

USER'S MANUAL FOR  
*LRFD STEEL GIRDER SPLICE  
DESIGN AND ANALYSIS  
(SPLRFD)*



**pennsylvania**  
DEPARTMENT OF TRANSPORTATION

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**USER'S MANUAL FOR  
COMPUTER PROGRAM SPLRFD  
LRFD STEEL GIRDER SPLICE DESIGN AND ANALYSIS  
VERSION 1.6.0.0**

Prepared by:  
Michael Baker Jr., Inc. for  
Pennsylvania Department of Transportation

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# LRFD STEEL GIRDER SPLICE DESIGN AND ANALYSIS

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## LRFD STEEL GIRDER SPLICE DESIGN AND ANALYSIS

### SUMMARY OF OCTOBER 2005 REVISIONS—VERSION 1.1.0.0

Since the release of SPLRFD Version 1.0, several error reports and user requested enhancements have been received. This release of SPLRFD Version 1.1.0.0 contains the following revisions:

1. The program was converted to use Digital Visual Fortran Version 6.5 (Request 001)
2. The extension of the Parameter Data File has been changed to PD to avoid conflicts with Adobe Acrobat files. (Request 003)
3. Chapter 9 of User Manual was updated for addresses and e-mail address for the contact person. (Request 004)
4. Program was updated to store input files anywhere facilitating multiple users to run the program from a shared directory. (Request 005)
5. Program was updated to prevent PDF date check failure on Windows 2000. (Request 006)
6. The program was modified to overcome the concerns pertaining to apparently large values for  $M_{grd}$  in the output. User manual was updated to reflect the changes made to the program. (Request 007)
7. Additional compiler settings were activated to trap divide-by-zero errors. (Request 008)
8. The program now pauses after execution so that if the program is run via an icon on the desktop or Start menu the Command Prompt window does not close immediately after program execution. At the end of program execution, a message is printed on the screen advising the user to "Press <ENTER> to exit program." (Request 009)
9. The program makes it easy to print a special copyright notice for Beta test versions of the program. (Request 010)
10. The program was updated for staggered bolt pattern specification checks. An additional check was introduced for staggered bolt pattern to check the clear inclined bolt distance rather than the pitch and the gage against minimum bolt clearance required. (Request 011)
11. Bolt resistance factors were updated to 0.38 and 0.48 from the old values of 0.4 and 0.5. (Request 012)
12. Originally during a design, bearing failure was overcome by increasing either the number of bolts or the splice plate thickness. Now the option of increasing the bearing distances (web edge, splice edge, splice end) to overcome the bearing failure has been provided. When bearing governs the failure for analysis problems, or

## **LRFD STEEL GIRDER SPLICE DESIGN AND ANALYSIS**

whenever there is a bearing failure and the bearing failure cannot be overcome by incrementing the bearing distances for the design runs, warning messages are now provided in the output to inform the user that the bearing has caused the failure and the user has the option to increment the bearing distances to overcome the bearing failure. (Request 013)

13. Modifications were made to the program to prevent stack dump problem during the program execution. Prints error messages if the user entered values are lower than the DM-4 mandates. (Request 014).
14. Chapter 7 of User Manual was updated to clarify the sign convention for shear. (Request 017)
15. The program now flags a code failure when the absolute value of the design flexural stress exceeds the factored flexural resistance for both positive and negative values of forces and stresses. (Request 019)
16. The program now increments the number of bolts by number of gage lines rather than fixed increment of two. (Request 020)
17. Eliminated unwarranted bolt pitch warning message for FSB line. Modifications are made such that the FSB maximum bolt pitch warning message is printed only for staggered bolt pattern. (Request 021)
18. Program and User Manual (Chapter 5) were updated to provide default values for Ductility Factor, Redundancy Factor and Importance Factor of 1.0. (Request 023)
19. Program and User Manual were modified to provide consistent SID parameter definitions. State Route field was changed from alphanumeric to numeric with a lower limit of 0 and an upper limit of 9999. (Request 024)
20. Redundant information has been eliminated from the design trial tables in the design output. (Request 031)
21. A new summary output report that provides a list of specification check warnings has been added to the output. (Request 032)
22. The program has been converted to run as a Windows DLL. (Request 033)
23. The program now supports long file names. (Request 034)
24. The program has been enhanced so temporary files are now created on the local drive for network compatibility. (Request 037)
25. Captions have been added to the EngAsst Image files (Request 038)

## **LRFD STEEL GIRDER SPLICE DESIGN AND ANALYSIS**

26. Example input files have been modified to eliminate all input warnings (Request 040)

27. The program has been modified to prevent it from crashing when more than one WBP command is entered on the input. (Request 041)

The following is a list of reported problems, user requests and clarifications that will be addressed in a later version of SPLRFD:

1. An input item will be added for the filler plate factor as per DM-4 (2000) (Request 012)
2. The upper limit of left and right flange edge distances (parameters 11 and 12 of FSB command) will be changed from 5" to 8" (Request 036)

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## **LRFD STEEL GIRDER SPLICE DESIGN AND ANALYSIS**

### **SUMMARY OF OCTOBER 2007 REVISIONS - VERSION 1.2.0.0**

Since the release of SPLRFD Version 1.1.0.0 several revision requests and user requested enhancements have been received. The release of SPLRFD Version 1.2.0.0 contains the following revisions and enhancements.

#### **Input Revisions**

1. The upper limit on the left and right flange edge distances (FSB command) have been increased from 5" (125 mm) to 8" (200 mm) to accommodate a splice where the flange on one side of the splice is significantly wider than on the other side. (Request 036)
2. The program has been enhanced to permit input commands to exceed 256 characters. Previously the program would truncate any lines exceeding 256 characters (Request 045).
3. The program has been revised to completely process each input command before stopping with an error message. Previously, the program would stop after the first error was found on an input command (Request 053).
4. The program has been revised to print warning messages and continue to run, for Analysis Runs, when the Edge/End Distances that are input are violated. Previously, the program would run but not print any warning messages for Analysis Runs. No revisions were made for Design Runs. The program prints an error message and stops when the Edge/End Distance has been violated for Design Runs (Request 064).

#### **Output Revisions**

5. The program was revised to allow a bearing type connection splice to run to completion and ignore printing the slip force output requested by the OSC command. Previously, if the slip force output was specified on the OSC command and the connection type on the CTL command was changed to a bearing connection type, this could cause the program to crash. (Request 059)

#### **Design Loads**

6. The program has been enhanced to permit splices to be designed for pedestrian live load only (no design vehicle live load) for use in designing splices for pedestrian bridges. Previously, if there was no live load vehicle and the pedestrian live load moment was of opposite sign from the dead load, the program could crash. (Request 046)
7. The program has been enhanced so that pedestrian loading can be evaluated in a single run of the program. Previously, pedestrian loading required that two runs of the program be made, once with pedestrian loading specified and once without (Request 047, 050, 063).

## LRFD STEEL GIRDER SPLICE DESIGN AND ANALYSIS

8. For simple span bridge splices, the program has been enhanced to permit the user to leave the negative live load moments blank on the DLL and DPL input commands, and to leave the negative factored flexural resistance blank on the GAS command. When all these input items are not entered, the program will now design the splice only for limit states of positive flexure. Previously, the program always designed for both positive and negative flexure limits states. (Request 049)

### Calculations

9. The filler plate reduction factor described in DM-4 6.13.6.1.5 has been incorporated into the calculation of factored resistance of bolts in shear. Previously the program ignored the filler plate reduction factor. (Request 12)
10. The program has been enhanced to permit the user to design or analyze a splice for oversize holes as per DM-4 6.13.2.4.1b. If oversize holes are specified a warning message is generated in the output that Approval of the Chief Bridge Engineer is required. Previously the program would only allow input of standard holes. (Request 052)
11. The maximum allowable gage spacing calculation for stitch bolts (AASHTO LRFD 6.13.2.6.3), has been corrected to be computed as 24 times the thickness of the plate. Previously, the program was using 12 times the thickness of the plate (Request 057).
12. The program has been enhanced to try increasing the thickness of the flange splice plate, if the maximum flange gage spacing exceeds the maximum allowable gage distance (based on the flange splice plates), and the maximum allowable gage distance is less than 7.0 inches (175 mm). Previously, the program would not resize the plates if the maximum flange gage spacing exceeded the allowable gage distance (Request 058).
13. A correction was made to the minimum end distance when oversize holes are present as per AASHTO Section 6.13.2.6.5. Previously, when the program computed the minimum end distance it always assumed there were no oversize holes (Request 060, 062).

## LRFD STEEL GIRDER SPLICE DESIGN AND ANALYSIS

### SUMMARY OF FEBRUARY 2010 REVISIONS - VERSION 1.3.0.0

Since the release of SPLRFD Version 1.2.0.0 several revision requests and user requested enhancements have been received. This release of SPLRFD Version 1.3.0.0 contains the following revisions and enhancements.

#### User's Manual Revisions

1. Chapter 5 of the user's manual has been revised to clarify bolt hole diameter input for parameter 2 and parameter 3 for Section 5.13 and 5.16 respectively (Request 065).
2. Chapter 9 of the user's manual has been updated for issues regarding the PennDOT Bureau name. Two instances of "Engineering Unit" and one instance of "Bureau of Information Systems" have been placed by "Engineering Software Section" and "Bureau of Business Solutions and Services", respectively (Request 068).

#### Output Revisions

3. SPLRFD will now produce PDF versions of all output in addition to the text-only files (Request 070).

#### Design Revisions

4. SPLRFD has been corrected for issues regarding the designed splice showing a web specification failure. The web splice plate thickness can now be automatically incremented if the web splice bolt pitch is greater than the maximum allowable bolt spacing (eliminating the possibility of a web specification failure). This feature is available via the 'BOLT PITCH CORRECTION' parameter in the WSB command. In addition to the bolt pitch correction, SPLRFD has been modified to calculate the minimum allowable number of bolts per gage line to start the design process, according to the upper bound of the *Maximum Spacing for Sealing Bolts* from the AASHTO LRFD Bridge Design Specifications (6.13.2.6.2-1 and 6.13.2.6.2-2), to reduce the number of design cycles. This enhancement will be enabled when the 'Minimum Bolts per Gage Line' parameter from the WSB command is left blank (Request 061).

## LRFD STEEL GIRDER SPLICE DESIGN AND ANALYSIS

### Input Revisions

5. SPLRFD has been revised to prevent a crash that results from the design live load moment exceeding the factored flexural resistance. This problem has been remedied by checking if the design live load is greater than the factored flexural resistance input by the user, and then aborting with an error message (Request 071).
6. SPLRFD has been revised to allow negative values to be entered for all DDL command parameters within the EngAsst program (Request 066).
7. As a result of a decision by the AASHTO Subcommittee on Bridges and Structures to no longer publish SI unit specifications, the program only supports US customary (US) units. The only acceptable entry for the CTL command parameter 1, System of Units, is "US" (Request 072).

## LRFD STEEL GIRDER SPLICE DESIGN AND ANALYSIS

### SUMMARY OF SEPTEMBER 2012 REVISIONS - VERSION 1.4.0.0

Since the release of SPLRFD Version 1.3.0.0 several revision requests and user requested enhancements have been received. This release of SPLRFD Version 1.4.0.0 contains the following revisions and enhancements.

#### Specification Related Revisions

NOTE: Unless otherwise indicated, the specification changes described below are in accordance with LRFD Specifications 5th Edition / 2012 DM-4 requirements

1. New methods for calculating the design flexural effects have been implemented in the program, superseding prior "design moment" calculations. These new expressions have simplified the calculations, and have resulted in extensive revisions to the program and program output. All existing SPLRFD input files will need to be revised for the new input command ASR (Adjacent Section Resistance). **Existing input files will no longer work with SPLRFD unless revised** (Requests 081, 091, 092).
2. New factors were added to the calculations of AASHTO equation 6.8.2.1-2 inside the program. However, since all holes are assumed to be "drilled full-size or subpunched and reamed to full size" inside SPLRFD, there are no changes to the final calculations of the program (Request 082).
3. The Fatigue limit state has been split into Fatigue-I and Fatigue-II limit states (Request 083).
4. The program will now print warnings if the user has entered values other than 1.0 for any of the eta factors. The lower limit of 1.1 for the product of the eta factors for the fatigue limit states of nonredundant structures has been removed. The upper limit of 1.16 for the product of the eta factors for strength and service limit states remains (Request 084).
5. The minimum required bolt tensions from AASHTO Table 6.13.2.8-1 have been implemented in the program (Request 086).
6. The surface condition coefficient,  $K_s$ , for Class C has been reduced to 0.33 from 0.40, as per AASHTO Table 6.13.2.8-3 (Request 087)
7. A new shear rupture check (AASHTO Equation 6.13.5.3-2) has been added to the program (Request 089).
8. The design bolt force for the bearing check on the inner plates of the flange splice is now based on the total force in the inner plates. Previously, it was only using half of the force in the inner plates (Request 098).

## **LRFD STEEL GIRDER SPLICE DESIGN AND ANALYSIS**

9. The fatigue design stress for the web splice plates of a simple span girder has been revised to be calculated based on the live load effects only. However, for a splice of a multi-span girder, the program continues to compute the dead load plus the fatigue live load stress for positive and negative moments to determine the fatigue stress range due to changing section properties (Request 100).

**10. The FLANGE SPLICE BOLT SPECIFICATION CHECKS - SHEAR STRENGTH output report now checks shear independently for each shear plane between the splice plates and girder flange (once for the plane between the outer plate and flange and again for the inner plates and flange). Previously, the program did a single check assuming the bolt was in double shear (Request 101).**

### **Input Revisions**

11. Input consistency checks were added to ensure the user has entered a shear capacity for both sides of the splice as well as making sure the flexural resistances ( $F_r$ ) entered on the ASR command do not exceed the yield stresses entered on the GAS command (Request 095).

### **User's Manual Revisions**

12. The PennDOT email domain has been updated to "pa.gov" in the User's Manual and on the Revision Request form (Request 080).

## LRFD STEEL GIRDER SPLICE DESIGN AND ANALYSIS

### SUMMARY OF MAY 2014 REVISIONS - VERSION 1.5.0.0

Since the release of SPLRFD Version 1.4.0.0, several revision requests and user requested enhancements have been received. This release of SPLRFD Version 1.5.0.0 contains the following revisions and enhancements.

#### **Program Source Revisions**

1. The method of calling the engineering program DLL from the Engineering Assistant has been changed for compatibility with EngAsst v2.5.0.0 which uses Microsoft's .NET Framework, version 4.5. Because of this, SPLRFD will no longer work with EngAsst v2.4.0.6 or v2.4.0.9 unless the EngAsst "Edit / Run EXE – Command Window" option is selected. SPLRFD will no longer work with EngAsst v2.4.0.0 and earlier. (Request 116)
2. The SPLRFD program has been updated to compile with Intel Fortran XE 2013 SP1 Update 1 using Visual Studio 2012 Update 4. (Request 107)

#### **General Revisions**

3. The program has been revised to perform block shear calculations. Previously, the program would perform block shear checks and indicate if the user would have to further investigate block shear. (Request 079)

#### **Input Revisions**

4. The input check to ensure the minimum number of bolts with the minimum bolt pitch will fit within a web splice depth has been revised to only apply to design runs. Previously, the check was also being performed on both design and analysis runs which could lead to problems for analysis runs web splices where the web bolt pitch varies. (Request 108)
5. An input check has been added to prevent the design of staggered flange bolts and plates. Previously, the user was able to erroneously select the option for the design of staggered flange bolts and plates. (Request 113)

#### **Output Revisions**

6. The program has been revised to show all relevant Strength and Service Limit States for Splice Bolt Specification Checks for Flanges relating to Bearing on Material, Shear Strength and Slip Resistance. (Request 076)
7. The program has been revised to apply a reduction of shear strength for bolts when connections exceed 50 inches in length for flanges. This change applies to both analysis and design runs. Previously, the program would only apply the shear strength reduction for applicable web bolts. (Request 090)

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## LRFD STEEL GIRDER SPLICE DESIGN AND ANALYSIS

### SUMMARY OF SEPTEMBER 2016 REVISIONS - VERSION 1.6.0.0

Since the release of SPLRFD Version 1.5.0.0, several revision requests have been received. This release of SPLRFD Version 1.6.0.0 contains the following revisions.

#### Program Input Revisions

1. The program will now accept input values of 0.0 for the moments and shears due to live loads. Previously, entering 0.0 for live loads would cause the program to crash (Request 109).
2. The program has been enhanced to now accept lateral stresses as part of the program input and include them in the design and analysis of the flange splice plates and bolts (Requests 117, 139).
3. An input check has been added to ensure that the flange splice plates defined on the FSP command are consistent with the plate configuration selected on the CTL command (i.e. If configuration 1 is chosen for the flange splice configuration on the CTL command, the user should not enter dimensions for inner flange splice plates) (Request 122).
4. Checks have been added to verify that the user entered both the TOTAL NUMBER OF BOLTS as well as the MAXIMUM BOLT DISTANCE on the Flange Splice Bolt (FSB) command for flange bolt analysis problems. Additional documentation has been added to describe how to calculate the TOTAL NUMBER OF BOLTS (Requests 124, 140).
5. An input parameter, RESISTANCE FACTOR FOR BOLTS IN SHEAR, has been added to the miscellaneous (MIS) command to allow the user to enter the resistance factor corresponding to type of bolts being used (Request 130).
6. The BOLTS PER GAGE LINE input of the WSB command has been revised to have an upper limit of 81 bolts per gage line in order to be consistent with the internal limits of the WEB BOLT PITCH (WBP) command. In addition, the documentation of the WBP command has been revised to better illustrate how to enter a splice where the web splice has multiple pitch distances (Requests 131, 141).
7. The lower limit on the MAXIMUM BOLT PITCH on the FSB command has been lowered to 1.875" to match the lower limit on the MINIMUM BOLT PITCH. A check has been added to the program to ensure that the MAXIMUM BOLT PITCH is greater than or equal to the MINIMUM BOLT PITCH (Request 135).
8. A check has been added to ensure that the tensile strengths entered on the GAS command are greater than or equal to their respective yield strengths. Additionally, the program will default to 58 ksi for the ultimate strength only if the yield strength has been entered as 36 ksi. For all other yield strengths, the user must provide a corresponding ultimate strength (Request 137).

## LRFD STEEL GIRDER SPLICE DESIGN AND ANALYSIS

9. The default bolt hole diameter for bolts greater than one inch in diameter has been increased to bolt diameter + 1/8". Previously, the bolt hole diameter for all bolts defaulted to bolt diameter + 1/16" (Request 142).

### Specification-Related Revisions

10. The flange resistance modification factor,  $R_g$ , is now considered when computing the resistance of the flange splices (Requests 110, 138).
11. The smaller girder section at the splice is now determined by multiplying the noncomposite moment of inertia by the smaller yield stress of the top or bottom flange (Request 119).
12. Dead loads are no longer considered when computing the fatigue stress range. The fatigue stress range now only considers live loads and uses the section properties based on the signs of the live load moments (Request 128).

### Program Documentation Revisions

13. The first page of the program User's Manual has been revised to be consistent with other engineering programs (Request 118).
14. The User's Manual now describes how to enter multiple instances of a command where multiple instances are allowed. The new description will allow input files not created with EngAsst to be read in successfully by EngAsst (Request 121).
15. The User Manual Chapter 5 descriptions for parameters that are no longer used by the program have been revised to make it clearer and easier to see that the input value is not needed (Request 125).
16. The User Manual Section 6.13.2 description of the calculation of the effective slab width for the SLAB WITH COMPOSITE GIRDER (SLB) command has been revised to be consistent with the current LRFD Specifications (Request 129).
17. Chapter 4 of the User's Manual has been revised to include Windows 10 in the list of supported operating systems and to describe the new program group containing the program on the start menu (revised because of changes in Windows 10) (Request 136).
18. A clarification has been added to the MAXIMUM BOLT DISTANCE input description on the FSB command. This value is used with analysis runs of the program, and is only used to determine if the distance between extreme fasteners is greater than or less than 50 inches (Request 143),

### Program Output Revisions

19. A program warning message that refers to DM-4 Table 6.13.2.6.6-1 was revised to now correctly refer to the LRFD Specifications Table 6.13.2.6.6-1 (Request 120).

## LRFD STEEL GIRDER SPLICE DESIGN AND ANALYSIS

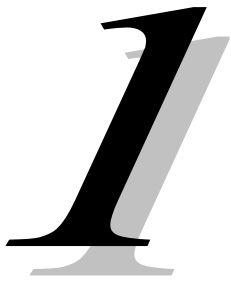
20. Warnings and error messages have been added to the program regarding the entry of the web bolt pitch (WBP) command. The WBP command should not be entered for a web bolt design problem, so a warning will now be generated and the program will ignore the input. The WBP command must be entered for a web bolt analysis program, so an error will now be generated if the WBP command is not entered for an analysis problem. Previously, the program would generate a poorly worded error for the web bolt analysis case (Request 123).
21. 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 (Request 127).

### Programming Revisions

22. The program has been revised to ensure that even if the block shear checks output report is turned off, the specification checks will still be done and the title of the output report will appear on the table of specification check failures at the end of the program output (Request 126).
23. The subroutine LRFDPAUSE will no longer be called if the program is run as an APRAS run, and the OTPTOC routine has been modified to accommodate very long file paths (Request 132).

**LRFD STEEL GIRDER SPLICE DESIGN AND ANALYSIS**

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# **GENERAL DESCRIPTION**

## **1.1 PROGRAM IDENTIFICATION**

**Program Title:** LRFD Steel Girder Splice Design and Analysis  
**Program Name:** SPLRFD  
**Version:** **1.6.0.0**  
**Subsystem:** Superstructure  
**Authors:** Pennsylvania Department of Transportation,  
Michael Baker Jr., Inc., and  
Modjeski and Masters, Inc.

### **ABSTRACT:**

The LRFD Steel Girder Splice Design and Analysis program (SPLRFD) performs an analysis and specifications check, in accordance with the AASHTO LRFD Bridge Design Specifications and the Pennsylvania Department of Transportation Design Manual Part 4, for steel girder splices. As result of a decision by the AASHTO Subcommittee on Bridges and Structures to no longer publish SI unit specifications, the program only supports US customary (US) units. The top and bottom flange configuration can consist of one outer plate, two inner plates, or both one outer and two inner plates. The bolt pattern for the flanges can be staggered or non-staggered. The spliced steel girder sections can be composite or non-composite. They can also be homogeneous or hybrid.

The program can design or analyze each of the following splice components: web splice plates, web splice bolts, top flange splice plates, top flange splice bolts, bottom flange splice plates, and bottom flange splice bolts. The program's design and analysis are based on inputted dead loads, live loads and pedestrian loads. Design, permit, and fatigue live loads can be entered by the user.

After the analysis is performed, SPLRFD checks for compliance with the AASHTO LRFD Bridge Design Specifications and the Pennsylvania Department of Transportation Design Manual Part 4. The program computes and checks the following specifications for the splice plates: flexural stress, shear force, and fatigue stress range. In addition, the program computes and checks the following specifications for the splice bolt forces: bearing on materials (bearing of bolts against steel plates), shear strength, and slip resistance.

## Chapter 1 General Description

### 1.2 ABBREVIATIONS

This section provides definitions of abbreviations that are commonly used throughout this User's Manual.

- AASHTO - American Association of State Highway and Transportation Officials.
- BSP - PennDOT Beam Section Properties program.
- CBA - PennDOT Continuous Beam Analysis program.
- DM-4 - Pennsylvania Department of Transportation Design Manual Part 4, April 2015 Edition.  
This publication can be ordered from:  
Pennsylvania Department of Transportation  
Publication Sales  
P.O. Box 2028  
Harrisburg, PA 17105  
This publication can also be downloaded free of charge from PennDOT's website.
- LRFD Specifications - AASHTO LRFD Bridge Design Specifications, Seventh Edition, 2014, published by:  
American Association of State Highway and Transportation Officials  
444 North Capitol Street, N.W., Suite 249  
Washington, D.C. 20001
- PennDOT - Pennsylvania Department of Transportation.
- SPLRFD - LRFD Steel Girder Splice Design and Analysis program.
- STLRFD - LRFD Steel Girder Design and Rating program.
- US - Customary United States units of measurement.



# ***PROGRAM DESCRIPTION***

## **2.1 GENERAL**

The purpose of this program is to provide a tool for bridge engineers to analyze and design steel girder splices. SPLRFD performs an analysis and specifications check in accordance with the AASHTO LRFD Bridge Design Specifications and the Pennsylvania Department of Transportation Design Manual Part 4. As result of a decision by the AASHTO Subcommittee on Bridges and Structures to no longer publish SI unit specifications, the program only supports US customary (US) units.

The top and bottom flange configuration can consist of one outer plate, two inner plates, or both one outer and two inner plates. The splice can use either a friction type connection or a bearing type connection. However, bearing type connections cannot be used for design and must be approved by the Chief Bridge Engineer for analysis. The bolt pattern for the flanges can be staggered or non-staggered. The spliced steel girder sections must be entered in terms of web depth and thickness, top flange width and thickness, and bottom flange width and thickness. The adjacent girder sections can be composite or non-composite, and they can also be homogeneous or hybrid.

The program can design or analyze each of the following splice components: web splice plates, web splice bolts, top flange splice plates, top flange splice bolts, bottom flange splice plates, and bottom flange splice bolts. When the program designs both the splice plates and the bolts for a specific splice component (web, top flange, or bottom flange), the user must specify whether the program is to increase the splice plate thickness or the number of splice bolts first for the situation in which both can be done (such as bearing on material). The program does not include an analysis engine to compute moment and shears; it designs and analyzes the splice based on moment and shear values for dead load, live load, and pedestrian load, as specified by the user. The user can enter design, permit, and fatigue live loads.

After the analysis is performed, SPLRFD checks for compliance with the AASHTO LRFD Bridge Design Specifications and the Pennsylvania Department of Transportation Design Manual Part 4. The program uses the load combinations listed in Table 3.2-3 for design and analysis. The program checks the specifications for the splice plates: flexural stress, shear force, and fatigue stress range. In addition, the program computes and checks the following specifications for the splice bolt forces: bearing on materials (bearing of bolts against steel plates), shear strength, and slip resistance. The program also checks bolt spacing requirements in the flanges and web, and performs a block shear check to determine if block shear must be investigated by the user.

## Chapter 2 - Program Description

### 2.2 PROGRAM FUNCTIONS

SPLRFD performs the following functions:

1. Input Processing - The program prompts the user for the name of the input file and output file and then processes the input. The program checks the user-entered input values and compares them with lower and upper limits stored in the program. If the user-specified value is less than the lower limit or greater than the upper limit, an error or warning is issued. If an error is detected, the program will stop processing; otherwise the program will continue on to the calculations of the girder section properties.
2. Evaluation of Girder Section Properties - The program computes the girder section properties for the left and right adjacent girder sections. The program computes the non-composite section properties (steel only, referred to in the program as DC1), the long-term composite section properties (3n section, referred to as DC2 and FWS), and the short-term composite section properties (n section, referred to as LL and PL) for positive and negative flexure.
3. Evaluation of Splice Design Loads - The program uses the user-specified moment and shear values for dead load, live load, and pedestrian load to compute the splice design loads. The program considers Strength I, Strength IP, Strength II, Service II, and Service IIB limit states. For each limit state, the permanent and transient loads are multiplied by the appropriate load factor, as stored in the program and described in the LRFD Specifications. The fatigue load effects are also multiplied by the appropriate load factor.
4. Evaluation of Web Splice Section Properties - The program computes the web splice section properties based on the non-composite section properties. For a design problem, the plate thickness and bolt configuration are assigned initializing values at the start of the design process.
5. Design or Analysis of Web Splice Plates and Bolts - The program designs or analyzes the web splice plates and bolts and checks conformance to the LRFD specifications. The user input controls whether a design or an analysis is performed for the web splice plates, as well as for the splice bolts. In addition, for a design of both the web splice plates and splice bolts, the user input controls whether the program increases the splice plate thickness or the number of bolts first for the situation in which both can be done. The specifications are checked for each limit state. The program checks specifications for flexure, shear, and fatigue.
6. Evaluation of Flange Splice Section Properties - The program computes the top and bottom flange splice section properties based on the non-composite section properties (steel only), the long-term composite section properties (3n section), and the short-term composite section properties (n section) for positive and negative flexure. For a design problem, the plate thickness and total number of bolts on one side of the centerline of splice are assigned initializing values at the start of the design process.

