



SPECIALISTS IN GEOTECHNICAL & FOUNDATION ENGINEERING

# Summary of Base Grouted Drilled Shaft Experience and Publications

February 2012

JOHN JAMES AUDUBON BRIDGE - New Roads, Louisiana



CHRISTOPHER S. BOND BRIDGE - Kansas City, Missouri

*GEOTECHNICAL*



HUEY P. LONG BRIDGE WIDENING - New Orleans, Louisiana

*INNOVATIVE*



GILMERTON BRIDGE - Chesapeake, Virginia

*SOLUTIONS*

## **Project Experience:**

**Gilmerton Bridge Replacement, Chesapeake, Virginia. *In-progress.*** A new lift span bridge over the Southern Branch of the Elizabeth River to replace the existing double-leaf bascule bridge that was constructed in 1938. The new bridge will be 1,908 ft long. The two main vertical lift span piers (Pier 9 and Pier 10) will be supported on 12 ft diameter base grouted drilled shafts. Each pier has 4 shafts with a length of approximately 112.5 feet. DBA is working as an expert consultant for the base grouted drilled shaft design, installation, and the load test program.

**Columbia University, Manhattanville, New York. *In-progress.*** DBA is providing value engineering services to the joint venture of E.E.Cruz and Nicholson to change the foundations to base grouting of drilled shafts to support interior column loads. The perimeter walls will be supported on slurry cut-off walls. The drilled shafts range in diameter from 6 ft to 8 ft, and in depth from 120 ft to 190 ft below grade.

**Snohomish River Bridge SR522, Washington. *In-progress.*** Pier foundations for this bridge will consist of three 10-ft diameter shafts each, depths ranging from 80 ft to 140 ft. DBA is providing consulting services to Shannon and Wilson for the base grouting design and specifications for two of the nine piers.

**Honolulu High Capacity Transit Corridor Project, Honolulu, Hawaii. *In-Progress.*** DBA is the foundation consultant for 6 mile long light rail elevated guideway structure in a congested urban environment. Structures are supported on drilled shaft foundations, and base grouting is designed for the shafts in sandy soils, often with basalt boulders, in the problematic areas of deep alluvium, and in filled areas along the alignment.

**Port Mann Bridge across the Frasier River, Vancouver, B.C., Canada. *In-Progress.*** The new Port Mann Bridge will replace an existing structure as part of the Gateway Project improving transportation infrastructure in the Province of British Columbia. The bridge will be 2.2 kilometers long, including an 850 meter cable-stayed main bridge and two approach structures. DBA is serving as an expert consultant to the Kiewit/Flat-Iron/Shannon and Wilson design/build team for remediation base grouting of a shaft at Pier 7 that experienced construction difficulties.

**I-15 Widening Beck Street Bridge, Salt Lake City, Utah. *Phase II completed May 2010; Phase I completed August 2009.*** This project consisted of two independent adjacent structures with long spans supported on base grouted drilled shafts with a single shaft beneath each column. The drilled shafts were 9 ft in diameter with lengths of 125 ft. DBA was the engineer of record, responsible for the base grouted shaft design. DBA also provided oversight of the field grouting, including review of all grouting data submittals.

**Huey P. Long Bridge Widening, New Orleans, Louisiana. *Completed December 2009.*** As part of this \$1 billion dollar major bridge widening project, one pier included base grouted drilled shafts. A total of 13 drilled shafts 9 ft in diameter and 184 ft in length were constructed under low head room conditions inside a cofferdam. DBA served as an expert consultant for the contractor joint venture during the installation and grouting of the shafts, providing recommendations for the contractor to achieve a successful and timely installation.



**Audubon Bridge, St. Francisville/New Roads, Louisiana DOTD.** *Completed October 2009.* This is a new cable-stay bridge across the Mississippi River supported on 8 ft diameter drilled shafts up to 220 ft in length. The bridge is the longest cable-stay span in North America. AFT was responsible for base grouting and instrumentation of 98 shafts. DBA was the engineer of record for the drilled shaft design, including the base grouting. DBA also provided construction engineering services, being present during the excavation and base grouting of each shaft. DBA was responsible for providing the analysis of the grouting process to verify the grouting achieved the design targets. DBA also developed the shaft load test plan, supervised the testing, and provided analysis of all load test results.

