PennDOT e-Notification

Bureau of Business Solutions and Services
Highway/Engineering Applications Division

pennsylvania
DEPARTMENT OF TRANSPORTATION

STLRFD
No. 013
October 17, 2016

Release of Version 2.4.0.0

The Department's LRFD Steel Girder Design and Rating (STLRFD) program has been revised as described in the attached "Summary of September 2016 Revisions – Version 2.4.0.0".

This version addresses the lateral torsional buckling resistance issue described in STLRFD e-Notification 012 (http://penndot.engrprograms.com/home/mailinglist/archive/PennDOT%20e-Notification_STLRFD_012_102115.pdf), issued on October 21, 2015.

The new program has been placed on PennDOT servers for use by the Districts. Consultants and others, who have a current license agreement for **STLRFD Version 2.3.0.0**, can obtain the updated version by submitting an Update Request form along with the **update fee of $500 for private organizations and $50 for governmental agencies**. Updates for **STLRFD Version 2.2.0.0 or earlier** will require an **additional fee**. For STLRFD update fee details, refer to the following link: http://penndot.engrprograms.com/home/Ordering/STLRFD.htm . The update fee is waived for federal and state transportation agencies.

The Software Update Request form can be obtained on the PennDOT Engineering Software Support website at http://penndot.engrprograms.com by clicking on "Ordering/Updating" and, then on "Update Form".

Please note that the software will no longer be provided on a CD. Once payment is received, an e-mail will be sent with download instructions. The new installation will require a License Key that will be provided in the e-mail. A valid e-mail address must be provided on the Update Form in order to receive the download instructions.

Please direct any questions concerning the above to:

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Attachment

SUMMARY OF SEPTEMBER 2016 REVISIONS - VERSION 2.4.0.0

Since the release of STLRFD Version 2.3.0.0 several revision requests and user requested enhancements have been received. This release of STLRFD Version 2.4.0.0 contains the following revisions and enhancements.

Lateral Torsional Buckling Revisions

1. The lateral torsional buckling calculations have been revised per LRFD Specification 6.10.8.2.3 and A6.3.3 to report the smallest lateral torsional buckling resistance along an unbraced length as the resistance for all analysis locations in that unbraced length. Combined with this, STLRFD now also reports the maximum applied flexural stress in an unbraced length as the factored stress for lateral torsional buckling calculations over the entire unbraced length. Finally, STLRFD now sets C_b, the moment gradient factor, to 1.0 for unbraced lengths that are nonprismatic.

   Also, the LRFD Specifications Article 6.10.8.2.3 and Appendix A calculations are implemented for all analysis points where the Appendix A criteria are met. The rating factors (or performance ratios) are calculated for the Article 6.10.8.2.3 and Appendix A resistances, and the combination creating the larger rating factor is selected as the governing calculation for the analysis point. Appendix A calculations are only considered inside an unbraced length if the Appendix A criteria are satisfied at every analysis point in the unbraced length.

   In addition, the following revisions have been made: sections with section holes are no longer automatically treated as noncompact for the purposes of lateral torsional buckling calculations; the net section fracture resistance results are no longer reported on the STRESS FLEXURAL CAPACITY output report because they are presented on the NET SECTION FRACTURE CHECK output report; and the Appendix A criteria are now considered for the construction and uncured slab specification checks (Requests 668 and 669). **Note that these changes will result in significantly lower ratings for girders that are governed by their lateral torsional buckling resistance** (Requests 643, 668, 669, 700, 704, 706, 726, 727, 731, 737, 738, and 743)

2. If the calculated scaled governing Appendix A lateral torsional buckling capacity at a given analysis point is larger than the local calculated Appendix A lateral torsional buckling capacity at the analysis point, the local value will be reported as the governing capacity at the analysis point. This can occur because when the Appendix A capacity governs in a non-prismatic section, the moment capacity at the governing location is scaled by the ratio of (Sxc,current location) / (Sxc,governing location) (Request 715).

