EXECUTED
- 9/25/14  BOE APPROVED PROJECT –$154,848
- 9/26/14  KNOPP ROAD – RIP-RAP PLACED
TIMELINE

- 10/1/14  STREAM CLOSURE DATE
- 10/3/14  MINOR PLAN COMMENTS RETURNED TO GSI
- 10/7/14  MDE APPROVAL – GLENVILLE & kNOPP
- 10/20/14 WORK TO DYE CONCRETE
- 11/3/14  kNOPP ROAD - START
  HIGHWAYS REMOVED EXCESS RIP-RAP, AND
  GRADED THE SLOPE FOR GSI
  GSI DRILLED THE NAILS, PLACED WIRE MESH AND
  GUNITED THE SLOPE
  USED CURING COMPOUND NO NEED TO COVER
- 11/10/14 GLENVILLE ROAD – START – VERY COLD WEATHER
- 11/12/14 GUNITE WORK – SLIDE 1
- 11/17/14 2 TREES REMOVED FROM SLIDE 2
- 11/20/14 GUNITE WORK – SLIDE 2
- 11/20/14 COLD WEATHER GUNITE CURING
- 11/26/14 GLENVILLE ROAD – OPEN TO TRAFFIC
  WEDNESDAY BEFORE THANKSGIVING
Thank you & Questions