Florida Department of Transportation

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STRUCTURES DESIGN BULLETIN 20-03

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TO: District Directors of Transportation Operations, District Directors of Transportation Development, District Design Engineers, District Construction Engineers, District Structures Design Engineers, Structures Manual Holders

FROM: Robert V. Robertson, P. E., State Structures Design Engineer

COPIES: Courtney Drummond, Will Watts, Tim Lattner, Dan Hurtado, Scott Arnold, SDO Staff, Rafiq Darji (FHWA)

SUBJECT: Concrete I-Beam Stability Criteria

This bulletin clarifies bracing requirements for concrete I-beams to address concerns with intermediate bracing being specified for 36", 45" and 54" Florida-I Beams when not required by calculations.

REQUIREMENTS

Replace ***Structures Design Guidelines*** Section 4.3.4 with the following:

4.3.4 I-Beam Stability

A. Analyze concrete beams for stability during each stage of construction in accordance with Paragraphs B and C below. See ***SDM*** 15.5 for Plan content requirements. See ***SDG*** 11.6 for the Contractor's bracing design requirements.

B. For simple-span prestressed Florida-I Beams (FIBs) and AASHTO Type II Beams, analyze stability for the following stages using the loads and limits shown below.

1. Stage 1 – Crane release
    a. Begin analysis with beams sitting on bearings without end bracing
    b. Loads: Construction Active design wind speed (***SDG*** 2.4.3)
    c. Beam Limits:
        i. Factor of Safety Against Cracking ≥ 1.0.
        ii. Factor of Safety Against Rollover ≥ 1.5.
    d. At a minimum, brace all I-Beams with spans greater than or equal to 160 feet at their ends prior to crane release.

Commentary: The SDG previously specified that the Factor of Safety Against Wind must be greater than or equal to 2.0 at Stage 1. This requirement is satisfied for I-Beams with spans less than 160 feet without end bracing at crane release. For I-Beams with spans greater than or equal to 160 feet, end bracing is required to satisfy the Factor of Safety Against Wind. See Section 5 of the Specifications for bracing requirements for the Construction Inactive condition prior to Stage 2.

2. Stage 2 – Beams erected
   a. Begin analysis with beam ends braced and no deck forms
   b. Loads: Construction Inactive design wind speed (***SDG*** 2.4.3)
   c. Beam Limits: Factor of Safety Against Cracking ≥ 1.0.
   d. The following minimum Stage 2 bracing applies:
      i. AASHTO Type II, FIB 63 and FIB 72 - end bracing and mid-span bracing
      ii. FIB 78 - end bracing and quarter point bracing
      iii. FIB 84 and 96 - end bracing and quarter point bracing with 3 beams erected and braced together within 24 hours.
   e. Specify end bracing only for FIB 36, 45 and 54 unless calculations show that intermediate bracing is required.

   Commentary: Due to their high stability, FIB 36, 45 and 54 generally do not require intermediate bracing in most situations. Additionally, installation of moment resisting bracing for these beam sizes is difficult because of their shallow and stocky shapes.

3. Stage 3 – Deck casting
   a. Begin analysis with beam ends braced
   b. Loads: Construction Active design wind speed (***SDG*** 2.4.3) and Construction Loads (***SDG*** 2.13).
   c. Beam Limits:
      i. Principal stresses at midspan ≤ ***LRFD*** Stress Limits after losses (***LRFD*** Table 5.9.2.3.2a-1).
      ii. Deck overhang deflection at the coping line due to beam rotation ≤ ¼"(assume the deck overhang formwork is rigid).
   d. The following minimum Stage 3 bracing applies:
      i. For deck overhangs ≤ 3 feet, use Stage 2 bracing.
      ii. For 3 feet < deck overhangs ≤ 3.75 feet, use the greater of Stage 2 bracing or mid-span bracing.
      iii. For 3.75 feet < deck overhangs, use quarter point bracing.
      iv. Avoid deck overhangs > 4.5 feet or ½ beam spacing, whichever is less.

C. For I shapes other than FIBs and AASHTO Type II beams, and for prestressed I-beams erected using temporary shoring and/or spliced together using post-tensioning, investigate stability during each stage of construction using the criteria in Paragraph B above and include additional bracing types and/or details in the Plans.

D. References

1. "Lateral Stability of Long Prestressed Concrete Beams - Part 2", Mast, R., PCI Journal, Vol. 38, No. 1, January-February 1993, pp. 70-88.)
2. "Determination of Brace Forces Caused by Construction Loads and Wind Loads During Bridge Construction", Consolazio, G., FDOT Contract No. BDK75-977-70, April 2014.
3. "Distribution Factors for Construction Loads and Girder Capacity Equations", Consolazio, G., FDOT Contract No. BDV31-977-46, March 2017.

BACKGROUND

Bracing requirements for concrete I-beams are being clarified to address concerns with intermediate bracing being specified for 36", 45" and 54" Florida-I Beams when not required by calculations, unnecessarily increasing project bids, schedules and risk exposure for construction personnel and motorists in the traffic controlled work zone. SDG 4.3.4 was also reorganized for clarity to avoid further misinterpretation or misapplication of the criteria.

IMPLEMENTATION

This bulletin clarifies existing criteria and is effective immediately.

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