Florida Department of Transportation

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M E M O R A N D U M

TO: District Structures Design Engineers
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SUBJECT: Temporary Design Bulletin CO4-02
Supplemental LRFD Design for Post–Tensioned Concrete Bridges and Deck Design for Box Girder Bridges

REQUIREMENTS:

1. The following requirements shall be added as a new Section 4.5.11 to the Structures Design Guidelines:

4.5.11 Principal Tensile Stresses

A. General
The principal tensile stress resulting from the long-term residual axial stress and maximum shear and/or maximum shear combined with shear from torsion stress at the neutral axis of the critical web shall not exceed the tensile stress limits specified herein. The principal stress shall be determined using classical beam theory and the principles of Mohr's Circle. Compressive stress due to vertical tendons provided in the web shall be considered in the calculation of the principal stress. The vertical force component of bonded draped longitudinal post-tensioned tendons shall be considered as a reduction in the shear force due to the applied loads. Local tensions produced in the webs resulting

from anchorage of tendons as discussed in AASHTO 5.10.9.2 shall be included in the principal tension check. Local transverse flexural stress due to the out-of-plane flexure of the web itself at the critical section may be neglected in computing the principal tension in web. The width of the web for these calculations shall be measured perpendicular to the plane of the web.

B. Construction: Add the following additional Principal Tensile Stress Limits to AASHTO LRFD Bridge Design Specification 5.14.2.3.3:
   a) Principal web tension excluding "Other Loads": $3\sqrt{f'_c}$, psi ($0.095\sqrt{f'_c}$, ksi)
   b) Principal web tension including "Other Loads": $4\sqrt{f'_c}$, psi ($0.126\sqrt{f'_c}$, ksi)

C. Service: Add the following additional Principal Tensile Stress Limits to AASHTO LRFD Bridge Design Specification 5.9.4.2.2 (using HL-93 loading at the Service III limit state regardless of environmental classification):
   Principal web tension: $3\sqrt{f'_c}$, psi ($0.095\sqrt{f'_c}$, ksi)

2. The following requirements shall be added as a new Section 4.6.9 to the Structures Design Guidelines:

4.6.9 Transverse Deck Analysis & Design
For concrete box girder bridges, perform a transverse deck analysis at the Service I and Strength I load combinations using the truck and tandem portion of the HL-93 live load (do not include the lane load). For deck design, do not include the wind effects for the Service I load combination. All analyses will be performed assuming no benefit from the stiffening effects of any traffic railing barrier and with a maximum multiple presence factor not greater than 1.0. For the for Service I load combination in transversely prestressed concrete decks, limit the outer fiber stress due to transverse bending to $3\sqrt{f'_c}$ for aggressive environments and $6\sqrt{f'_c}$ for all other environments. For the Service I load combination in reinforced concrete decks of "I" girder bridges, see LRFD Article 5.7.3.4.

3. The following requirements shall be added as a new Section 5.6.5 to the Structures Design Guidelines:

5.6.5 Transverse Concrete Deck Analysis
For steel box girder bridges, perform a transverse deck analysis at the Service I and Strength I load combinations using the truck and tandem portion of the HL-93 live load (do not include the lane load). For deck design, do not include the wind effects for the Service I load combination. All analyses will be performed assuming no benefit from the stiffening effects of any traffic railing barrier and with a maximum multiple presence factor not greater than 1.0. For the for

Service I load combination in transversely prestressed concrete decks, limit the outer fiber stress due to transverse bending to $3\sqrt{f'c}$ for aggressive environments and $6\sqrt{f'c}$ for all other environments. For the Service I load combination in reinforced concrete decks, see LRFD Article 5.7.3.4.

IMPLEMENTATION:

All projects submitted for the July bid letting will comply with the requirements established within this temporary design bulletin.

COMMENTARY:

It has been proposed to the AASHTO Subcommittee for Bridges by the Florida DOT to amend the "LRFD Bridge Design Specifications" as summarized below:

- Add a maximum upper limit of $3\sqrt{f''c}$ for principle tension in the webs of concrete box girders ($4\sqrt{f''c}$ during construction);
- Delete the uniform lane load from transverse design of bridge decks;
- Limit the multiple presence factor for transverse design to less than or equal to 1.0;
- Use Service I load combination in the transverse analysis for the determination of tension in prestressed concrete members.

These issues are important to the Florida DOT; therefore, implementation will precede adoption by AASHTO.

When checking principal tension in the webs of concrete box girders the effects of transverse web bending may be ignored for cross sections when the effects of the cantilever wings are approximately balanced by the effect of the inner portion of the slab between the webs.

BACKGROUND:

The basis for these supplemental requirements were developed with consultation among the following parties; FDOT staff; Corven Engineering staff; Dr. Dennis Mertz. A complete discussion of these and other requirements were presented at our workshop on July 24 and 25, 2003 titled "New Directions for Florida Post-Tensioned Bridges – Final Phase of Implementation."

WNN/LMS/h