



DEPARTMENT OF
TRANSPORTATION

RESEARCH SERVICES & LIBRARY

TECHNICAL SUMMARY

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PROJECT COST:

\$134,806



Following bridge inspections, about one-third of discovered grout voids were filled using vacuum-assisted or pressure grouting repair techniques.

Cost-Effective Strategies for Repairing Grout in Post-Tensioned Bridges

What Was the Need?

Some concrete bridges in the United States are strengthened using post-tensioning—a method of reinforcing concrete by running steel strands through a hollow plastic or metal duct placed within the concrete element. Tension is then applied to these strands with a hydraulic jack, compressing the concrete and creating internal stresses that resist external traffic loads. Post-tensioning improves the durability of concrete and virtually eliminates cracking.

Post-tensioning ducts are filled with grout—a mixture of cement, sand and water that hardens around the steel strands. This practice prevents the strands from corroding if they are exposed to air, water and deicing chemicals.

Grouting materials used in bridges built before 2003 frequently produced voids where grout did not fully fill the post-tensioning ducts or cover the strands. These post-tensioning strands were vulnerable to corrosion, which can lead to deterioration in bridge elements over time. Once transportation agencies and the industry became aware of these issues, they improved their construction practices and began using prepackaged grout materials with additives so that the post-tensioning ducts would be completely filled.

About 40 post-tensioned bridges were built in Minnesota before 2003 that might still require repair. MnDOT commissioned a two-phase project to develop techniques for evaluating these structures. In the first phase of the project, completed in 2012, researchers inspected a representative sample of these bridges and developed a general inspection protocol to guide future investigations. In the second phase, described here, researchers developed additional guidance about grout repairs, as well as the most cost-effective contracting methods for such repairs.

What Was Our Goal?

The goal of the second phase of this project was to provide recommendations and general guidance that MnDOT could use to develop cost-effective strategies for future investigation and repair of post-tensioned bridges built in Minnesota before 2003. As part of this project, researchers identified grout voids in post-tensioning ducts on two representative bridges, documented strand corrosion and repaired voids by filling them with grout.

What Did We Do?

In 2013, researchers inspected three spans on two Minnesota bridges for voids around post-tensioning strands. They began the project by using ground penetrating radar to map the location of the ducts. Once the ducts were located and mapped, researchers used a borescope to visually inspect the duct interiors at locations where voids were likely to be present. When they found voids, they documented the percentage of the duct filled by grout and the extent of corrosion in the post-tensioning strands within the ducts, if any. Following inspection, researchers filled the voids with grout and installed sensors within the voids at two locations to monitor the long-term corrosion of post-tensioning strands.

Using their experience with these repairs, researchers then created guidelines that would help MnDOT develop cost-effective strategies that can be implemented in future post-tensioning duct investigation and repair contracts.

The guidelines developed in this project give MnDOT a framework for soliciting and procuring engineering and construction services to cost-effectively repair post-tensioned bridges in Minnesota.

“With the guidelines developed in this project, we have a good basis for cost-effectively and efficiently inspecting post-tensioned bridges built before 2003.”

—Dustin Thomas,
South Region Bridge
Construction Engineer,
MnDOT Bridge Office

“From a fiscal perspective, it makes sense to do limited inspections on these bridges before committing additional resources to more comprehensive inspection and repair.”

—Mark Chauvin,
Associate Principal
and Unit Manager,
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Researchers installed corrosion-monitoring sensors within grout voids at two locations. Measurements are taken manually using a handheld data collection unit and patch cable.

What Did We Learn?

Researchers found voids in 32 percent of inspected ducts. These voids were typically at least 10 feet long and about one-half the diameter of the duct. Although prestressing steel strands were exposed at approximately half of the grout voids, no significant corrosion of the strands was observed at any location. Light to moderate corrosion was usually observed on the inside surfaces of the galvanized metal ducts at grout voids.

The guidelines developed by researchers address:

- Typical work plans for investigation and repair, including considerations for bridge access and traffic maintenance during inspection and repair.
- Document review, including bridge design drawings and post-tensioning shop drawings.
- Visual surveys to identify signs of distress near post-tensioning ducts.
- Procedures for borescope inspection and remedial grouting repair.
- Various contract and project approaches for developing specialized inspection and remedial repair contracts, with a discussion of the advantages and disadvantages of each approach. Using multiple contracts with graduated levels of inspection and repair will most likely provide MnDOT with the best value.
- Planning-level cost information for seven representative pre-2003 post-tensioning bridges identified by MnDOT to assist in future budget calculations.

What's Next?

The guidelines developed in this project will provide MnDOT with a framework to solicit and procure similar engineering and construction services contracts for post-tensioning bridges in Minnesota. Researchers recommend exploring additional techniques to more rapidly assess and inspect post-tensioned bridges, including noninvasive investigative methods that do not require drilling holes.

This Technical Summary pertains to Report 2017-04, “Considerations for Development of Inspection and Remedial Grouting Contracts for Post-tensioned Bridges,” published January 2017. The full report can be accessed at mndot.gov/research/TS/2017/201704.pdf.