Tied-Back Grade Beams for Stabilization of State Route 7 in Jefferson County, Ohio
Outline

- Project Background
- Exploration/Analysis/Design
- Construction
- Q & A
Location Map

Office of Geotechnical Engineering, Geotechnical Workshop, April 13, 2010
Sta. 205+00 to Sta. 213+00

Shale, gray, silty, moderately hard to hard, weathered, with frequent clay seams

Shale, gray, silty, moderately hard, clay mottling and broken zones

Shale, gray, moderately hard to hard, weathered, with broken zones

Shale and Siltstone Bedrock

Siltstone, hard, water stained, highly fractured

Shale, gray, moderately hard to hard, weathered, with frequent clay seams

Shale, soil like, soft to stiff, dry, highly weathered
Slope Inclinometer Data (B1)
Slope Inclinometer Data (B4)
Contributing Factors to Slope Movement

- Fill over colluvial/alluvial deposits with soft zones
- Steeply sloping bedrock
- Ohio River fluctuations
- Possible increased shear stresses due to Brown’s Island
Alternative Stabilization Schemes

- Drilled Shafts ($3M)
- Drilled Shafts with Tiebacks ($3.4M)
- Soldier Pile w/ Lagging and Tiebacks ($3.5M)
- Tiedback Grade Beams ($2M)
Typical Section

Rock Anchor Installation

- Rock Anchors
- Bond Length
  To Achieve 195k Design Load (Typ.)
- 30° (Typ.)
- 3’6” (Typ.)
- Approximate Top of Rock
## Anchor Information

<table>
<thead>
<tr>
<th>Section</th>
<th>Force to be Resisted “P” (kips/ft)</th>
<th>Horizontal Component “Pₓ” (kips/ft)</th>
<th>Horizontal Anchor Component “Tₓ” (kips)</th>
<th>Total Number of Anchors</th>
<th>Number of Rows</th>
<th>Estimated Anchor Spacing</th>
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<tbody>
<tr>
<td>206+50 – 207+30</td>
<td>72.4</td>
<td>69.9</td>
<td>168.9</td>
<td>33</td>
<td>3</td>
<td>7.0</td>
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<td>207+30 – 208+40</td>
<td>75.2</td>
<td>71.5</td>
<td>168.9</td>
<td>48</td>
<td>3</td>
<td>6.75</td>
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<td>208+40 – 209+97</td>
<td>69.7</td>
<td>63.7</td>
<td>168.9</td>
<td>60</td>
<td>3</td>
<td>7.75</td>
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<tr>
<td>209+97 – 212+00</td>
<td>46.9</td>
<td>43.3</td>
<td>168.9</td>
<td>54</td>
<td>3</td>
<td>11.5</td>
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<tr>
<td>209+97 – 212+00 (ALT)</td>
<td>46.9</td>
<td>43.3</td>
<td>168.9</td>
<td>52</td>
<td>2</td>
<td>7.75</td>
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<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>195 (193)</strong></td>
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Post Remediation Stability Analysis

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<thead>
<tr>
<th>NO.</th>
<th>DESCRIPTION</th>
<th>UNIT WEIGHT</th>
<th>SHEAR STRENGTH</th>
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<td>1</td>
<td>Fill Material</td>
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<td>3</td>
<td>Alluvial-Colluvial Material</td>
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<td>Friction angle: 28</td>
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<td>4</td>
<td>Bedrock</td>
<td>145</td>
<td>Cohesion: 2000.0</td>
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<tr>
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<td></td>
<td>Friction angle: 45</td>
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</table>

Factor of safety: 1.313
Side force Inclination: 0.8 degrees
Post Remediation Stability Analysis of Slope Below Anchors
Construction

- September 2008 – May 2009
- Contractor – A. P. O’Horo
- Anchor Subcontractor – Schnabel Foundations
- Cost - $1.8M
Thank You!