Geotechnical Challenges at Mitchell Avenue

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ODOT District 8
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Mill Creek Expressway

- Project is in Several Phases
- First phase is Mitchell Ave – HAM-75-5.58
- Sold May 2011
- $53.6 Million
- Next phase is Hopple Street – HAM-75-2.30 (Sold 11-15-12 for $90.7 Million)
• Project Team
• Burgess & Niple – Lead Designers, some geotechnical work
• CTL Engineering – Geotechnical
• BBCM Engineering (S&ME) – Pressuremeter Testing, supplemental borings
• HC Nutting (Terracon) – MSE Wall addition
• OGE CPT Testing
Project Location
Design Issues

• Poor Soil Conditions
• Cemeteries
• Construction Debris Landfill
• Presence of the Mill Creek
• Congested urban construction
Mitchell Avenue
HAM-75-5.58
Actual Soil Conditions
Lacustrine Clay
Unusual Soils
Lacustrine Evidence
Lacustrine Evidence
Sand Pockets
Geotechnical Specialty Items

- Stone Column Ground Improvement
- Wick Drains
- Tieback and Soldier Pile Walls
- MSE Walls
- Reinforced Slope
- Geofoam VECP
Geotechnical Specialty Items
<table>
<thead>
<tr>
<th>Work Type</th>
<th>Quantity</th>
<th>Unit Cost</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stone Columns</td>
<td>54,932 ft.</td>
<td>$58/ft.</td>
<td>$3.4M</td>
</tr>
<tr>
<td>Wick Drains</td>
<td>81,879 ft.</td>
<td>$0.69 /ft.</td>
<td>$56,500</td>
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<tr>
<td>Tieback Wall</td>
<td>25,920 sf.</td>
<td>$177/sf.</td>
<td>$4.6M</td>
</tr>
<tr>
<td>Soldier Pile Wall</td>
<td>7,100 sf.</td>
<td>$159/sf.</td>
<td>$1.13M</td>
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<tr>
<td>MSE Walls</td>
<td>41,717 sf.</td>
<td>$126/sf.</td>
<td>$5.23M</td>
</tr>
<tr>
<td>Reinforced Slopes</td>
<td>43,000 cy</td>
<td>$9.50/cy</td>
<td>$409,000</td>
</tr>
</tbody>
</table>
Stone Columns

- Vibro Piers installed by Hayward Baker
- Depth of Improvement ranges from 10 to 45 ft.
- Spacing ranges from 5.25 to 8 ft. square
- Uncontrolled fill and stiff soil required upper 15 ft. to be predrilled.
Stone Columns
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Stone Column Completion

Wall 2A – 120 Vibro Piers, 6 days
Reinforced Slope 4B – 728 Vibro Piers, 17 days
Wall 6A – 115 Vibro Piers, 6 days
Wall 6B – 72 Vibro Piers, 4 days
Load Test of Stone Columns

**Design Modulus** = 125 pci

**Wall 2A** = 574 pci

**Wall 6A** = 350 pci
Wick Drains for Reinforced Slope

- 802 wick drains
- 67 ft. in length
- 6’ triangular spacing
- 3 days to complete
Wick Drains at Slope 4B
Tieback Walls

- Permitted the use of Continuous Flight Auger for installation of soldier piles
- Resulted in cost savings to the project.
- Saved significant amount of time.
- Value engineered to save $981K
- 70 to 75 ft. anchors (30-35' unbonded, 40' bonded)
- 115 to 128 kip required capacity
Grout Quality Control
Soldier Pile

VECP changed from double C-Channels to HP 12x53 with through anchor
Completed Anchor
Cast-in-place Facing
Cast-in-place Facing
Reinforced Slope 4B
Geotextile Secondary Reinforcement
Secondary Reinforcement Repair
EPS Geofoam VECP

• Contractor prepared VECP for Walls 4a (Clifton Avenue) and Walls 6c and 6d (east side of Mitchell Bridge)

• The VECP removed the MSE Wall and ground improvement and replaced with expanded polystyrene foam (geofoam)

• Wall 4A savings = $76,017
• Wall 6C savings = $242,935
• Wall 6D savings = $357,115
• Total Savings = $656,068 + TIME ($$$$$)
Block Details

• Weight varies from approximately 1.5 to 1.8 pcf
• Compressive strength is 5.6 to 6.1 psi
• Blocks are 3 ft. x 4 ft. x 8 ft. in dimension
• Blocks weight approximately 145 lbs
• Wall 4A used 7,556 cy of EPS 22
• Wall 6C will use 4,054 cy
• Wall 6D will use 4,959 cy
Precast Panel Leveling Pad
Cutting of Geofoam Blocks
Geofoam Construction
Geofoam Construction
Geofoam Load Distribution Slab
Backfill above the LDS
Wall 4A Precast Panels

- Panels Weigh from 10,000 to 38,000 lbs
- 6” to 10” thick
- 34 ft. max height
Lifting Anchor Damage
Panel Placement
Rear of Panel
Temporary Panel Support
Temporary Panel Support
Closure Pour
Completed Precast Wall
Completed Precast Wall
MSE Wall Removal

Installed in 1978
Sand and Gravel Backfill

Used cruciform Panels
MSE Wall Panels
MSE Wall Straps
MSE Wall Straps

Little to no corrosion or loss of strap section
Additional Geotechnical Issues

- Surface Slips above Wall 3B
- Use of lacustrine silt and clay as embankment
- Lime kiln dust added
Lightweight Fill over Storm Sewer
Questions ???