# Mississippi River Bridge Project Includes Record Load Test: A Three Part Story

by Paul Axtell, Dan Brown and Associates

*The information in the following article is a composite of material that came to* **Foundation Drilling** *magazine from three separate sources. Part I is based on information gleaned from an article that was published on the Associated Press newswire. It provides an overview of the project. Part II is excerpted from ENR's August 18th, E-Newsletter. Part III was provided by Paul Axtell and Dan Brown of ADSC Technical Affiliate company, Dan Brown and Associates. The bridge project is of interest in general. The Osterberg Load Cell test will be of particular interest to professionals in the deep foundation industry, and specifically for those who work in the drilled shaft segment. (Editor)*

*Paul Axtell with 50 ton core.*

## Part I: Ground Broken for Mississippi River Bridge

Top politicians from Missouri and Illinois joined the nation's transportation chief in ceremoniously breaking ground in April on the first new Mississippi River bridge at congestion-plagued St. Louis in some four decades.

The event was largely anticlimactic. Construction on the main span of the $670 million project got under way weeks before, after a ground-breaking ceremony first planned in February was foiled because dignitaries from Washington were snowed in and couldn't make it to St. Louis. But given another chance, Transportation Secretary Ray LaHood heralded the new span as vital in easing snarls at one of the nation's busiest crossings, and proof that two neighboring states, despite years of bickering over financing that delayed the project, ultimately could make it happen.

***Both states ended the impasse in February 2008, announcing a $640 million compromise after Missouri relented on the tolls. The cost has since grown to $670 million because bids came in higher than expected.***

Scheduled for completion in the middle part of this decade, the four-lane, cable-stayed bridge will divert Interstate 70 traffic from an existing bridge that's one of just two in the nation that accommodates three freeways. The plan also allows for the bridge, designed to be two lanes in each direction, to be expanded by a lane each way.

The project, meant to relieve the 47-year old Poplar Street Bridge now used by more than 120,000 vehicles daily, is being funded by a mix of state funds and the $239 million U.S. taxpayers are contributing.

Until both states struck a deal in early 2008, the project was consistently downsized and stalled by chronic haggling between Illinois and Missouri over financing even as traffic across the river continued to mushroom. In the early 2000s, the new span was conceived to be eight lanes, cost $1.6 billion and be named the Ronald Wilson Reagan Memorial Bridge, ideally becoming a "signature bridge" and possible tourist draw near St. Louis' towering Gateway Arch. Both states ended the impasse in February 2008, announcing a $640 million compromise after Missouri relented on the tolls. The cost has since grown to $670 million because bids came in higher than expected.

The new bridge is expected to carry about 40,000 vehicles a day initially, and up to 55,000 vehicles daily by 2030.

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*O-Cell testing at bridge site confirms design assumptions.*

## Part II: ENR Reports on Record Load Test

*The following description of the test is excerpted from the August 18, 2010 issue of ENR's ENewsletter.*

Companies working on the $670 million Mississippi River Bridge in St. Louis, Missouri, have shattered geotechnical records with a 36,067-ton load test on one of the bridge's drilled shaft concrete foundations.

The test performed this past June, consisted of drilling an 11.5 ft-diameter shaft 43.5-ft under the riverbed, then cutting an 11-ft diameter socket more than 23-ft into the underlying limestone bedrock. Several Osterberg hydraulic load cells, provided by ADSC Associate Member, Loadtest, Inc., Gainesville, Florida, were then lowered to the bottom of the rock socket, and concrete was poured into the shaft to fill the socket and encase the cells.

The load test confirmed about 18,000 tons of base resistance force and about 18,000 tons of side resistance force resulting in the highest total load ever for any foundation test. According to ADSC Honorary Technical Affiliate Member, Dan Brown, Dan Brown & Associates, Sequatchie, Tennessee, "There may have been higher per-square foot pressures, but for total load, this is the highest ever."

ADSC Honorary Technical Affiliate Member, Clyde Baker, STS Consultants/AECOM, Chicago, confirmed Brown's assessment. "As far as total load, 36,000 tons would be the largest." Baker is one, if not *the* most noted designer of foundations for the world's tallest buildings.

The successful test means huge cost and time savings for construction of the massive new Mississippi River Bridge, which will be the country's third-longest cable-stayed bridge when it is completed in January 2014. The bridge's 1,500 ft-long main span will be supported by two, large river piers, each of which is founded on a group of drilled shafts. The successful test verified that using six, 11.5-ft diameter drilled shafts, instead of a proposed fourteen, 10-ft diameter drilled shafts, in each foundation group will provide ample support.

