High Capacity Minicaissons in New York City

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High-capacity Mini-caissons in an Urban Environment

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High-capacity Mini-caissons

- “Macropiles”
- Characteristics
  - Like a micropile – permanent steel casing, grout, all-thread bars
  - Capacity – 250 to 1700 tons
  - 12" to 24" diameter
  - “Rebar” cage
  - Ready-mix grout (6,000+ psi)
  - Rock-socketed
Applications

- Urban Environments
- Difficult Drilling Conditions
- High(er) Lateral Loads
- Bedrock

NYC - Urban Environment

- 23rd Street - Manhattan
- Future 53-story building
- Lot Size - 45' wide x 100' deep
- Working Grade - 15' below sidewalk
- 24" mini-caissons
# NYC – Urban Environment

Washington Street - 24” caissons

## Design

<table>
<thead>
<tr>
<th>Category</th>
<th>Current NYCBC</th>
<th>Pending NYCBC</th>
<th>FHWA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground</td>
<td>0.25 (^{\gamma}e)</td>
<td>0.33 (^{\gamma}e)</td>
<td>0.4 (^{\gamma}e)</td>
</tr>
<tr>
<td>Casing</td>
<td>0.35 (f_{y} \leq 12.6) ksi</td>
<td>0.35 (f_{y})</td>
<td>0.47 (f_{y} \leq 40.9) ksi</td>
</tr>
<tr>
<td>Rebar</td>
<td>0.4 (f_{y} \leq 50) ksi</td>
<td>0.5 (f_{y})</td>
<td>0.47 (f_{y} \leq 40.9) ksi</td>
</tr>
<tr>
<td>Other Considerations</td>
<td>Casing transfer</td>
<td>Casing transfer</td>
<td>Plunge length</td>
</tr>
</tbody>
</table>

### Allowable Stress Values

Proposed loads relative to minimum loads of each

Typ. 45 ksi casing
Equipment

- Barber Rig
- Truck rig

Bauer Rig – Track Mounted
Installation Methods

- Rotary Duplex Drilling
  - Air Flush/Water Flush
  - Down-the-hole Hammer/Roller Bit
  - Permanent Casing – Seated in Rock
- Fixed Casing Lengths
  - 18"/24" casing
  - Welded joints
- Prefabricated Cages
- Crane
- Tremie Grouted

Rotary Duplex Drilling

Typical single piece casing or weld joints
Chelsea Arts Tower

Typical Cage Configuration

SOMETIMES H-PILE IS USED FOR REINFORCING

East 23rd Street

- 24" diameter mini-caissons
- 1400 tons
- Compression bearing plate
- Tension bars
Borden Avenue

- Tremie Tube Attached
- Centralizers/Spacers – 10' c.t.c.

QA/QC

- As-built Surveys
- Load Testing
- Video Inspection
- Grout Testing – Onsite and Plant
Load Testing

- Lateral Load Test (Free Head)
- 25-ton Design Load

Video Inspection

- Micropiles vs. Caissons
  - Mini-caissons – benefit from caisson designation
- Inspection of rock sockets, but based on design criteria / assumptions
  - Casing connection – threaded
  - Casing embedment
  - Rock quality
Images – Video Inspection

Casing joint not completely shouldered

Images – Video Inspection

Casing on Bedrock – Above Water
Images – Video Inspection

Bedrock – Below Water

Images – Video Inspection

Concrete Rubble – Above Water
Images – Video Inspection

Casing on Bedrock – Below Water

Images – Video Inspection

Weathered Bedrock and Large Void
Images – Video Inspection

Weathered bedrock below casing bottom

Grout Inspection

- Onsite Inspection
  - Independent (usually retained by Owner)
  - Slump
  - Cast cylinders – compressive strength breaks
- Plant Inspection
  - Independent (usually retained by Owner)
  - Required for design grouts of 6,000+ psi
Benefits

- Cost Savings
  - Fewer piles
  - Higher capacity per pile
- Schedule
- Drilled, not driven

Limitations / Considerations

- Design
  - Must be finished
  - Value engineered – flexible architect/engineer
  - Redesigns – pile caps, grade beams, mats
- Equipment
  - Size – mobility, height/clearance/access
  - Trucking costs
- Materials
  - Storage
  - Handling/Unloading
  - Assembly – coupling (if needed)
Limitations / Considerations (continued)

- Installation
  - Large volume of spoils
  - Rock profile – fixed casing lengths

Acknowledgements

- Engineer
  - Larry Johnsen, P.E. – Heller & Johnsen
- Bar/Cage Vendor
  - Felix Ferrer, P.E. – SAS Stressteel