Summary of November 2021 Revisions - Version 10.4.0.0 (AASHTO 9th Edition)

Since the release of LRFD Simon Version 10.3.0.0, several revision requests and user-requested enhancements have been received. This release of LRFD Simon Version 10.4.0.0 (AASHTO 9th Edition) contains the following revisions and enhancements.

Input Revisions

1. The maximum number of traffic lanes that can be input on the General Properties Form has been increased from 8 to 12 (Revision NSBA083).
2. In the three comment lines on the General Properties Form, the special characters &, <, >, ', and " may now be used in the problem description without later causing the display of the transformed XML output to fail (Revision NSBA085).
3. On the Distribution Factors Form (Article 3.3.2), whenever a distribution factor definition of 'Program Defined' is selected, a girder location option of 'Both' has been added. When 'Both' is selected, the program computes the distribution factors for both an exterior and an interior girder for both moment and shear and uses the largest values to compute the live-load force effects. LRFD Simon then checks or designs one girder in a single run using the largest distribution factors. LRFD Simon does *not* perform separate designs for the interior and exterior girders and combine the results in a single run of the program when this option is chosen. (Revisions NSBA088 and NSBA099).
4. On the Result Controls Form (Article 3.14), "printed" and "print" have been replaced with "output" (Revision NSBA111).

Output Revisions

1. The calculated second-order lateral stress amplification factor applied to the top (compression) flange lateral bending stress in the CONSTRUCTION and DECK POUR load combinations is now reported in the Detailed Information table (Revision NSBA025).
2. The calculated weighted average values of the longitudinal stiffness parameter, K_g, and slab thickness, t_s, are now reported in the Live Load Distribution Factor table whenever the Program Defined Distribution Factors option is selected. These values are not reported when the User Defined Distribution Factors option is selected (Revisions NSBA093 and NSBA100).
3. The calculated value of the skew correction factor for support shear in I-girders is now output in the Live Load Distribution Factor table whenever the Program Designed Distribution Factors option is selected, and the input girder skew angle is not zero. The full correction factor is applied in the computation of the live load support reactions in addition to all the live load shears in each span. A skew correction factor is not reported when the User Defined Distribution Factors option is selected; the user is responsible for calculating and including this factor in the input shear distribution factors (Revision NSBA092).

4. The live load deflection output tables have been revised to report which live load case from the loading for optional live load deflection evaluation specified in AASHTO LRFD Article 3.6.1.3.2 controlled the deflection. Maximum deflections in each span and at any hinges located in each span due to the design truck only and the design lane only are now provided. The governing maximum live load deflection in each span is also now provided; i.e., the deflection due to the design truck only (T) or due to the design lane plus 25 percent of the design truck (L). For the user-defined design vehicle, separate maximum deflections are reported for the truck and lane portions of the loading in addition to the sum of the maximum truck and lane load deflections (S). A separate table (labeled 'ENVELOPE') provides the maximum of the deflections due to the loading for optional live load deflection evaluation (H) and the user-defined design vehicle (U). Maximum live load deflections due to the design truck and design lane at any hinges located within the span are also now provided. Corrections have also been made to the live load deflections reported at hinge locations (Revisions NSBA087 and NSBA107).
5. When the Program Defined Distribution Factors option is chosen and an 'Exterior' or 'Interior' girder location is selected, a letter code is provided in the Live Load Distribution Factor table indicating which method was used to calculate the reported distribution factor; i.e., "A" indicates the factor was computed from the equations given in AASHTO LRFD Table 4.6.2.2.2b-1, 4.6.2.2.2d-1, 4.6.2.2.3a-1, or 4.6.2.2.3b-1, as applicable; "L" indicates the factor was computed using the lever rule; and "C" indicates the factor was computed from the rigid cross-section approximation given by AASHTO LRFD Eq. 4.6.2.2.2d-1 (exterior girders only) (Revisions NSBA056 and NSBA108).
6. When the Program Defined Distribution Factors option is chosen and a girder location of 'Both' is selected, the Live Load Distribution Factor tables for both the 'Exterior' and 'Interior' girder locations are provided along with a separate table showing the governing factors for moment and shear. "E" indicates the 'Exterior' girder location governed that particular distribution factor and "I" indicates the 'Interior' girder location governed that factor. The values of the skew correction factor, longitudinal stiffness parameter, and slab thickness used in the calculation of the individual distribution factors are reported in the respective tables. Also, the Distribution Factor Definition that is selected (i.e., 'Program Defined' or 'User Defined') is now reported under the Secondary Level Input Parameters. When 'Program Defined' is selected, the user input distribution factors are now reported as "N/A" instead of as zeroes (Revision NSBA088).
7. The design information tabulated at each field splice location entered by the user on the Field Splice Cross Section Information Form whenever an acceptable design is found by LRFD Simon has been revised to match the data format of the latest version of the NSBA Splice design spreadsheet (Article 5.3.8). The XSLT file has also been revised to match the new data structure (Revision NSBA075).