**Christopher S. Bond Bridge, Kansas City, Missouri.** *Completed April 2009.* \$245 million landmark cable-stay Missouri River bridge to upgrade I-29/I-35 to eight lanes. The bridge is supported on drilled shafts 6.5 ft to 10.5 ft in diameter up to 120 ft in length. DBA was the engineer of record for the bridge foundations, including base grouting design for the approach span shafts. The main span shafts were rock-socketed drilled shafts without base grouting. One approach pier utilized base grouting to increase the base resistance of the drilled shafts to keep the shafts tipped above a thick layer of cobbles and boulders, reducing potential difficulties associated with drilling through the boulders. The remaining approach piers utilized base grouted shafts that were bearing on the top of the underlying bedrock. The base grouting was used as a quality assurance technique, rather than counting on any increase in the base resistance of the shafts.

**I-35W Bridge over Minnehaha Creek, Minneapolis, Minnesota.** *Completed September 2008.* Bridge widening over Minnehaha Creek included 13 base grouted drilled shafts with diameters of 48, 72 and 96 inches. DBA served as a consultant to Mn/DOT for the project, providing advice during the design process as well as reviewing the designs submitted by the design/build contractor. DBA was also assisted Mn/DOT with the load test program, including the base grouting process.

**The Peninsula, Jacksonville, Florida.** *Completed February 2006.* 33 base grouted drilled shafts 6 ft in diameter up to 70 ft in length, value engineered by Dr. Dapp to change from belled shafts.

**PGA Boulevard Bridges, West Palm Beach, Florida.** *Completed January 2004.* Three bridges supported on a total of 116 base grouted drilled shafts. All drilled shafts were 914mm diameter with average lengths of 16.5 meters. Valued Engineered for Treviicos by Dr. Dapp who was finishing his dissertation and working for AFT at that time.

**Royal Park Bridges, West Palm Beach, Florida.** *Completed January 2004.* This is a bridge crossing the Intracoastal Waterway near West Palm Beach, Florida. A total of 76 base grouted drilled shafts with a diameter of 1.2 m were constructed. The test shafts on the project were part of Dr. Dapp's Dissertation research.

**My Thuan Bridge over the Mekong River, Vinh Long, Vietnam.** *Completed May 2000.* A 1.5 km long, 3 span, cable stay bridge supported by a total of 40 base grouted shafts. Eighteen shafts support each of the two 115m high main towers, while two shafts support each of the two tie-down piers. Dr Dapp was employed by Loadtest Inc. during installation and load testing of the first two shafts.

## **Publications by DBA Staff:**

Brown, D.A., Turner, J.P., and Castelli, R. J. (2010). Drilled Shafts: Construction Procedures and LRFD Design Methods (Geotechnical Engineering Circular No. 10), FHWA-NHI-10-016, Federal Highway Administration, Washington, DC.

Brown, D.A. and Axtell, P.J. (2010). "Design and Construction Challenges at kcICON Bridge" Deep Foundations, Spring, 2010.

Dapp, S.D. and Brown, D.A. (2010). "Evaluation of Base Grouted Drilled Shafts at the Audubon Bridge", GeoFlorida 2010, Advances in Analysis, Modeling and Design, Geotechnical Special Publication No. 199, ASCE, pp1553-1562.

Axtell, P.J., Thompson, W.R., and Brown, D.A. (2009). "Drilled Shaft Foundations for the kcICON Missouri River Bridge", Deep Foundations Institute 34th Annual Conference on Deep Foundations, Conference Proceedings 2009, October 21-23, 2009, Kansas City, Missouri, pp. 3-12.

Dapp, S., Muchard, M., and Brown, D. (2006). "Experiences with Base Grouted Drilled Shafts in the Southeastern United States," Proc. of 10th International Conference on Deep Foundations, Amsterdam, Netherlands.

Mullins, G., Winters, D., and Dapp, S. (2006). "Predicting End Bearing Capacity of Post-Grouted Drilled Shaft in Cohesionless Soils," Journal of Geotechnical and Geoenvironmental Engineering, Volume 132, No. 4, ASCE, pp478-487.

Mullins, A.G. and Dapp, S.D. (2002). "Pressure-Grouting Drilled Shaft Tips: Full-Scale Research Investigation for Silty and Shelly Sands" in ASCE Deep Foundations Institutes Annual Conference, Orlando, Florida.

Mullins, A.G., Dapp, S.D., and Frederic E. (2001). "Post-Grouting of Drilled Shafts, Final Report." submitted to the Florida Department of Transportation, Tallahassee, Florida.

Mullins, A.G., and Dapp, S.D. (2000). "Royal Park Post-Grouting Results" submitted to the Florida Department of Transportation, Tallahassee, Florida.

Mullins, A.G., Dapp, S.D., and Lai, P. (2000). "Pressure-Grouted Drilled Shaft Tips in Sand" Advances in Deep Foundation Design & Construction ASCE Geotechnical Special Publication No.200:1-17.



SPECIALISTS IN GEOTECHNICAL & FOUNDATION ENGINEERING