4000404 CONCRETE STRUCTURES
COMMENTS FROM INTERNAL/INDUSTRY REVIEW

Bob Burleson
bburleson@ftba.com

Comment: (5-8-14) (Internal Review)
Most long span steel we see is in locations that fall under "public safety" and would require signed & sealed calculations anyway. I see this as a means & methods thing that hasn't been a problem for years. Why add to the specifications now?

Response:
The Structures Design Office provides a detailed response and background information below. The State Construction Office supports this change.

(Robert Robertson response): The issue of beam rotation and the need to control the location of the overhang deck form has been known for many years and improper brace locations have been witnessed many times over the years and is still being done today. This is not a new problem that we are resolving as it a discussion point in a Construction self study course and acknowledged by Steve Plotkin in an NCHRP survey in 2005. We offered the language in an effort to be preventative and minimize efforts by the contractor to meet deck acceptability standards. AASHTO discusses the issue in both the Construction and Design specifications. We initiated the spec revision as part of our effort to evaluate girder stability that also resulted in new requirements for temporary beam bracing. I do not know why this requirement was not already included in the specifications, or at least as a specification requirement for the Specialty Engineer to properly evaluate the specific issue. Generally the Specialty Engineer calculations we have seen are more about global stability and not inclusive of this issue.

Ben Goldsberry has put together the background for the specification revision in the following:

Construction's publication titled Critical Structures Construction Issues - Self Study Course has tried to educate construction personnel on this issue (see pdf page 18 of 50):

"In recent years . . . fascia beams have rotated during placement of deck concrete due to inadequate overhang brackets and/or bracing between the fascia beam and the adjacent beam."

The current specification language does not address the issue of screed rails supported by bridge deck overhang falsework on steel I-girders during deck placement. The deck overhang falsework, which bears against steel I-girder webs during deck placement, supports the overhang formwork, wet deck concrete, screed machine and any construction loads. The steel I-girder supporting this falsework can experience excessive web plate deformations, top and bottom flange lateral bending deformations, and out-of-plane rotations, especially between cross frame bracing points. The girder deformations and rotations translate to vertical deflections of the screed rails which can result in poor bridge deck profiles, loss of structural bridge deck concrete thickness, loss of concrete cover for bridge deck reinforcing steel, and ponding of water along the toe of concrete railings.

The AASHTO LRFD Bridge Design Specifications requires that the effects of forces from deck overhang falsework acting on the fascia girders be considered. Article C6.10.3.4 states the following:

"Where practical, forming brackets should be carried to the intersection of the bottom flange and the web. Alternatively, the brackets may bear on the girder webs if means are provided to ensure that the web is not damaged and that the associated deformations permit proper placement of the concrete deck."

Keep in mind that this is language written to the designer and is mostly intended as a strength check, not a constructability check. For conventional design-bid-build projects the designer can't possibly know or accurately predict what bracket size and spacing the contractor will use. Even in a design-build scenario the designer will not likely have the necessary information from the contractor to properly consider the need for temporary bracing during the design. The Contractor's Engineer should be responsible to investigate the need for temporary bracing because the deck overhang falsework size, spacing, and construction loads are only known at the time of construction. See the following from Article 11.8.6.1.2 of the AASHTO LRFD Bridge Construction Specifications:

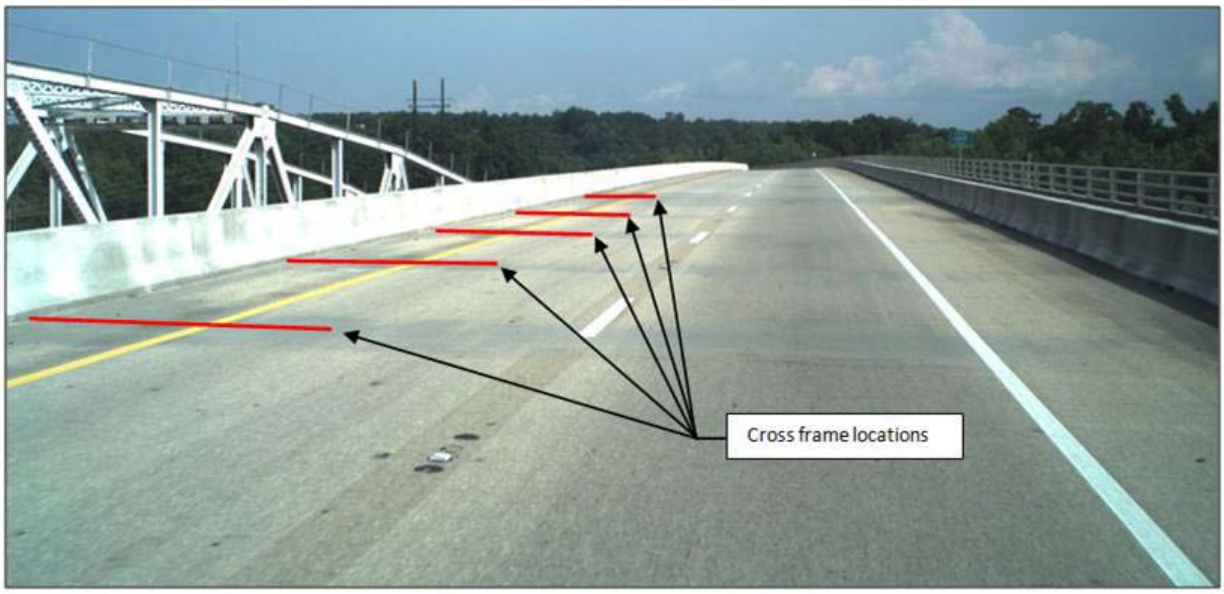
"Wherever practical, overhang brackets should bear ear the bottom flange and be attached to the top flange. If overhang brackets bear against the web, the Contractor's Engineer shall ensure that precautions have been taken to prevent permanent deformation of the web and excessive deflection of the wet slab and forms. The lateral force on the top flange due to overhang brackets shall be investigated to ensure that the flange is adequate as specified in Article 6.10.3.4, "Deck Placement," of the AASHTO LRFD Bridge Design Specifications."

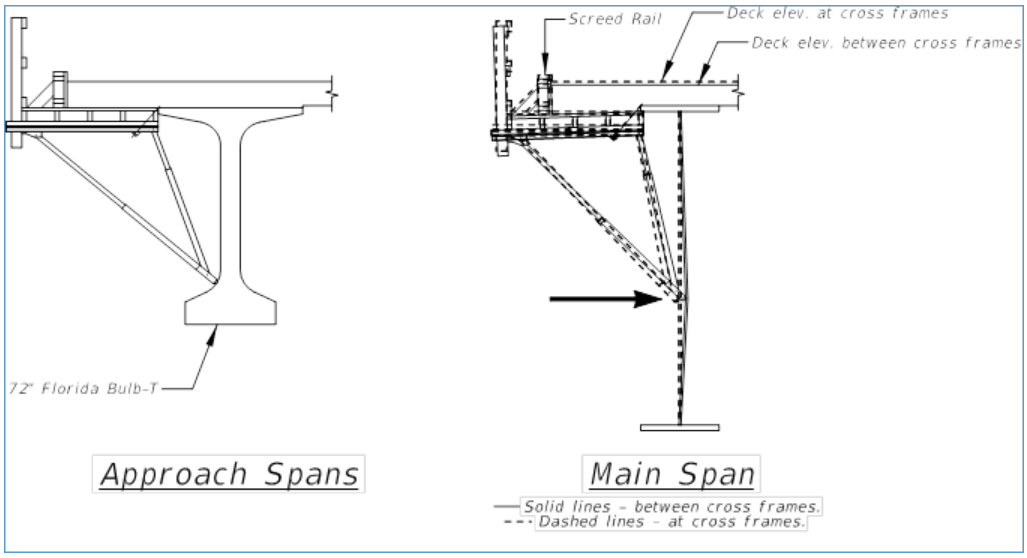
Also see this language from Chapter 2 of the AASHTO Construction Handbook for Bridge Temporary Works:

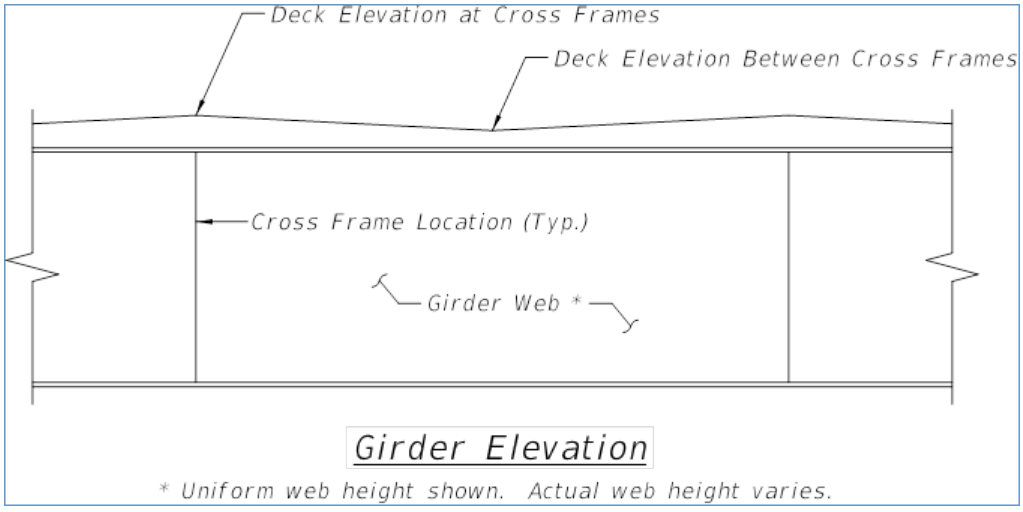
"The diagonal leg brace should bear on the web within 6 in (152 mm) of the bottom flange."