The *ENR* article states, "Using fewer but larger piers will reduce the foundations' footprints and cut in half the total time needed to construct both piers from about six months to three months."

The MTA joint venture and geotechnical engineer, Dan Brown & Associates, developed the concept of using fewer but larger piers as an alternative before bidding the project to the owners, Missouri Department of Transportation and Illinois DOT.

*ENR's* report asserts that "The 11-ft diameter shafts are much larger than the typical 5-ft to 8-ft diameter shafts normally used in hard rock to support major bridges. The project also is unusual because piers are being excavated using a core-barrel drill that cuts a 6-in kerf through the rock, then uses a 500-ton jack to snap off the rock core. Production drilling began the first week of August, 2010.

## Part III: Dan Brown and Associates Adds Commentary

Dan Brown & Associates (DBA) was part of foundation engineering and construction history while participating in a drilled shaft load test for the new I-70 Mississippi River Bridge in St. Louis, Missouri. A new O-cell world record of 36,000 tons (bi-directional) was achieved on the test, besting the former record of just under 32,000 tons set in 2005 in Korea.

The test shaft was built by MTA (a joint venture of several general contractors) as part of an Alternative Technical Concept (ATC) that MTA submitted in their winning bid. During the bid phase, the owner allowed ATCs to be submitted by pre-qualified teams. These ATCs were unique to the team that submitted them (e.g., each team was allowed to submit their own ATCs if they desired, but the ATCs were not shared amongst all the teams.) DBA worked with MTA to develop an ATC that optimized the drilled shaft foundations shown in the "baseline" drawings provided by the owner. That ATC provided a more economical foundation solution that was accepted, bid and awarded (note: MTA also had the option of bidding the "baseline" drawings as-is). A full-scale load test on a

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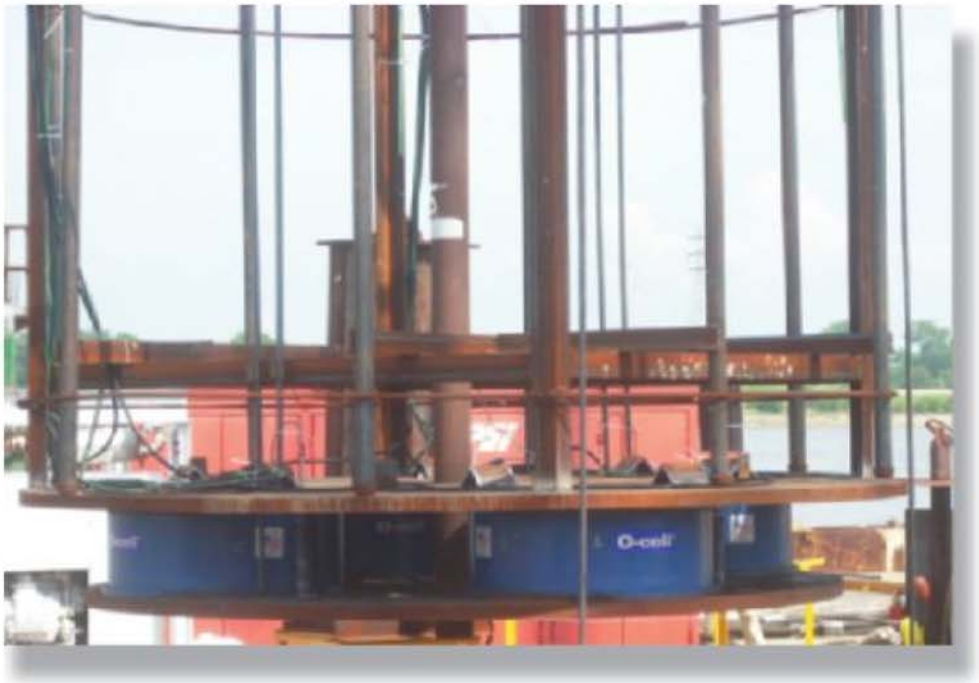


*O-Cell test broke previous record.*

dedicated test shaft using the Osterberg (O-cell) test method was included in the ATC to: 1) prove the design values used for the resistance in the rock socket; and 2) take advantage of higher resistance factors for using a load test as opposed to only calculations. The baseline drawings did not include a load test.

Loadtest, Inc. performed the load test. The bottom-up static load test applied slightly greater than 36,000 tons (bi-directional) to the shaft resulting in about 1/8 inch of upward movement of the shaft and about the same magnitude of downward displacement at the base. The rock socket was about 23 feet deep and 11 feet diameter in very hard limestone. Four 34 inch O-cells placed at the base of the shaft were loaded to 150% of their rated capacity to achieve the record load.

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