Field Performance Evaluation of Pile Points

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Overview

- New Hampshire DOT Qualified Products List (QPL)
- Qualification Criteria – Pile Points
- Field Evaluation
- Findings & Preliminary Conclusions
Qualified Products List (QPL)

- 99 unique product categories
- Updated annually
- Qualification criteria varies:
  - In-house testing
  - NTPEP test results
  - Field trials
  - Other DOTs
  - Independent tests
A. ITEM 510.65 - DRIVING POINTS FOR STEEL BEARING PILES
Conforming to AASHTO M 103 (ASTM A27), Grade 65-35 or ASTM A148, Grade 90-60.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assoc. Pile &amp; Fitting Corp.</td>
<td>Hard-Bite HP 77600-B</td>
</tr>
<tr>
<td>Assoc. Pile &amp; Fitting Corp.</td>
<td>Hard-Bite HP 77750-B</td>
</tr>
<tr>
<td>Assoc. Pile &amp; Fitting Corp.</td>
<td>Hard-Bite HP 7780-B *</td>
</tr>
<tr>
<td>Assoc. Pile &amp; Fitting Corp.</td>
<td>Pruyn Point HP 75750-B</td>
</tr>
<tr>
<td>Dougherty Foundation Prod., Inc.</td>
<td>Tuftip Tufloy H-777 *</td>
</tr>
<tr>
<td>Mid-America Foundation</td>
<td>Model HPH **</td>
</tr>
<tr>
<td>Piling Accessories, Inc.</td>
<td>Super-Bite PAR-T Series</td>
</tr>
<tr>
<td>Versabite Piling Accessories</td>
<td>Versa-Bite VB 300-P Series</td>
</tr>
<tr>
<td>Versa-Steel Inc.</td>
<td>Versa Steel VS-300N Series</td>
</tr>
</tbody>
</table>

* Available only in Grade 90-60
** Available only in Grade 65-35
Qualification Criteria – Pile Points

• Steel Grade
• Weight
• Configuration, including web and flange thickness
• But… No hard & fast limits.
  New products compared to those on the list already. Qualitative evaluation.
c. 2002

- NHDOT received a submittal for a pile point that was significantly lighter than those listed on QPL.
- Need for a more objective, consistent and transparent qualification criteria.
- Minimum weight/thickness requirements?
- Tighten steel grade requirements?
Preliminary Research

• Contacted State DOTs, product manufacturers
• Reviewed specifications
  – Most states specify by steel grade
  – No uniform criteria in place
• No relevant research found
• NHDOT decision to conduct field experiment
Field Experiment Design

- Existing construction project in area of known shallow bedrock – Rochester Spaulding Turnpike
- Selected points representing various combinations of weight, thickness & steel grade
  - Plan was to include the lightweight point that had been submitted; however, when the pile installation occurred the product was no longer being produced. No comparable alternative found.
# Pile Point Properties (HP 12x53)

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
<th>Web (in.)</th>
<th>Flange (in.)</th>
<th>Avg. Wt.</th>
<th>Grade</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC Dougherty Foundation Products</td>
<td>Tuftip Tufloy H-777</td>
<td>0.78125</td>
<td>0.75</td>
<td>22.2 lb</td>
<td>ASTM A148 90/60</td>
<td>Good condition</td>
</tr>
<tr>
<td>DEF Versa-Steel, Inc.</td>
<td>VS 312N</td>
<td>1.0 (Avg.)</td>
<td>0.9 (Avg.)</td>
<td>23.5 lb</td>
<td>ASTM A148 90/60</td>
<td>Bean-size void, rod attached, pinholes, flange teeth missing</td>
</tr>
<tr>
<td>GHI Associated Pile &amp; Fitting Corp</td>
<td>Hard-Bite 77600 B</td>
<td>1.3125</td>
<td>1.0</td>
<td>31.4</td>
<td>ASTM A27 65/35</td>
<td>Good condition</td>
</tr>
<tr>
<td>JKL Versa-Bite Piling Accessories, Inc.</td>
<td>Super Bite PAR-T</td>
<td>0.875</td>
<td>0.875</td>
<td>23.2</td>
<td>ASTM A27 65/35</td>
<td>Good condition</td>
</tr>
<tr>
<td>PQR Control</td>
<td>No Pile Point</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Soil Conditions

• Excavated to pile cap elevation
• 16.5-17.5 ft thick - medium stiff to very soft, silty marine clay
• 2.5-7.5 ft thick - medium dense silty fine sand (stratified)
• Bedrock (at 14-19 ft depth)
Pile Points Installed
Piles Driven & Extracted 4/18/08

- **Vibratory Hammer** – set piles to bedrock
- **Impact Hammer** – drove to refusal (200 blows/no penetration vs. 10 blows typical)
  - Rated energy 42,000 ft-lbs (typ. medium size hammer)
  - Energy transferred to top of pile = 15,000 ft-lbs (OK)
- **Pile Driving Analyzer** used to measure hammer energy and pile stress
- **Vibratory hammer** extracted driven piles for inspection
Pile Driving Analyzer (PDA)
Impact Hammer
Extracting Piles
Pile Point Samples

Before and After
Sample ABC
Tuftip Tufloy H-777
Sample ABC
Tuftip Tufloy H-777
Sample ABC
Tuftip Tufloy H-777
Sample A
Tuftip Tufloy H-777
Sample B
Tuftip Tufloy H-777
Sample C
Tuftip Tufloy H-777
Sample DEF
VS 312 N
Sample DEF
VS 312 N
Sample DEF
VS 312 N
Sample DEF
VS 312 N
Sample DEF
VS 312 N
Sample DEF
VS 312 N
Sample D
VS 312 N
Sample E
VS 312 N
Sample F
VS 312 N
Sample DEF
VS 312 N
Sample DEF
VS 312 N
Sample GHI
Hard-Bite 77600 B
Sample GHI
Hard-Bite 77600 B
Sample GHI
Hard-Bite 77600 B
Sample GHI
Hard-Bite 77600 B
Sample GHI
Hard-Bite 77600 B
Sample G
Hard-Bite 77600 B
Sample H
Hard-Bite 77600 B
Sample I
Hard-Bite 77600 B
Sample JKL
Super Bite PAR-T
Sample JKL
Super Bite PAR-T
Sample JKL
Super Bite PAR-T
Sample JKL
Super Bite PAR-T
Sample J
Super Bite PAR-T
Sample K
Super Bite PAR-T
Sample L
Super Bite PAR-T
Control Piles (PQR)

Without pile points
Control Pile P

Web curled - Damage detected by PDA
Control Pile Q
Control Pile Q

Web bent but intact. Damage not detected by PDA.
Control Pile R

Web bent but intact. Damage not detected by PDA
Findings & Preliminary Conclusions

- Pile points are necessary to minimize damage to end-bearing H-piles.
- The configuration (shape, taper, protrusions) of available pile point models vary significantly and make quantitative comparisons based on dimensional attributes difficult.
- There was no observed correlation between dimensional attributes (i.e. web & flange thickness, thickness ratios, Missouri DOT thickness factor, etc.) and performance of the pile point. Each of the points tested met the Missouri criteria. It is reasonable to require a minimum thickness relative to the H-pile dimensions.
• There was no observed correlation between steel grade and performance of the pile point.

• There was no observed correlation between weight and performance of the pile point. However, it is reasonable to require a minimum weight (e.g. 22#) commensurate with the points evaluated during this field test.

• The lack of prominent protrusions on pile point sample F may have contributed to wander and potential bucking of the pile.

• The PDA was successful in detecting web damage in piles but less successful in detecting flange damage only
Questions?