## **Chapter 2 - Program Description**

7. Design or Analysis of Flange Splice Plates and Bolts - The program designs or analyzes the top and bottom flange splice plates and bolts and checks conformance to the LRFD Specifications. The user specifies whether design or analysis is performed for the top and bottom flange splice plates, as well as for the splice bolts. In addition, for a design of both the flange splice plates and splice bolts, the user specifies whether the program increases the splice plate thickness or the number of bolts first for the situation in which both can be done. The specifications are checked for each limit state. The program checks specifications for flexure, shear, and fatigue.
  
8. Output - The output from SPLRFD includes a summary of the input and the results from the design or analysis. All computed values are printed to an output file for review by the user. The user controls the amount of output presented by the program.

## Chapter 2 - Program Description

### 2.3 ASSUMPTIONS AND LIMITATIONS

The following is a list of basic assumptions and limitations for SPLRFD. Many of the following items are explained in further detail in Chapter 3.

1. The girder adjacent sections must be entered by the user in terms of web depth and thickness, top flange width and thickness, and bottom flange width and thickness.
2. The girder adjacent sections on the left and right side of the splice must either both be composite or both be non-composite. One girder adjacent section cannot be composite and the other non-composite.
3. The program loops through the specification check for each applicable live loading.
4. The program neglects the effects of the deck reinforcement for a composite girder section in positive flexure. However, it assumes that the reinforcement acts compositely with the steel section for a composite girder section in negative flexure.
5. The program assumes that the haunch is measured from the top of the web to the bottom of the deck slab. In accordance with PennDOT policy, the user should input a haunch depth equal to the top flange thickness.
6. The program uses maximum moments and maximum shears entered by the user for all calculations. The program assumes that maximum moments and maximum shears occur simultaneously under the same loading conditions.
7. When determining the application of load-induced fatigue, as presented in LRFD Specifications Article 6.6.1.2.1, the program neglects the compressive stress induced by the future wearing surface since the future wearing surface may not always be present on the structure.
8. If the user leaves the fatigue resistance values blank on the MIS command, the program assumes a Fatigue-I, Category B detail in determining the applied fatigue stress range and fatigue resistance. If fatigue resistance values are entered, the Fatigue-II limit state is used to compute the applied fatigue stress range, which is then compared to the user input fatigue resistance value.

As per DM-4 Table 6.6.1.2.3-2, if the  $(ADTT)_{SL}$  is less than 645, the user should calculate and enter the Fatigue-II resistance.

9. The program computes the moment resisted by the web using the procedure described in the LRFD Specifications Article C6.13.6.1.4b.

## Chapter 2 - Program Description

10. In the design cycles involving web splice bolts and plates, the forces and stresses, as applicable, are computed on both the left side and right side of the splice. However, section properties of the **smaller** of the two adjacent girder sections are used to compute several quantities on both sides of the splice. The **smaller** adjacent girder section **is the section** that has the smaller **product of** moment of inertia **for the noncomposite steel section and the smallest minimum flange yield strength on the side of the splice under consideration.**
11. To compute fatigue stresses in the flange splice plates, the program first multiplies the fatigue stress at the center of the girder flange by the girder flange area to compute the fatigue force in the girder flange. The program then divides the fatigue force in the girder flange by the gross splice plate area to compute the fatigue stress in the flange splice plate. This procedure is based on the assumption that the fatigue force resisted by the girder flange is equal to that resisted by the splice plates.
12. For design, all web bolt pitches are equal. For analysis, bolt pitches within a single gage line can vary, but each gage line must have the same pattern of bolt pitches. For both analysis and design, all gage lines must have the same number of bolts and all gage lines must be spaced at the same gage distance apart.
13. For flanges with a non-staggered bolt pattern, all bolt pitches are equal.
14. The program allows the use of standard size holes and oversize holes.
15. The program imposes a restriction that both adjacent girder sections (on the left and right of the centerline of splice) must have the same depth of web.
16. For design, the strength of a splice element (the yield strength and the tensile strength) is determined to be the minimum of the strengths of the corresponding girder element on the left and right of the centerline of splice.
17. All splice plates and bolts are assumed to be positioned symmetrically with respect to the two planes passing through the centerline of splice that are perpendicular and parallel to the girder web plane. For design, the top web splice end distance must equal the bottom web splice end distance.
18. The program does not take into account the effect of filler plates, if present, on the stresses in the splice plates and the forces in the bolts.
19. For strength limit states, the program considers all design live loads and all permit live loads entered by the user. For service limit states, the program considers only the first design live load and the first permit live load entered by the user.

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20. For design, the maximum splice plate thickness used by the program is 4 inches.
21. Engineering judgment is required in preparing the input and evaluating the output for this program. The user must check that the results are within reasonable engineering limits and adjust the input accordingly.
22. The program prints a list of all output tables for which one or more specification checks have failed. This list is printed at the end of the output. Therefore, a good starting point for the user is to look at this list and then refer to each output table that is included in this list to find out the specific nature of the specification check failure. This list may include tables that were not selected by the user to be printed.
23. The implementation of concurrent live load effects has been studied with the conclusion that concurrent moments/shears would rarely control, given the minimum design criteria of 75% of the factored resistance. When concurrent live load effects would control the design, the difference was found to be minimal.
24. All bolt holes are assumed to either be drilled full size or subpunched and reamed to size.
25. Block shear calculations assume the number of bolts along each gage line are equal.

Additional assumptions and limitations, including lower limits, upper limits, and defaults of input parameters, are presented with the input descriptions in Chapter 5.

# 3

## **METHOD OF SOLUTION**

The primary purpose of this program is to analyze or design a bolted splice system in single span and continuous span steel girders. The structural analysis and specification checking are performed in accordance with the LRFD Specifications and DM-4. This chapter provides detailed information regarding the method of solution used in the program.

For the analysis and design of a bolted splice system in a steel girder used for highway bridges, the following steps are generally required:

1. Calculate section properties of the adjacent girder sections framing into the splice.
2. Calculate factored dead load effects.
3. Calculate factored live load effects.
4. Combine factored dead load and factored live load effects to get splice design loads.
5. Calculate stresses and forces in splice elements.
6. Perform specification checks.
7. Adjust splice plate sizes and number of bolts, if necessary, for a design problem.

The program performs the above calculations following the specifications provided in the LRFD Specifications and DM-4. For the purpose of this program, the analysis and design are defined as follows.

For an analysis, the geometry and the forces of the splice element being analyzed are known and the program performs all calculations mentioned above except for Step 7. A splice element includes such elements as the top flange splice plate or the web splice bolt pattern. For a design, all calculations mentioned above are performed for the splice element being designed. A single run of the program can consist of analyses of some splice elements and designs of the other splice elements. A single run can also consist of exclusive analyses of all splice elements or exclusive designs of all splice elements.

The following sections describe the above calculations briefly. Refer to any standard textbook on structural analysis and the appropriate sections of this manual for calculations performed in Steps 1, 2, 3, 4 and 5. Refer to the LRFD Specifications and DM-4 for calculations performed in Steps 6 and 7. Refer to the appropriate sections of this manual for calculations performed in Step 7.

## Chapter 3 - Method of Solution

### 3.1 NOTATION

The following are the meanings of equation notations used in various expressions throughout this manual. Definitions of abbreviations can be found in Section 1.2.

$A_{fsp}(*,*,*)$	=	Cross-sectional area of individual flange splice plates (for top flange or bottom flange, either inner or outer plate, and either gross or net section) (in <sup>2</sup> )
$A_{gas}(*)$	=	Cross-sectional area of girder (either gross or net) (in <sup>2</sup> )
$A_{gpl}(*,*)$	=	Cross-sectional area of girder plate (either top flange or bottom flange or web, either gross or net) (in <sup>2</sup> )
$A_{spl}(*,*)$	=	Cross-sectional area of splice plates (for top flange or bottom flange or web, either gross or net) (in <sup>2</sup> )
$AS_{slab}$	=	Actual value of deck reinforcement area within the effective width of slab (in <sup>2</sup> )
$AS_{slab,use}$	=	Value of $AS_{slab}$ to be used in the calculation of section properties (in <sup>2</sup> )
BF	=	Value of FS for bottom flange of girder
BFSP	=	Value of FS for bottom flange splice
$CL_{wspl}$	=	Vertical distance between centerline of web splice plate and centerline of girder web (in)
DC1	=	Value of SLC for non-composite dead load
DC2	=	Value of SLC for composite dead load
$DIA_{hl,bot}(*)$	=	Diameter of bolt hole (for top flange, bottom flange, or web) (in)
DIR	=	General index for direction of load (either positive or negative)
$DNA_{clweb}(*,*,*)$	=	Depth of neutral axis of the girder cross-section measured from the center of the girder web (for gross or net, for positive or negative flexure, and for a certain load category) (in)
$DNA_{gas}(*,*,*)$	=	Depth of neutral axis of the girder cross-section measured from the bottom of the bottom flange of the girder (for gross or net, for positive or negative flexure, and for a certain load category) (in)
$D_{web}$	=	Depth of girder web (in)
$D_{wspl}$	=	Depth of web splice plate (in)
$END_{clr,wspl}$	=	Clear distance from the top of girder web to top of web splice plate (in)
FAT	=	Index for fatigue limit state
FS	=	Index for top flange, bottom flange, or web
FWS	=	Value of SLC for future wearing surface load
$F_{n,fsr}$	=	Nominal fatigue resistance (ksi)
$F_{total}(*)$	=	Total stress in web splice (either at top or bottom) (ksi)
$F_u(*,*,*,*)$	=	Component stress in flange splice (either at top or bottom, for a flexure direction, for shear direction, and for a load category) (ksi)
$F_{u,dl}(*,*,*)$	=	Total stress in flange splice due to dead loads only (either at top or bottom, for a flexure direction, and for shear direction) (ksi)
$F_{u,fspl,ac,max}(*)$	=	Maximum stress in flange splice plate for gross section compressive yielding (either at top or bottom) (ksi)

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$F_{u,fspl,gt,max}^{(*)}$	=	Maximum stress in flange splice plate for gross section tensile yielding (either at top or bottom) (ksi)
$F_{u,fspl,nt,max}^{(*)}$	=	Maximum stress in flange splice plate for net section fracture (either at top or bottom) (ksi)
$F_{u,negm}^{(*)}$	=	Maximum stress in web splice plate under negative flexure (either at top or bottom) (ksi)
$F_{u,posm}^{(*)}$	=	Maximum stress in web splice plate under positive flexure (either at top or bottom) (ksi)
$F_{u,wspl,fsr,max}^{(*)}$	=	Maximum fatigue stress range in web splice plate (either at top or bottom) (ksi)
$GAGE_{bolts}^{(*)}$	=	Gage distance of bolts (either for top or bottom flange or web) (in)
GROSS	=	Value for gross section properties
INPL	=	Index for inner flange splice plates
$I_{o,wspl}^{(*)}$	=	Moment of inertia of the web splice plates only about the horizontal centroidal axis of the web splice plates (for gross section) (in <sup>4</sup> )
$I_{x,gas}^{(*,*,*)}$	=	Moment of inertia of the girder cross-section about the neutral axis of the girder cross-section (for a limit state, for a flexure direction, and for a load category) (in <sup>4</sup> )
$I_{x,web}^{(*,*,*)}$	=	Moment of inertia of the girder web only about the neutral axis of the girder cross-section (for a limit state, for a flexure direction, and for a load category) (in <sup>4</sup> )
$I_{x,webolts}^{(*,*,*)}$	=	Moment of inertia of the web splice bolt group about the neutral axis of the girder cross-section (for gross section, for a flexure direction, and for a load category) (in <sup>2</sup> )
$I_{x,wspl}^{(*,*,*)}$	=	Moment of inertia of the web splice plates only about the neutral axis of the girder cross-section (for gross section, for a flexure direction, and for a load category) (in <sup>4</sup> )
$I_{y,webolts}^{(*,*,*)}$	=	Moment of inertia of the web splice bolt group about the vertical centroidal axis for the bolt group (for gross section, for a flexure direction, and for a load category) (in <sup>2</sup> )
$J_{webolts}^{(*,*,*)}$	=	Polar moment of inertia of the web splice bolt group about the neutral axis of the girder cross-section (for gross section, for a flexure direction, and for a load category) (in <sup>2</sup> )
LADD	=	A length quantity to be subtracted from the width of holes in a staggered bolt configuration (in)
LL	=	Index for live load truck
LLIM	=	Value of SLC for live load plus impact (dynamic load allowance)
LOC	=	General index for location (this can be either the location of flange or web splice or the location of plates within a flange splice)
LS	=	Index for limit states (Strength I, Strength IP, Strength II, Service II, Service IIB, Fatigue I, Fatigue II)
MDIR	=	Index for flexure direction (either positive or negative)
MODN	=	Elastic modular ratios for girder steel to deck concrete
$M_{ev}^{(*)}$	=	Moment arising out of eccentric design shear component (kip-ft)
$M_{r,sas}^{(*,*)}$	=	Moment of resistance of the smallest adjacent girder cross-section at the splice location (for a limit state and for a flexure direction) (kip-ft)
$M_u^{(*,*,*,*)}$	=	Component of applied factored moment at the splice location (for a limit state, for a live load truck, for a flexure direction, and for a load category) (kip-ft)
$M_{u,spl}^{(*,*,*,*)}$	=	Component of design splice moment (for a limit state, for a live load truck, for a flexure direction, and for a load category) (kip-ft)

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$M_{ut}(*, *, *)$	=	Total factored moment applied to the girder at splice location (for a limit state, for a live load truck, and for a flexure direction) (kip-ft)
$M_{ut,spl}(*, *, *)$	=	Total design splice moment (for a limit state, for a live load truck, and for a flexure direction) (kip-ft)
$M_{u,wspl}(*, *, *, *, *)$	=	Component of moment to be resisted by the web splice plate (for a limit state, for a live load truck, for a shear direction, for a flexure direction, and for a load category) (kip-ft)
$M_{web}(*)$	=	Moment resisted by the girder web only (for a load category) (kip-ft)
NEG	=	Value of DIR or MDIR for negative direction of load
NET	=	Value for net section properties
$N_{bolts}(*)$	=	Total number of bolts on one side of the centerline of splice (for top flange or bottom flange or web)
$N_{gl}(*)$	=	Total number of gage lines on one side of the centerline of splice for a web splice, or total number of gage lines for a flange splice (for top flange or bottom flange or web)
$N_{webolts,gl}(*)$	=	Number of bolts in a web gage line
OUTPL	=	Index for outer flange splice plate
$P_{gpl,total}(*, *, *, *)$	=	Total force in girder flange plate (either at top or bottom flange, for a limit state, for a live load truck, and for a load category) (kip)
$PITCH_{bolts}(*)$	=	Pitch distance of bolts (either for top or bottom flange or web) (in)
PLL	=	Value of SLC for pedestrian live load
$P_{result}(*)$	=	Total resultant force in a web splice bolt (either at top or bottom) (kip)
$P_{u,fspl}(*, *, *, *)$	=	Total force in flange splice plate (either at top or bottom flange, for a limit state, for a live load truck, and for a load category) (kip)
$P_{u,fspl,cmax}(*)$	=	Maximum compressive force in flange splice plate (either at top or bottom flange) (kip)
$P_{u,fspl,tmax}(*)$	=	Maximum tensile force in flange splice plate (either at top or bottom flange) (kip)
$P_{x,tot}(*)$	=	Total horizontal force in a web splice bolt (either at top or bottom) (kip)
$P_{y,tot}$	=	Total vertical force in a web splice bolt (kip)
POS	=	Value of DIR or MDIR for positive direction of load
Q	=	Total factored load (moment, shear, etc.)
$q_i$	=	Unfactored load component (moment, shear, etc.)
$RATIO_m(*, *, *)$	=	Ratio of total design splice moment to the total factored moment at splice location (for a limit state, for a live load truck, and for a flexure direction)
$RATIO_{p,fspl}(*, *)$	=	Ratio of outer or inner flange splice plate area to the total cross-sectional area of the flange splice (for either top or bottom flange and for inner or outer plate)
$RATIO_v(*, *, *, *)$	=	Ratio of total design splice shear to the total factored shear at the splice location (for a limit state, for a live load truck, for a shear direction, and for a flexure direction)
SIGN	=	A factor equal to -1.0 for top flange and 1.0 for bottom flange
$SL_{dir}$	=	Direction index (either POS or NEG) depending upon the sign of the splice component moment
SLC	=	Index for load category (noncomposite dead load, composite dead load, etc.) in a variable
$T_{flg}(*)$	=	Thickness of girder flange (either top or bottom) (in)

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$T_{fsp}(*, *)$	=	Thickness of flange splice plate (either top or bottom flange, either inner or outer plate) (in)
$T_{haunch}$	=	Thickness of haunch in the composite section measured from top of top flange (in)
$T_{slab}$	=	Thickness of slab in a composite girder (in)
$T_{web}$	=	Thickness of girder web (in)
TF	=	Value of FS for top flange of girder
TFSP	=	Value of FS for top flange splice
$V_{r,sas}(*, *)$	=	Shear resistance of the smallest adjacent girder cross-section at the splice location (for a limit state and for a shear direction) (kip)
$V_u(*, *, *, *)$	=	Component of applied factored shear at the splice location (for a limit state, for a live load truck, for a shear direction, and for a load category) (kip)
$V_{u,spl}(*, *, *, *, *)$	=	Component of splice design shear at the splice location (for a limit state, for a live load truck, for a shear direction, for a flexure direction, and for a load category) (kip)
$V_{ut}(*, *, *)$	=	Total factored shear applied to the girder at splice location (for a limit state, for a live load truck, and for a flexure direction) (kip)
$V_{ut,spl}(*, *, *)$	=	Total design splice shear (for a limit state, for a live load truck, and for a flexure direction) (kip)
$V_{ut,spl,temp}$	=	Temporary value of total design splice shear (kip)
WEB	=	Value of FS for girder web
$W_{fig}(*)$	=	Width of girder flange (either top or bottom) (in)
$W_{slab,use}(*)$	=	Width of slab to be used in the calculation of section properties (for a load category) (in)
$W_{hls,fig,use}(*)$	=	Width of bolt holes in girder flange (either top or bottom) to be used in the calculation of areas (in)
$W_{hls,fsp}(*, *)$	=	Width of bolt holes in flange splice plate (either top or bottom flange, either inner or outer plate) (in)
WSPL	=	Value of FS for web splice
$W_{slab}$	=	Actual effective width of slab (in)
$W_{slab,use}(*)$	=	Width of slab to be used in the calculation of section properties (for a load category) (in)
$X_{cg,webolts}$	=	Horizontal distance from the center of gravity of bolt group to the splice centerline (in)
$X_{webolts}(*)$	=	Horizontal distance from a web bolt gage line to the centerline of splice (for a gage line) (in)
$Y_{cg,webolts}$	=	Vertical distance from the center of gravity of the web bolt group to the top of girder web (in)
$Y_{webolts}(*, *)$	=	Vertical distance from a web bolt to the top of girder web (for a gage line and for a pitch line) (in)
$Z_{fig}(*, *, *, *)$	=	Section modulus at the middle of girder flange plate with respect to the neutral axis of the girder section (either at top or bottom, for gross or net, for a flexure direction, and for a load category) (in <sup>3</sup> )
$Z_{wsp}(*, *, *, *)$	=	Section modulus of web splice plate with respect to the neutral axis of the girder section (either at top or bottom, for gross or net, for a flexure direction, and for a load category) (in <sup>3</sup> )
$\gamma_i$	=	Load factor
$\gamma_{DC}$	=	Load factor for permanent dead load of structural components and nonstructural attachments
$\gamma_{FWS}$	=	Load factor for future wearing surface load

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$\gamma_{LL}$	=	Load factor for vehicular live load
$\gamma_{PL}$	=	Load factor for pedestrian live load
$\eta_i$	=	Load modifier

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### 3.2 CONSTANT INITIALIZATION

The program begins execution by initializing several constants. These constants are described in the following sections.

#### 3.2.1 Design Constants

Design constants are the constants required for performing the design of a splice system. These include minimum plate thickness, minimum increment in plate thickness for design, minimum bolt hole clearance, maximum hole diameter for neglecting hole area, and maximum distance between the farthest bolts in one side of flange splice. The numerical values assigned by the program to the design constants are provided in Table 1.

Table 3.2-1 Design Constants

Constant	Value
Minimum Plate Thickness	0.375 in
Minimum Increment in Plate Thickness for Design	0.0625 in
Minimum Bolt Hole Clearance	0.0625 in
Maximum Hole Diameter for Neglecting Hole Area	1.25 in
Maximum Distance between the Farthest Bolts in Flange Splice	50 in
Minimum Web Bolt Pitch Increment	0.0625 in

#### 3.2.2 Load Modifier

The program computes the design values of factored moments and shears as required by the LRFD Specifications and DM-4. In accordance with DM-4, the program computes the total factored loads using the following equation:

$$Q = \sum \left[ \eta_i \gamma_i q_i \text{ or } \frac{\gamma_i q_i}{\eta_i} \right]$$

where: Q = Total factored load  
 $\eta_i$  = Load modifier (see Table 2)  
 $\gamma_i$  = Load factor (see Table 3)  
 $q_i$  = Load (unfactored analysis results; user input)

In the above equation, when the maximum load factor is used for a given load, then  $\eta_i \gamma_i q_i$  is used. When the minimum load factor is used with a given load, then  $\gamma_i q_i / \eta_i$  is used.

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The program determines the load modifier in accordance with LRFD Specifications Article 1.3.2 and the corresponding section of DM-4. The load modifiers used for all limit states are summarized in Table 2.

Table 3.2-2 Load Modifier

Load Combination	Load Modifier
All Strength Limit States	$\eta$ = product of inputted importance factor, ductility factor, and redundancy factor (see DRI command) Minimum $\eta$ = 1.0 Maximum $\eta$ = 1.16  As per PennDOT DM-4 Section 1.3.2.1, ETA factors other than 1.0 are not permitted by PennDOT.
All Service Limit States	$\eta$ = 1.0
Fatigue	$\eta$ = 1.0

#### 3.2.3 Load Factors

The load factors (as mentioned in Section 3.2.2) used to compute the design loads vary from one type of load to another and from one limit state to another, as specified in DM-4. The program considers Strength I, Strength IP, Strength II, Service II, and Service IIB limit states. In addition, the program uses different load factors for checking fatigue.

The load factors used for each load type per limit state are presented in Table 3. In addition, the load factors used for fatigue are also presented in Table 3. When two load factors are presented, the first load factor is the maximum load factor and the second load factor is the minimum load factor.

Table 3.2-3 Load Factors

Load Combinations	Loadings				
	$\gamma_{DC}$	$\gamma_{FWS}$	$\gamma_{LL}$	$\gamma_{PL}$	LL Vehicle
Strength I	1.25 (Max.), 0.90 (Min.)	1.50 (Max.), 0.65 (Min.)	1.75 (Max.), 0.00 (Min.)	--	PHL-93
Strength IP	1.25 (Max.), 0.90 (Min.)	1.50 (Max.), 0.65 (Min.)	1.35 (Max.), 0.00 (Min.)	1.75	PHL-93
Strength II	1.25 (Max.), 0.90 (Min.)	1.50 (Max.), 0.65 (Min.)	1.35 (Max.), 0.00 (Min.)	--	Permit (P-82)
Service II	1.00	1.00	1.30 (Max.), 0.00 (Min.)	--	PHL-93
Service IIB	1.00	1.00	1.00 (Max.), 0.00 (Min.)	--	Permit (P-82)
Fatigue I	1.00	1.00	(1.50) (PTF)	--	HS20-30

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Table 3.2-3 Load Factors (continued)

Load Combinations	Loadings				
	Y <sub>DC</sub>	Y <sub>FWS</sub>	Y <sub>LL</sub>	Y <sub>PL</sub>	LL Vehicle
Fatigue II	1.00	1.00	(0.75) (PTF)	--	HS20-30

The maximum and minimum load factors in the above table are used in the following manner. The unfactored load effects (moments and shears from user input) are multiplied by the minimum load factors and divided by the load modifier if the sign of the unfactored load is opposite of the optimizing sign of factored load. For example, if unfactored load is negative and the maximum positive factored load effect is sought, then the unfactored load will be multiplied by minimum load factors and divided by the load modifier. On the other hand, the unfactored load effects are multiplied by the maximum load factors and multiplied by the load modifier if the sign of the unfactored load is the same as that of the optimizing sign of factored load. For example, if unfactored load is negative and the maximum negative factored load effect is sought, then the unfactored load will be multiplied by maximum load factors and also multiplied by the load modifier.

#### 3.2.4 Resistance Factors

Categories and values of the resistance factors used by the program are presented in Table 4.

Table 3.2-4 Resistance Factors

Category of Resistance Factor	Value of Resistance Factor
Plate Flexure	1.00
Plate Shear	1.00
Gross Section Compression in Plate	<b>0.95</b>
Tension - Net Section Fracture in Plate	0.80
Tension - Gross Section Yielding in Plate	0.95
Bolt Bearing on Material	0.80
Bolt Shear	<b>0.75 or 0.80, based on type of bolts, user input</b>
For Shear, Rupture in Plate Element	0.80
For Block Shear	0.80

#### 3.2.5 Dynamic Load Allowance

The effect of dynamic load allowance (impact) is assumed to be included in the unfactored live load values entered by the user. Hence, the program does not make any modification to the user-specified load to include dynamic load allowance.

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#### 3.2.6 Preferred Bolt Spacing

PennDOT's preferred minimum distances between centers of bolts in standard holes are presented in Table 5. Inputted bolt spacings should be entered by the user in accordance with this table.

Table 3.2-5 Preferred Bolt Spacing

<b>Bolt Diameter</b>	<b>Preferred Distance Between Centers of Bolts</b>
0.625 inches	2.25 inches
0.75 inches	2.5 inches
0.875 inches	3 inches
1 inch	3.5 inches

## Chapter 3 - Method of Solution

### 3.3 GEOMETRY OF SPLICE SYSTEM

A typical splice system consists of a pair of web splice plates and up to three plates grouped together and connected to the girder top flange and bottom flange. For convenience, the splice components are categorized as follows:

1. Web splice plates
2. Web splice bolts
3. Top flange splice plates
4. Top flange splice bolts
5. Bottom flange splice plates
6. Bottom flange splice bolts

The geometry of the splice system is defined by a number of input parameters through the commands GAS, SLB, WSB, WBP, WSP, FSB, and FSP. For design problems, the parameters affected by the design iterations, such as the web splice plate thickness, some web splice bolt parameters (such as number of gage lines), flange splice plate thickness, and number of flange splice bolts, should be left undefined at the start of the program.

An element of one adjacent girder section (web plate, top flange plate, or bottom flange plate) can be different from the corresponding element in the other adjacent girder section in terms of dimensions and strengths. However, for the girder web, the program imposes a restriction that both adjacent girder sections (on the left and right of the centerline of splice) must have the same depth of web. For design, the strength of a splice element (yield strength and tensile strength) is determined to be the minimum of the strengths of the corresponding girder element on the left and right of the centerline of splice.

