Construction of Drilled Shaft Foundations
Huey P. Long Bridge

Dan Brown, P.E., Ph.D.
Dan Brown and Associates

Peter Faust
Malcolm Drilling Company
Huey P. Long Bridge Widening

Owner:
La. DOTD

Structural Engineers:
Modjeski and Masters

Geotechnical Engineers:
Eustis Engineering

General Contractor:
Kiewit/Massman/Traylor

Subcontractor:
Malcolm Drilling Company

Foundation Consultant:
Dan Brown and Associates
Pier IVA

Test Shaft

Production Shafts
Work Platform

Driven steel sheet piling

Geogrid reinforced granular fill

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Work Platform

Geogrid reinforced granular fill

Driven steel sheet piling
Drilled Shaft Excavation

- Fully cased excavation
- Segmental casing advanced ahead of excavation
- Rotator system for casing installation & extraction
- Excavation using hammer-grab
Cased-Ahead Construction

(a) starter casing
(b) slurry
(c) concrete
(d) tremie
(e) concrete
Rotator System
Casing
Excavation Using Hammer-grab
Base Grouting

- Enhance Axial Resistance
- Improve Reliability
- Mitigate Imperfections in Base Conditions
The Base Grouting Process

1. Shaft Constructed
2. Base Grout Pressure Applied
3. Some Relaxation Occurs
4. Structural Load Applied
Base Grouting

Tube á Manchette (using CSL tubes)

Cover Plate
Criteria

- Target Pressure
- Minimum Net Volume
- Limit Upward Shaft Movement

Exhumed Shaft
Results from Previous Project: John James Audubon Bridge, La.

- Shaft 11W Load Test
- Shaft 11E Load Test
- Shaft T2 Load Test
- Shaft T4 Load Test
- Shaft T3 Load Test

NOT Base Grouted

Base Grouted

O-Cell Load (tons)

Downward Displacement (inches)

136 ksf
Completion of Shaft Base Excavation

STEPS 8A THROUGH 8F

ADDITIONAL NOTES

The elevation of the bottom of excavation is constantly monitored during the final hole excavation. At the completion of the shaft excavation, an independent final elevation check of the bottom of the excavation will be made by Kmtc and the owner's inspector shall verify the elevation. The elevation will be marked on the casing string and will be used to determine the correct depth of the gravel.

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Shaft Cleaning & Inspection

Airlift (Hydraulic) Cleaning Bucket

SID

Place Gravel

‘Bottle Brush’
Reinforcement

Bar Splices

Backbone Frame
Shaft/Cap Connection

Isolation Casing

Shaft Cutoff at -11

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## Concrete

### Mix Proportions For One Cubic Meter (Cubic Yard) of Concrete

<table>
<thead>
<tr>
<th>Component</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td>455 kg</td>
</tr>
<tr>
<td>Fly Ash</td>
<td>124.5 kg</td>
</tr>
<tr>
<td>Slag</td>
<td>124.5 kg</td>
</tr>
<tr>
<td>Fine Aggregate (SSD)</td>
<td>150 lbs</td>
</tr>
<tr>
<td>Coarse Aggregate 1 (SSD)</td>
<td>141 lbs</td>
</tr>
<tr>
<td>Coarse Aggregate 2 (SSD)</td>
<td>141 lbs</td>
</tr>
<tr>
<td>Water</td>
<td>351 L</td>
</tr>
<tr>
<td>Water Reducer</td>
<td>140 mL</td>
</tr>
<tr>
<td>Air Entrained</td>
<td></td>
</tr>
<tr>
<td>Set Accelerator</td>
<td></td>
</tr>
<tr>
<td>Superplasticizer</td>
<td>21 lbs</td>
</tr>
<tr>
<td>Special Additive A</td>
<td>149 lbs</td>
</tr>
<tr>
<td>Special Additive B</td>
<td>121 lbs</td>
</tr>
<tr>
<td>Special Additive C</td>
<td></td>
</tr>
<tr>
<td>Contractor</td>
<td>Kiewitt Massman Taylor</td>
</tr>
<tr>
<td>Certified Concrete Technician</td>
<td>B. Scholder</td>
</tr>
<tr>
<td>Date Submitted</td>
<td>4/10/08</td>
</tr>
</tbody>
</table>