A sensitivity study performed by our office shows that if bridge deck overhang falsework bears more than 6" above the bottom flange and/or the concrete deck overhang is 4 feet or greater, the deflections of the screed rail between cross frames can well exceed 1/4", with some deflections well exceeding 1/2". These deflections may or may not be correctable with grinding of the deck. Section 400-15.2.5.5 (smoothness evaluation for long bridges) requires that a minimum of 1/4" of the deck be planed off, and allows up to 1/2" of deck planing to meet the smoothness criteria; however, it is not preferred or recommended to eat into the 1/4" of reserve thickness.

This is not a new problem and has been observed in Florida and around the country. This picture is from SR 20 over Apalachicola River. The cross frame locations are clearly visible after deck grinding. The contractor used the same overhang brackets on the steel plate girder main span structure that were used for the 72" Florida Bulb-T approach span beams. The overhang brackets were braced too high on the girder web resulting in web distortion and problems with the deck profile. The deck profile is rough and water ponds along the toe of the concrete railing. See Steve Plotkin's response to a state survey questionnaire for NCHRP Synthesis 345 - Steel Bridge Erection Practices, 2005: *"Bridge with 9-ft deep girders where overhang brackets did not extend to bottom flange of girders. Webs deflected badly and the deck ride was bad. Had to grind deck for ride and bore holes in deck because of ponding. Ride still bad."*


Cross frame locations


Screed Rail
Deck elev. at cross frames
Deck elev. between cross frames
72" Florida Bulb-T
Approach Spans
Main Span
Solid lines - between cross frames.
Dashed lines - at cross frames.


Deck Elevation at Cross Frames
Deck Elevation Between Cross Frames
Cross Frame Location (Typ.)
Girder Web *
Girder Elevation
* Uniform web height shown. Actual web height varies.

Because this problem does occur, and will occur again, other states have similar specification language or standards in place to address this issue:
ODOT Construction Specifications (see 508.02.B)
TxDOT Standard Drawing for Steel Bracing Requirements (see Intermediate Bracing Details)

In addition to the SR 20 project, SDO staff has personally observed numerous steel I-girder projects throughout the state with deck overhang falsework braced high on the webs. Designers from URS, HNTB and Atkins have acknowledged the problem to us in writing. These situations are likely where the contractor is using falsework brackets that have been used on a previous concrete girder project. This is usually not an issue with concrete girders because they have a much higher torsional resistance. I assume the contractor doesn't want to invest in the larger brackets needed for the steel I-girder project. The CEI is often not aware of the issue, in spite of the Self Study course, and is left wondering why additional grinding is needed to meet the smoothness specification. In addition to this spec change, we recommend updating the Construction Issues Self Study Course to include more detail on this particular issue so that the problem is fully understood.

****

Brian Blair
863-519-2676
brian.blair@dot.state.fl.us

Comment: (5-19-14)
Just a minor comment for consideration:

400-4.4 Bridge Deck Overhang Falsework for Steel I-Girders: Locate the lower contact point of bridge deck overhang falsework supporting screed rails within 6 inches of the bottom flange. If the lower contact point of the overhang falsework bears more than 6 inches above the bottom flange and/or if the deck overhang is 4 feet or greater, submit ~~to the Engineer~~ shop drawings and calculations *to the Engineer* in accordance with Section 5 and Chapter 11 of the Structures Design Guidelines (SDG). The deck overhang is measured from the centerline of the girder supporting the overhang falsework to the outside edge of the concrete deck.

Response: The proposed text "submit to the Engineer" is consistent with language used throughout the Standard Specifications.
From the Specs Office: Text “to the Engineer” will be moved as suggested: Change made.

****