All splice plates and bolts are assumed to be positioned symmetrically with respect to the two planes passing through the centerline of splice that are perpendicular and parallel to the girder web plane (see Figures 1 and 2). SPLRFD does not take into account the effect of filler plates, if present, on the stresses in the splice plates and the forces in the bolts. For the design of a web splice, the program assumes a uniform distribution of bolts (that is, all gage lines have the same number of bolts, all gage lines are spaced at the same gage distance apart, and the bolts in the gage lines are spaced uniformly with a constant pitch distance). However, in a problem involving analysis of web splice bolts, the pitch distances can be different (defined in the WBP command). For the convenience of data handling, the locations of bolts in the web splice are defined by two coordinates measured as follows:

$X(GL)$  = Horizontal distance of the bolt from the centerline of splice

$Y(GL, BN)$  = Vertical distance of the bolt from the top of the girder web

where:  $GL$  = Gage line number in which the bolt is located (the gage line closest to the centerline of splice being gage line 1) (see Figure 3.5-1)

$BN$  = Number assigned to the bolt (the topmost bolt being bolt 1) (see Figure 3.5-1)

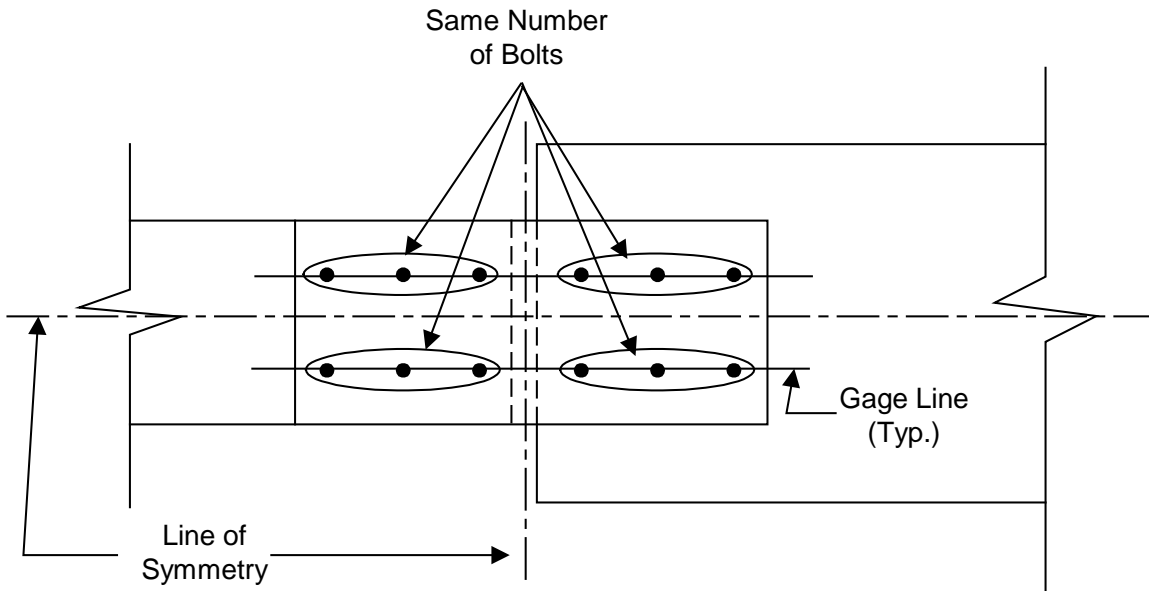


Figure 3.3-1 Symmetrical Splice Configuration

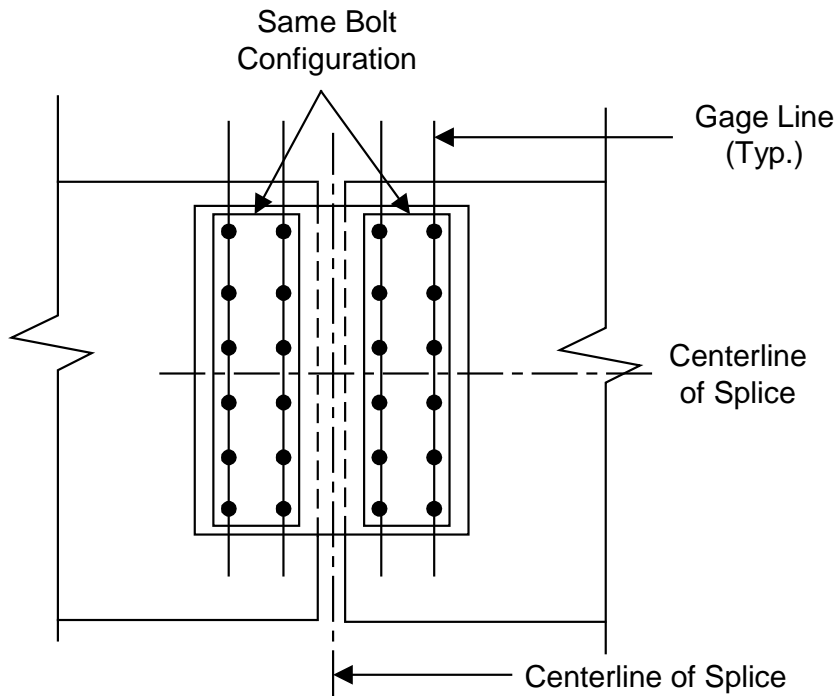


Figure 3.3-2 Symmetrical web Splice Configuration

### **Chapter 3 - Method of Solution**

The End Clear Distance (parameter 4 of WSB command) represents the clear distance from the top of the girder web to the top of the web splice plate. The user is not required to enter a similar quantity at the bottom (that is, the distance from the bottom of the web splice plate to the bottom of the girder web). This distance is computed by SPLRFD using the entered value for End Clear Distance (parameter 4 of WSB command) and the user input parameters Web Depth (parameter 5 of GAS command) and Web Splice Depth (parameter 1 of WSP command). Hence, it is possible to analyze or design a splice system with different clear distances at the top and the bottom of the web splice plate.

## Chapter 3 - Method of Solution

### 3.4 SECTION PROPERTIES

The program computes the gross and net section properties of two adjacent girder sections and each splice plate as follows:

$$A_{gas} (*) = (W_{flg}(BF) - W_{hls,flg,use}(BF)) T_{flg}(BF) + D_{web} T_{web} + (W_{flg}(TF) - W_{hls,flg,use}(TF)) T_{flg}(TF) + W_{slab,use} T_{slab}$$

The subscript for  $A_{gas}$  stands for either GROSS or NET. For gross section properties,  $W_{hls,flg,use} (*)$  is assumed to be zero. For net area calculations, they are taken as the total width of holes in the tension flange only. For the compression flange,  $W_{hls,flg,use} (*)$  is assumed to be zero. Thereafter, the depth of the neutral axis as measured from the bottom of the bottom flange is computed for positive flexure by the following formula:

$$DNA_{gas} (*, POS, *) = \frac{AR1 + AR2 + AR3 + AR4}{A_{gas} (*)}$$

$$AR1 = ((W_{flg}(BF) - W_{hls,flg,use}(BF)) T_{flg}(BF) \frac{T_{flg}(BF)}{2})$$

$$AR2 = D_{web} T_{web} \left( T_{flg}(BF) + \frac{D_{web}}{2} \right)$$

$$AR3 = W_{flg}(TF) T_{flg}(TF) \left( T_{flg}(BF) + D_{web} + \frac{T_{flg}(TF)}{2} \right)$$

$$AR4 = W_{slab,use} T_{slab} \left( T_{flg}(BF) + D_{web} + T_{flg}(TF) + T_{haunch} + \frac{T_{slab}}{2} \right)$$

The first subscript of  $DNA_{gas}$  represents the type of section (GROSS only for neutral axis and moment of inertia calculations), the second subscript represents the flexure direction, and the third one represents the load category type. Hence, the formula given above is for  $DNA_{gas}$  under positive flexure. As previously mentioned,  $W_{hls,flg,use}(BF)$  and  $W_{hls,flg,use}(TF)$  are zero for gross section. The values of  $W_{slab,use}$  and  $T_{slab}$  depend on the load category being considered. Five load categories are considered in the program, as listed below:

1. DC1 - effect of noncomposite dead load
2. DC2 - effect of composite dead loads other than future wearing surface
3. FWS - effect of composite dead load due to future wearing surface
4. LLIM - effect of live load with dynamic load allowance (impact)
5. PLL - effect of pedestrian live load

The value of  $W_{slab,use}$  in the expression for  $DNA_{gas} (*, POS, *)$  is chosen as follows:

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$$W_{slab,use} = 0, \text{ for DC1}$$

$$W_{slab,use} = \frac{W_{slab}}{3 \text{ MODN}}, \text{ for DC2 and FWS}$$

$$W_{slab,use} = \frac{W_{slab}}{\text{MODN}}, \text{ for LLIM and PLL}$$

Thereafter, the value of the gross moment of inertia for the girder section is computed as follows (assuming that the neutral axis is above the top of the bottom flange):

$$I_{x,gas}(*, POS, *) = IX1 + IX2 + IX3 + IX4$$

$$IX1 = (W_{flg}(BF) W_{hls,flg,use}(BF)) \left[ \frac{T_{flg}(BF)^3}{12} + T_{flg}(BF) \left( \frac{T_{flg}(BF)}{2} - DNA_{gas}(*, POS, *) \right)^2 \right]$$

$$IX2 = T_{web} \left[ \frac{D_{web}^3}{12} + D_{web} \left( T_{flg}(BF) + \frac{D_{web}}{2} - DNA_{gas}(*, POS, *) \right)^2 \right]$$

$$IX3 = W_{flg}(TF) \left[ \frac{T_{flg}(TF)^3}{12} + T_{flg}(TF) \left( T_{flg}(BF) + D_{web} + \frac{T_{flg}(TF)}{2} - DNA_{gas}(*, POS, *) \right)^2 \right]$$

$$IX4 = W_{slab,use} \left[ \frac{T_{slab}^3}{12} + T_{slab} \left( T_{flg}(BF) + D_{web} + T_{flg}(TF) + T_{haunch} + \frac{T_{slab}}{2} - DNA(*, POS, *) \right)^2 \right]$$

For negative flexure, these quantities are computed as follows (assuming that the neutral axis is below the bottom of the top flange):

$$DNA_{gas}(*, NEG, *) = \frac{AR1 + AR2 + AR3 + AR5}{A_{gas}(*)}$$

$$A_{gas}(* ) = W_{flg}(BF) T_{flg}(BF) + D_{web} T_{web} + (W_{flg}(TF) W_{hls,flg,use}(TF)) T_{flg}(TF) + AS_{slab,use}$$

$$AR1 = W_{flg}(BF) T_{flg}(BF) \frac{T_{flg}(BF)}{2}$$

$$AR3 = (W_{flg}(TF) - W_{hls,flg,use}(TF)) T_{flg}(TF) \left( T_{flg}(BF) + D_{web} + \frac{T_{flg}(TF)}{2} \right)$$

$$AR5 = AS_{slab,use} \left( T_{flg}(BF) + D_{web} + T_{flg}(TF) + T_{haunch} + T_{slab} - CGS_{slab} \right)$$

$$I_{x,gas}(*, NEG, *) = IX1 + IX2 + IX3 + IX5$$

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$$IX1 = W_{flg}(BF) \left[ \frac{T_{flg}(BF)^3}{12} + T_{flg}(BF) \left( \frac{T_{flg}(BF)}{2} - DNA_{gas}(*, NEG, *) \right)^2 \right]$$

$$IX3 = (W_{flg}(TF) - W_{hls,flg,use}(TF)) \left[ \frac{T_{flg}(TF)^3}{12} + T_{flg}(TF) \left( T_{flg}(BF) + D_{web} + \frac{T_{flg}(TF)}{2} - DNA_{gas}(*, NEG, *) \right)^2 \right]$$

$$IX5 = AS_{slab,use} \left( T_{flg}(BF) + D_{web} + T_{flg}(TF) + T_{haunch} + T_{slab} - CGS_{slab} - DNA_{gas}(*, NEG, *) \right)^2$$

In the above equations, the area of deck reinforcement to be used,  $AS_{slab,use}$ , is taken as zero for load category DC1; for all other load categories,  $AS_{slab,use}$  is the actual value of  $AS_{slab}$ . The variables AR2 and IX2 are the same for positive and negative flexure.

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### 3.5 CYCLES OF DESIGN ITERATIONS

There are six cycles of design iterations incorporated in the program. These six cycles are as follows:

1. Design cycle for web splice plates
2. Design cycle for web splice bolts
3. Design cycle for top flange splice plates
4. Design cycle for top flange splice bolts
5. Design cycle for bottom flange splice plates
6. Design cycle for bottom flange splice bolts

Each of these cycles is independent of the others. For a particular problem, some of these design cycles may not be applicable. For example, in a problem with analysis of web splice bolts, the design cycle for web splice bolts will not be present. The various design cycles are briefly described in the following sections.

#### 3.5.1 Design Cycle for Web Splice Plates

This design cycle involves the following steps:

1. The program assumes a thickness of web splice plate as the greater of  $T_1$  and  $T_2$  as given below:

$T_1$  = Minimum plate thickness as described in Section 3.2.1

$$T_2 = \frac{A_{gpl}(\text{WEB, GROSS})}{2 D_{wsp}}$$

In case the webs on the left and right of the centerline of splice have different gross areas, then  $A_{gpl}$  is taken as the minimum of the gross areas of the two webs in the adjacent sections.

2. The program then assumes that the web splice plate has the same yield strength and tensile strength as those of the girder web plate. In case the girder webs on the left and right have different strengths, the minimum values are taken for the web splice plate strengths.
3. The program computes section properties of the web splice plates (such as area, moment of inertia, and section modulus).
4. The program checks if the maximum flexural stress in the web splice plate (at either top or bottom) exceeds the yield strength of the web splice plate. For this purpose, the gross section properties of the web splice plates are used.

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5. If the maximum flexural stress exceeds the yield strength of the web splice plates, then the thickness of the plate is increased and the computations are repeated from Step 3. Otherwise the shear force carried by the web splice plates is computed and compared with the shear capacity of the web splice plates.
6. If the shear carried by the web splice plates exceeds the shear capacity, then the web splice plate thickness is increased and computations are repeated from Step 3. The program then exits from this design cycle.

### 3.5.2 Design Cycle for Web Splice Bolts

This design cycle involves the following steps:

1. The program starts with two gage lines and the minimum number of bolts per gage line as specified by the user in the WSB command. If the minimum number of bolts parameter is left blank by the user, the program will automatically calculate the minimum number of bolts according to the maximum allowable spacing, as per the LRFD Specifications Equations 6.13.2.6.2-1 and 6.13.2.6.2-2.
2. The program then computes section properties of the web splice bolts (such as distances of center of gravity of bolt group and polar moment of inertia of the bolt group).
3. The program evaluates under various limit states the maximum bolt forces in the four corners as follows:
  - A. Top of the gage line closest to the centerline of splice
  - B. Bottom of the gage line closest to the centerline of splice
  - C. Top of the gage line furthest from the centerline of splice
  - D. Bottom of the gage line furthest from the centerline of splice

The sign conventions and formulas used to evaluate these forces are shown in Figures 1 and 2 and described in Section 3.6.

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4. For each of the four corner bolts listed in Step 3, the program checks if the forces carried by the bolts exceed either the shear strength, the slip resistance, or the bearing capacity of the material. For computing the shear force and bearing force, strength limit states are used; for computing the slipping force, service limit states are used.
  
5. If the force carried by the bolt exceeds either the shear strength of the bolt, the slip resistance of the faying surface, or the bearing capacity of the plates connected by the bolt, then one bolt is added to each gage line. If the addition of one bolt violates the condition of minimum pitch distances as specified by the user in the WSB command, then the number of gage lines is increased by one and all gage lines are once again assigned the minimum number of bolts per gage line as specified by the user in the WSB command. Thereafter, the computations are repeated from Step 2. In case there is a failure in bearing on material, there are two alternatives to strengthen the bolt system. The program either increases the number of web splice bolts or increases the thickness of the web splice plate, as determined by the user input in the CTL command or increases the edge distance (Section 3.6.8) as determined by the user input in the WSB command. If the force carried by the bolt does not exceed either the shear strength, slip resistance, or bearing capacity, the program exits from this design cycle.
  
6. If at the end of the design cycle, the program has determined that the actual WSPL Pitch is not within the Least WSPL Pitch (versus WSPL limits) and Greatest WSPL Pitch (versus WSPL limits) range, the program will increment the thickness of the web splice plate. The Web Splice Bolt design cycle will then design the number of bolts according to the increased web splice plate thickness.  
NOTE: This feature may be turned off via the 'BOLT PITCH CORRECTION' parameter of the WSB command, with the default setting equal to "N", thus disabling this feature.

#### 3.5.3 Design Cycle for Top Flange Splice Plates

This design cycle involves the following steps:

1. The program assumes the total gross area of the top flange splice plate as the greater of  $A_1$  and  $A_2$  as given below:

$A_1$  = Product of the minimum thickness as described in Section 3.2.1 and the total width of all top flange splice plates. The total width of all flange splice plates is the sum of the widths of all splice plates (two inner splice plates and one outer splice plate, as applicable).

$$A_2 = A_{gpl} ( \text{TFSPL} , \text{GROSS} )$$

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In case the top flanges on the left and right of the centerline of splice have different gross areas, then  $A_2$  is taken as the minimum of the gross areas of the two top flanges in the adjacent sections.

2. The program then assumes that the top flange splice plates have the same yield strength and tensile strength as those of the girder top flange plate. In case the girder top flanges on the left and right have different strengths, the minimum values are taken for the flange splice plate strengths.
3. The program then computes section properties of the flange splice plates (such as net areas of outer and inner plates, as applicable).
4. The program checks if the maximum axial stress in the top flange splice plate (at either outer or inner plate, as applicable) exceeds the factored resistance. For this purpose, the gross area is used for checking gross section compression and gross section tensile yielding; the net area is used for checking net section fracture.
5. If the stress in the top flange splice plate exceeds the factored resistance, then the gross area of the top flange splice plate is increased by an amount equal to the product of the minimum increment in thickness ( $T_1$ ) and the width of the outer plate (or the total width of inner plates, depending upon the configuration of top flange splice). The computations are then repeated from Step 3. The program then exits from this design cycle.

### 3.5.4 Design Cycle for Top Flange Splice Bolts

This design cycle involves the following steps:

1. The program starts with a total number of bolts equal to the total number of gage lines as specified by the user in the FSB command. This total number of bolts represents the total number of bolts on one side of the centerline of splice.
2. The program then computes the maximum shear force, maximum slipping force, and maximum bearing force in the bolts by dividing the corresponding total force by the total number of bolts. For computing the shear force and bearing force, strength limit states are used; for computing the slipping force, service limit states are used.
3. The program checks if the forces carried by the bolts exceed either the shear strength, slip resistance, or bearing capacity of the material.
4. If the force carried by the bolt exceeds either the shear strength of the bolt, the slip resistance of the faying surface, or the bearing capacity of the plates connected by the bolt, then the program

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increments the total number of bolts in the top flange splice by the number of gage lines. In case there is a failure in bearing on material, there are two alternatives to strengthen the bolt system. The program either increases the number of top flange splice bolts or increases the thickness of the top flange splice plate, as determined by the user input in the CTL command. If the force carried by the bolt does not exceed either the shear strength, slip resistance, or bearing capacity, the program exits from this design cycle.

### 3.5.5 Design Cycle for Bottom Flange Splice Plates

This design cycle is similar to that for the top flange splice plates except that all components being considered are at the bottom of the splice system.

### 3.5.6 Design Cycle for Bottom Flange Splice Bolts

This design cycle is similar to that for the top flange splice bolts except that all components being considered are at the bottom of the splice system.

### 3.5.7 Miscellaneous Design Considerations

In the design cycles involving web splice bolts and plates, the forces and stresses, as applicable, are computed on both the left side and right side of the splice. However, section properties of the **smaller** of the two adjacent girder sections are used to compute several quantities on both sides of the splice. The **smaller** adjacent girder section **is the section** that has the smaller **product of** moment of inertia **for noncomposite steel section and the smallest minimum flange yield strength on the side of the splice under consideration.**

### 3.5.8 Miscellaneous Analysis Considerations

If any splice component is being analyzed instead of designed, then the analysis stops after the computations of forces and stresses and after the specification checks. If a failure in specification check occurs during the analysis, then the program issues a warning message without attempting to revise the dimensions or properties of the splice element being analyzed.

### 3.5.9 Usage of Loads - Assumptions

The user must specify the loads (moments and shears) acting on the girder at the location of the splice. The program assumes the following:

1. The user acquires the loading information by analyzing the girder using either the CBA program, the STLRFD program, or any other standard beam analysis program.

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2. Maximum moment and maximum shear are acting at the splice location simultaneously under the same loading condition. (In reality, maximum moment and maximum shear usually occur under different loading conditions.)
3. For both design and analysis, the self-weight of the splice elements (plates and bolts) is included in the DC1 moment and shear entered by the user.
4. The externally applied moments and shears follow the sign conventions shown in Figures 1 and 2.

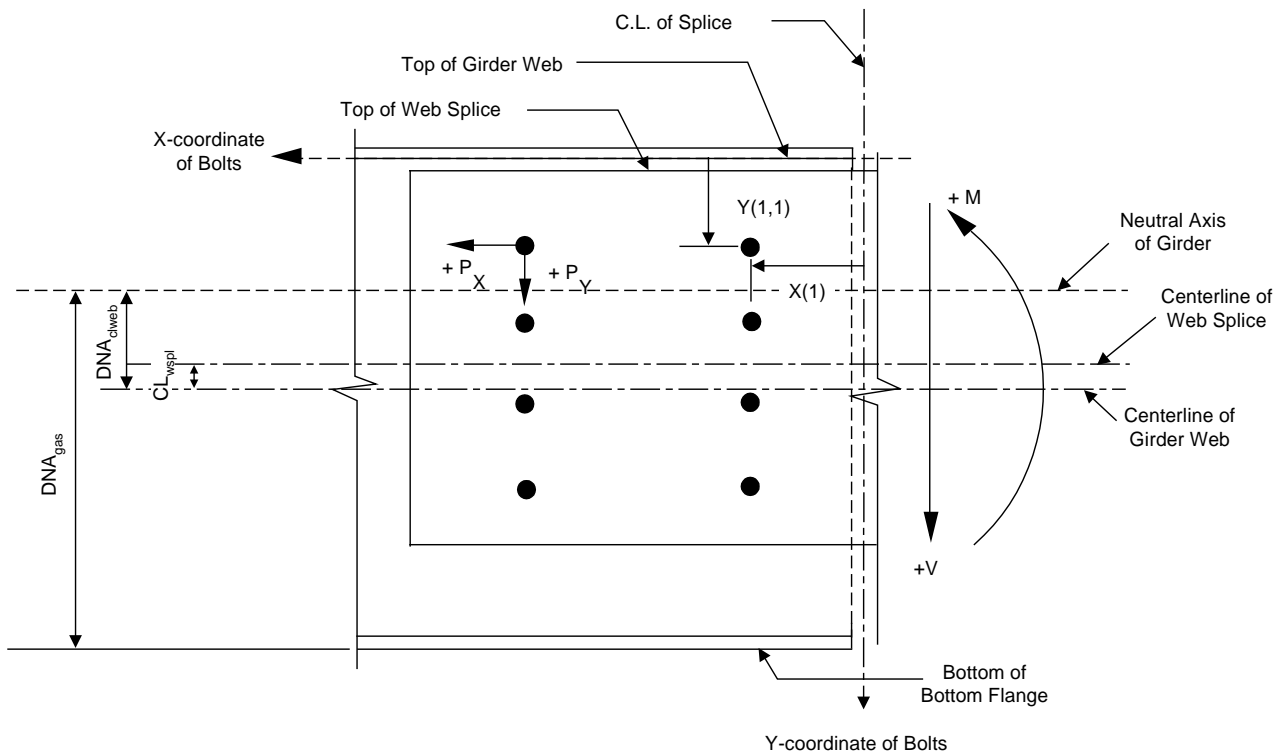


Figure 3.5-1 Adjacent Girder Section on Left Side of Splice Centerline and Sign Convention

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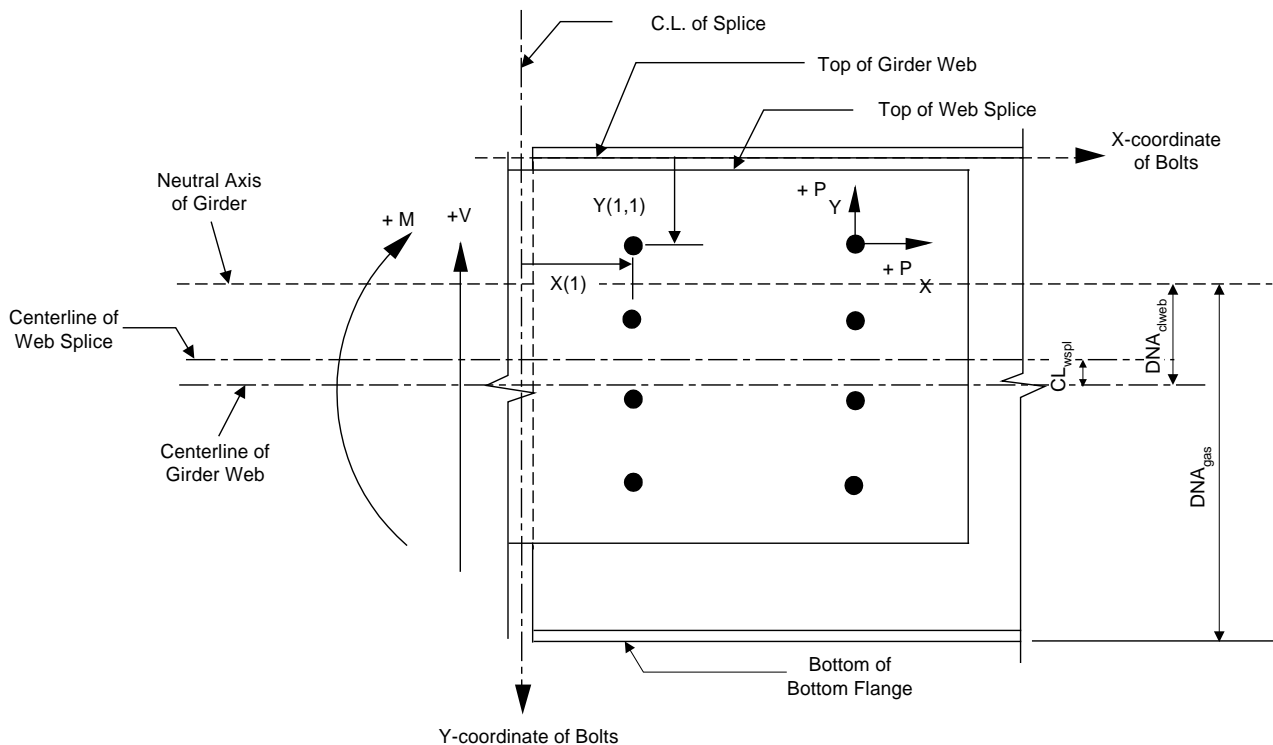


Figure 3.5-2 Adjacent Girder Section on Right Side of Splice Centerline and Sign Convention

### 3.5.10 Checking of Bolt Spacings in Web Splice and Flange Splice

The program checks the spacing of bolts in the web splice, top flange splice, and bottom flange splice according to LRFD Specifications Articles 6.13.2.6.1, 6.13.2.6.2, and 6.13.2.6.3. In particular, the following quantities are evaluated and checked against the limits set forth in the LRFD Specifications and DM-4.

For the web splice:

1. Minimum and maximum allowable bolt pitch, using the girder web and web splice plates.
2. Minimum and maximum allowable gage, using the girder web and web splice plates.
3. Minimum and maximum allowable end distances, using the girder web and web splice plates.
4. Minimum and maximum allowable edge distances, using the girder web and web splice plates.
5. Minimum actual bolt pitch for the girder web and web splice plates. These are checked against the minimum value of the quantities in Item 1.
6. Maximum actual bolt pitch for the girder web and web splice plates. These are checked against the maximum value of the quantities in Item 1.
7. Minimum actual bolt gage for the girder web and web splice plates. These are checked against the minimum value of the quantities in Item 2.
8. Maximum actual bolt gage for the girder web and web splice plates. These are checked against the maximum value of the quantities in Item 2.

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9. Minimum actual bolt end distance for the girder web and web splice plates. These are checked against the minimum value of the quantities in Item 3.
10. Maximum actual bolt end distance for the girder web and web splice plates. These are checked against the maximum value of the quantities in Item 3.
11. Minimum actual bolt edge distance for the girder web and web splice plates. These are checked against the minimum value of the quantities in Item 4.
12. Maximum actual bolt edge distance for the girder web and web splice plates. These are checked against the maximum value of the quantities in Item 4.

