PENNDOT e-Notification
Bureau of Business Solutions and Services
Highway/Engineering Applications Division

pennsylvania
DEPARTMENT OF TRANSPORTATION

STLRFD
No. 012
October 21, 2015

Problems with Lateral Torsional Buckling Calculations in STLRFD v2.0.0.0~v2.3.0.0

The STLRFD program for LRFD steel girder design and rating, versions 2.0.0.0 through 2.3.0.0, incorrectly calculates the Lateral Torsional Buckling (LTB) resistance for continuous steel girder bridges under certain conditions which may lead to overstated LTB ratings. This issue, although mitigated by the notes in the "assumptions and limitations" section of the User Manual, was initially introduced with the release of STLRFD v2.0.0.0 on 6/6/2011 and continues in v2.3.0.0, which was released 9/15/14. The next release of STLRFD is scheduled in January 2016, which will correct the LTB issue. In the interim, the problem is described and the recommended workarounds are provided below.

Problem Statement:

For continuous steel girders with composite sections in negative flexure or non-composite sections in positive or negative flexure where the compression flange is non-prismatic (i.e. transitions) within an unbraced length (see attached example on Page 2) and:

1) The transition to a smaller section is at a distance greater than 20% of the unbraced length from the brace point, with smaller moment. Or,
2) The lateral moment of inertia of the flange or flanges of the smaller section is less than one-half the corresponding value in the adjacent larger section anywhere within the unbraced length.

Section 6.10.8.2.3 and Appendix A6.3.3 of AASHTO 2007 and later require:

1) The LTB resistance must be calculated with C_b (moment gradient factor) set to 1.0.
2) The LTB resistance (F_{nc}) is to be determined per AASHTO 6.10.8.2.3
3) The LTB flexural resistance (M_{nc}) is to be determined per AASHTO A6.3.3

The STLRFD v2.0.0.0 thru v2.3.0.0 program is not correctly taking the A6.10.8.2.3 and Appendix A6.3.3 criteria into account when calculating the LTB ratings, potentially overstating the LTB flexural ratings. Although the User Manual for STLRFD has included the subject limitation in Table 2.7-1 since v2.1.0.0, warnings should have been generated to advise users to make brace point adjustments to ensure that this portion of the specification is addressed.

