

Structures Design Bulletin 20-03
Concrete I-Beam Stability Criteria
Comments from Industry Review

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Comment 04/30/2020: The Department has included a brief summary of the issue in the transmitting email. The first sentence states that intermediate bracing of the smaller FIBs (36", 45" and 54") is not required due to their high stability. If this is the intent of the SDB it is not made clear in the proposed language. I read the SDB as a clarification of the existing Structures Guidelines to some degree. It lists minimum requirements for Stage 2 and 3 bracing, yet does not clearly relieve the EOR with short FIBs from checking all of the stress and overhang deflection limits in the SDG.

Response: The EOR is not relieved from performing the required checks.

Action: The language under Stage 2 was revised to direct the EOR to specify end bracing only for FIB 36, 45 and 54 unless calculations show that intermediate bracing is required.

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Comment 04/30/2020: It is not clear what the intent is of Items 2.a and 3.a. If it is to tell the EOR to start the analysis with end bracing only, I suggest replacing "Analyze beams" with "Begin the analysis". Otherwise, at first reading it seems to connote that end bracing is all that is required.

Response: The intent is to start the analysis with end bracing only.

Action: The language was revised per the comment.

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Comment 04/30/2020: Item 2.d.i. is listed under Stage 2 minimum bracing and reads “FIB 36, 35 and 54 – end bracing only”. If this is meant to be the minimum, then delete the word “only”. If the Department is saying that end bracing is all these beams require in Stage II, remove the language from the minimum bracing heading

Response: The intent is for the EOR to specify end bracing only for FIB 36, 45 and 54 unless calculations show that intermediate bracing is required.

Action: The language under Stage 2 was reorganized and revised to direct the EOR to specify end bracing only for FIB 36, 45 and 54 unless calculations show that intermediate bracing is required.

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Comment 04/30/2020: I fully agree with the email’s point that the shorter FIB’s are a challenge to brace. Achieving the ¼” deflection limit at the screed rail is particularly difficult with short beams. The FDOT Beam Stability Program includes the finisher load and personnel live loads in the deflection calculation.

I recommend removing the finisher (Bidwell) wheel load from the deflection calculation. This load is present during the required dry run prior to concrete placement. The contractor will make an adjustment at this time to the finisher or screed rail if top cover or depth is shy. On wide bridges with heavy (16,000 lbs. plus) finishers, the wheel load is the major contributor to beam rotation.

Consider removing or reducing construction LL from the strength and deflection calculations. There are no workers at the overhang that is occupied by the finisher truss. Typically, one or two finishers work a few feet behind the machine to finish the barrier and gutter area. I have always believed the AASHTO guideline calling for 75 plf live load on the overhang is a carryover from the days before modern finishing machines when several workers were needed to handle a beam screed.

Further comment clarification provided 05/14/2020 per Department request: The problem originates with the beam program's assumption of torsional fixity at the ends of Lb. The resulting moments are such that brace forces to resist the torque are high enough to present problems with the shorter FIB's.

You need a tension force at the top and a compression force at the bottom to resist the outboard roll. Taking a FIB 36 spaced at 8' for example, the 3 1/2" top flange does not lend itself to a tension anchor. If you establish a tension tie just below the web fillet and a compression strut mid-depth of the bottom flange, parallel braces are 1.92' apart. This results in high forces depending on the moment. Designing an X or K rigid frame for this 4:1 span to depth ratio is not practical, nor is it economical, especially when you consider that FIB 36 and 45 sections have become our "workhorses".

The 1/4" deflection comes into play when you are forced to depart from a rigid brace. We analyze parallel tension/compression braces with RISA-3D. Applying loads per the beam program, the deflection becomes controlling. We have had jobs where bracing between beams worked for strength, yet we had to use a tension tie in the deck with anchor shoes at each end to limit the deflection. In some instances, we have moved the screed rail near the beam C/L and called for the contractor to finish the gutter by hand. Removing the finisher load from the deflection calculation, as suggested, would be a big help.

Response: The accepted design practice has been to limit screed rail deflections to 1/4" to ensure correlation with the deck smoothness criteria in the construction specifications. The construction loads in the SDG are considered appropriate design assumptions.

Action: No change needed.

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Comment 04/30/2020: For the reasons I've stated above, it is not clear if the Department intends to require only end bracing for the shorter FIBs. If we're not there yet, I suggest a parametric study of these beams to determine if a set of span lengths, overhangs and bridge widths can be identified and labeled as requiring end braces only.

Response: The EOR is not relieved from performing the required checks.

Action: The language under Stage 2 was revised to direct the EOR to specify end bracing only for FIB 36, 45 and 54 unless calculations show that intermediate bracing is required.

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Comment 05/05/2020: 4.3.4.A SDG uses "phase," not "stage," almost exclusively to designate each step of construction, except for Section 4.3.4. Change "stage" to "phase" for internal document consistency.

Response: Construction phase is intended to indicate the condition of a project during a certain period, typically associated with the MOT configuration. Stage is intended to indicate a certain step in the erection or construction process of the bridge.

Action: No change needed.

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Comment 05/05/2020: 4.3.4.B.2.d.i Doesn't seem clear with wording of end bracing "only" underneath a "minimum" category. Is it intended that FIB 36, 45 and 54 receive only end bracing? The way it is written still leaves an opening for the EOR to add intermediate bracing.

Response: The intent is that the FIB 36, 45 and 54 receive only end bracing unless calculations show that intermediate bracing is required.

Action: The language under Stage 2 was revised to direct the EOR to specify end bracing only for FIB 36, 45 and 54 unless calculations show that intermediate bracing is required.

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Comment 05/05/2020: 4.3.4.B.2.b.iv Clarify the intent when there are less than three beams in a phase, as is often the case in bridge widenings.

Response: The intent is that widenings with FIB 84 or 96 will be handled on a case-by-case basis. The Department would be skeptical of using less than three FIB 84 or 96 in a phase.

Action: No change needed.

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Comment 05/05/2020: 4.3.4.B.3.d.iv This guidance may require modification to be enforceable for non-conventional projects.

Response: The EOR is not restricted from using an overhang greater than 4.5 feet.

Action: No change needed.