For the flange splice:

1. Minimum and maximum allowable bolt pitch, using the girder flange and flange splice plates.
2. Minimum and maximum allowable gage, using the girder flange and flange splice plates.
3. Minimum and maximum allowable end distances, using the girder flange and flange splice plates.
4. Minimum and maximum allowable edge distances, using the girder flange and flange splice plates.
5. Minimum actual bolt pitch for the girder flange and flange splice plates. These are checked against the minimum value of the quantities in Item 1.
6. Maximum actual bolt pitch for the girder flange and flange splice plates. These are checked against the maximum value of the quantities in Item 1.
7. Minimum actual bolt gage for the girder flange and flange splice plates. These are checked against the minimum value of the quantities in Item 2.
8. Maximum actual bolt gage for the girder flange and flange splice plates. These are checked against the maximum value of the quantities in Item 2.
9. Minimum actual bolt end distance for the girder flange and flange splice plates. These are checked against the minimum value of the quantities in Item 3.
10. Maximum actual bolt end distance for the girder flange and flange splice plates. These are checked against the maximum value of the quantities in Item 3.
11. Minimum actual bolt edge distance for the girder flange and flange splice plates. These are checked against the minimum value of the quantities in Item 4.
12. Maximum actual bolt edge distance for the girder flange and flange splice plates. These are checked against the maximum value of the quantities in Item 4.

It should be noted that if failure is detected in the Maximum Actual Bolt Gage for the Flange Splice Plates spacing, with CTL Parameters 7 or 11 set to Flange Design, and CTL Parameters 10 or 14 set to increase the splice plate thickness, then the program will try to increase the flange splice plate thickness to correct the spacing failure.

For all other bolt spacing checks shown above, the program does not take any corrective measures. In case of failure, the program continues execution after issuing a warning message.

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### 3.5.11 Checking Block Shear

Block shear analysis in the splice plates is not performed by the program for a design or an analysis problem though it is not considered during the design loop. The following section outlines the procedure used by the program to check for block shear failure.

#### Equations for block shear

$$R_{r(Avn)} = \phi_{bs} R_p (0.58 * F_y A_{vn} + U_{bs} F_u * A_{tn})$$

$$R_{r(Avg)} = \phi_{bs} R_p (0.58 * F_y A_{vg} + U_{bs} F_u * A_{tn})$$

$$R_r = R_{r(Avn)} \leq R_{r(Avg)}$$

Where:

$U_{bs} = 1.0$  as splices are assumed to be not coped

$R_p = 1.0$  as all holes are assumed to be either drilled full size or subpunched and reamed to size

$\phi_{bs} = 0.8$  for block shear (A6.5.4.2)

#### Staggered bolt pattern equations for flanges and flange splice plates

For staggered bolts the number of gage lines determines which end distances are used.

If the number of gage lines on one side of the centerline of the web is odd then the end distance is greatest splice distance. The program assumes the number of bolts per gage line is equal between all gage lines on one side of the splice otherwise an informational message is issued.

While the SPLRFD program does not currently allow a user to dimension chamfers on the ends of the splice plates, it is assumed that in practice this chamfering may occur. The SPLRFD program assumes that the resisting shear region ends at the bolt hole nearest the chamfer.

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#### 3.5.11.1 Flange Splice Plates – Staggered Bolts - Straight Tension

##### Double L - Condition #1

(Odd No. Gage Lines and Even No. Pitch Lines shown)

(Odd No. Gage Lines and Odd No. Pitch Lines would be similar without the right most pitch line of bolts)

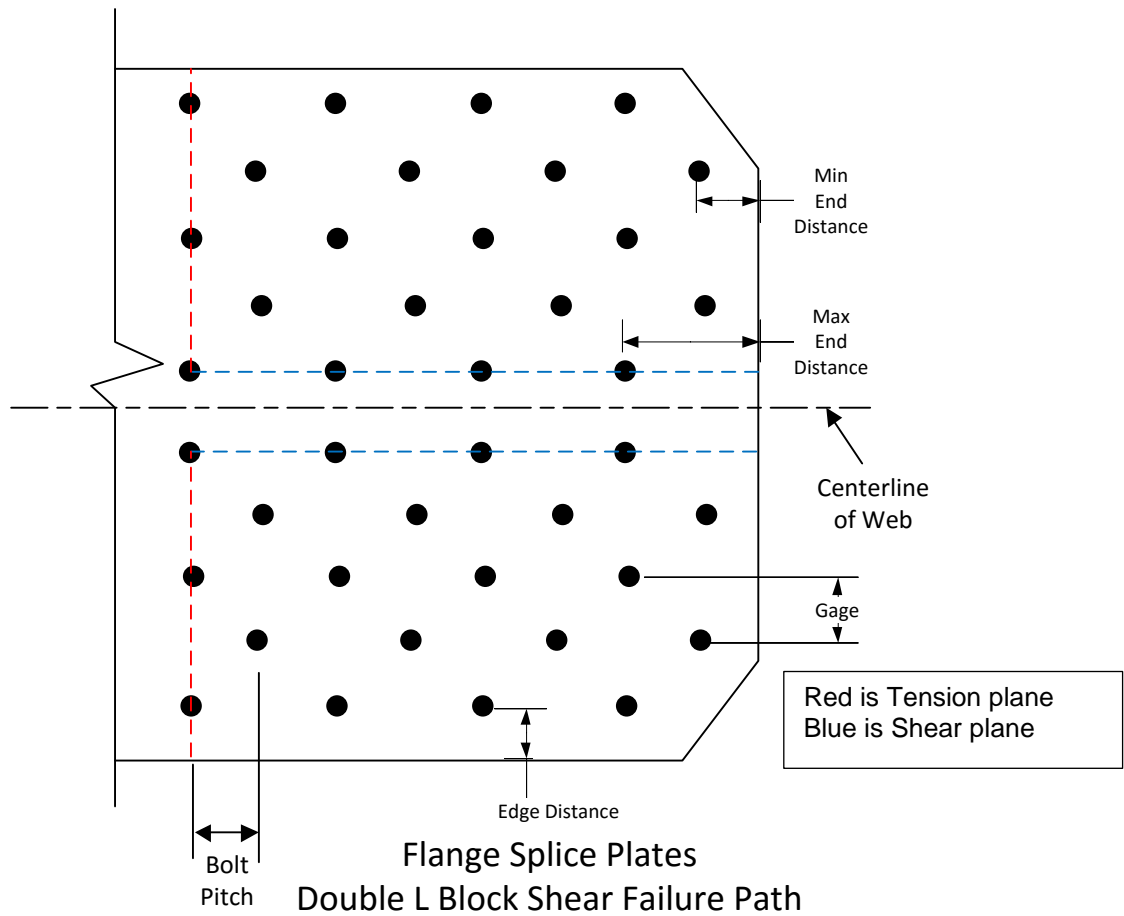


Figure 3.5.11-1 Flange Splice Plates – L-L Straight Tension Failure Path– Condition #1

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Double L - Condition #2

(Even No. Gage Lines and Even No. Pitch Lines shown)

(Even No. Gage Lines and Odd No. Pitch Lines would be similar without the right most pitch line of bolts)

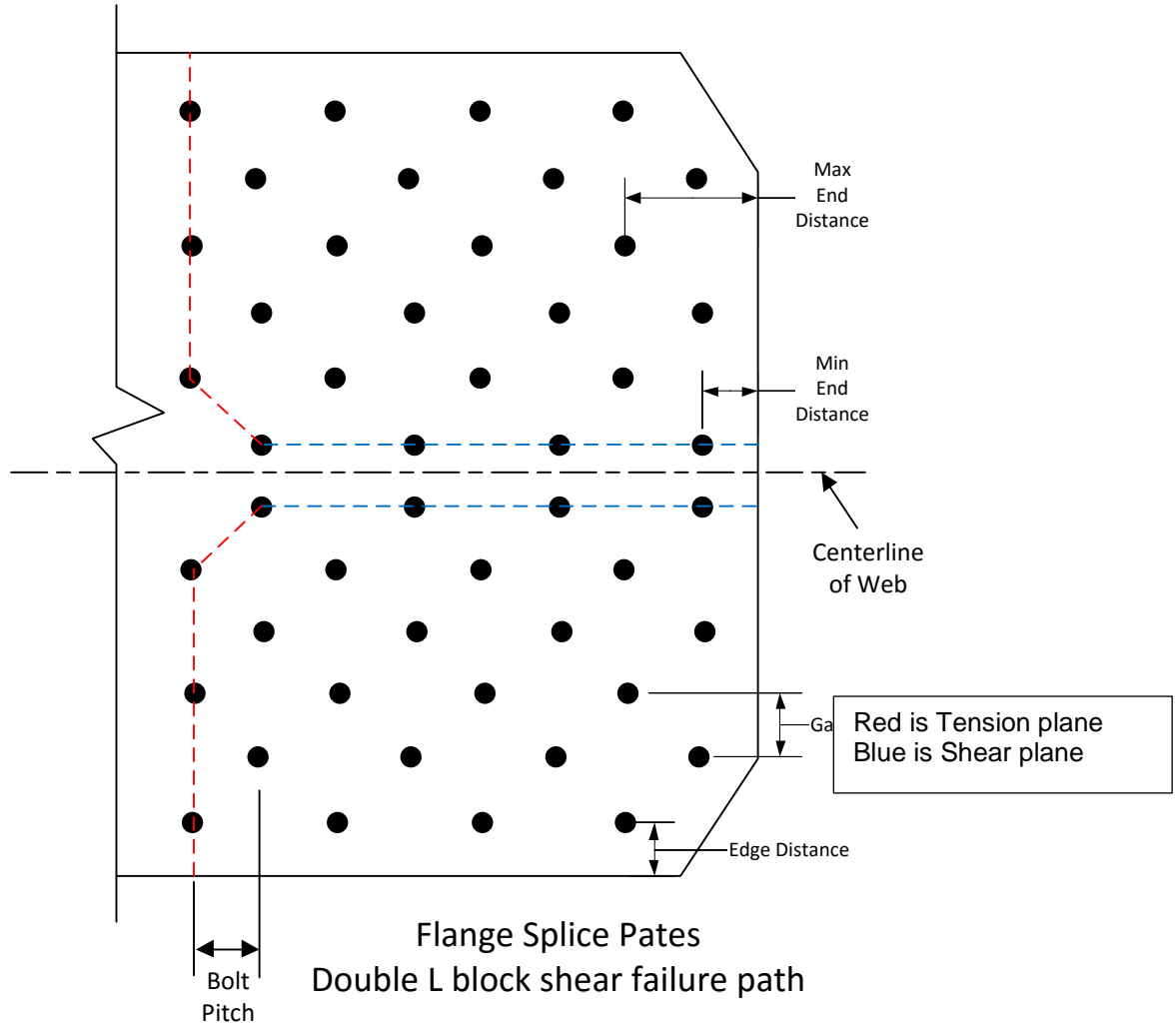


Figure 3.5.11-2 Flange Splice Plates – L-L Straight Tension Failure Path– Condition #2

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$$\text{Bolts per line} = \text{BLTPL} = \frac{N_{bolts}}{N_{gl}}$$

		Number of Pitch Lines on one side of splice	
		Even	Odd
Number of Gage Lines on one side of splice	Even	Condition #2 EndDist = Min End Distance	Condition #2 EndDist = Max End Distance
	Odd	Condition #1 EndDist = Max End Distance	Condition #1 EndDist = Min End Distance

If  $GAGE_{bolts} > 2 * DIA_{hl}$

$$NBoltsV = 2 * (BLTPL - 0.5)$$

If  $GAGE_{bolts} \leq 2 * DIA_{hl}$

If  $N_{gl} \geq 4$

(Odd number of gage lines on one side of splice)

$$NBoltsV = 2 * (2 * BLTPL - 0.5)$$

(Even number of gage lines on one side of splice)

$$NBoltsV = 2 * (2 * BLTPL - 1.5)$$

If  $N_{gl} < 4$

$$NBoltsV = 2 * (BLTPL - 0.5)$$

Gross Area along plane resisting shear stress

$$A_{gv} = 2 * \{(BLTPL - 1) * (2 * PITCH_{bolts}) + EndDist\} * T$$

Net Area along plane resisting shear stress per AASHTO 6.13.4

$$A_{nv} = A_{gv} - (NBoltsV * DIA_{hl} * T)$$

Net Area along plane resisting tension stress

Odd number of Gage Lines on one side of splice

$$NBoltsT = 2 * \left(\frac{N_{gl}}{4}\right)$$

$$A_{nt} = \left\{2 * \left\{\left(\frac{N_{gl}}{2} - 1\right) * (GAGE_{bolts}) + EdgeDist\right\} - (NBoltsT * DIA_{hl})\right\} * T$$

Even number of Gage Lines on one side of splice

$$NBoltsT = 2 * \left(\frac{N_{gl}}{4} + 0.5\right)$$

$$A_{nt} = \left\{2 * \left\{\left(\frac{PITCH_{bolts}^2}{4 * GAGE_{bolts}}\right) + \left(\left(\frac{N_{gl}}{2} - 1\right) * GAGE_{bolts}\right) + EdgeDist\right\} - (NBoltsT * DIA_{hl})\right\} * T$$

### Chapter 3 - Method of Solution

#### Double U - Condition #1

(Odd No. Gage Lines and Even No. Pitch Lines shown)

(Odd No. Gage Lines and Odd No. Pitch Lines would be similar without the right most pitch line of bolts)

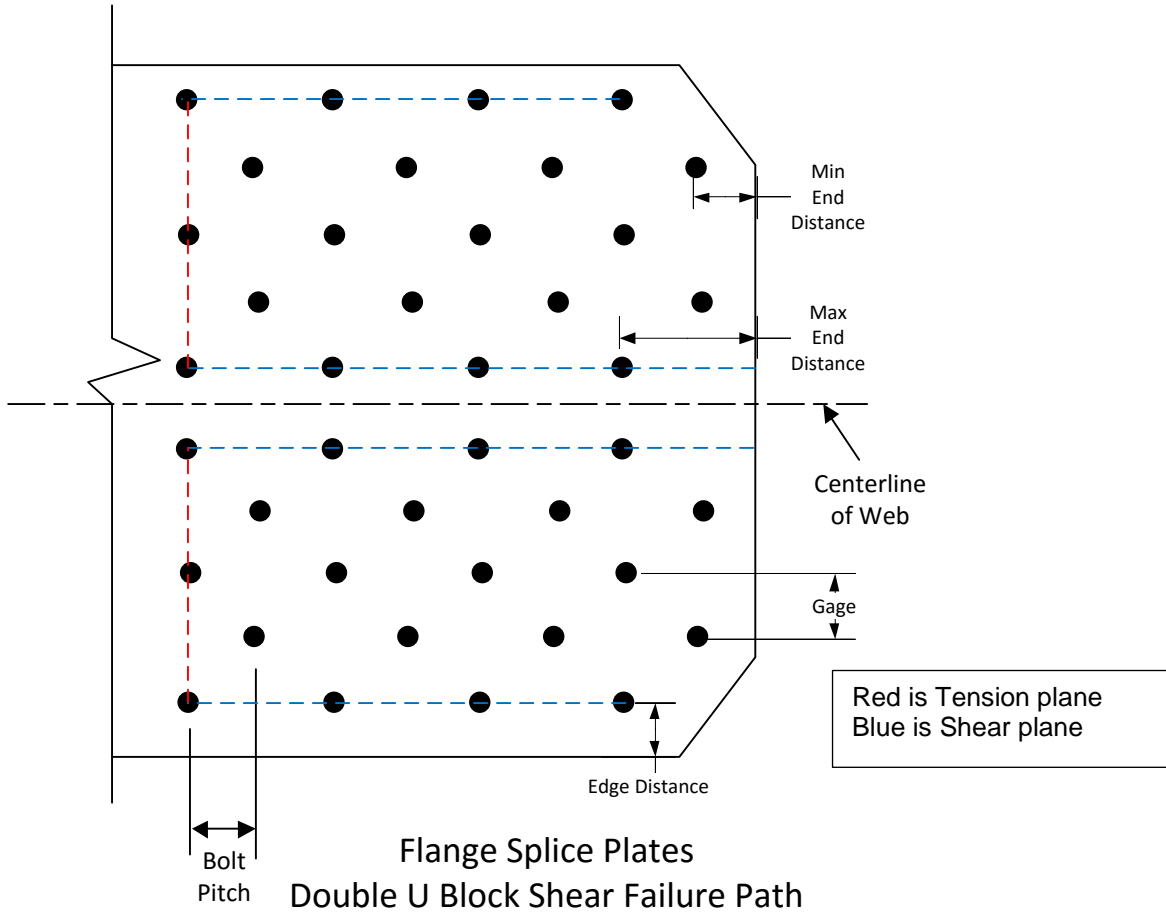


Figure 3.5.11-3 Flange Splice Plates – U-U Straight Tension Failure Path– Condition #1

### Chapter 3 - Method of Solution

#### Double U - Condition # 2

(Even No. Gage Lines and Even No. Pitch Lines shown)

(Even No. Gage Lines and Odd No. Pitch Lines would be similar without the right most pitch line of bolts)

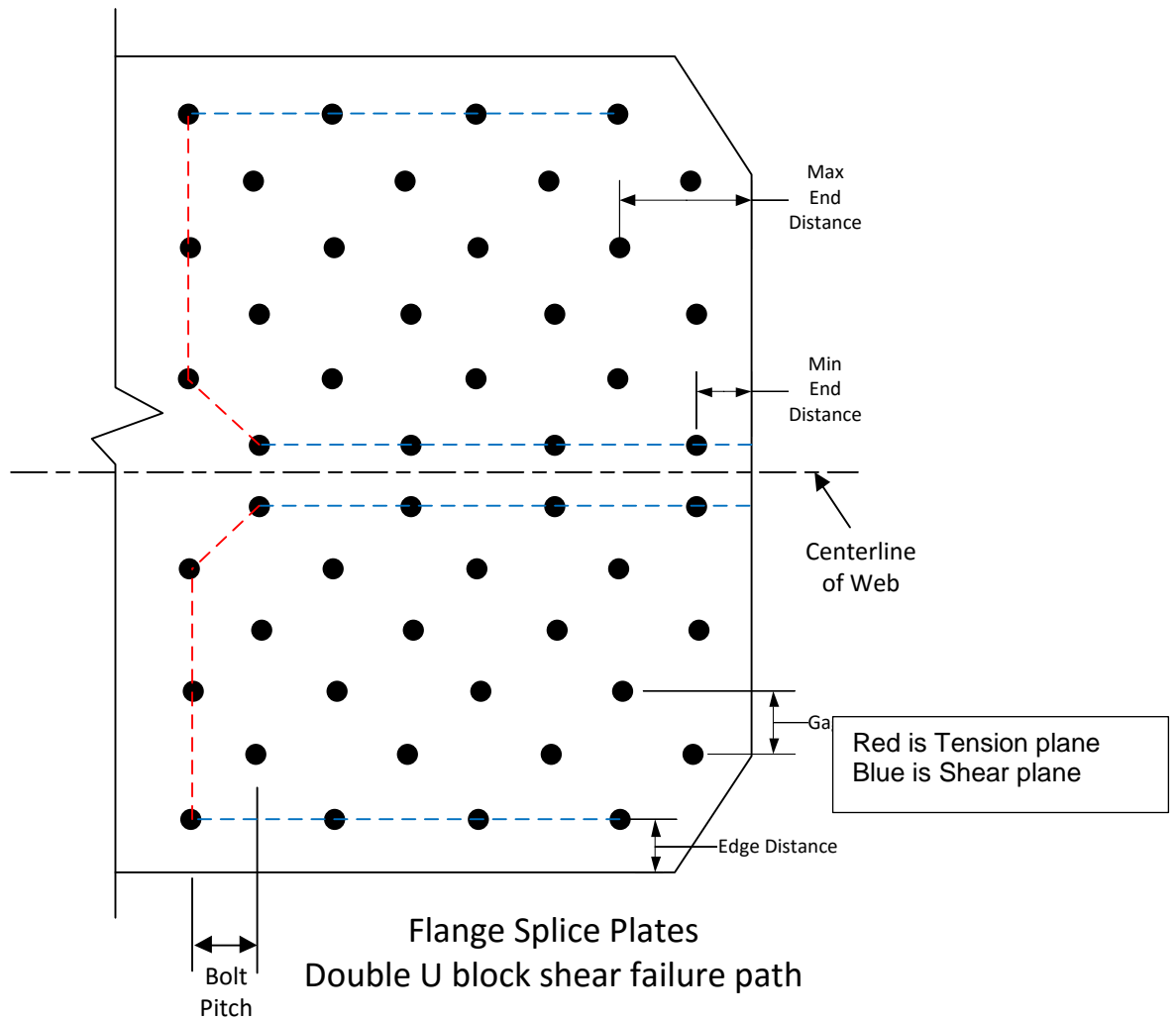


Figure 3.5.11-4 Flange Splice Plates – U-U Straight Tension Failure Path– Condition #2

### Chapter 3 - Method of Solution

While the SPLRFD program does not currently allow a user to dimension chamfers on the ends of the splice plates, it is assumed that in practice this chamfering may occur. The SPLRFD program assumes that the resisting shear region ends at the bolt hole nearest the chamfer.

$$\text{Bolts per line} = \text{BLTPL} = \frac{N_{bolts}}{N_{gl}}$$

		Number of Pitch Lines on one side of splice	
		Even	Odd
Number of Gage Lines on one side of splice	Even	Condition #2 EndDist = Min End Distance	Condition #2 EndDist = Min End Distance + Max End Distance
	Odd	Condition #1 EndDist = Max End Distance	Condition #1 EndDist = 2*Min End Distance

If  $GAGE_{bolts} > 2 * DIA_{hl}$

$$NBoltsV = 2 * (2 * BLTPL - 1)$$

If  $GAGE_{bolts} \leq 2 * DIA_{hl}$

If  $N_{gl} \geq 8$

$$NBoltsV = 2 * (4 * BLTPL - 1) \quad (\text{Condition \#1})$$

$$NBoltsV = 2 * (4 * BLTPL - 2) \quad (\text{Condition \#2})$$

If  $N_{gl} < 8$

$$NBoltsV = 2 * \left( \frac{N_{gl}}{2} * BLTPL - 1 \right)$$

Gross Area along plane resisting shear stress

$$A_{gv} = \{ 2 * \{ 2 * [(BLTPL - 1) * (2 * PITCH_{bolts})] + EndDist \} \} * T$$

Net Area along plane resisting shear stress per AASHTO 6.13.4

$$A_{nv} = A_{gv} - (NBoltsV * DIA_{hl} * T)$$

Net Area along plane resisting tension stress

Odd number of Gage Lines on one side of splice

$$NBoltsT = 2 * \left( \frac{N_{gl}}{4} - 0.5 \right)$$

$$A_{nt} = \left\{ 2 * \left\{ \left( \frac{N_{gl}}{2} - 1 \right) * (GAGE_{bolts}) \right\} - (NBoltsT * DIA_{hl}) \right\} * T$$

Even number of Gage Lines on one side of splice

$$NBoltsT = 2 * \left( \frac{N_{gl}}{4} \right)$$

$$A_{nt} = \left\{ 2 * \left\{ \left( \frac{PITCH_{bolts}^2}{4 * GAGE_{bolts}} \right) + \left( \left( \frac{N_{gl}}{2} - 1 \right) * GAGE_{bolts} \right) \right\} - (NBoltsT * DIA_{hl}) \right\} * T$$

### Chapter 3 - Method of Solution

#### 3.5.11.2 Flange Splice Plates – Staggered Bolts - Staggered Tension

##### Double L – Condition #1

(Odd No. Gage Lines and Even No. Pitch Lines shown)

(Odd No. Gage Lines and Odd No. Pitch Lines would be similar without the right most pitch line of bolts)

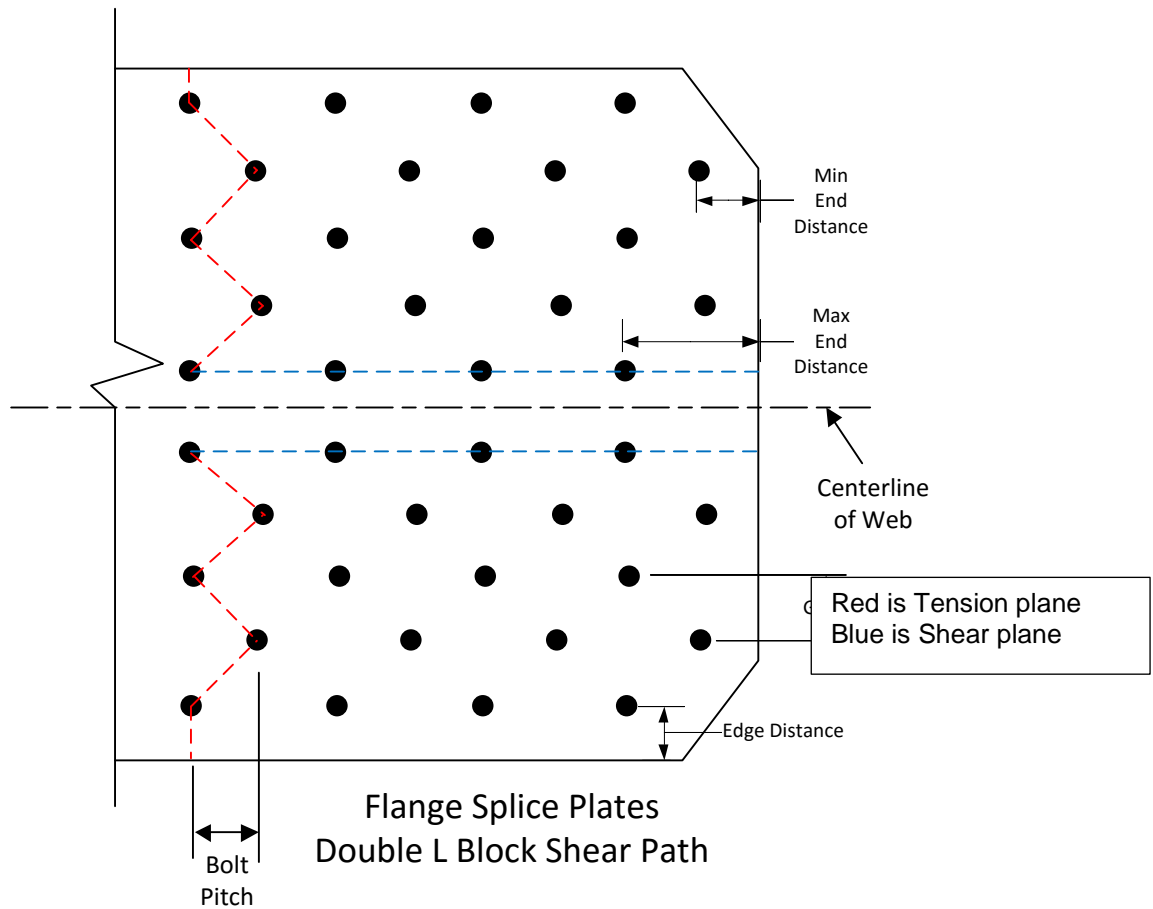


Figure 3.5.11-5 Flange Splice Plates – L-L Staggered Tension Failure Path– Condition #1

### Chapter 3 - Method of Solution

#### Double L – Condition #2

(Even No. Gage Lines and Even No. Pitch Lines shown)

(Even No. Gage Lines and Odd No. Pitch Lines would be similar without the right most pitch line of bolts)

