

Using Standard Repair Procedures to Streamline the Repair Process for Prestressed Concrete Members

by W. Cabell Garbee II and Jason L. Civils, North Carolina Department of Transportation

The North Carolina Department of Transportation (NCDOT) has 18,877 bridges in the state inventory, with 1325 (7%) classified as poor condition according to the January 2022 National Bridge Inventory data. With the return of gas-tax revenues from a resurgence of travel and increased funding from the Infrastructure Investment and Jobs Act, also known as the Bipartisan Infrastructure Deal, the number of bridges that are scheduled to be replaced, repaired, or newly constructed, according to NCDOT's current 5-year schedule, is expected to increase by approximately 30 bridges, large and small, per year.

The proposed schedule will provide increased opportunities for the prestressed concrete industry to produce bridge components for use on the NCDOT network. It will also require even greater

cooperation and streamlining of processes used by NCDOT and producers to ensure timely delivery of projects.

One of the responsibilities of NCDOT's Materials and Tests (M&T) Unit is to approve prestressed concrete members before shipment from the production facilities to project sites. To ensure that prestressed concrete members are fabricated according to NCDOT's *Standard Specifications for Roads and Structures* and specific contract requirements, an M&T Unit inspector is assigned to each facility to perform quality assurance checks alongside the producer's quality control personnel, and to inspect and approve the members.¹

At times, as-cast members have repairable defects. These defects are documented by the M&T inspector and are submitted,

along with the producer's detailed repair procedure, as a nonconformance report (NCR) to the Structures Management Unit (SMU) for review and approval. After a repair procedure has been approved by the SMU, the repair is performed in the presence and to the satisfaction of the on-site NCDOT inspector, who updates the NCR to document the repair and then prepares the usual and customary shipment authorizations.

During a regular Georgia/Carolinas PCI-NCDOT Joint Technical Committee meeting, methods of streamlining and improving the NCR process were discussed. A suggestion was made to standardize the procedures for repairing common defects for which producers had been submitting essentially the same procedures over and over. An ad hoc committee with members from the M&T Unit and the



Void in the bottom flange at the end of a girder observed after form removal (left). Completed repair of void after finishing (right). A high-modulus, two-component structural epoxy adhesive that was mixed with oven-dried sand was used for the repair, which was similar to North Carolina Department of Transportation Standard Repair Procedure, but on a larger scale. All Photos: North Carolina Department of Transportation.



Photos of the preparation and repair of a defect at the corner of the bottom flange of a prestressed concrete girder. The left photo is a close-up of the area prepared for repair by removing unsound concrete from the void area and squaring the edges. The center photo is an overhead view of the same area to be repaired where concrete has been chipped out behind the strand. The right photo shows the completed repair. An on-site North Carolina Department of Transportation (NCDOT) inspector documents the defect, is present during the repair, and, if satisfied, approves the repair. This defect is similar to one of the NCDOT Standard Repair Procedures, but it is deeper than the limit so the Materials and Tests Unit inspector needs to document the defect. That documentation, along with the producer's detailed repair procedure, is then submitted as a nonconformance report to the Structures Management Unit for review and approval.

SMU reviewed the NCR submittals for the previous 3 years and selected the most common submittals for discussion.

After the first group of common NCRs was selected, members of the SMU's Working Drawing Review group used previously submitted repair procedures to draft consolidated standard repairs. These drafts were then given to volunteers from Georgia/Carolinas PCI for review and comment and to ensure that they conformed to PCI standard practices as well as the NCDOT *Standard Specifications*.

The first Standard Repair Procedure was formally approved and adopted on January 9, 2020. Standard Repair Procedures have a number of conditions that must be met for the repair to be exempt from review by the SMU. If the conditions are met, the repair is performed and an NCR is created for documentation. If the conditions are not met, or the initial repair is not satisfactory, an NCR is created and submitted to the SMU for review.

Following the completion of the first Standard Repair Procedure, seven more have been created, covering such items as longitudinal cracks, spalls, missing or broken continuity bars, and, most recently, shrinkage cracks.² With assistance from members of Georgia/Carolinas PCI, the SMU, and others, it is expected that additional Standard Repair Procedures will be developed to streamline the review process for additional types of nonconforming prestressed concrete members.

NCDOT's Standard Repair Procedures have been posted in PDF form on the

NCDOT website for unrestricted access.² Microsoft Word versions have been shared with the M&T Unit's prestressed concrete inspection staff and with PCI producer members in the Georgia/Carolinas, Mid-Atlantic, and Central Regions.


To further enhance communication and strengthen the NCR process, NCDOT is working to develop a semiautomated tracking system using the features of a web-based collaborative platform to streamline the submittal, tracking, and filing of the requests and repairs. The system will ensure that any Standard Repair Procedures that have been used for a girder are properly shared and retained for future reference during the life of the structure. The system is also designed to allow use, review, and tracking of nonstandard repairs that require engineering review, as well as tracking and reporting of the types of nonconformances and the frequency of use for each repair.

When repair procedures require review, NCDOT typically allows 10 working days for review of repairs by the engineer of record via the SMU. For precast concrete members with defects that can use a Standard Repair Procedure, the time required for approval has been reduced in most cases to 1 day or less. As a result, producers are able to expedite repairs and obtain approval and shipping authorizations faster for affected members, and SMU staff can focus more time and resources on reviewing more critical repairs and other tasks.

The authors wish to thank the members of Georgia/Carolinas PCI and the NCDOT Structures Management Unit

for their assistance in both developing the procedures discussed herein and preparing this article.

References

1. North Carolina Department of Transportation (NCDOT). 2018. *Standard Specifications for Roads and Structures*. Raleigh, North Carolina: NCDOT. <https://connect.ncdot.gov/resources/Specifications/Pages/StandSpecifications.aspx>.
2. NCDOT. "Prestress Concrete Standard Repair Procedures." <https://connect.ncdot.gov/resources/Materials/Pages/Prestress-Concrete-Standard-Repair-Procedures.aspx>. 

W. Cabell Garbee II is a manufactured products engineer and Jason L. Civils is a concrete products specialist in the Materials and Tests Unit of the North Carolina Department of Transportation.

EDITOR'S NOTE

The first of the NCDOT Standard Repair Procedures, "SRP-01, Vertical Cracks," includes provisions for rejecting some girders with vertical cracks prior to detensioning. These provisions are not consistent with industry practice, as stated in PCI MNL-137, which says vertical cracks prior to detensioning that close to a width of 0.006 in. or less have no engineering effect on the girder, so the girder is fit for service without repair. MNL-137 requires consideration of other factors when vertical cracks occur at certain locations.