3. The moments due to the beam self-weight are now used in order to determine which end of a given unbraced length has the smaller moment. This change now allows the methodology to be consistent between the staging/uncured slab conditions and final conditions. This change was also necessary to correct the calculations for the staging/uncured slab checks for the lateral torsional buckling capacities (Request 714).

4. A change in web thickness will not cause an unbraced length to be considered nonprismatic. Changes in flange dimensions or web depth will continue to cause a section to be considered nonprismatic (Request 728).

5. LRFD Specifications Section 6 Appendix A calculations are no longer considered for the constructability checks reported in the uncured slab and staged construction output (Request 732).

6. A girder with a transition from a larger section to a smaller section in the 20% range at the end of an unbraced length with the smaller section continuing past the 20% range will have the larger section ignored so that the girder can be considered to be prismatic and have Cb > 1.0. If there are other transitions in the girder outside the 20% range, the larger section will NOT be ignored (Request 734).

7. A check has been added to the program to generate a Chief Bridge Engineer warning for bracing ranges that have analysis points in negative flexure, a varying web depth, and flange transitions further than one foot from either end of the unbraced length (Request 753).

Specification Related Revisions

8. The CONTROL OF CRACKING BY DISTRIBUTION OF REINFORCEMENT output report has been replaced with the MINIMUM NEGATIVE FLEXURE CONCRETE DECK REINFORCEMENT output report. The information provided on the CONTROL OF CRACKING output report did not apply to the design of composite steel girders, but the input information provided for the checks was repurposed to perform slab reinforcement checks as per DM-4 Article 6.10.1.7 (Request 589 and 670).

9. When computing the value of the stress in the compression flange at the midpoint of an unbraced length, the program now interpolates the value (using a straight-line interpolation) rather than just taking the average of the values at the analysis points around it (Request 599).

10. The program can now rate an existing bridge for the Strength II and Service IIA Limit States with P-82 in one lane and PHL-93 in the other lanes in accordance with DM-4 Article 3.4.1. This is accomplished by using Live Load Code “G” for an Analysis Run (Requests 602 and 671).

11. The slab thickness is now included as part of the wind cross section for the results on the UNCURED SLAB WIND EFFECTS output report (Request 607).

12. The fatigue stress range calculations now only include live load effects, with the section properties used to compute the stresses determined based on the sign of the live load moments. Previously, unfactored dead load effects were included with the live load effects in order to determine the section properties to use in computing the stresses (Requests 621 and 672).

13. The program has been modified to use unfactored moments to compute the stress in the slab to determine which section properties to use for calculating factored flexural stresses (LRFD Specifications 6.10.1.1.1b) (Request 659).

14. It has been verified that the program already requires transverse stiffeners to be defined along the length of any longitudinal stiffeners (LRFD Specifications 6.10.11.1.1). No changes were required (Request 660).

15. The load factors for DC, DW and LL for the construction and uncured slab limit states have been increased to 1.4 from 1.25. The load factor for the wind load for the construction and uncured slab limit states has been decreased to 1.0 from 1.25 because the construction wind pressure is now based on ASCE 7-10. In conjunction with this, the user must also enter a new wind pressure input parameter for the construction and uncured slab limit states. Previously, the user could enter a construction wind speed on the WPD command and have the program compute the corresponding wind pressure but that construction wind speed parameter is no longer supported. The user will need to review BD-620M and DM-4 C3.4.2.1 for guidance on how enter the new construction wind pressure parameter. **(NOTE: All input files using the WPD command must be revised with the new construction wind pressure parameter or they will stop with an input error.)** (LRFD Specifications and DM-4 Article 3.4.2.1) (Request 661)

16. It was verified that the program neglects any concrete on the tension side of the neutral axis when the neutral axis is located in the slab. The program neglects this for all limit states, not just the strength limit states (LRFD Specifications 6.10.1.1.1b) (Request 662).