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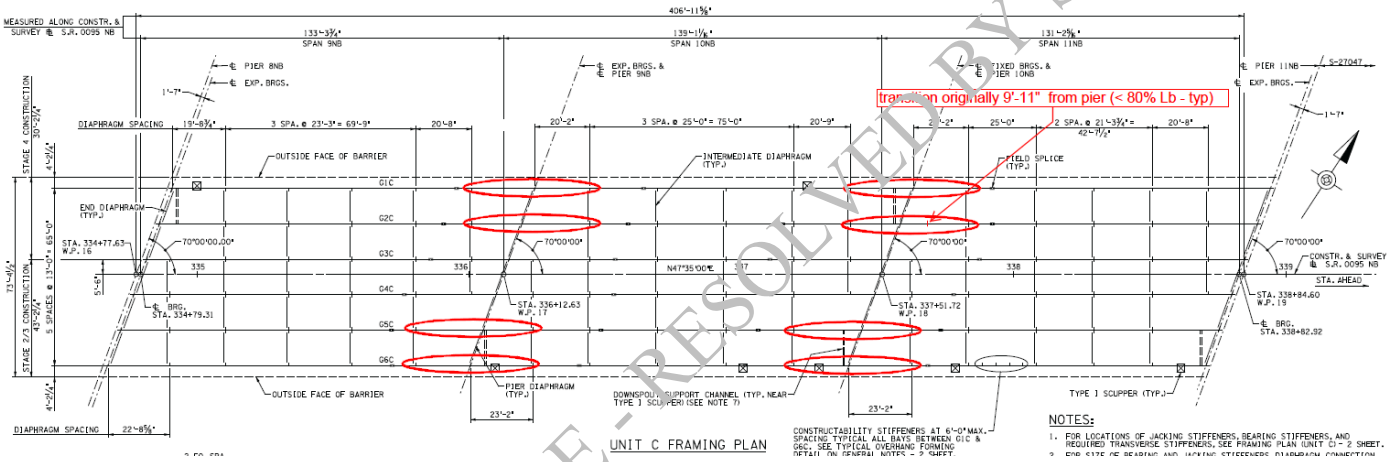
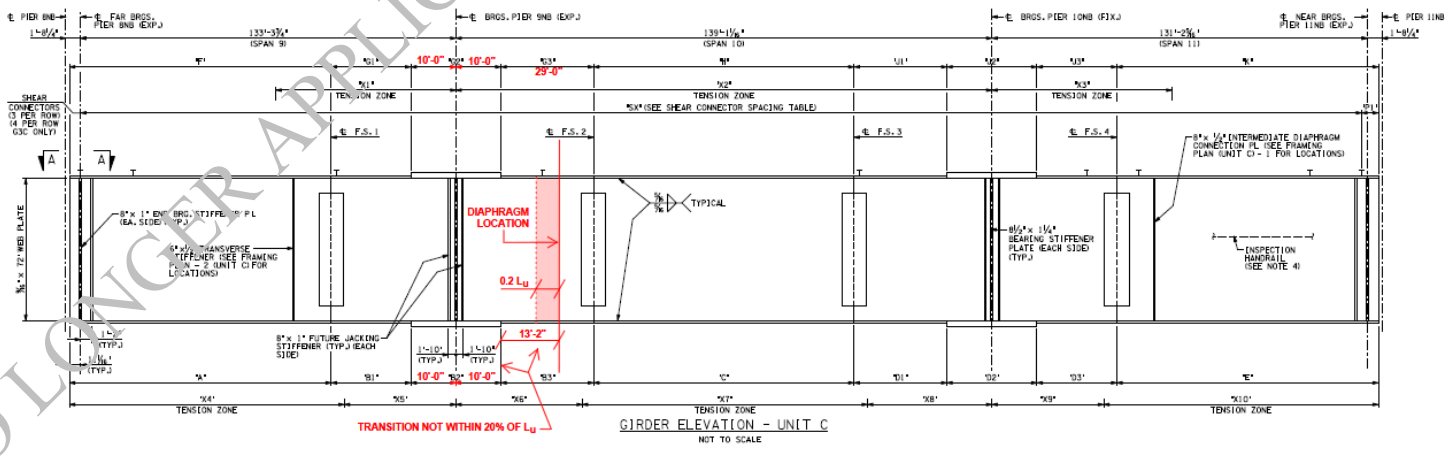
The example framing plan and girder elevation shown below indicate the problem areas for a 3-span superstructure that requires further investigation.



Example framing plan showing diaphragm locations and unbraced lengths



Note that the flange transition does not occur within the 20% of Lb area.

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Interim Workaround:

For continuous steel girder bridges using STLRFD v2.0.0.0 thru v2.3.0.0 that are still in design, or are already designed but the shop drawings have not been accepted, in addition to verifying that the smaller I_{yc} is at least ½ of the larger I_{yc}, any of the three (3) following options may be used so that all of the flange transitions are within 20% of the unbraced length from the brace point with the smaller moment:

a) Extend all of the flange transitions to within 20% of the unbraced length from the brace point with the smaller moment. There must be no other flange transitions within the unbraced length.
b) Add diaphragms at or near the transition to reduce the unbraced length.
c) Adjust the diaphragm spacing to change the unbraced length.

Problem Resolution:

This issue will be resolved in the next release of STLRFD, Version v2.4.0.0, which is due to be released in January 2016. Additionally, DM-4 will be revised via SOL whereby D6.10.8.2.3 and A6.3.3 will be revised to require that flange transitions be within 20% of L_b, that the smaller I_{yc} is at least ½ of the larger I_{yc}, and that there must be no other flange transitions within the unbraced length.

Please direct any questions to:

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