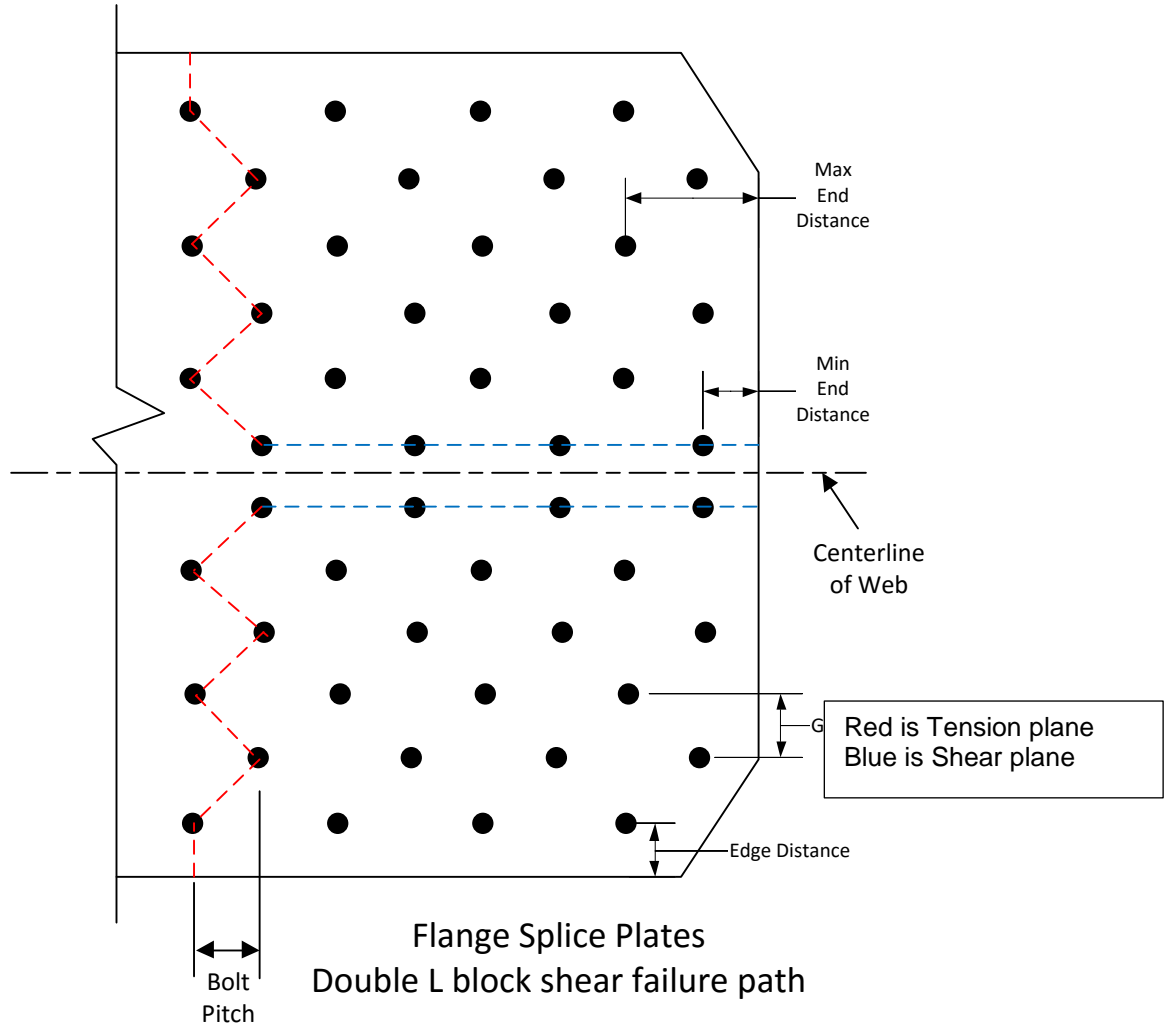


Figure 3.5.11-6 Flange Splice Plates – L-L Staggered Tension Failure Path– Condition #2

### Chapter 3 - Method of Solution

$$\text{Bolts per line} = \text{BLTPL} = \frac{N_{bolts}}{N_{gl}}$$

		Number of Pitch Lines on one side of splice	
		Even	Odd
Number of Gage Lines on one side of splice	Even	Condition #2 EndDist = Min End Distance	Condition #2 EndDist = Max End Distance
	Odd	Condition #1 EndDist = Max End Distance	Condition #1 EndDist = Min End Distance

If  $GAGE_{bolts} > 2 * DIA_{hl}$

$$NBoltsV = 2 * (BLTPL - 0.5)$$

If  $GAGE_{bolts} \leq 2 * DIA_{hl}$

$$NBoltsV = 2 * (2 * BLTPL - 1.5)$$

Gross Area along plane resisting shear stress

$$A_{gv} = \{2 * \{(BLTPL - 1) * (2 * PITCH_{bolts}) + EndDist\}\} * T$$

Net Area along plane resisting shear stress per AASHTO 6.13.4

$$A_{nv} = A_{gv} - (NBoltsV * DIA_{hl} * T)$$

Net Area along plane resisting tension stress

$$NBoltsT = 2 * \left(\frac{N_{gl}}{2} - 0.5\right)$$

$$A_{nt} = \left\{2 * \left\{\left(\frac{N_{gl}}{2} - 1\right) * \left(\frac{PITCH_{bolts}^2}{4 * GAGE_{bolts}}\right) + \left(\left(\frac{N_{gl}}{2} - 1\right) * GAGE_{bolts}\right) + EdgeDist\right\} - (NBoltsT * DIA_{hl})\right\} * T$$

### Chapter 3 - Method of Solution

#### Double U – Condition #1

(Odd No. Gage Lines and Even No. Pitch Lines shown)

(Odd No. Gage Lines and Odd No. Pitch Lines would be similar without the right most pitch line of bolts)

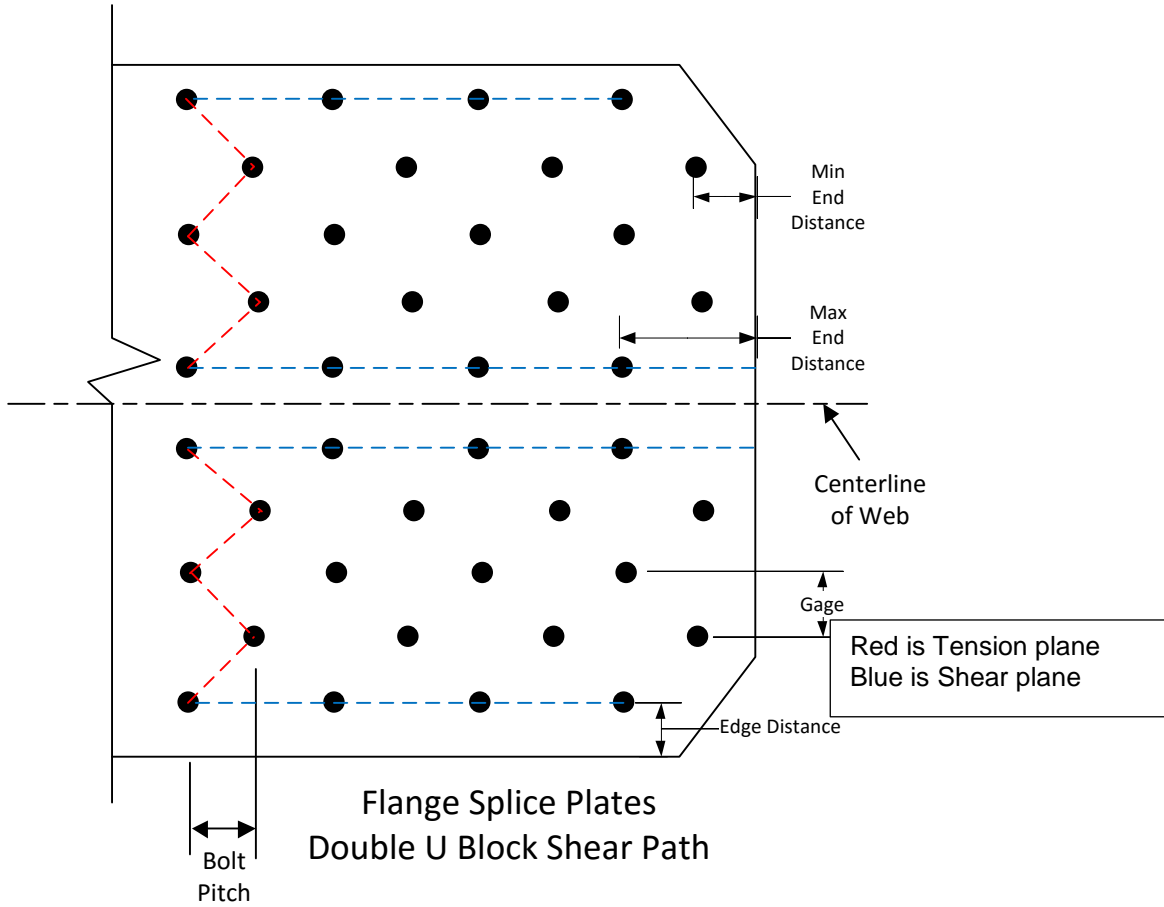


Figure 3.5.11-7 Flange Splice Plates – U-U Staggered Tension Failure Path– Condition #1

### Chapter 3 - Method of Solution

#### Double U – Condition #2

(Even No. Gage Lines and Even No. Pitch Lines shown)

(Even No. Gage Lines and Odd No. Pitch Lines would be similar without the right most pitch line of bolts)

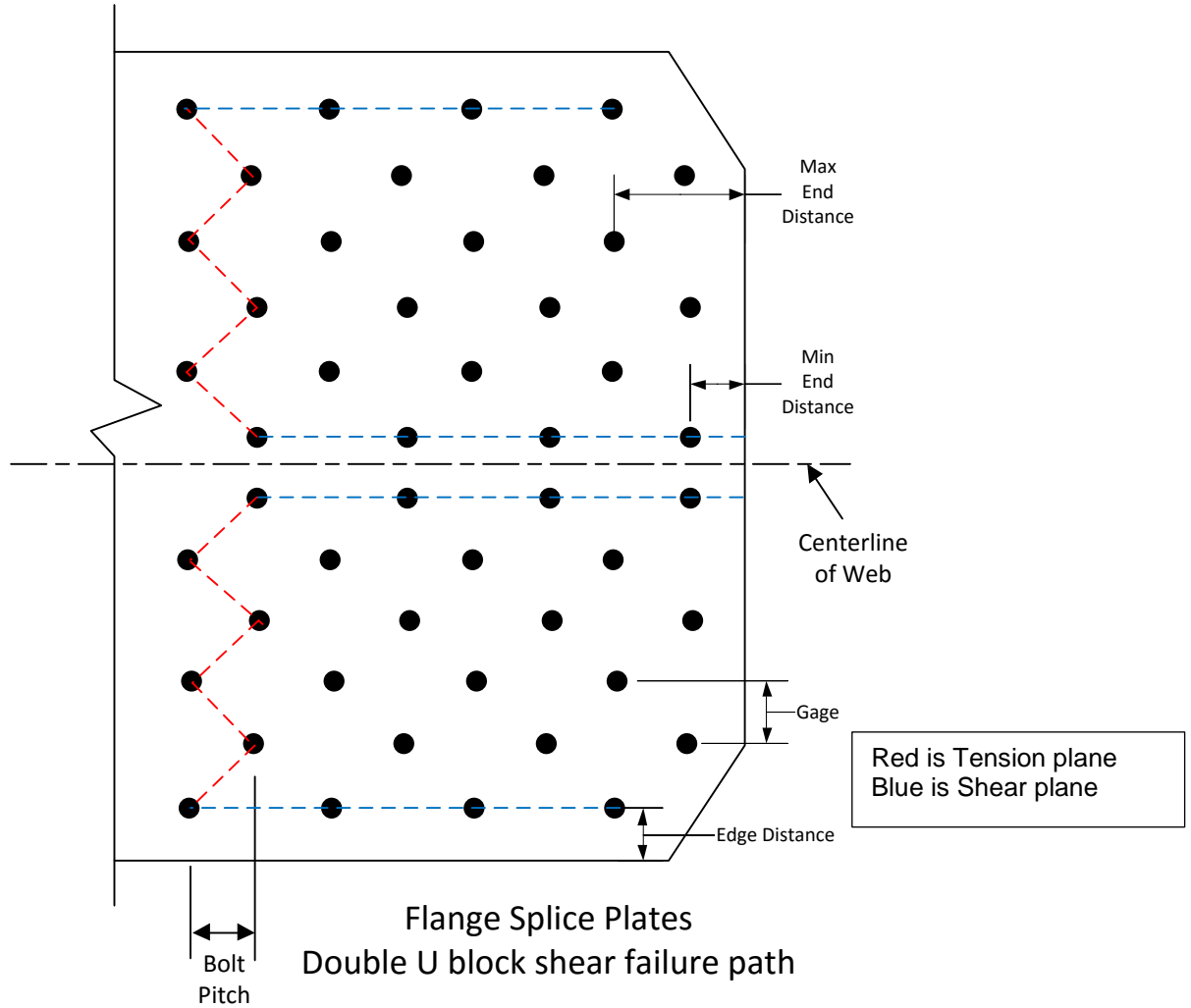


Figure 3.5.11-8 Flange Splice Plates – U-U Staggered Tension Failure Path– Condition #2

### Chapter 3 - Method of Solution

While the SPLRFD program does not currently allow a user to dimension chamfers on the ends of the splice plates, it is assumed that in practice this chamfering may occur. The SPLRFD program assumes that the resisting shear region ends at the bolt hole nearest the chamfer.

$$\text{Bolts per line} = \text{BLTPL} = \frac{N_{bolts}}{N_{gl}}$$

		Number of Pitch Lines on one side of splice	
		Even	Odd
Number of Gage Lines on one side of splice	Even	Condition #2 EndDist = Min End Distance	Condition #2 EndDist = Min End Distance + Max End Distance
	Odd	Condition #1 EndDist = Max End Distance	Condition #1 EndDist = 2*Min End Distance

If  $GAGE_{bolts} > 2 * DIA_{hl}$

$$NBoltsV = 2 * (2 * BLTPL - 1)$$

If  $GAGE_{bolts} \leq 2 * DIA_{hl}$

If  $N_{gl} \geq 8$

$$NBoltsV = 2 * (4 * BLTPL - 3)$$

If  $N_{gl} = 6$

$$NBoltsV = 2 * \left( \frac{N_{gl}}{2} * BLTPL - 2 \right)$$

If  $N_{gl} = 4$

$$NBoltsV = 2 * \left( \frac{N_{gl}}{2} * BLTPL - 1 \right)$$

Gross Area along plane resisting shear stress

$$A_{gv} = \{2 * [2 * [(BLTPL - 1) * (2 * PITCH_{bolts})] + EndDist]\} * T$$

Net Area along plane resisting shear stress per AASHTO 6.13.4

$$A_{nv} = A_{gv} - (NBoltsV * DIA_{hl} * T)$$

Net Area along plane resisting tension stress

$$NBoltsT = 2 * \left( \frac{N_{gl}}{2} - 1.0 \right)$$

$$A_{nt} = \left\{ 2 * \left\{ \left( \frac{N_{gl}}{2} - 1 \right) * \left( \frac{PITCH_{bolts}^2}{4 * GAGE_{bolts}} \right) + \left( \left( \frac{N_{gl}}{2} - 1 \right) * GAGE_{bolts} \right) \right\} - (NBoltsT * DIA_{hl}) \right\} * T$$

### Chapter 3 - Method of Solution

#### 3.5.11.3 Flanges - Staggered Bolts – Straight Tension Plane

##### Double L – Condition #1

(Odd No. Gage Lines and Even No. Pitch Lines shown)

(Odd No. Gage Lines and Odd No. Pitch Lines would be similar without the left most pitch line of bolts)

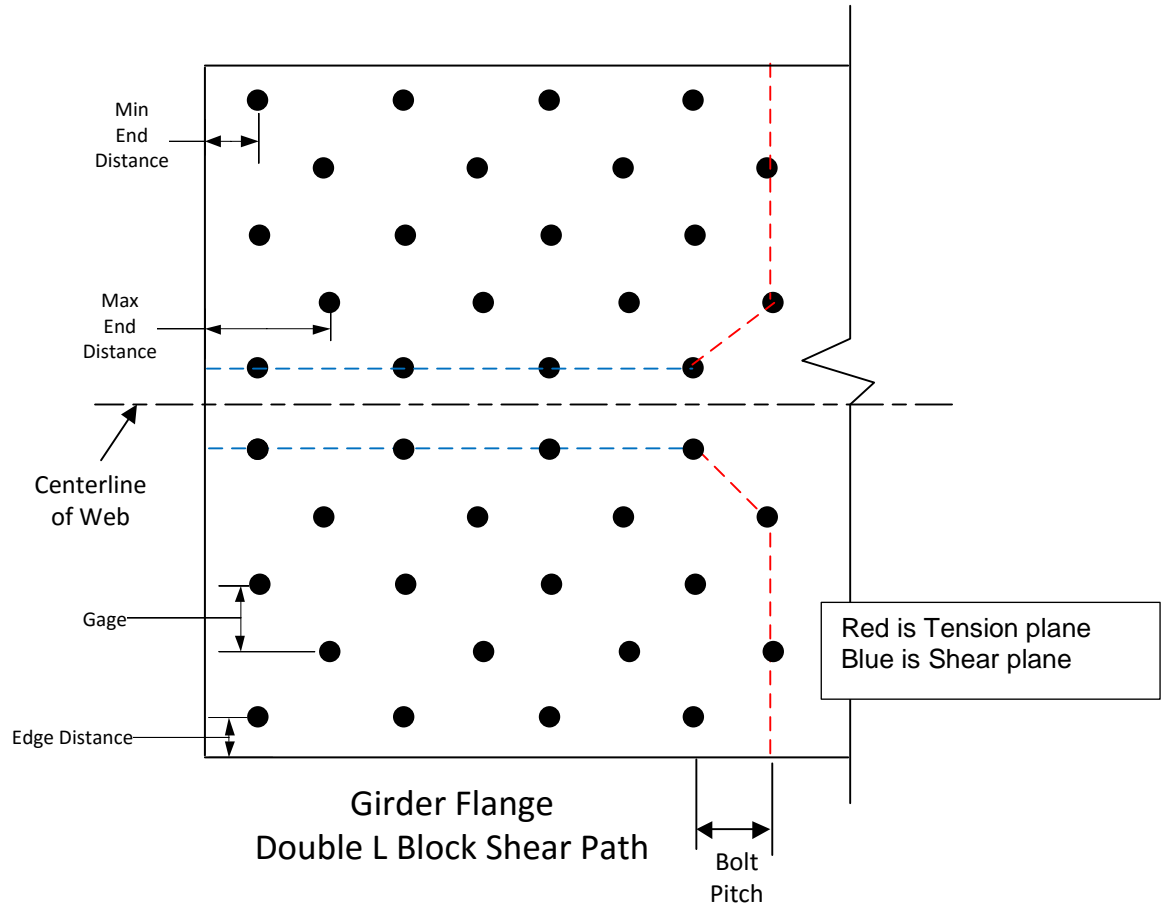


Figure 3.5.11-9 Flange – L-L Straight Tension Failure Path– Condition #1

### Chapter 3 - Method of Solution

#### Double L – Condition #2

(Even No. Gage Lines and Even No. Pitch Lines shown)

(Even No. Gage Lines and Odd No. Pitch Lines would be similar without the left most pitch line of bolts)

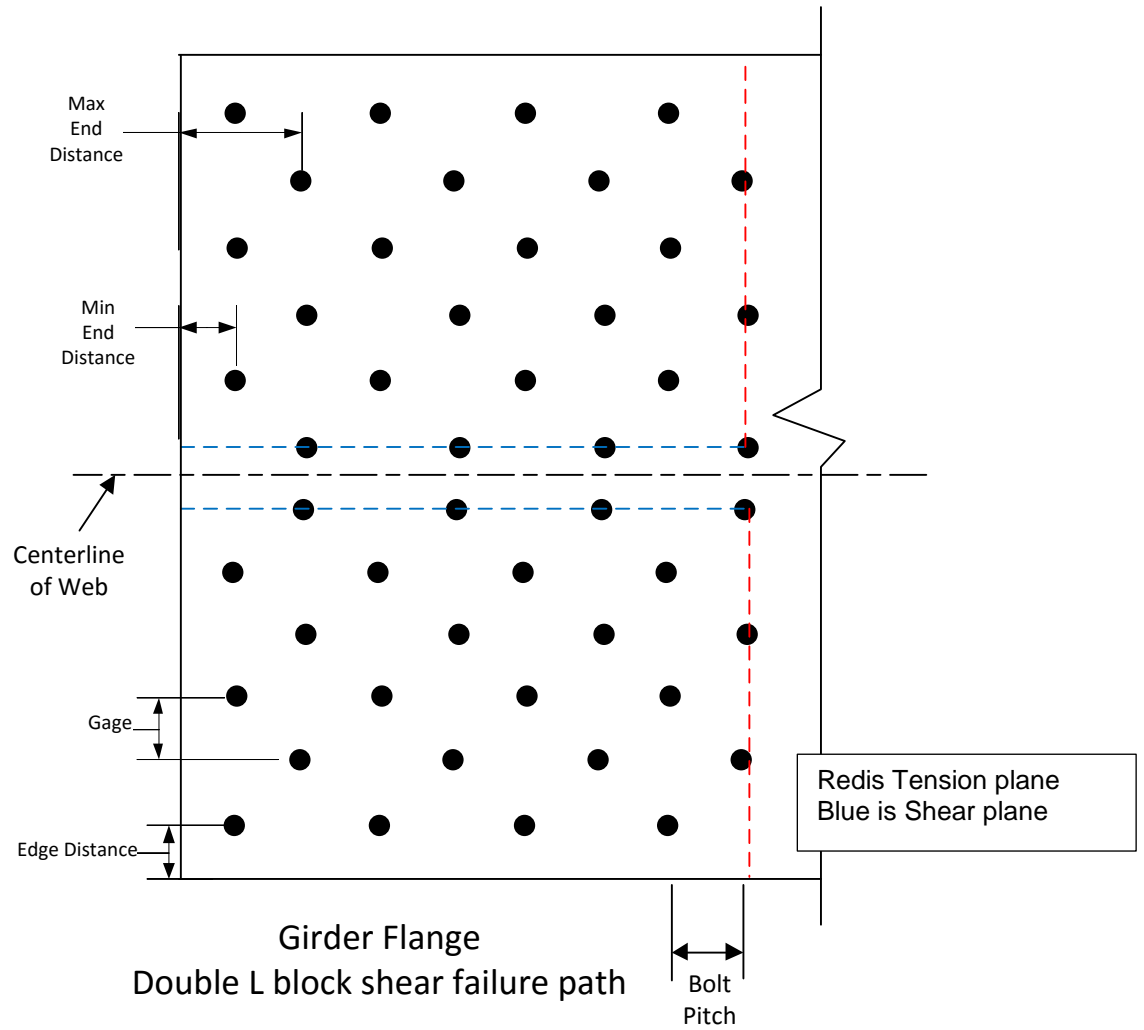


Figure 3.5.11-10

Flange – L-L Straight Tension Failure Path– Condition #2

### Chapter 3 - Method of Solution

$$\text{Bolts per line} = \text{BLTPL} = \frac{N_{bolts}}{N_{gl}}$$

		Number of Pitch Lines on one side of splice	
		Even	Odd
Number of Gage Lines on one side of splice	Even	Condition #2 EndDist = Max End Distance	Condition #2 EndDist = Min End Distance
	Odd	Condition #1 EndDist = Min End Distance	Condition #1 EndDist = Max End Distance

If  $GAGE_{bolts} > 2 * DIA_{hl}$

$$NBoltsV = 2 * (BLTPL - 0.5)$$

If  $GAGE_{bolts} \leq 2 * DIA_{hl}$

$$NBoltsV = 2 * (2 * BLTPL - 1.5) \text{ (Condition \#1)}$$

$$NBoltsV = 2 * (2 * BLTPL - 0.5) \text{ (Condition \#2)}$$

Gross Area along plane resisting shear stress

$$A_{gv} = \{2 * \{(BLTPL - 1) * (2 * PITCH_{bolts}) + EndDist\} * T$$

Net Area along plane resisting shear stress per AASHTO 6.13.4

$$A_{nv} = A_{gv} - (NBoltsV * DIA_{hl} * T)$$

Net Area along plane resisting tension stress

Odd number of Gage Lines on one side of splice

$$NBoltsT = 2 * \left(\frac{N_{gl}}{4}\right)$$

$$A_{nt} = \left\{2 * \left\{\left(\frac{PITCH_{bolts}^2}{4 * GAGE_{bolts}}\right) + \left(\left(\frac{N_{gl}}{2} - 1\right) * GAGE_{bolts}\right) + EdgeDist\right\} - (NBoltsT * DIA_{hl})\right\} * T$$

Even number of Gage Lines on one side of splice

$$NBoltsT = 2 * \left(\frac{N_{gl}}{4} + 0.5\right)$$

$$A_{nt} = \left\{2 * \left\{\left(\frac{N_{gl}}{2} - 1\right) * (GAGE_{bolts}) + EdgeDist\right\} - (NBoltsT * DIA_{hl})\right\} * T$$

### Chapter 3 - Method of Solution

#### Double U – Condition #1

(Odd No. Gage Lines and Even No. Pitch Lines shown)

(Odd No. Gage Lines and Odd No. Pitch Lines would be similar without the left most pitch line of bolts)

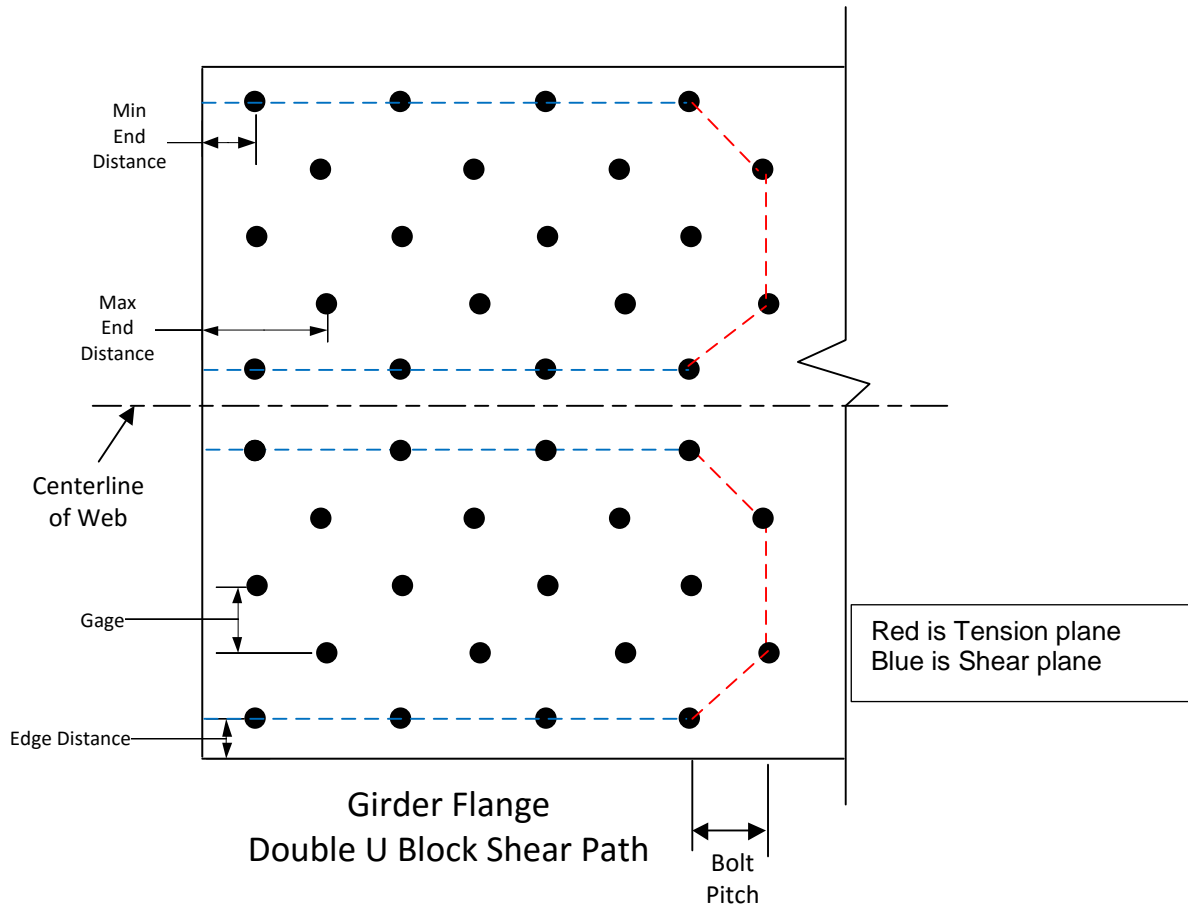


Figure 3.5.11-11

Flange – U-U Straight Tension Failure Path– Condition #1

### Chapter 3 - Method of Solution

#### Double U – Condition #2

(Even No. Gage Lines and Even No. Pitch Lines shown)

(Even No. Gage Lines and Odd No. Pitch Lines would be similar without the left most pitch line of bolts)