8. LRFD Simon now automatically determines the location of cross-frames within each span and performs specification checks (including fatigue checks) at those locations. This frees up the user from having to define a web range to each cross-frame on the Web Cross Section Information Form to generate an analysis point and have LRFD Simon perform specification checks at those locations. The cross-frames are located based on the user-input value(s) of the top-flange cross-frame spacing (Article 3.10.7) wherever the top flange is subject to compression and located based on the user-input value of the bottom-flange cross-frame spacing (Article 3.10.6) wherever the bottom flange is subject to compression. If the user-input value of the bottom and/or top flange cross-frame spacing does not divide a span into a whole number of uniform unbraced lengths, LRFD Simon assumes that the cross-frames are located at each end of the adjusted uniform unbraced lengths calculated by the program (see the User Note in Article 3.10.7), which may not correspond exactly with their actual locations in the bridge. At analysis points in the vicinity of points of contraflexure, top flange lateral-torsional buckling checks will be output at top-flange cross-frame locations, while bottom flange lateral-torsional buckling checks will be output at bottom-flange cross-frame locations. A warning message is output if a cross-frame is located at a defined field splice location (Article 3.11.6) based on either the user-input or adjusted uniform cross-frame spacings (Revisions NSBA060, NSBA102, NSBA113, and NSBA116).
9. The web-load shedding factor, R_b, is now reported as "1.000" instead of as "N/A" for the Deck Pours in the Detailed Information table given in the Results (Revision NSBA106).
10. A description has been added to each analysis point indicating what each analysis point represents (i.e., a cross-frame location based on the top or bottom flange cross-frame spacing, a field splice location, a plate change, a point of maximum compressive bending stress within an unbraced length, or a point of maximum moment) (Revision NSBA102).
11. For the lateral-torsional buckling checks, the words "top" and "bottom" have been added to the description of the check to identify which flange is being checked (Revision NSBA116).

Specification Related Revisions

1. The program has been revised to be consistent with the AASHTO LRFD 9th Edition Specifications. These changes include updating the calculations for the web load-shedding factor, R_b, for webs with longitudinal stiffeners (AASHTO LRFD Article 6.10.1.10.2); increasing the maximum permitted transverse stiffener spacing on webs with longitudinal stiffeners from 1.5D to 2.0D (AASHTO LRFD Article 6.10.9.1); and revising the λ_{rw} limit for composite sections in negative flexure and noncomposite sections that delineates a non-slender web from a slender web (AASHTO LRFD Article 6.10.6.2.3). In LRFD Simon, λ_{rw} is used in the computation of R_b for webs without longitudinal stiffeners (AASHTO LRFD Article 6.10.1.10.2) (Revisions NSBA081 and NSBA112).

