Case Histories of Reinforced Slopes Using Marginal Fills and Draining Geogrids

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The Need

- To take from here
- Or from here
- And use here
Imported fills are:

Expensive to quarry and becoming more so as tax penalties increase.

Environmentally unacceptable as quarrying damages the countryside.

Costly and environmentally unacceptable to transport.
What are the advantages in using poor quality and waste soils?

They can be cheap. They can even be a positive source of income in some situations.

They are usually readily available.

Their use results in reduced haulage and the consequent environmental impact of this.

Their use results in reduced quarrying which helps to preserve the environment.
Poor quality backfills - what are the concerns about their use?

Constructability - compaction, structure face movements, settlements.

Long term stability - pore water pressures affecting shear strength and bond between reinforcement and soil.

Durability - water in soil, pH and chemical content of poor quality and waste soils and their effect on the reinforcement inclusions.
So what do we need to do to the soil?

Change it from an undrained to a drained soil by adding drainage which will result in

- The strength increasing;
- The bond between the soil and the reinforcement improving;
- Better control being achieved over settlements and deflections.
Geogrid ParaDrain

- Reinforcement element
- Filter material
- Drain
CASE HISTORY – CYTEC REINFORCED SLOPE BERM
Project: Cytec Stormwater Facility, Niagara Falls, ON

Contractor: Newman Bros. Contracting

Proj Geotech: Inspecsol (GHD)

System: Paradrain – 50/15 geogrid reinforced slope

Project Engineering: Ausenco, Burlington, ON
Design

Stamped Drawing
Excavation to remove native soil
Installation - Paradrain
Reno Mattress installation
Hydro seeded - Macmat
CASE HISTORY – DAVENPORT VILLAGE  GREEN TERRAMESH
ORIGINAL BERM DESIGN

- 4.2m high, 60º reinforced soil slope using woven wire mesh geogrids
- 104m long
- Gravelly sand backfill (OPSS Granular ‘B’ – Type I).
- Reinforcement spaced at 0.7m vertically (6 layers of reinforcement)
- Unreinforced portion of berm to be marginal fill.
- Approximately 3,400m³ of imported fill (Gran ‘B’ – 2,200m³, Marginal – 1,200m³)
REDESIGN BERM USING DRAINING GEOGRID

- 4.48m high, 60° reinforced soil slope using woven wire mesh facing and draining geogrids
- 104m long
- Sandy silt fill for entire berm
- Reinforcement spaced at 0.56m vertically (8 layers of reinforcement)
- Cost to supply reinforcement 10% higher than original design
CONSTRUCTION

July 2011
CONSTRUCTION

Mid August 2011
CONSTRUCTION
Fence Post Footing
CONSTRUCTION

September 2011

November 2011
POST CONSTRUCTION OBSERVATIONS

A visual inspection done one year after the start of construction observed the following:

- no signs of tensile cracking along the crest of the berm or settlement.

- No bulging of the wire mesh facing panels was observed.

- A vegetated cover of primarily annual and perennial ryegrasses was present. The vegetation is estimated to cover approximately 85% to 90% of the area of the reinforced slope face.

- No signs of horizontal or vertical deformation in fencing located at near crest of slope
POST CONSTRUCTION OBSERVATIONS

November 2011

July 2012
## COST COMPARISON

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit Cost ($/m²)</th>
<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>Original Design, Granular Backfill included</td>
<td>486.00</td>
<td>$ 237,654</td>
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<tr>
<td>Redesign with Draining Geogrid and Sandy Silt fill</td>
<td>329.00</td>
<td>$ 160,881</td>
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Estimated Cost to dispose of sandy silt fill: $62,700 (2,200m³)

Redesigned berm reduced construction cost by 46%

Conclusion
QUESTIONS ???