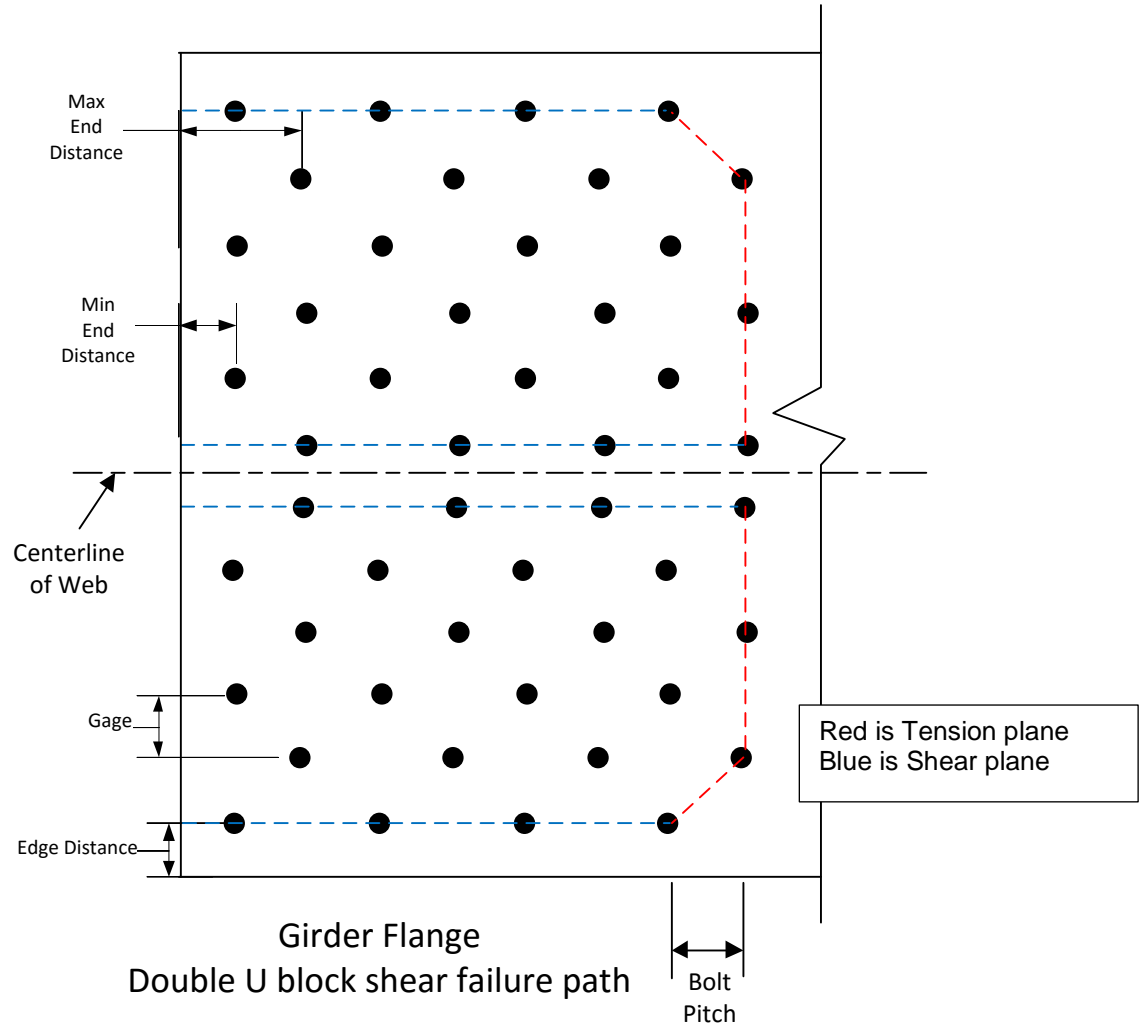


Figure 3.5.11-12

Flange – U-U Straight Tension Failure Path– Condition #2

### Chapter 3 - Method of Solution

$$\text{Bolts per line} = \text{BLTPL} = \frac{N_{bolts}}{N_{gl}}$$

		Number of Pitch Lines on one side of splice	
		Even	Odd
Number of Gage Lines on one side of splice	Even	Condition #2 EndDist = Min End Distance + Max End Distance	Condition #2 EndDist = Min End Distance + Max End Distance
	Odd	Condition #1 EndDist = 2*Min End Distance	Condition #1 EndDist = 2*Max End Distance

If  $GAGE_{bolts} > 2 * DIA_{hl}$

$$NBoltsV = 2 * (2 * \text{BLTPL} - 1)$$

If  $GAGE_{bolts} \leq 2 * DIA_{hl}$

If  $N_{gl} \geq 8$

$$NBoltsV = 2 * (4 * \text{BLTPL} - 3) \text{ (Condition \# 1)}$$

$$NBoltsV = 2 * (4 * \text{BLTPL} - 2) \text{ (Condition \# 2)}$$

If  $N_{gl} < 8$

$$NBoltsV = 2 * \left( \frac{N_{gl}}{2} * \text{BLTPL} - 1 \right)$$

Gross Area along plane resisting shear stress

$$A_{gv} = \{ 2 * \{ 2 * [(\text{BLTPL} - 1) * (2 * \text{PITCH}_{bolts})] + \text{EndDist} \} * T$$

Net Area along plane resisting shear stress per AASHTO 6.13.4

$$A_{nv} = A_{gv} - (NBoltsV * DIA_{hl} * T)$$

Net Area along plane resisting tension stress

Odd number of Gage Lines on one side of splice

$$NBoltsT = 2 * \left( \frac{N_{gl}}{4} - 0.5 \right)$$

$$A_{nt} = \left\{ 2 * \left\{ \left( \frac{N_{gl}}{2} - 1 \right) * (GAGE_{bolts}) \right\} - (NBoltsT * DIA_{hl}) \right\} * T$$

Even number of Gage Lines on one side of splice

$$NBoltsT = 2 * \left( \frac{N_{gl}}{4} \right)$$

$$A_{nt} = \left\{ 2 * \left\{ \left( \frac{\text{PITCH}_{bolts}^2}{4 * GAGE_{bolts}} \right) + \left( \left( \frac{N_{gl}}{2} - 1 \right) * GAGE_{bolts} \right) \right\} - (NBoltsT * DIA_{hl}) \right\} * T$$

### Chapter 3 - Method of Solution

#### 3.5.11.4 Flanges - Staggered Bolts – Staggered Tension Plane

##### Double L – Condition #1

(Odd No. Gage Lines and Even No. Pitch Lines shown)

(Odd No. Gage Lines and Odd No. Pitch Lines would be similar without the left most pitch line of bolts)

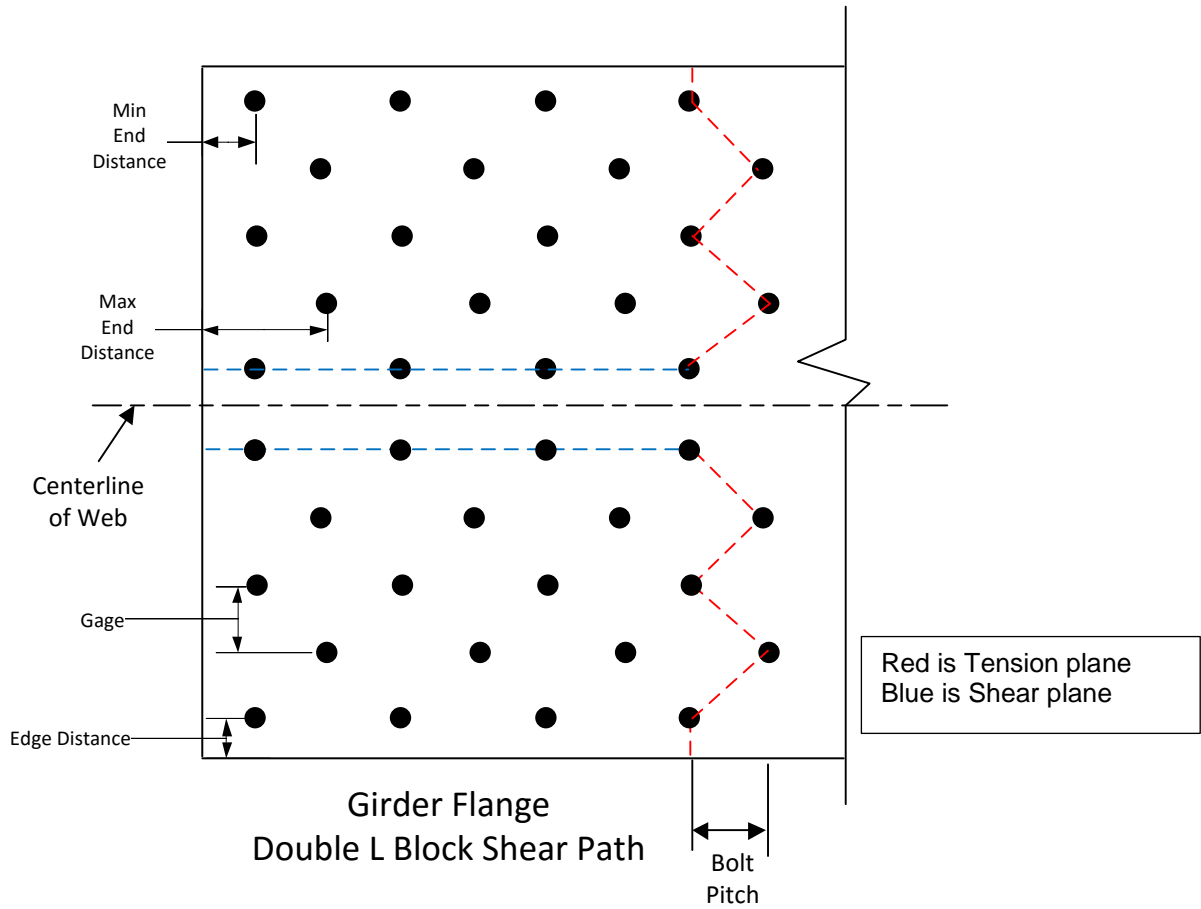


Figure 3.5.11-13

Flange – L-L Staggered Tension Failure Path– Condition #1

### Chapter 3 - Method of Solution

#### Double L – Condition #2

(Even No. Gage Lines and Even No. Pitch Lines shown)

(Even No. Gage Lines and Odd No. Pitch Lines would be similar without the left most pitch line of bolts)

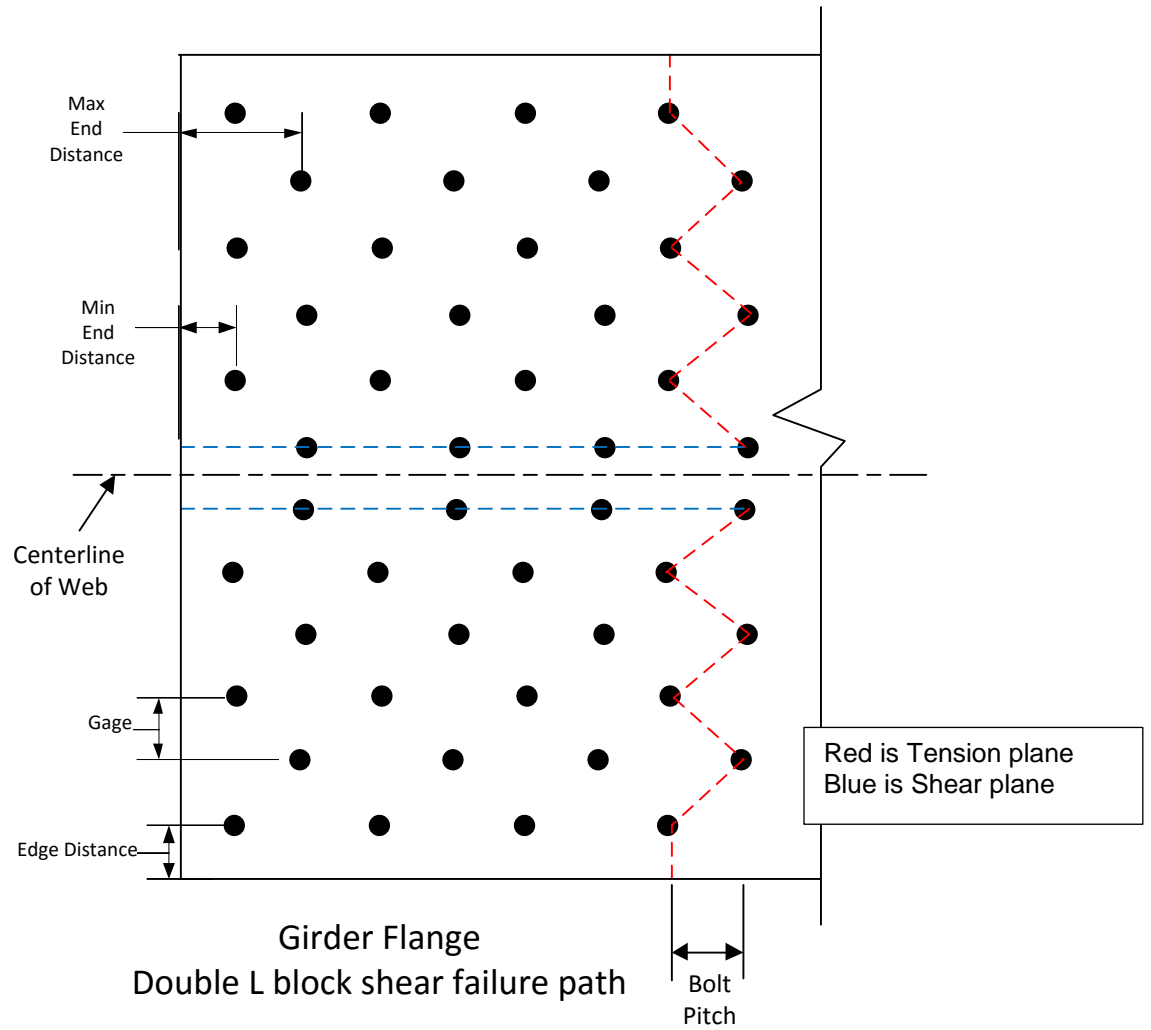


Figure 3.5.11-14

Flange – L-L Staggered Tension Failure Path– Condition #2

### Chapter 3 - Method of Solution

$$\text{Bolts per line} = \text{BLTPL} = \frac{N_{bolts}}{N_{gl}}$$

		Number of Pitch Lines on one side of splice	
		Even	Odd
Number of Gage Lines on one side of splice	Even	Condition #2 EndDist = Max End Distance	Condition #2 EndDist = Min End Distance
	Odd	Condition #1 EndDist = Min End Distance	Condition #1 EndDist = Max End Distance

If  $GAGE_{bolts} > 2 * DIA_{hl}$

$$NBoltsV = 2 * (BLTPL - 0.5)$$

If  $GAGE_{bolts} \leq 2 * DIA_{hl}$

$$NBoltsV = 2 * (2 * BLTPL - 1.5)$$

#### Gross Area along plane resisting shear stress

$$A_{gv} = \{2 * \{(BLTPL - 1) * (2 * PITCH_{bolts}) + EndDist\} * T$$

#### Net Area along plane resisting shear stress per AASHTO 6.13.4

$$A_{nv} = A_{gv} - (NBoltsV * DIA_{hl} * T)$$

#### Net Area along plane resisting tension stress

$$NBoltsT = 2 * \left(\frac{N_{gl}}{2} - 0.5\right)$$

$$A_{nt} = \left\{2 * \left\{\left(\frac{N_{gl}}{2} - 1\right) * \left(\frac{PITCH_{bolts}^2}{4 * GAGE_{bolts}}\right) + \left(\left(\frac{N_{gl}}{2} - 1\right) * GAGE_{bolts}\right) + EdgeDist\right\} - (NBoltsT * DIA_{hl})\right\} * T$$

### Chapter 3 - Method of Solution

#### Double U – Condition #1

(Odd No. Gage Lines and Even No. Pitch Lines shown)

(Odd No. Gage Lines and Odd No. Pitch Lines would be similar without the left most pitch line of bolts)

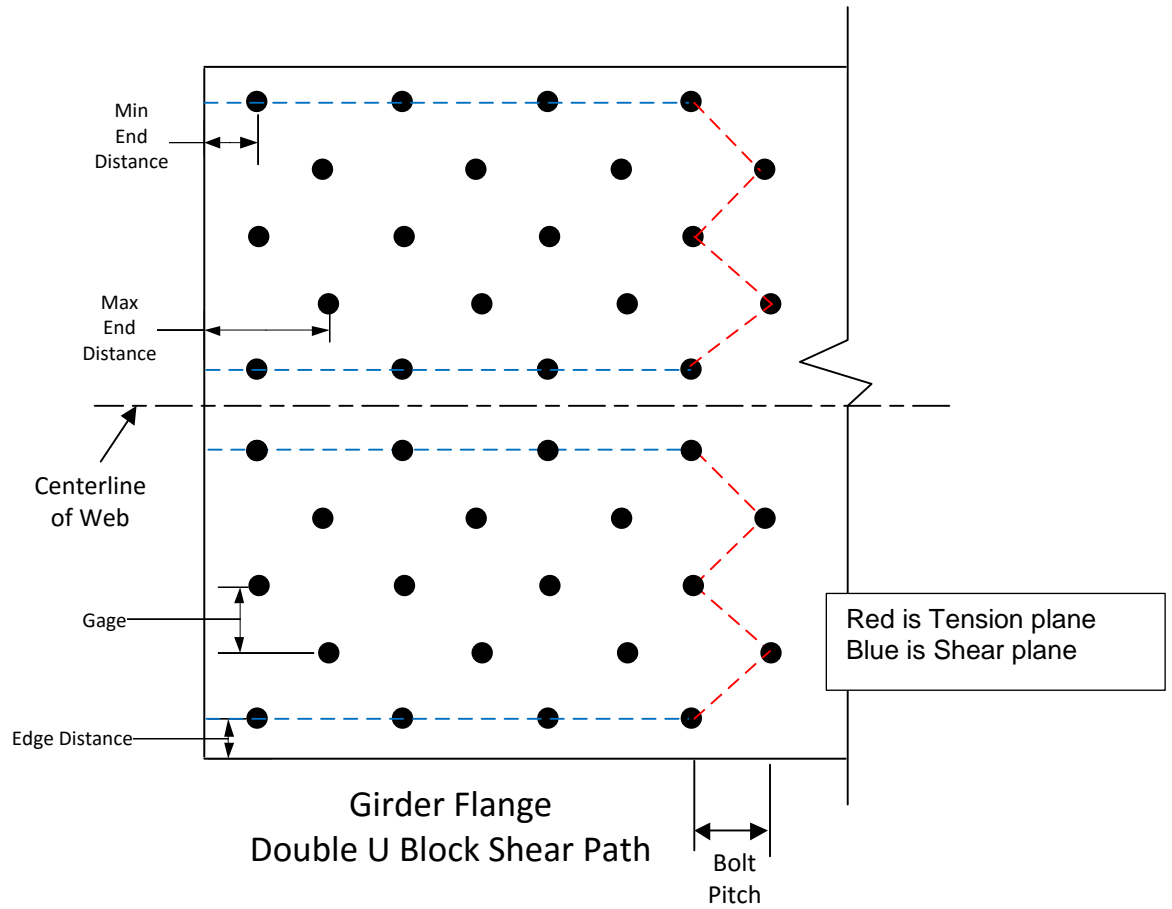


Figure 3.5.11-15

Flange – U-U Staggered Tension Failure Path– Condition #1

**Chapter 3 - Method of Solution**

Double U – Condition #2

(Even No. Gage Lines and Even No. Pitch Lines shown)

(Even No. Gage Lines and Odd No. Pitch Lines would be similar without the left most pitch line of bolts)

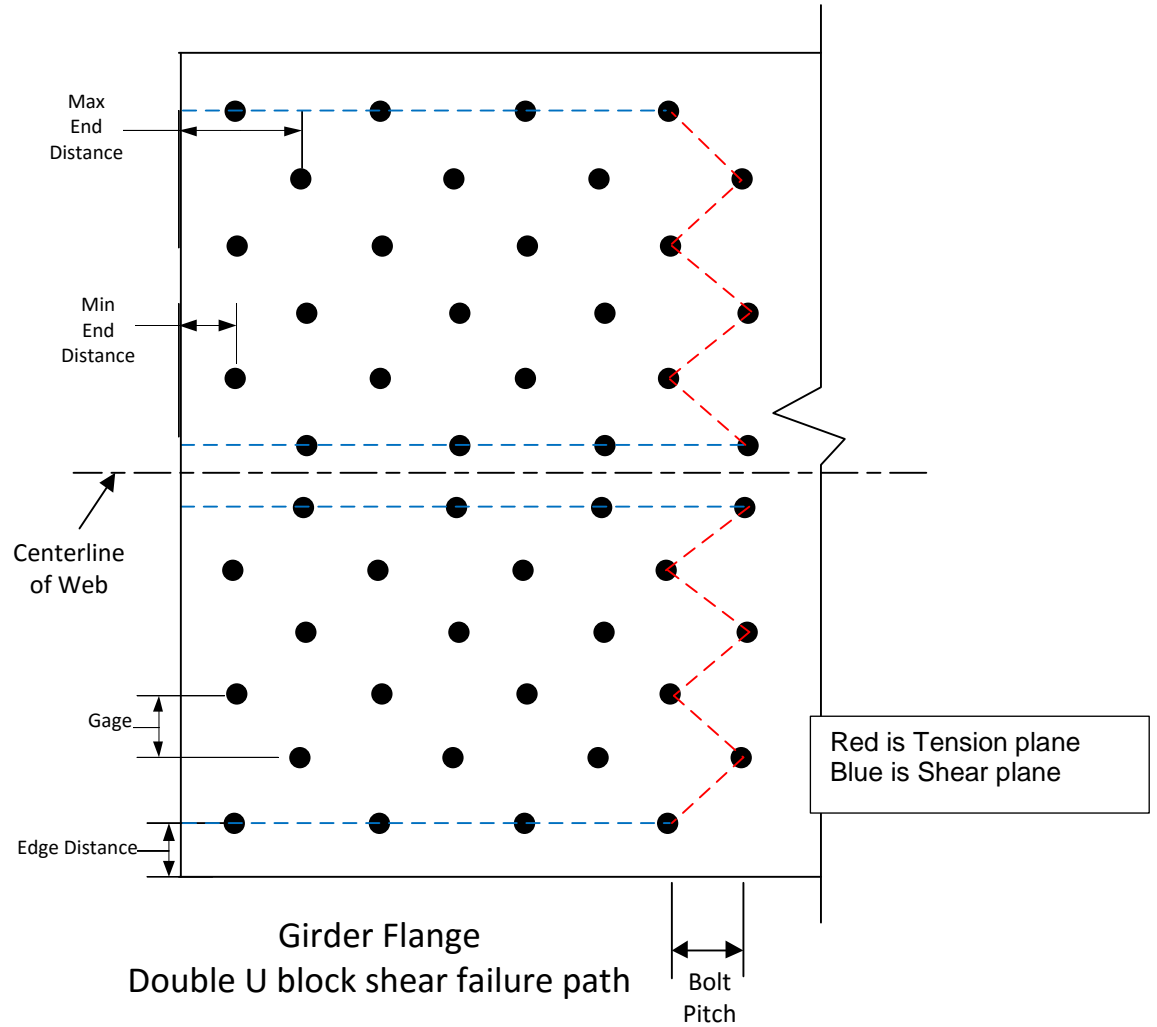


Figure 3.5.11-16

Flange – U-U Staggered Tension Failure Path– Condition #2

### Chapter 3 - Method of Solution

$$\text{Bolts per line} = \text{BLTPL} = \frac{N_{bolts}}{N_{gl}}$$

		Number of Pitch Lines on one side of splice	
		Even	Odd
Number of Gage Lines on one side of splice	Even	Condition #2 EndDist = Min End Distance + Max End Distance	Condition #2 EndDist = Min End Distance + Max End Distance
	Odd	Condition #1 EndDist = 2*Min End Distance	Condition #1 EndDist = 2*Max End Distance

If  $GAGE_{bolts} > 2 * DIA_{hl}$

$$NBoltsV = 2 * (2 * BLTPL - 1)$$

If  $GAGE_{bolts} \leq 2 * DIA_{hl}$

If  $N_{gl} \geq 8$

$$NBoltsV = 2 * (4 * BLTPL - 3)$$

If  $N_{gl} = 6$

$$NBoltsV = 2 * \left( \frac{N_{gl}}{2} * BLTPL - 2 \right)$$

If  $N_{gl} = 4$

$$NBoltsV = 2 * \left( \frac{N_{gl}}{2} * BLTPL - 1 \right)$$

Gross Area along plane resisting shear stress

$$A_{gv} = \{ 2 * \{ 2 * [(BLTPL - 1) * (2 * PITCH_{bolts})] + EndDist \} \} * T$$

Net Area along plane resisting shear stress per AASHTO 6.13.4

$$A_{nv} = A_{gv} - (NBoltsV * DIA_{hl} * T)$$

Net Area along plane resisting tension stress

$$NBoltsT = 2 * \left( \frac{N_{gl}}{2} - 1.0 \right)$$

$$A_{nt} = \left\{ 2 * \left\{ \left( \frac{N_{gl}}{2} - 1 \right) * \left( \frac{PITCH_{bolts}^2}{4 * GAGE_{bolts}} \right) + \left( \left( \frac{N_{gl}}{2} - 1 \right) * GAGE_{bolts} \right) \right\} - (NBoltsT * DIA_{hl}) \right\} * T$$

**Chapter 3 - Method of Solution**

3.5.11.5 Flange and Flange Splice Plates – Non Staggered Bolts

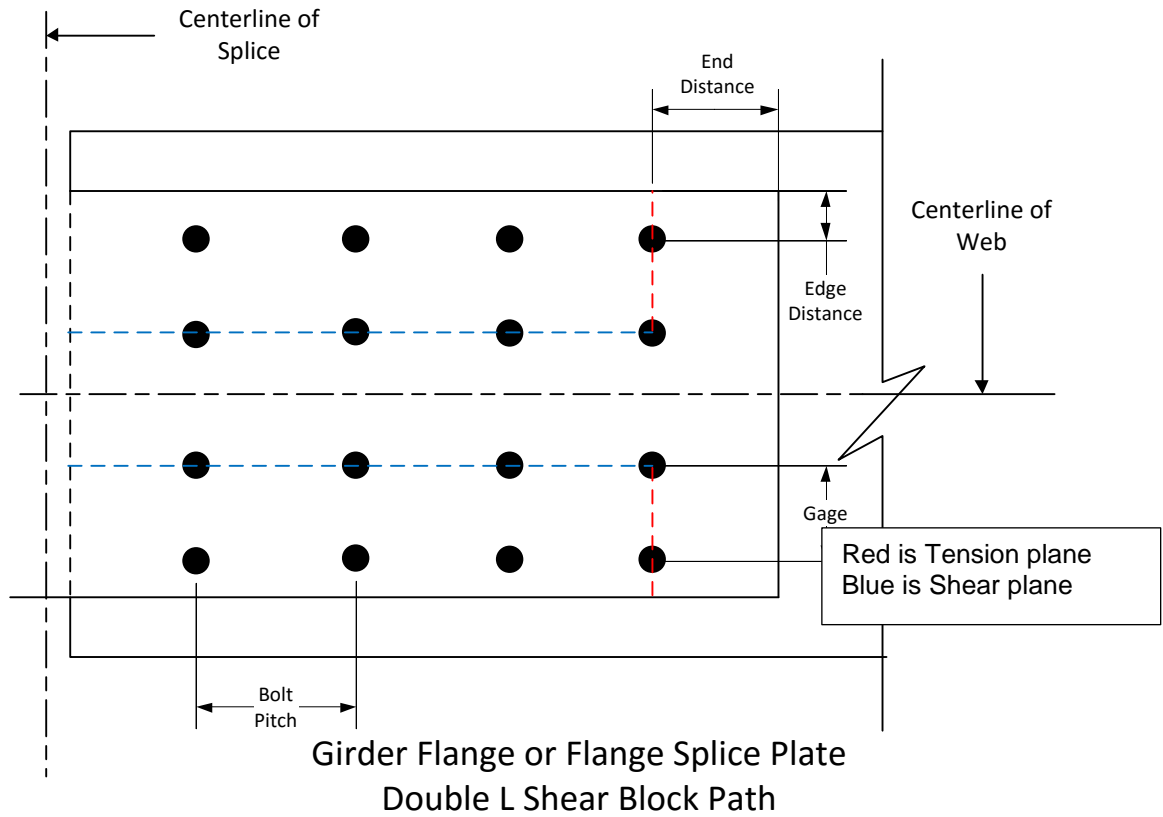


Figure 3.5.11-17 Flange Splice Plates – L-L Non staggered

**L Failure Path**

$$\text{Bolts per line} = \text{BLTPL} = \frac{N_{bolts}}{N_{gl}}$$

If the number of gage lines on one side the splice is greater than 2

If  $\text{GAGE}_{bolts} > 2 * \text{DIA}_{hl}$

$$\text{NBoltsV} = 2 * (\text{BLTPL} - 0.5)$$

If  $\text{GAGE}_{bolts} \leq 2 * \text{DIA}_{hl}$

$$\text{NBoltsV} = 2 * (2 * \text{BLTPL} - 1.5)$$

Gross Area along plane resisting shear stress

$$A_{gv} = \{2 * \{(\text{BLTPL} - 1) * (\text{PITCH}_{bolts}) + \text{EndDist}\}\} * T$$