2. The rigid cross-section approximation given by AASHTO LRFD Eq. C4.6.2.2.2d-1 is now considered in the computation of the live load distribution factors for shear and moment in exterior girders whenever the Program Defined Distribution Factors option is chosen (Revision NSBA056).
3. When the Program Defined Distribution Factors option is selected and there are three girders in the cross-section, the distribution factor for moment from AASHTO LRFD Tables 4.6.2.2.2b-1 and 4.6.2.2.2d-1 for the interior and exterior girders will now be computed by LRFD Simon as the lesser of the values obtained from the equations in the respective table or the lever rule. The distribution factors for shear in the case are still computed by the lever rule only (Revision NSBA097).
4. Lateral-torsional buckling of an unbraced length is now checked by LRFD Simon using the maximum factored compressive bending stress within that unbraced length (AASHTO LRFD Article 6.10.1.6). The single performance ratio for lateral-torsional buckling of the unbraced length under consideration that is reported at all analysis points associated with that unbraced length is calculated as the maximum factored compressive stress divided by the minimum lateral-torsional buckling resistance within that unbraced length. Refer to Articles 5.3.10 and 5.3.3 for a further description of the lateral-torsional buckling checks made by LRFD Simon, and the analysis points that are now provided for each unbraced length (Revisions NSBA027 and NSBA109).
5. In cases where the computed value of C_b is greater than 1.0, LRFD Simon now computes the lateral-torsional buckling resistance using the equations specified in AASHTO LRFD D6.4.1 in lieu of the equations specified in AASHTO LRFD Article 6.10.8.2.3 (Revision NSBA028).

Installation Related Revisions

1. The file description and copyright date for the LRFD Simon Installer executable have been revised. The LRFD Simon Sample Input Files (Article 2.2.2.3.1) are now installed by default underneath the folder 'C:\Users\Public\Public Documents' so they are accessible to all users. A shortcut is provided in the FILE Menu in LRFD Simon (Article 2.2.2.3) and in the user's Windows START Menu in the folder 'NSBA LRFD Simon (AASHTO 9th Edition)' to give the user direct access to the Sample Input Files. The Sample Input Files are now installed with a "Read Only" attribute to prevent an accidental overwrite of the files by the user (Revision NSBA050).
2. The LRFD Simon License File has been updated and the NSBA e-mail address in 'NSBA_Simon_Library_Data.txt', the GUI, and the engine source code has been updated from 'nsbasimon@steelbridges.org' to 'nsbaresources@aisc.org' (Revision NSBA115).

Programming Revisions

1. A program assumption leading to a program crash (i.e., divide by zero) in the lateral-torsional buckling calculations for girders that are entirely in negative bending in the end spans has been changed, allowing the program to run to a successful completion (Revision NSBA086).
2. The User Defined Design Vehicle will now always use the "Distribution factor type for truck" and "Distribution factor type for lane" as defined by the user on the User Defined Design Vehicle Properties form (Article 3.6.2). Previously, in some situations the program would ignore the selections by the user for these input items (Revision NSBA091).
3. The User Defined Design Vehicle entered by the user is now included in the Best Design (.BD) file (Article **Error! Reference source not found.**) generated by the program whenever the LRFD Design option is chosen (Revision NSBA084).
4. The program has been modified to allow multiple instances of LRFD Simon to be open and running at the same time (Revision NSBA082).
5. In the lateral-torsional buckling routines, section property calculations for stress calculations now include the longitudinal stiffeners and the haunch depth is now calculated. Also, section property calculations at the midpoint and at the right end of the unbraced length are now using the correct corresponding concrete slab thickness values (Revision NSBA027).
6. A warning message is output if the user enters a value for 'Distance from interior support to nearest shear connector' on the Shear Stud Properties Form (Article 3.8) for a box-girder design. If a value is entered for a box-girder design, the program will run to completion if the user chooses 'No' for a shear connector design. The program will stop if the user chooses 'Yes' (Revision NSBA103).
7. When the program cannot design shear stud connector spacings within a span because the required spacing for fatigue is less than the minimum pitch based on the user-input desired pitch increment on the Shear Stud Properties Form (Article 3.8), a warning message is now provided in the program output indicating that the required stud pitch due to fatigue considerations is less than the minimum pitch based on the user-input desired pitch increment and that no stud pitches can be calculated for the span. In this case, the user should revise the desired pitch increment and run the program again. Also, several shear connector design warning messages that were only appearing in the text file output will now also appear in the transformed program output (Revision NSBA104).
8. The fatigue checks for transverse stiffeners (Trans Stiff Weld near Bottom Flange - Cat C') and connection plates (Conn Pl at Bot Flange (Welded) - Cat C', Conn Pl at Bot Flange (Bolted) - Cat B) are no longer used to determine if a girder needs to be redesigned. If any of these details result in a performance ratio greater than 1.0, a warning will print in the output and the user will need to determine if any changes need to be made – see Article 5.3.9.3 (Revision NSBA102).