Proposed Sections on Debonded Top Strands for NCDOT Structure Design Manual
For NCDOT - G/C PCI Joint Technical Committee Meeting – July 14, 2016

Proposed revisions to NCDOT Structure Design Manual (January 2016)

6.3 PRESTRESSED CONCRETE GIRDERS

[*The following is shown as being added to the Prestressed Concrete Girders section. Would it also need to be added in other sections, or can it be referenced?*]

6.3.1 Design

6.3.1.2 Prestressing Strands

[*Add the following new section at the end of Section 6.3.1.2 following the "Draped Strands" section.*]

Debonded Top Strands

Debonded top strands are usually used for the following reasons:

a. to control stresses at ends of girders at transfer (reducing the required compressive strength at transfer and/or reducing debonding/draping requirements)
b. to improve lateral stability of girders for handling, shipping, and erection
c. to reduce the camber of girders.

Debonded top strands are typically fully stressed with other strands in the girder. The strands are bonded at the ends of the girder (typically for at least 10 ft) and are debonded in the center portion of the girder, the opposite situation as in typical debonding applications. Unlike typical debonded strands, the prestress force remains in the debonded portion of the debonded top strands after detensioning in the prestress bed and must be considered when computing initial concrete stresses and camber. The top debonded strands are generally detensioned in the field after the girder has been erected and temporary bracing has been installed between girders; access ports for detensioning the strands are typically located near midspan. After the debonded top strands have been detensioned, there is no longer any stress (or force) in the debonded portion of the strand; however, the bonded portions of the strand at the ends of the girder are still stressed, just like typical bonded pretensioned strands, with transfer lengths at both ends of the bonded portion. From experience in the Northwest, top strand debonding is typically used for deeper girders, but can also be used for shallow girders and other sections if necessary.

Typical debonding procedures and materials can be used, although some producers have used slightly over-sized debonding sheaths to reduce the potential for developing splitting cracks in thin top flanges when the top debonded strands are detensioned.

Detensioning is typically performed in the field by the contractor after the girder is erected and temporary bracing is installed. Debonded top strands must be detensioned by flame detensioning procedures similar to those used in a prestressing plant to minimize energy release at transfer and avoid possible damage to the top flange of the girder. The strands must not be simply cut. Instead, a cool flame should be played across the strand to gradually heat each strand until individual wires begin to break. The detensioning procedure must be clearly shown on the plans as a note to the contractor.

Field detensioning of the debonded top strands allows the improved stress conditions and lateral stability of the girder to be utilized during shipping and erection. Debonded top strands should be detensioned in a sequence that alternates sides of the top flange to minimize lateral bending effects. After all wires have broken in a strand, it should retract fully into the debonding sheath. For reference, a 50 ft length of debonded strand should shorten approximately 4 in. when detensioned. In some cases, where top strands are not needed to improve lateral stability or stresses during handling, transportation, or erection, plans and shop drawings must indicate when top debonded strands should be detensioned, such as in the prestress plant or prior to erection.

Top strand access blockouts must be detailed in the top of top flange, typically near midspan, to access the debonded top strands for detensioning. Only one blockout is provided for each debonded strand. The length of the blockout must be adequate to accommodate the flame detensioning procedure that requires the flame to be played along at least a 5 in. length of strand. When several top flange strands are debonded in a girder, blockout locations should be staggered across the top flange to prevent weakening of the top flange. Mild reinforcement may be provided crossing and parallel to the debonded strands at strand access blockout locations to control potential cracking in the flange. Blockouts should be protected from entry of water into the debonding sheathing which can later freeze, potentially causing splitting of the top flange.

If several top strands are debonded, the location of the termination of the debonding should be staggered to prevent potential top flange cracking from the energy release when the top strands are detensioned. Mild reinforcement should be provided parallel to and crossing the debonded top strands at locations where debonding is terminated to control potential cracking in the top flange when these strands are detensioned.

In some cases, post-tensioning methods have been used to stress debonded top strands. This can be an appropriate option, but requires evaluation and design of anchorage hardware and reinforcement in the top flange to resist anchorage forces. Post-tensioned strands are

typically stressed prior to lifting the girder from the bed, since they are generally required to provide adequate lateral stability and/or control stresses during handling. Post-tensioned strands have been detailed with a bonded length (usually 10 ft) at the dead end to keep them from being ejected from the girder when detensioned.

After detensioning of the debonded top strands and prior to placement of deck concrete, the blockouts should be cleaned of any foreign material and standing water. It is recommended that strand access blockouts be filled with grout to prevent penetration of water into the duct which can later freeze, potentially causing splitting of the top flange.

It is important for the contractor to recognize that the girder camber will increase as debonded top strands are detensioned. Therefore, the contractor should survey the girders for setting deck form support elevations after top debonded strands are detensioned. If necessary, temporary bracing should be detailed to accommodate the changing camber of the girders as debonded top strands are detensioned. The plans should indicate the anticipated camber change after debonded top strands are detensioned.

6.3.2 Camber and Dead Load Deflection

[*Add the following as a new section at the end of Section 6.3.2*]

6.3.2.2 Debonded Top Strands

When debonded top strands are used, as discussed in Section 6.3.1.2, a row shall be added to the camber and dead load deflection table that indicates the camber change expected when the debonded top strands are detensioned, which usually occurs in the field after girders have been erected and temporary bracing has been installed between girders.