Net Area along plane resisting shear stress

$$A_{nv} = A_{gv} - (\text{NBoltsV} * \text{DIA}_{hl} * T)$$

### Chapter 3 - Method of Solution

#### Net Area along plane resisting tension stress

$$NBoltsT = 2 * \left(\frac{N_{gl}}{2} - 0.5\right)$$

$$A_{nt} = \left\{ 2 * \left\{ \left(\frac{N_{gl}}{2} - 1\right) * (GAGE_{bolts}) + EdgeDist \right\} - (NBoltsT * DIA_{hl}) \right\} * T$$

If the number of gage lines on one side the splice is equal to 2

$$NBoltsV = 2 * (BLTPL - 0.5)$$

#### Gross Area along plane resisting shear stress

$$A_{gv} = \left\{ 2 * \{(BLTPL - 1) * (PITCH_{bolts}) + EndDist\} \right\} * T$$

#### Net Area along plane resisting shear stress

$$A_{nv} = A_{gv} - (NBoltsV * DIA_{hl} * T)$$

#### Net Area along plane resisting tension stress

$$NBoltsT = 1.0$$

$$A_{nt} = \left\{ \{2 * EdgeDist\} - (NBoltsT * DIA_{hl}) \right\} * T$$

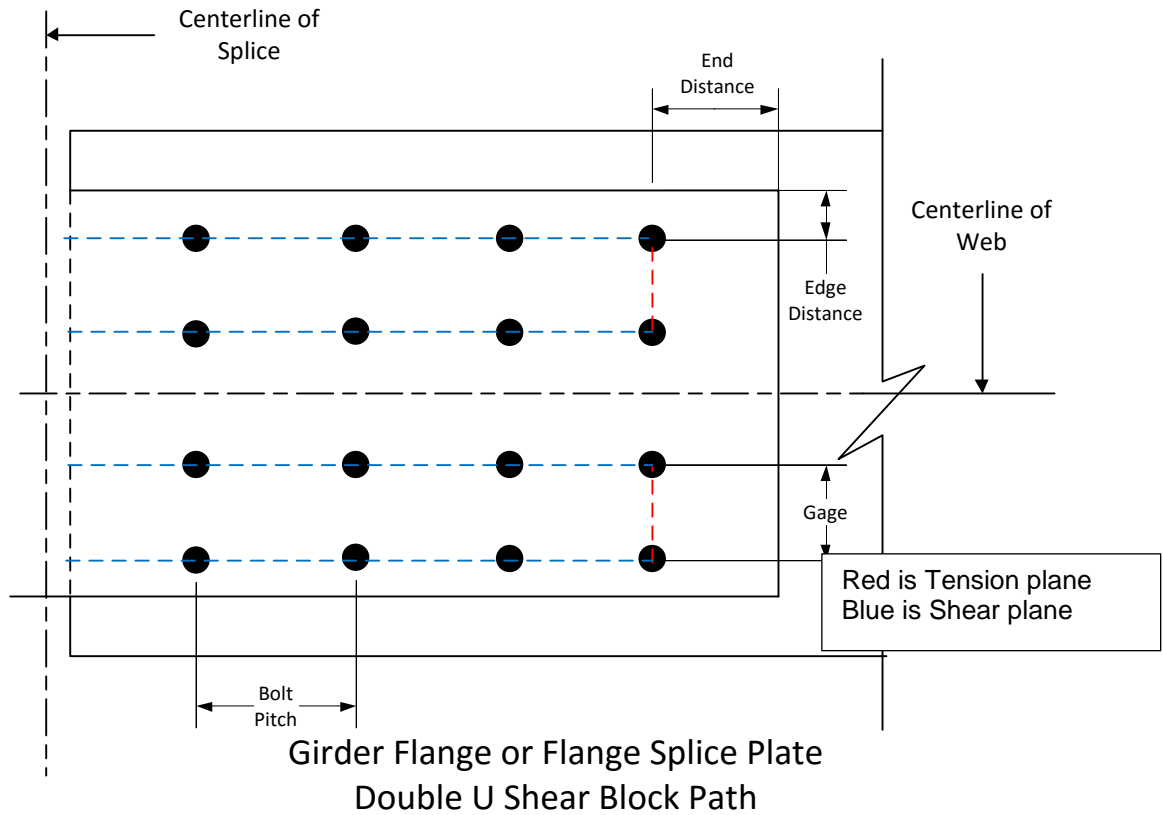


Figure 3.5.11-18 Flange Splice Plates – U-U Non staggered

**U Failure Path**

If the number of gage lines on one side the splice is greater than 2

$$\text{Bolts per line} = \text{BLTPL} = \frac{N_{bolts}}{N_{gl}}$$

If  $\text{GAGE}_{bolts} > 2 * \text{DIA}_{hl}$

$$\text{NBoltsV} = 2 * (2 * \text{BLTPL} - 1.0)$$

If  $\text{GAGE}_{bolts} \leq 2 * \text{DIA}_{hl}$

If  $N_{gl} \geq 8$

$$\text{NBoltsV} = 2 * (4 * \text{BLTPL} - 3)$$

If  $N_{gl} = 6$

$$\text{NBoltsV} = 2 * \left( \frac{N_{gl}}{2} * \text{BLTPL} - 2 \right)$$

If  $N_{gl} = 4$

$$\text{NBoltsV} = 2 * \left( \frac{N_{gl}}{2} * \text{BLTPL} - 1 \right)$$

### Chapter 3 - Method of Solution

#### Gross Area along plane resisting shear stress

$$A_{gv} = [2 * \{2 * \{(BLTPL - 1) * (PITCH_{bolts}) + EndDist\}\}] * T$$

#### Net Area along plane resisting shear stress

$$A_{nv} = A_{gv} - (NBoltsV * DIA_{hl} * T)$$

#### Net Area along plane resisting tension stress

$$NBoltsT = 2 * \left(\frac{N_{gl}}{2} - 1.0\right)$$

$$A_{nt} = \left\{2 * \left\{\left(\frac{N_{gl}}{2} - 1\right) * (GAGE_{bolts})\right\} - (NBoltsT * DIA_{hl})\right\} * T$$

If the number of gage lines on one side the splice is equal to 2 then the U failure path does not apply.

## Chapter 3 - Method of Solution

### 3.5.11.6 Web Splice Plates – Non Staggered Bolts

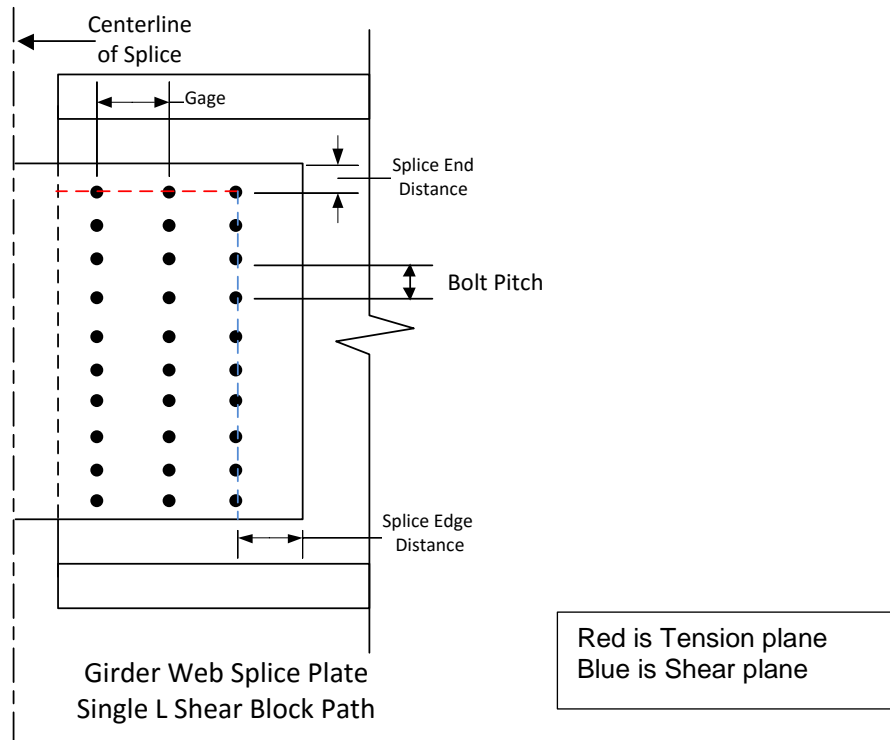


Figure 3.5.11-19 Web Splice Plates – Single L- Non staggered

#### L Failure Path

$$\text{Bolts per line} = \text{BLTPL} = \frac{N_{bolts}}{N_{gl}}$$

If  $\text{GAGE}_{bolts} > 2 * \text{DIA}_{hl}$

$$\text{NBoltsV} = 2 * (\text{BLTPL} - 0.5)$$

If  $\text{GAGE}_{bolts} \leq 2 * \text{DIA}_{hl}$

$$\text{NBoltsV} = 2 * (2 * \text{BLTPL} - 1.5)$$

#### Gross Area along plane resisting shear stress

The following equation is for design and analysis runs with constant bolt pitch.

$$A_{gv} = \{2 * \{(\text{BLTPL} - 1) * (\text{PITCH}_{bolts}) + \text{EndDist}\}\} * T$$

For analysis runs with variable bolt pitch, the  $(\text{BLTPL}-1) * (\text{PITCH}_{bolts})$  is replaced with the sum of all the bolt pitch values for each pitch defined using the WBP command.

#### Net Area along plane resisting shear stress

$$A_{nv} = A_{gv} - (\text{NBoltsV} * \text{DIA}_{hl} * T)$$

#### Net Area along plane resisting tension stress

$$\text{NBoltsT} = 2 * (N_{gl} - 0.5)$$

$$A_{nt} = \{2 * \{(N_{gl} - 1) * (\text{GAGE}_{bolts}) + \text{EdgeDist}\} - (\text{NBoltsT} * \text{DIA}_{hl})\} * T$$

## Chapter 3 - Method of Solution

### 3.6 STRUCTURAL ANALYSIS

In order to perform the design or analysis of a splice component, the relevant forces, stresses, and geometric properties are computed using classical methods of structural analysis. The most significant computations, along with any underlying assumptions, are briefly described in this section.

#### 3.6.1 Computation of Flange Splice Design Force

LRFD Specifications Article 6.13.6.1.4c requires that the flange splice plates "be proportioned to provide a minimum resistance" taken as the design stress,  $F_{cf}$  or  $F_{ncf}$  (depending on the whether the flange in question is the controlling or noncontrolling flange) multiplied by the effective area of the flanges on the smaller side of the splice. First, the controlling flange is determined as described in LRFD Specifications Commentary C6.13.6.1.4c, which states "the controlling flange is defined as either the top or bottom flange for the smaller section at the point of splice, whichever flange has the maximum ratio of the elastic flexural stress at its midthickness due to the factored loads for the loading condition under investigation to its factored flexural resistance."

After determining the controlling and noncontrolling flanges, the design stresses for strength limit states are calculated as follows:

$$F_{cf} = \frac{\left(\frac{f_{cf}}{R_h}\right) + \alpha\phi_f F_{yf} R_g}{2} \geq 0.75\alpha\phi_f F_{yf} R_g \quad (\text{LRFD Specifications Equation 6.13.6.1.4c-1})$$

where:  $F_{cf}$  = design stress in the controlling flange  
 $f_{cf}$  = maximum flexural stress due to the factored loads at the midthickness of the controlling flange at the point of splice  
 $R_h$  = hybrid factor specified in LRFD Specifications 6.10.1.10.1  
 $\alpha$  = 1.0, except that a lower value equal to  $F_n / F_{yf}$  may be used for flanges where  $F_n$  (the nominal flexural resistance of the flange) is less than  $F_{yf}$   
 $\phi_f$  = resistance factor for flexure  
 $F_{yf}$  = specified minimum yield strength of the flange  
 **$R_g$  = flange resistance modification factor (LRFD Specifications Equation 6.13.6.1.4c-3)**

$$F_{ncf} = R_{cf} \left| \frac{f_{ncf}}{R_h} \right| \geq 0.75\alpha\phi_f F_{yf} R_g \quad (\text{LRFD Specifications Equation 6.13.6.1.4c-4})$$

where:  $F_{ncf}$  = design stress in the noncontrolling flange  
 $R_{cf}$  = the absolute value of the ratio of  $F_{cf}$  to  $f_{cf}$  for the controlling flange

### Chapter 3 - Method of Solution

$f_{ncf}$	= maximum flexural stress due to the factored loads at the midthickness of the noncontrolling flange at the point of splice
$R_h$	= hybrid factor specified in LRFD Specifications 6.10.1.10.1
$\alpha$	= 1.0, except that a lower value equal to $F_n / F_{yf}$ may be used for flanges where $F_n$ is less than $F_{yf}$
$\phi_f$	= resistance factor for flexure
$F_{yf}$	= specified minimum yield strength of the flange
$R_g$	= flange resistance modification factor (LRFD Specifications Equation 6.13.6.1.4c-3)

These design stresses are then multiplied by the effective area of each flange to determine the design forces for each flange splice. For flanges in compression, the effective area is equal to the gross area of the flange. For tension flanges, the effective area shall be taken as:

$$A_e = \left( \frac{\phi_u F_u}{\phi_y F_{yt}} \right) A_n \leq A_g \quad (\text{LRFD Specifications Equation 6.13.6.1.4c-2})$$

where: $A_e$	= effective area of the flange
$\phi_u$	= resistance factor for fracture of tension members
$F_u$	= specified minimum tensile strength of the tension flange
$\phi_y$	= resistance factor for yielding of tension members
$F_{yt}$	= specified minimum yield strength of the tension flange
$A_n$	= net area of the tension flange determined as specified in LRFD Specifications Article 6.8.3
$A_g$	= gross area of the tension flange

#### 3.6.2 Computation of Splice Design Shear

A value of total design shear is determined as described in LRFD Specifications Article 6.13.6.1.4b. For the strength limit states, if:

$$V_u < 0.5\phi_v V_n$$

where: $V_u$	= shear due to the factored loading at the point of splice
$\phi_v$	= resistance factor for shear
$V_n$	= nominal shear resistance of the adjacent girder sections (note that SPLRFD uses the minimum of the user input shear resistances to either side of the splice. The user input value is actually $V_r$ , which is equal to $\phi_v * V_n$ )

### Chapter 3 - Method of Solution

then:

$$V_{uw} = 1.5V_u \quad (\text{LRFD Specifications Equation 6.13.6.1.4b-1})$$

where:  $V_{uw}$  = design shear

$V_u$  = shear due to the factored loading at the point of splice

otherwise:

$$V_{uw} = \frac{(V_u + \phi_v V_n)}{2} \quad (\text{LRFD Specifications Equation 6.13.6.1.4b-2})$$

where:  $V_{uw}$  = design shear

$V_u$  = shear due to the factored loading at the point of splice

$\phi_v$  = resistance factor for shear

$V_n$  = nominal shear resistance of the adjacent girder sections (again, note that SPLRFD uses  $V_r$ , which is equal to  $\phi_v V_n$ )

#### 3.6.3 Computation of Moments Resisted by Web Splice Plates

The calculations of the moment resisted by the web splice plates are described in the LRFD Specifications Article C6.13.6.1.4b. The design moment is applied about the middepth of the web along with a horizontal force acting to keep the section in equilibrium. The moment and horizontal force are based on the stresses in the flanges described in section 3.6.1 of this manual. The final piece of the moment resisted by the web splice comes from the eccentricity of the design shear calculated as described in section 3.6.2 of this manual.

The design moment for strength limit states is calculated as:

$$M_{uw} = \frac{t_w D^2}{12} |R_h F_{cf} - R_{cf} f_{ncf}| \quad (\text{LRFD Specifications Equation C6.13.6.1.4b-1})$$

where:  $M_{uw}$  = design moment due to applied moment

$t_w$  = web thickness of the smaller section

$D$  = web depth of the smaller section

$R_h$  = hybrid factor

$F_{cf}$  = design stress for the controlling flange

$R_{cf}$  = absolute value of the ratio of  $F_{cf}$  to the maximum flexural stress  $f_{cf}$  in the controlling flange

$f_{ncf}$  = flexural stress due to the factored loads in the noncontrolling flange

### Chapter 3 - Method of Solution

the horizontal force to establish equilibrium is calculated as:

$$H_{uw} = \frac{t_w D}{12} (R_h F_{cf} + R_{cf} f_{ncf}) \quad (\text{LRFD Specifications Equation C6.13.6.1.4b-2})$$

where:  $H_{uw}$  = design horizontal force  
 $t_w$  = web thickness of the smaller section  
 $D$  = web depth of the smaller section  
 $R_h$  = hybrid factor  
 $F_{cf}$  = design stress for the controlling flange  
 $R_{cf}$  = absolute value of the ratio of  $F_{cf}$  to the maximum flexural stress  $f_{cf}$  in the controlling flange  
 $f_{ncf}$  = flexural stress due to the factored loads in the noncontrolling flange

Finally, the moment due to the applied shear:

$$M_{uv} = V_{uw} e$$

where:  $M_{uv}$  = design moment due to applied shear  
 $V_{uw}$  = design shear  
 $e$  = eccentricity of shear measured from centerline of splice to centroid of web splice bolts

For service limit states, the design moment is calculated as:

$$M_{uw} = \frac{t_w D^2}{12} |f_s - f_{os}|$$

where:  $M_{uw}$  = design moment due to applied moment  
 $t_w$  = web thickness of the smaller section  
 $D$  = web depth of the smaller section  
 $f_s$  = maximum flexural stress at the midthickness of the flange  
 $f_{os}$  = flexural stress at the midthickness of the other flange

the horizontal force to establish equilibrium is calculated as:

$$H_{uw} = \frac{t_w D}{12} (f_s + f_{os})$$

where:  $H_{uw}$  = design horizontal force

### Chapter 3 - Method of Solution

$t_w$	= web thickness of the smaller section
$D$	= web depth of the smaller section
$f_s$	= maximum flexural stress at the midthickness of the flange
$f_{os}$	= flexural stress at the midthickness of the other flange

**For fatigue limit states, these equations and their terms are slightly modified to preserve the signs of the moments:**

$$M_{uw} = \frac{t_w D^2}{12} (f_s - f_{os})$$

$$H_{uw} = \frac{t_w D}{12} (f_s + f_{os})$$

<b>where: <math>M_{uw}</math></b>	<b>= design moment due to applied moment</b>
<b><math>H_{uw}</math></b>	<b>= design horizontal force</b>
<b><math>t_w</math></b>	<b>= web thickness of the smaller section</b>
<b><math>D</math></b>	<b>= web depth of the smaller section</b>
<b><math>f_s</math></b>	<b>= factored flexural stress at the bottom of the web</b>
<b><math>f_{os}</math></b>	<b>= factored flexural stress at the top of the web</b>

#### 3.6.4 Computation of Stresses in Web Splice Plates

The general formula for web splice plate flexural stress is given as follows:

$$F_{total}(LOC) = \frac{M_{uw} + M_{uv}}{Z_{wspl}(LOC, GROSS, SL_{dir})} + \frac{H_{uw}}{A(GROSS)}$$

where: LOC	= location (top or bottom)
GROSS	= flag indicating gross section properties
SL <sub>dir</sub>	= flag indicating moment direction (positive or negative)
F <sub>total</sub>	= total stress at extreme fiber of web splice
M <sub>uw</sub>	= total design moment due to applied moment
M <sub>uv</sub>	= total design moment to eccentric applied shear
Z <sub>wspl</sub>	= section modulus of web splice plate
H <sub>uw</sub>	= horizontal force to counter applied moment
A	= cross sectional area of web splice plates

Since all design effects are applied at the middepth of the web the section properties need not be calculated for the different composite states of the girder cross section. The total design moment is applied to the web splice about a single axis about its middepth.

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### 3.6.5 Computation of Force in Web Splice Bolts

As previously stated, four corner bolts are considered to find the maximum force in the bolts - the top and bottom bolts on the gage lines nearest to and farthest from the splice centerline. The formulas used to compute the forces in the web splice bolts are given below.

The total horizontal and vertical forces in the top and bottom bolt of gage line N (containing B number of bolts) are computed as follows:

$$P_{x,tot} (TOP, BTM) = \frac{M_{u,wspl} (LS, LL, MDIR) \left[ \frac{D_{web}}{2} - Y_{webolts} (N, I) \right]}{J_{webolts} (GROSS, SL_{dir})}$$

$$P_{y,tot} = \frac{V_{UTN,SPL} (LS, LL, MDIR)}{N_{bolts} (WSPL)} - \frac{M_{u,wspl} (LS, LL, MDIR) [X_{cg,webolts} - X_{webolts,gl} (N)]}{J_{webolts} (GROSS, SL_{dir})}$$

As previously mentioned,  $SL_{dir}$  is the direction index (either POS or NEG) depending upon the direction of the splice component moments,  $M_{u,wspl}$ . The formula given above for  $P_{y,tot}$  is valid only for bolt groups on the left side of the splice centerline. For bolt groups on the right side of the splice centerline, the negative sign in front of the summation is changed to a positive sign. The polar moment of inertia,  $J_{webolts}(*, *, *)$ , is computed as follows:

$$J_{webolts} (DIR) = I_{x,webolts} (DIR) + I_{y,webolts}$$

$$I_{x,webolts} = \sum_{N=1}^{N_{gl}(WSPL)} \sum_{C=1}^B \left[ Y_{webolts} (N, C) - Y_{cg,webolts} \right]^2 + N_{bolts} (WSPL) * \left( \frac{D_{web}}{2} - Y_{cg,webolts} \right)^2$$

$$B = N_{webolts,gl} (N)$$

$$I_{y,webolts} = \sum_{N=1}^{N_{gl}(WSPL)} N_{webolts,gl} (N) \left[ X_{webolts} (N) - X_{cg,webolts} \right]^2$$

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$$X_{cg,webolts} = \frac{\sum_{N=1}^{N_{gl}(WSPL)} X_{webolts}(N) * N_{webolts,gl}(N)}{N_{bolts}(WSPL)}$$

$$Y_{cg,webolts} = \frac{\sum_{N=1}^{N_{gl}(WSPL)} \sum_{C=1}^B Y_{webolts}(N, C)}{N_{bolts}(WSPL)}$$

As previously mentioned, the y-coordinates of bolts are measured from the top of the girder web and the x-coordinates of bolts are measured from the centerline of splice. Thereafter, a resultant force is computed in each corner bolt as follows:

$$P_{result}(LOC) = \sqrt{(P_{x,tot}(LOC))^2 + (P_{y,tot}(LOC))^2}$$

The maximum value of  $P_{result}$  is computed and compared with the corresponding resistive force based on LRFD Specifications Articles 6.13.2.2, 6.13.2.7, 6.13.2.9, and 1.3.2.1.

#### 3.6.6 Computation of Forces in Flange Splice Plates and Bolts

The stresses in the flange splice plates are computed indirectly by computing the stress in the middle of the girder flange plate. The stress in the girder flange plate is then multiplied by the total girder flange area to obtain the total force in the girder flange ( $P_{gpl,total}$ ). Then, it is assumed that the total force in the flange splice plates ( $P_{u,fspl}$ ) is the same as the force in the girder flange plate. Hence,

$$P_{u,fspl} = P_{gpl,total}$$

The total forces in the girder flange plates are computed as described in section 3.6.1 of this manual.

Considering a particular limit state and all possible moment directions, the maximum values of  $P_{u,fspl}$  are computed for compression and tension. Hence, the values of  $P_{u,fspl,cmax}$  and  $P_{u,fspl,tmax}$  are obtained. These forces are first distributed among the outer plate and inner plates, as applicable, based on their areas. The distributed forces are then used to find several stresses as stated below.

Stress for net section fracture:

$$F_{u,fspl,nt,max} = \frac{RATIO_{p,fspl}(FS, ILOC) * P_{u,fspl,tmax}(FS)}{A_{fspl}(FS, ILOC, NET)}$$

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Stress for gross section compressive yielding:

$$F_{u,fspl,ac,max} = \frac{RATIO_{p,fspl}(FS, ILOC) * P_{u,fspl,cmax}(FS)}{A_{fspl}(FS, ILOC, GROSS)}$$

Stress for gross section tensile yielding:

$$F_{u,fspl,gt,max} = \frac{RATIO_{p,fspl}(FS, ILOC) * P_{u,fspl,tmax}(FS)}{A_{fspl}(FS, ILOC, GROSS)}$$

In the equations above, ILOC represents the location of the outer plate (ILOC = OUTPL) and inner plates (ILOC = INPL). The gross and net areas of the flange splice plates and the area ratios are given as follows:

$$A_{fspl}(ILOC, GROSS) = W_{fspl}(ILOC) * T_{fspl}(ILOC)$$

$$A_{fspl}(ILOC, NET) = (W_{fspl}(ILOC) - W_{hls,fspl}(ILOC)) * T_{fspl}(ILOC)$$

$$A_{spl}(ST) = A_{fspl}(OUTPL, ST) + 2 * A_{fspl}(INPL, ST)$$

$$RATIO_{p,fspl}(ILOC) = \frac{A_{fspl}(ILOC, GROSS)}{A_{spl}(GROSS)}$$

For non-staggered bolt configurations, the width of holes,  $W_{hls,fspl}(FS, ILOC)$ , is computed as follows:

$$W_{hls,fspl}(FS, OUTPL) = N_{gl}(FS) * DIA_{hl,bolt}(FS)$$

$$W_{hls,fspl}(FS, INPL) = \frac{N_{gl}(FS) * DIA_{hl,bolt}(FS)}{2}$$

For staggered bolt configurations, the term,

$$LADD = \frac{(PITCH_{bolts}(FS))^2}{4 * GAGE_{bolts}(FS)}$$

is subtracted appropriately from the width of holes pertaining to the non-staggered bolt configuration in accordance with LRFD Specifications Article 6.8.3.

## Chapter 3 - Method of Solution

The total force,  $P_{u,fspl}$ , is also divided by the total number of bolts in the flange splice to obtain the average force in one bolt.

### 3.6.7 Modifications for Lateral Loads

SPLRFD allows the user to enter stresses in each girder flange due to lateral loads on the girder. These stresses are factored and combined with the design forces described in Section 3.6.6. In general the forces in the flange plates are combined following the general equation:

$$\frac{P}{A} + f_L \leq F_r$$

where:  $P$  = design force calculated in Section 3.6.6  
 $A$  = flange area used with design force, either gross area or effective area depending on whether  $P$  is compressive or tensile  
 $f_L$  = factored lateral stress  
 $F_r$  = calculated stress resistance

SPLRFD works in terms of force rather than stress, so the equation given above is multiplied through by the flange area so the lateral force equals the total factored lateral stress multiplied by the appropriate flange area, either effective or gross:

$$P + f_L A \leq F_r A$$

where:  $P$  = design force calculated in Section 3.6.6  
 $A$  = flange area used with design force, either gross area or effective area depending on whether  $P$  is compressive or tensile  
 $f_L$  = factored lateral stress  
 $F_r A$  =  $P_r$   
calculated resistance, in terms of force

The lateral load effects on the flange bolts are calculated similarly to the major-axis bending effects on the web bolts. Because the flange bolts are symmetrical about the centerline of web and the lateral effects are assumed to act about the centerline of web, there are no additional effects due to eccentric shear to consider. The polar moment of inertia of the flange bolt group is calculated, and the lateral moment assumed to be applied at the center of gravity of the bolt group. The design flange force is combined with the longitudinal component of the force due to the lateral moment, then the resultant force calculated.