17. Violations of the overhang criteria of DM-4 9.7.1.5.1P now require District Bridge Engineer approval, rather than Chief Bridge Engineer approval (Request 663).

18. Violations of the applicability limits for variables used to determine distribution factors now require District Bridge Engineer approval, rather than Chief Bridge Engineer approval (Request 664).

19. The use of hybrid sections with web yield strength greater than flange yield strength (DM-4 Article 6.10.1.3) and the use of girders with variable web depth (DM-4 Article 6.10.1.4) now require District Bridge Engineer approval, rather than Chief Bridge Engineer approval (Request 665).

20. The calculation for the constant amplitude fatigue threshold for straight reinforcement has been updated to follow the 2014 LRFD Specifications (Article 5.5.3.2) (Request 686).

Program Output Revisions

21. A new BRIDGE LOAD RATINGS table has been added to the program after the OVERALL RATING SUMMARY table that will report rating information similar to DM-4 Part A Table 1.8.3-1 (Requests 593 and 673).

22. The DISTRIBUTION FACTORS FOR DESIGN LIVE LOADING output report name, as well as a Chief Bridge Engineer advisory will now appear in the SPECIFICATION CHECK WARNINGS output report, even if the user has chosen to not show the DISTRIBUTION FACTOR reports in the program output (Request 606).

23. When a fatigue analysis point is defined at a transition location, the fatigue results will now print on both sides of the location, as was already being done for other specification checks (Request 609).

24. The field section length and weight have been added to the FIELD SECTIONS output report (Request 624).

25. The page layout of the output file has been enhanced to allow for more characters per page width and more lines per page in the PDF output file. The new layout has 99 characters per page width and 83 lines per page. The Table of Contents now includes a second level which is converted to a second level of bookmarks to assist in navigating the PDF file (Requests 651, 674, and 729).

26. The FACTORED ANALYSIS RESULTS output report will now always show the factored stress in the compression flange for all locations that are in negative bending or are noncomposite in the final state (Request 703).

27. The lateral torsional buckling capacity results for the staging/uncured slab conditions have been moved to their own output report LATERAL TORSIONAL BUCKLING CAPACITY (CONSTRUCTION STAGE ii) or LATERAL TORSIONAL BUCKLING CAPACITY (UNCURED SLAB) and a report named INTERMEDIATE VALUES FOR LATERAL TORSIONAL BUCKLING CALCULATIONS (CONSTRUCTION STAGE ii) or INTERMEDIATE VALUES FOR LATERAL TORSIONAL BUCKLING CALCULATIONS (UNCURED SLAB) containing intermediate values has also been added. As a result, the output on the CONSTRUCTION STAGE ii FLANGE SPECIFICATION CHECK (PART 2) will no longer contain lateral torsional buckling capacities (Request 707).

28. The program output warning message regarding girders with web yield strengths greater than flange yield strengths now includes a DM-4 reference (DM-4 6.10.1.3) (Request 718).

29. Occasionally, an output file was found to have several pages that were showing only an output table header with no further information. The program has been revised to remove these empty table headers (Request 720).

30. The top and bottom mats of reinforcement are now checked on the MINIMUM NEGATIVE FLEXURE CONCRETE DECK REINFORCEMENT output report. Previously, only the top mat was checked for maximum bar size and spacing (Request 721).

31. The FATIGUE STRESS RANGE LIMITS IN REINFORCING BARS calculations and output report have been removed from the program, as they do not apply to deck slabs in multigirder applications according to LRFD Specifications 5.5.3.1 (Request 722).

32. The tonnage of the P-82C load combination has been removed from the RATING FACTORS - SUMMARY and RATING FACTORS - OVERALL SUMMARY output reports because the P-82C load combination represents a combination of the P-82 and PHL-93 loadings. Also, the distribution factor for the P-82C load combination has been removed from the BRIDGE LOAD RATINGS output report because several distribution factors are used when analyzing for the P-82C load combination (Request 723).

