Soil Nailing Best Practices and Problems

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USE OF SOIL NAIL WALLS ON TxDOT PROJECTS

CUT SITUATIONS

TEXAS TURN AROUNDS
DEPRESSED ROADWAYS
WIDENED ROADWAYS
TEMPORARY SPECIAL SHORING

CUT/FILL SITUATIONS

TEMPORARY SPECIAL SHORING
FOR FILL WALLS
HYBRID – SOIL NAIL/MSE
“Texas Turn Around”
Widening and Depressing a Roadway
Temporary Special Shoring
Temporary Special Shoring for Fill Walls
Soil Nail Hybrid Walls
**TxDOT SOIL NAIL USE**

- TxDOT’s first soil nail wall was built in 1988 for a Texas Turn Around.
- In the last 20 years soil nail wall use has increased.

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<th>2007 Soil Nail Wall Statistics</th>
<th>2018 – 2019 (last 12 mon.)</th>
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<tr>
<td>Soil Nail Wall Fascia</td>
<td>229,127 sf</td>
<td>344,128 sf</td>
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<tr>
<td>Average Cost of Fascia</td>
<td>35 $/sf</td>
<td>44 $/sf</td>
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<tr>
<td>Soil Nail Anchors</td>
<td>406,803 lf</td>
<td>603,654 lf</td>
</tr>
<tr>
<td>Average Anchor Cost</td>
<td>18 $/lf</td>
<td>19 $/lf</td>
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SOME IMPORTANT ASPECTS OF SOIL NAIL WALL CONSTRUCTION
1) Contract Drawings
   - dependent upon the design

2) Soil Nail Specification
   - Item 410. Soil Nail Anchors
   - Item 423. Retaining Walls
   - Item 431. Pneumatically Placed Concrete

3) Inspection
CONTRACT DRAWINGS INCLUDE:

- Wall Layout
- Specific Wall Details
- Specific Nail Location Details
  - (Soil Nail Layout)
SOIL NAIL SPECIFICATION (Item 410) GOVERNS

- Materials (soil nails, grout, etc.)
- Equipment (drilling rig, augers, etc.)
- Construction Methods (drilling, grouting, centralizers, etc.)
- Soil Nail Anchor Testing
- Measurement of Soil Nails
- Payment of Soil Nails
Typical drill rig is a continuous flight auger.

In soils which will not remain open a hollow stem auger is to be used.
Verify nail length. Make certain that hole is open, clean and stable.

Hole diameter – typically 6 in or 8 in. Verify nail diameter. Augers may wear down.
Make sure the centralizers are the proper type as well as at the proper spacing.

Wheel type centralizers are not acceptable.

Epoxy coated threadbars are used for permanent walls of the size and grade shown in the plans.
Allowable Grouting Methods

Grout tube and tendon in the hole simultaneously.

Grout tube inserted to fill the hole and then the tendon is installed.
Grout must be fluid. No shotcrete mix!!
Grout was too thick during installation.

Improper spacing of centralizers

Tendon needs to be within 1 inch of the center of the hole
**Birds Mouth**

- Void
- 6" Dia. Hole
- Epoxy coated Reinf. Bar, Gr. 60 (Dywidag Threadbar or equal)

- Design Nail Length
- Actual Nail Length
Final Grouting

- “Birds Mouth”

- May require a second or third round of grout.

- This area is critical for corrosion protection and to support face.

- Small birds mouth may be filled during shotcreting by a careful operator.
SHOTCRETE - “Pneumatically Placed Concrete”

- Serves as construction facing.
- May be used to complete filling of “Bird’s Mouth”.
- Check placement of steel.
- Check thickness of shotcrete.
- Tighten anchor plates and nuts against shotcrete.
Shotcrete applied to fill in small birds mouth

Applying shotcrete to the face
Final shotcrete face

Addition of the plates and nuts
- Most like other reinforced concrete construction.
- Should be completed within 45 days of nailing.
- May include a coping or other top treatment.
Cast In-Place Fascia

- #4-12" O.C. Horiz. and Vert.
- 6" X 6"-W2.9 WWF
- Epoxy coated Reinf. Bar, Gr. 60 (Dywidag Threadbar or equal). See wall layout for size.
- Anchor Plate and Nut (Ø 8" X 8" X 3/8")
- Concrete Fascia Wall

Nail Length For Payment
Pneumatically placed Concrete

9" min.
4" min.
Pre-Cast Fascia

- Anchor Plate and Nut (Ø 8" x 8" x 3/8"")
- Nail Length For Payment
- Pneumatically placed Concrete
- #5-12" O.C. Horiz. and Vert.
- 6" X 6"-W2.9 WWF
- Epoxy coated Reinf. Bar, Gr. 60 (Dywidag Threadbar or equal). See wall layout for length.

Pre-Cast Concrete Panels
SOIL NAIL TESTING

- Performed before production work begins.
- Typically performed on sacrificial soil nails.
- Tests performed to verify design and construction method used.
Soil Nail Testing
Test Nails Pass?

- Proceed with production.

- Contractor should use the same methods and grout as used in test nails.

- If contractor wants to change method or grout, new test nails should be utilized.

- If soil changes dramatically, may want to require additional test nails.
Test Nails Fail?

- Review Contractor's methods and materials.
- Modify and re-test
- Review design.
- Modify design if Contractor’s methods are determined to be sound.
Soil Nail Wall Failures
Failure Due To:
Marginal Design
And Poor Drainage
Failure Due To:
Nailed Wall Built
In Area of Previous
Slope Failure
Failure Due To:
Poor Construction Practices/Control
Failure Due To:
Poor Construction Practices/Control
CONCLUSIONS

- Soil nail walls on TxDOT projects:
  - Used for 20 years
  - Used on a wide variety of projects and in a wide variety of soil types
  - Second most widely used retaining wall type

- To obtain a quality wall TxDOT relies on:
  - Contract Drawings (project specific and dependent upon the design)
  - Soil Nail Specification
  - Inspection