



February 9, 2018

Technique Shaft Results

The technique shaft has been constructed and the project team would like to provide our Red Wing Bridge project partners with some feedback on what we learned.

What is a technique shaft?

A technique shaft is a trial run at building a permanent drilled shaft where the contractor features their construction means and methods to see if any changes are necessary prior to actually building the permanent shafts. For the new river bridge, there are four (4) - 9' diameter drilled shafts for the pier #2 foundation and two (2) - 10' diameter drilled shafts for the pier #1 foundation. The technique shaft was built just off the shoreline on the Wisconsin side of the project outside the footprint of the new bridge. It will be removed at least down to the channel bottom when the project is finished.

What is a technique shaft made of?

The technique shaft is comprised of an outer steel casing with an added rock socket into bedrock in the bottom of the river, with a reinforcing cage and concrete placed inside.

What can go wrong?

Drilled shafts can be built in the dry or under wet conditions. On this project, we are building them in the river under wet conditions. The biggest concerns with wet condition shaft construction are voids in the final concrete shaft structure either around the reinforcing bars due to poor consolidation of the concrete or voids caused by sediment getting into the concrete during placement. That is why the contractor means and methods are so important in high quality drilled shaft construction.

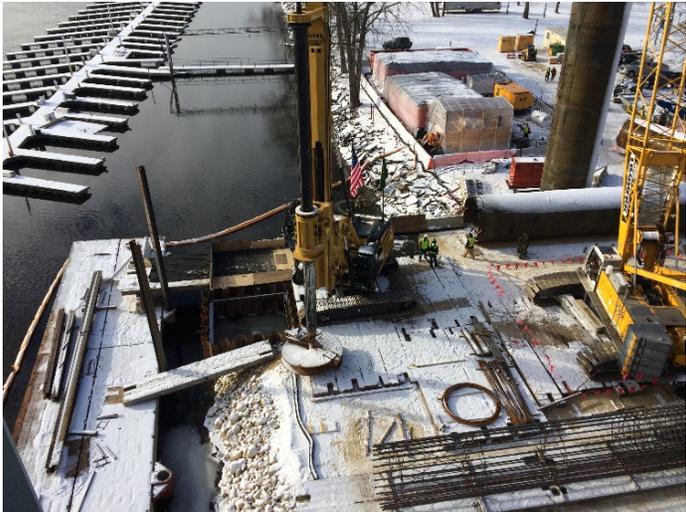
How was the technique shaft built?

First, a trial pour of the concrete mix, which we call self-consolidating concrete or SCC, was placed to see if any changes were necessary in the SCC mix. The SCC mix performed very well and no voids were encountered when our team cored the trial pour concrete.



Technique Shaft SCC trial pour. Exterior forming system (left) and finished concrete (right).

The next step was to mobilize to the technique shaft site and install a tank system to handle the slurry mixture used in the construction of the shaft. A slurry is a mineral or synthetic fluid with a higher density than water. It is used to stabilize the sides of the drilled shaft excavation by maintaining a head differential above the river water elevation. For the technique shaft a 5-8' head differential above the Mississippi river level was utilized inside the drilled shaft casings. A temporary cofferdam was also installed surrounding the technique shaft work area.



Technique Shaft Construction with the slurry tank setup in the background and the cofferdam installed off the river bank



Red Wing Bridge Project

Next the construction team installed an exterior temporary casing larger in diameter than the actual permanent 9' casing. The permanent 9' casing was then installed and the inside excavated out. The shaft bottom and water is then cleaned of sediment, inspected and a reinforcing cage then installed. The SCC mix placed by tremie method, again underwater and finally testing is done to validate the integrity of the shaft.



Technique Shaft Construction with casing cleanout (left) and rebar cage installation (right).

How far down was the permanent casing installed on the technique shaft?

The permanent casing for the technique shaft had a total length of 96.5 feet, with an additional "rock socket" into the bedrock.



Technique Shaft Permanent Casings in Background.



How powerful is the drilled shaft equipment?

The Veit team used a EK300 drill rig from CZM Foundation Equipment that can generate 252,999 ft-lbs of force.



CZM Foundations Drill Rig.

What did we learn from the technique shaft construction?

- While it did not cause any major difficulties for the project team, we found an artesian condition at approximately 68 feet down from the Mississippi River water elevation.
- The SCC mix produced by Cemstone at their Red Wing plant performed very well.
- The CZM drill rig has difficulties in the extremely cold weather periods we had.
- The excavated “cuttings” from the shaft are not highly contaminated and can be re-used as fill for the project.
- The environmental controls, including the temporary outer casing, worked very well for our team.
- Based on the integrity testing, a very high quality drilled shaft was constructed and only minimal changes are in order for the permanent drilled shaft construction.