**UNIT**
- kg, L, mL<br>
- (lb, gal, oz)

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Recover (7 oz/cwt)  
VMA (3 oz/cwt)
Concrete Placement and Testing

Segmental Tremie

CSL:
No Anomalies!
Base Grouting
**Base Grouting QC/QA**

### General Information
- **Date:** August 7, 2009
- **AFT Project No.:** 808117
- **Project Description:** Huey P. Long Bridge Widening, State Project No.: 006-01-0021
- **Client Name:** Kiewit-Massman-Traylor Constructors (KMT)
- **Client Address:** 4910 Pontchartrain Avenue Suite T, Jefferson, LA 70123
- **Client Contact:** Mr. Luis Paiz
- **Post Grout Date:** July 29, 2009
- **AFT Grout Specialist:** Jason Frederick
- **AFT Data Acquisition Specialist:** Mike Muchard, P.E.
- **AFT Responsible Engineers:** Mike Muchard, P.E., Tom Santee, P.E.

### Drilled Shaft Information

<table>
<thead>
<tr>
<th>Shaft Number</th>
<th>Bent/Pier Number</th>
<th>Diameter (inches)</th>
<th>Length (feet)</th>
<th>Installation Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Shaft</td>
<td>N/A</td>
<td>110</td>
<td>~190</td>
<td>7/21/09</td>
</tr>
</tbody>
</table>

### Post Grout Criteria
- **Minimum Required Grout Pressure:** 850 psi (60 bar) (measured at pump)
- **Maximum Permissible Displacement:** 0.25 inch (measured via survey at shaft top)
- **Minimum Grout Volume:** 5 cubic feet (net pumped to the toe of the shaft)

### Post Grout Measurements
- **Data Acquisition System Used:** MEGADAC
- **Pressure Transducer Used:** Hewlett Packard
- **Strain Gages:** AFT Sisterbars
- **Manual Grout Pressure:** Manual Oil Filled Bourdon Gage
- **Survey Level:** By AFT
- **Manual Grout Volume:** Holding Tank Level Manual Measurement

### SUMMARY OF POST GROUT RESULTS

<table>
<thead>
<tr>
<th>Maximum Grout Pressure (psi)</th>
<th>Upward Shaft Displacement (inches)</th>
<th>Maximum Gross Volume Placed (cubic feet)</th>
<th>Estimated Net Volume Placed (cubic feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>800</td>
<td>0.081</td>
<td>168.8</td>
<td>156.8</td>
</tr>
</tbody>
</table>

Notes:
- Net volume calculated as follows:
  - Net Volume = Gross Volume - Theoretical Volume of Grout Tubes (cu. ft.)
  - Tube I.D. = 2.0 in., Avg. tube length 210 feet
  - Total 12 ft. length, 4 tubes, 48 cu. ft. Note: tubes became blocked approximately 2hrs-40min. before the end of the test.

**Pressure and Volume During Base Grouting of Test Shaft**

- **Huey P. Long Bridge Widening**
- **New Orleans, Louisiana**

![Graph showing pressure and volume during base grouting](#)
Performance of Load Test

- Graph showing the relationship between load in kips and displacement in inches.
- The graph on the left illustrates an increase in displacement with increasing load, up to a value of 1.0 units of displacement at 10000 kips.
- The graph on the right shows a decrease in displacement with increasing load, starting from 0 displacement at 0 kips and reaching -6 units at 10000 kips.

- The image shows the structure being tested, with a label indicating a load of 131 ksf.
Completed Foundation
Summary

Foundations for large bridges present special challenges: key issues

- *Construction plan to minimize risks*
- *Constructability issues of design*
- *Coordinated effort of partners*
- *Performance verification requirements*

Don’t get bit!