33. The text "(NO LTB)" has been added to the titles of output reports containing flange specification checks for construction staging and uncured slab loading that do not contain lateral torsional buckling calculations (Request 736).

Program Input Revisions

34. A new program input, "DC1S Percentage" has been added to the CTL command to allow the user to specify a percentage of steel self-weight to be applied to the girder as a DC1S load. This load will be in addition to any DC1S loads specified by the user on the DLD or CLD commands (Request 591 and 675).

35. The example input files have been revised to use the PennDOT designation for skew angle (Request 634 and 676).

Program Documentation Revisions

36. Notes have been added to Chapter 2 of the STLRFD User's Manual to indicate that blast loading is not considered by STLRFD (Request 658).

37. User Manual Section 3.7.17 has been updated to document that a web depth variation anywhere in a given unbraced length causes the program to consider the entire unbraced length as having a nonprismatic member, therefore the program will always use a moment gradient factor, Cb, equal to 1.0 (Request 708).

38. The detailed descriptions of the parameters of the PLD (Pedestrian Load) command in User Manual Chapter 6 have been revised to reflect the methodology specified in DM-4 (Request 712).

39. User's Manual Section 6.7.2 has been revised to add a statement documenting that a District Bridge Engineer warning will appear in the output if the actual overhang dimension exceeds the allowable overhang shown in the DEFLECTION LIMITS FOR LIVE LOAD output table. (Request 717)

40. User Manual Section 3.7.17, Lateral Torsional Buckling Calculations, has been updated to document that the program will always include transitions that are located outside 20% of the unbraced length when the program calculates the lateral torsional buckling capacity (Request 705).

41. User Manual Section 3.7.17, Lateral Torsional Buckling Calculations, has been updated to document that the maximum factored flexural stress or moment throughout the unbraced length combined with the maximum lateral stress throughout the unbraced length are reported in the output with the lateral torsional buckling capacity that results in the larger rating factor or performance ratio at each analysis point (Request 711).

42. Assumption 13 in User Manual Section 2.7 has been revised to clarify how the program determines whether the stresses in a given section should be calculated using positive or negative flexure section properties (Request 716).

Programming Revisions

43. The method of comparing the total reinforcement areas from the SST command and the ARB/APL/ABU commands has been modified to remove a tolerance that was sometimes resulting in incorrect behavior when the reinforcement values were very close (Request 585).

44. The PDF version of the program output will now be produced if the input filename ends in a space (Request 604).

45. The comparison of the ratio $f_{mid} / f_2 > 1$ for the calculation of the moment gradient factor, C_b, has been revised to remove a tolerance from the comparison. The tolerance caused unexpected behavior when the ratio was slightly greater than 1.0 (Request 605).

46. A number of subroutines that were modified when implementing the program in BRADD have been reincomporated to the STLRFD source code (Request 656).

47. The flange to web weld size that is passed to BRADD is now set properly (Request 667).

48. Floating point underflow traps have been removed so that from runs of the program from EngAsst will be consistent with runs from the console executable (Request 681).

49. The deflections reported to BRADD had redundant values in some situations. These redundant values have been removed, and the program only reports the deflections once for each tenth point (Request 682).

50. The program is now compatible with APRAS NextGen (Request 392).

51. The deck reinforcement distribution requirements on the MINIMUM NEGATIVE FLEXURE CONCRETE DECK REINFORCEMENT output report have been revised to make sure that 2/3 of 1% of the deck area is specified for the top layer and 1/3 of 1% of the deck area for the bottom layer (Request 730).

52. APRAS runs will no longer generate PDF output (Request 741).

53. The LRFDPAUSE and OTPTOC routines have been modified based on comments from the developers of APRAS NextGen (Request 742).