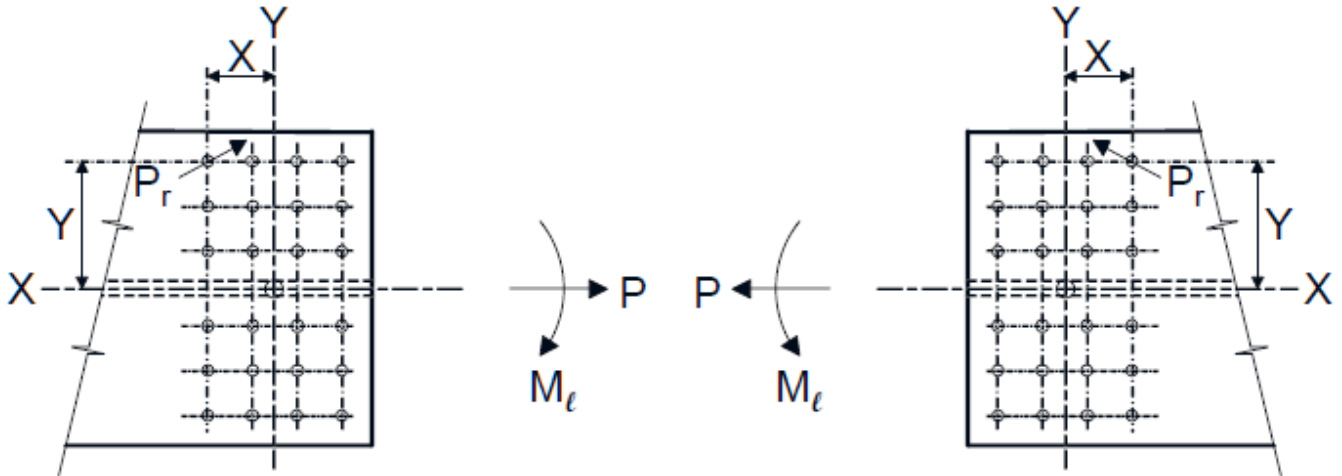


Figure 3.6-1 Lateral Moment Application to Flange

Note that for all calculations including lateral effects, the force due to the lateral load will always increase the effect due to the major axis bending effect. The lateral effect will never decrease the bending effect.

This logic is followed for both Strength and Service checks for the flange splice plates and flange splice bolts.

## Chapter 3 - Method of Solution

### 3.7 SPECIFICATION CHECKS

For both analysis and design runs the program checks the splice components for conformance with the LRFD Specifications and DM-4. The following sections provide details on several of the specification checks that are performed.

#### 3.7.1 Computation and Specification Check of Bearing Capacity

Bearing capacity of the splice section is computed in accordance with LRFD Specifications Equations 6.13.2.9-1, 6.13.2.9-2, 6.13.2.9-3 and 6.13.2.9-4. Clear bearing distance is the distance between the edges of the holes or the distance between the edge of the hole and the end of the member (Figure 3.7-1) .

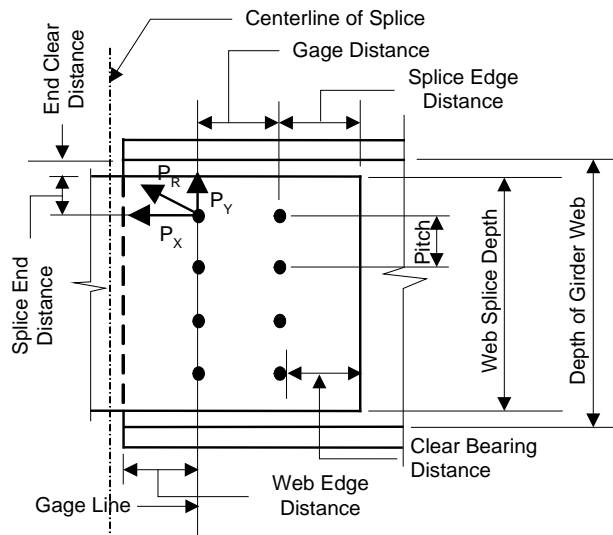


Figure 3.7-1 Bearing Distances

*Bearing resistance of web material:*

If the minimum clear bearing distance is less than 2 \* diameter of the bolt:

$$\text{Bearing Resistance}(\text{Web}) = 1.2 * \text{LCGPL} * \text{TWEB} * \text{FUGPL}$$

If the minimum clear bearing distance is greater than or equal to 2 \* diameter of the bolt:

$$\text{Bearing Resistance}(\text{Web}) = 2.4 * \text{DIABOLT} * \text{TWEB} * \text{FUGPL}$$

where: LCGPL = Controlling clear bearing distance for web material  
 TWEB = Thickness of web material  
 FUGPL = Tensile strength of web material  
 DIABOLT = Nominal diameter of the bolt

*Bearing resistance of splice material:*

If the minimum clear bearing distance is less than 2 \* diameter of the bolt:

### Chapter 3 - Method of Solution

$$\text{Bearing Resistance}(\text{Splice}) = 1.2 * \text{LCSPL} * (2 * \text{TWSPL}) * \text{FUSPL}$$

If the minimum clear bearing distance is greater than or equal to 2 \* diameter of the bolt:

$$\text{Bearing Resistance}(\text{Splice}) = 2.4 * \text{DIABOLT} * (2 * \text{TWSPL}) * \text{FUSPL}$$

where: LCSPL = Controlling clear bearing distance for splice material  
TWSPL = Thickness of splice web splice plate  
FUSPL = Tensile strength of splice plate  
DIABOLT = Nominal diameter of the bolt

For analysis problems if the section fails due to any of the checks (shear, slip, bearing) then an error message is written and the next step is executed (Figure 3.7-2). For analysis, when either of the shear or the slip or both failures occur along with the bearing failure then bearing is said to govern the failure if the bearing resistance causing the failure is smaller than the shear and slip resistances. When bearing governs, a warning message (Sections 7.6.27 and 7.6.28) informs that bearing is governing the failure. When bearing governs the failure and the minimum clear bearing distance that causes the bearing failure is smaller than 2 \* diameter of the bolt, then the warning message informs that there is an option to increase the relevant clear bearing distance to overcome the bearing failure as per LRFD Specifications Article 6.13.2.9. When bearing governs the failure and the minimum clear bearing distance that causes the bearing failure is greater than or equal to 2 \* diameter of the bolt, then the warning message informs that incrementing bearing distances as per LRFD Specifications Article 6.13.2.9 does not increase the bearing resistance since the bearing distance in the bearing resistance equations are being replaced by diameter of the bolt.

For design problems, when a section fails in bearing, the bearing failure is overcome by incrementing either number of bolts or plate thickness. If parameter 12 on the WSB command (Chapter 5, 5.14, WSB-Web Splice Bolt Command) is entered, then the program tries to overcome bearing failure by incrementing the controlling bearing distance before incrementing the number of bolts and plate thickness. The bearing distance increment is applied only if the clear bearing distance that causes the bearing failure is either web edge, web splice edge or web splice end (Figure 3.7-1). The bearing distance is incremented by 0.125 in until bearing failure is overcome, or until the upper limit specified with the parameter 12 on WSB command is reached, or until the total controlling bearing distance (initial value + incremented value) exceeds 2 \* diameter of the bolt (Figure 3.7-3). If the sum of the user specified initial value and the incremented value is less than 2 \* diameter of the bolt and the section still fails in bearing, or controlling clear bearing distance is greater than 2 \* diameter of the bolt and the section fails in bearing, then the number of bolts or plate thickness is incremented to prevent bearing failure. If the section has failed in bearing during the design process, and either bearing distance increment was not enough to overcome bearing failure, or the total clear bearing distance has exceeded 2\*diameter of the bolt, the warning message (Sections 7.6.27 and 7.6.28) will inform that bearing failure had occurred, how the program overcame the bearing failure, and whether user can still increase the bearing distance to overcome the failure, without increasing the number of bolts or the plate thickness.

### For Analysis

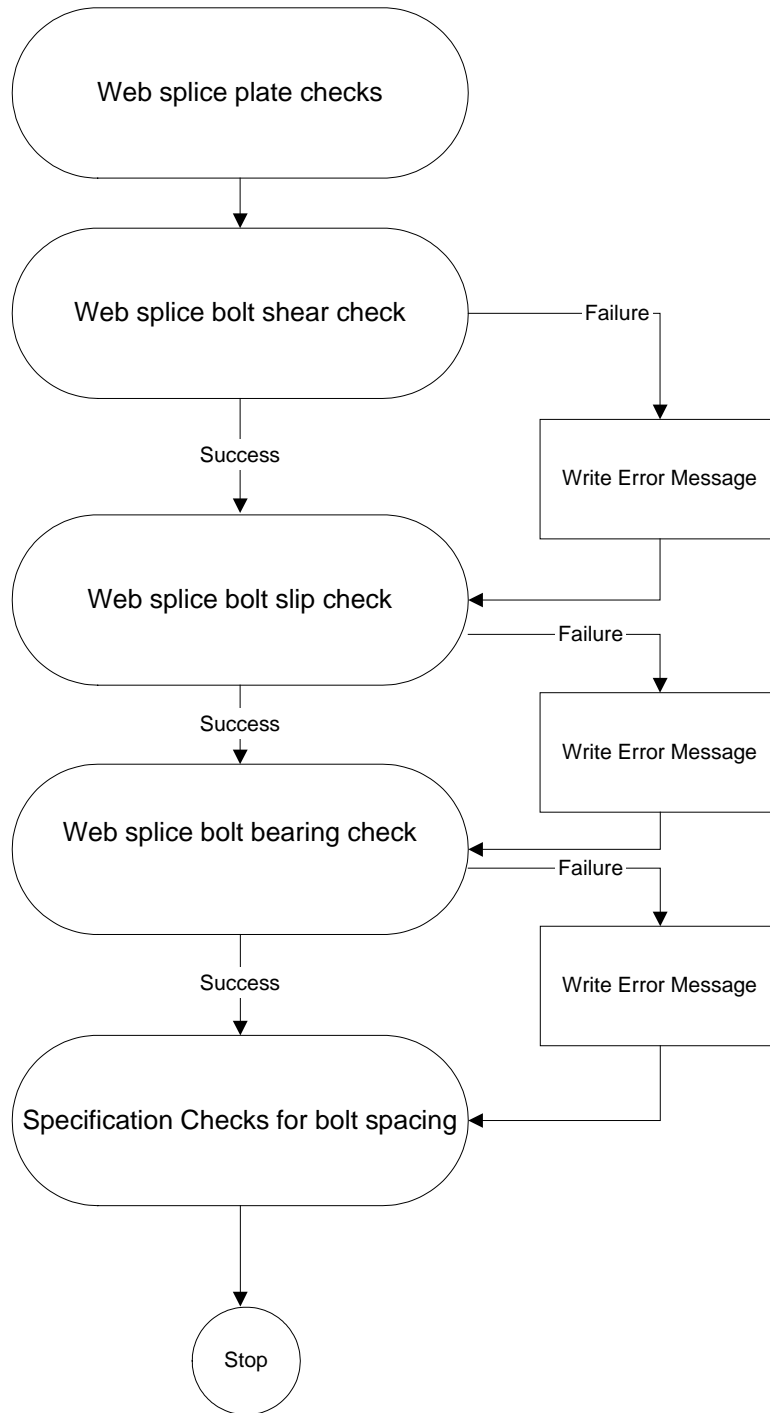


Figure 3.7-2 Analysis Check Procedure

For Design

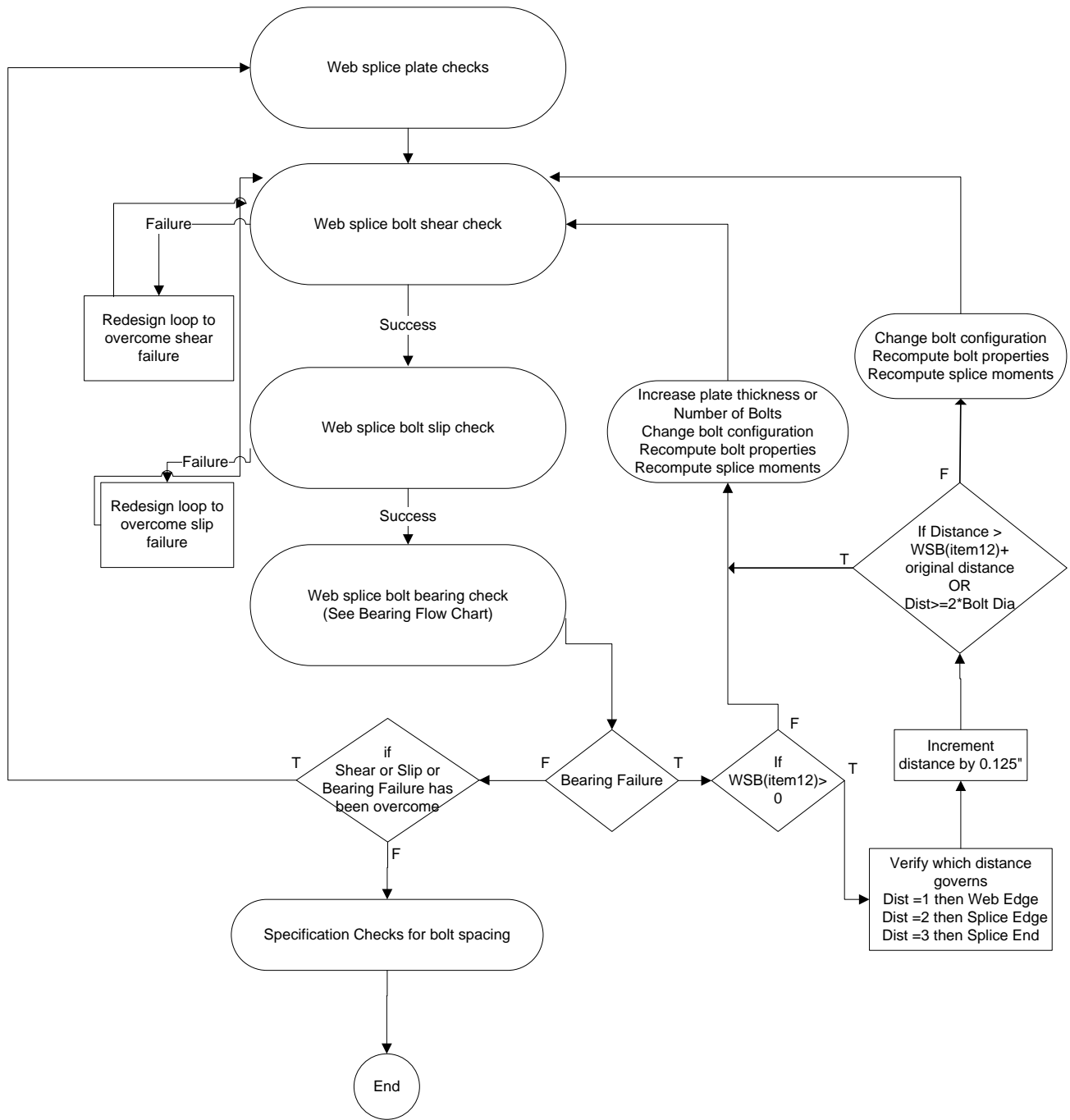


Figure 3.7-3 Design Check Procedure

## Chapter 3 - Method of Solution

### 3.7.2 Computation and Specification Check of Flange Bolt Shear Strength Resistance

The Flange Bolt Shear Strength Resistance is computed as per AASHTO Equations 6.13.2.7-1 and 6.13.2.7-2.

$$R_n = C_{bolt} C_{thread} A_b F_{ub} N_s$$

$$R_r = \phi R_n R_f$$

Where:

$C_{bolt}$  = 0.80 for connections greater than 50 in., otherwise 1.0

$C_{thread}$  = 0.48 when threads are excluded from the shear plane. 0.38 when threads are included in the shear plane

$A_b$  = area of the bolt corresponding to the nominal bolt diameter (in<sup>2</sup>)

$F_{ub}$  = specified minimum tensile strength of the bolt (ksi)

$N_s$  = number of shear planes (always set to one since the shear planes between the splice plates and girder flange are checked independently)

$\Phi$  = resistance factor

$R_f$  = filler plate reduction factor specified in LRFD Specifications 6.13.6.1.5

The filler plate reduction factor  $R_f$  is computed assuming that only one filler plate will be used, it is assumed to be located beneath the outer splice plate and the filler plate will have the same width as the outer splice plate. The thickness of the filler plate will be equal to the difference in the thickness of the left and right flange. The program assumes symmetrical placement of the bolts on either side of the centerline of the splice. The following equations and assumptions from LRFD Specifications 6.13.6.1.5 are used to compute the filler plate reduction factor.

$R_f = 1.0$  when the filler plate thickness is less than 0.25 in.

$R_f = \left[ \frac{(1 + \gamma)}{(1 + 2\gamma)} \right]$  when the filler plate thickness equal to or greater than 0.25 in.

$$\gamma = \frac{A_f}{A_p}$$

$A_f$  = Area of the filler plate beneath the outer splice plate

$A_p$  = Smaller of either the flange area or the sum of the splice plate areas on the top and bottom of the flange

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# 4

## GETTING STARTED

### 4.1 INSTALLATION

This program is delivered via download from the Department's website. Once payment has been received by PennDOT you will receive a confirmation e-mail with instructions on how to download the software. The download file is a self-extracting installation file for the licensed PennDOT engineering software. The engineering program runs as a 32-bit application and is supported on Windows Vista, Windows 7 (32 and 64 bit versions), Windows 8, **and Windows 10** operating systems.

Your license number, license key and registered company name, found in the e-mail received from the Department, are required to be entered when installing the program and must be entered exactly as shown in the e-mail. The license number, license key and registered company name will also be needed when requesting future versions of the program (i.e., enhancements, modifications, or error corrections), and requesting program support. A backup copy of the program download and e-mail instructions should be made and used for future installations. You may want to print the software license agreement, record the license number, license key and registered company name and keep it in a safe place.

To install the program, follow the installation instructions provided with the original e-mail from the Department.

The following files will be installed in the program destination folder, which defaults to "C:\Program Files\PennDOT\SPLRFD v<version\_number>" or "C:\Program Files (x86)\PennDOT\SPLRFD v<version number>" for 64-bit operating systems:

- |                               |   |   |
|-------------------------------|---|---|
| 1. SPLRFD.exe, SPLRFD_DLL.dll | - | Executable program and Dynamic Link Library.                  |
| 2. SPLRFD.pd                  | - | Parameter definition file.                                    |
| 3. SPLRFD Users Manual.pdf    | - | Program User's Manual (PDF Format).                           |
| 4. SPLRFDRevReq.dot           | - | Revision Request form (MS Word template).                     |
| 5. GettingStarted.pdf         | - | A document describing installation and running of the program |
| 6. LicenseAgreement.pdf       | - | The program license agreement                                 |
| 7. *.dat                      | - | Example problem input files                                   |
| 8. MSVCR71.dll                | - | Runtime Dynamic Link Library.                                 |

The program example problem files (ex\*.dat) will be installed in the program example folder, which defaults to "C:\PennDOT\SPLRFD v<version\_number> Examples\". Users must have write access to this folder in order to run the input files from this folder.

## **Chapter 4 - Getting Started**

### **4.2 PREPARING INPUT**

The program requires an ASCII input file. The input file consists of a series of command lines. Each command line defines a set of input parameters that are associated with that command. A description of the input commands can be found in Chapter 5 of the User's Manual. The input can be created using Engineering Assistant, described below or any text editor.

## **Chapter 4 - Getting Started**

### **4.3 ENGINEERING ASSISTANT**

The Engineering Assistant (EngAsst) is a Windows application developed by the Pennsylvania Department of Transportation (PENNDOT) to provide a graphical user interface (GUI) for PENNDOT's engineering programs. The data for the input to the engineering program is presented in a user-friendly format, reflecting the implied structure of the data, showing each record type on a separate tab page in the display and showing each field on each record with a defining label.

With EngAsst the user can create a new input file, modify an existing input file, import input files, run the associated engineering program and view the output in a Windows environment. The help and documentation are provided, including text descriptions of each field, relevant images, and extended help text at both the record/tab level and the field level. Access to all parts of the Engineering Program User's Manual, where available, is also provided within EngAsst.

EngAsst is not included with this software. It requires a separate license that can be obtained through the Department's standard Engineering Software licensing procedures. Order forms can be obtained from program support website at <http://penndot.engrprograms.com>.

## Chapter 4 - Getting Started

### 4.4 RUNNING THE PROGRAM WITHOUT ENGASST

SPLRFD is a FORTRAN console application program. It may be run from a command window, by double-clicking on the program icon from Windows Explorer, by selecting the shortcut from the Start menu under Programs\PennDOT **SPLRFD <version number>**, or by double-clicking the shortcut icon on the desktop. To run the program in a command window, the user must specify to the directory in which the program has been installed or change to the directory.

The program will prompt for an input file name, and the user should then enter the appropriate input file name. The input file must be created before running the program. The program will then prompt for whether the output should be reviewed on the screen. The user should enter Y if the output is to be reviewed on the screen after execution or N if the output is not to be reviewed on the screen. The program will then prompt for the name of the output file in which the output is to be stored, and the user should then enter the desired output file name. If a file with the specified output file name already exists, the program will ask the user whether to overwrite the existing file. The user should enter Y if the existing file is to be overwritten or N if the existing file is not to be overwritten. If the user enters N to specify that the existing file is not to be overwritten, the program will prompt the user for another output file name. The program will then execute.

To cancel the program during execution, press <Ctrl C> or <Ctrl Break>, and then press <Enter>.

When the program completes execution, the user is prompted to "Press <ENTER> to exit program." This allows the user to view the last messages written to the screen when the program was started by double-clicking on the program icon from Windows Explorer.

The user can view the \*.OUT output file with a text editor and the \*.PDF output file with Adobe Acrobat Reader.

# 5

## ***INPUT DESCRIPTION***

### **5.1 INPUT DATA REQUIREMENTS**

Before running SPLRFD, the user must create an input file. The input file consists of a series of command lines. Each command line defines a set of input parameters that are associated with that command. The program interprets each command line and checks the input parameters to insure that the input data is of the correct type and within the allowable ranges set by the program.

The syntax of a command line is given as:

```
KWD parm1, parm2, , , parm5, ,
```

where, KWD is a 3 character keyword representing a command, and  
parm1, parm2.... are the parameter values associated with the KWD.

If a command line begins with an exclamation point (!), then it is treated as a comment line that is not used by the program. Comment lines can be inserted by the user to provide descriptions and clarifications. The following are two examples of a comment line:

```
! THE FOLLOWING COMMAND LINE CONTAINS BOLT HOLE SIZE FACTOR  
! FATIGUE DETAIL CATEGORY "B" IS USED IN THIS INPUT.
```

To temporarily make a command line void, the user can use an exclamation point (!) to transform the command line into a comment line. For an input line to be treated as a comment line, the exclamation point must be put in column 1 of the input line. For example, in the following case, the program will use the input data on the second line but will not use the input data on the first line:

```
! DDL 400.0, 500.0, 600.0, 300.0, 200.0, . . .  
DDL 440.0, 500.0, 600.0, 300.0, 200.0, . . .
```

A command line must not exceed 256 characters in length. Command lines can be continued on any number of data lines in the input file by placing a hyphen (-) at the end of each data line to be continued, and by placing any remaining parameters on the following lines starting in column 4 of each continuation line. The limit of 256 characters includes all characters and parameters on all continuation lines of a given command line. Some commands are repeatable and some commands have parameters or groups of parameters that are repeatable. When parameters

## Chapter 5 Input Description

are repeatable, the user has the option of repeating the parameters in a single command or repeating the command. For example, the FSP (flange splice plate) command has all parameters as repeatable parameters. The user could enter top and bottom flange splice plate data in one command line. Alternatively, the user could enter the top flange splice plate data in one FSP command and the bottom flange splice plate data in another FSP command.

```
FSP  B, 44.0, 1.5, 22.0, 1.75  
FSP  T, 42.0, 1.25, 20.0, 1.5
```

or

```
FSP  B, 44.0, 1.5, 22.0, 1.75, T, 42.0, 1.25, 20.0, 1.5
```

Groups of repeatable parameters must stay together in a command line unless a continuation character (-) is used. For example, web bolt pitch distances in the WBP command should all be entered by using one WBP command. That is, a WBP command cannot end with a pitch distance followed by another WBP command having the remaining pitch distances. When a continuation character is used, the repeatable data can be separated on two lines. The program reads all continuation lines as one command. For example,

Incorrect input:

```
WBP  4.0, 4.5, 4.0, 4.5, 4.0  
WBP  4.5, 4.0
```

Correct input:

```
WBP  4.0, 4.5, 4.0, 4.5, 4.0, -  
      4.5, 4.0
```

The first three columns of each command line are reserved for keywords that define the command type. Columns 4 through 256 are to be used to input the parameters associated with a command. One or more spaces are recommended between the keyword and the input parameters to improve readability.

The parameters associated with each command must be entered in the order they appear in the command description tables. The user must place commas to separate the parameters on the command line. Blank spaces cannot be used to separate parameters. The parameter field width is not restricted; however, the total number of characters cannot exceed 256.

## Chapter 5 Input Description

The default value for a parameter is assigned by the program by placing a comma without any value for the parameter. For example, in the command syntax example shown below, the default values will be assigned to parameters parm3 and parm4.

```
KWD parm1, parm2, , , parm5
```

If the user places a comma and there is no default value, the program will return an error status. If a comma is entered after the command keyword, the program will assign the default value to the first parameter. If the user does not enter all the parameters for a command, the program will assign default values for those parameters not entered. That is, the user is not required to place commas at the end of a command line. If the above example required seven parameters, parm6 and parm7 would also be assigned default values by the program.

The default values are stored in a parameter file which can be changed only by the Department's system manager. The parameter file stores the parameter description, type of data, units, upper limit, lower limit, error or warning status if the upper or lower limits are exceeded, and the default value for each parameter.

Any numerical value, within the upper and lower limits, can be entered for a parameter. The status codes, shown in parentheses below the lower and upper limits, indicate the status if an input item exceeds the lower or upper limits. The status code, (E), indicates an error. The status code, (W), indicates a warning. The status code, (C), indicates a warning that can be accepted/ignored only upon the approval of the Department's Chief Bridge Engineer.

In the following sections, all available commands and associated parameters are described with two tables for each command. The first table contains the keyword for a particular command along with a description of the command. The second table gives all the parameters associated with the given command, parameter description, units, limits, and default values.

The program will process all input and will check for errors and warnings. If the number of errors exceeds 25 during input processing, the program will terminate immediately. After all input is processed, the program checks if any errors were found. If an error was found, the program will terminate. If warnings are found, the program will continue to process. If the number of warnings exceeds 200 during input processing for a single run, the program will terminate immediately. The user should review all warnings in the output file to insure that the input data is correct. Warnings are an indication that the input value has exceeded normally acceptable limits for that parameter.

## Chapter 5 Input Description

### 5.2 ORDER OF COMMANDS

If the user wants to control the number of lines printed on a page or the number of lines to be left blank at the top of each page, the CFG (configuration) command should be the first command. The CFG command is optional and the program will use default values if the CFG command is not entered. The first required command is one or more TTL (title) commands. As many as ten TTL commands may be entered by the user. The first TTL command is printed in the header at the top of each output page. A maximum of ten TTL commands are printed on the first page of the output. The second required command after the title commands is the CTL (control) command. The CTL command is used to specify the System of Units which is required for checking the range of the input data. The CTL command also includes other major control parameters such as Design/Analysis of splice elements and Composite/Non-composite.

The remaining commands can be entered in any order, provided certain required parameters for a given command have been entered previously. For example, the total number of bolts in each gage line of the web splice is defined by an integer, Bolts per Gage Line, in the WSB (web splice bolt) command. Since Bolts per Gage Line is used in the WBP (web bolt pitch) command, the WSB command must precede the WBP command. The program will return an error status if a command requires data that has not been previously entered.

The user need not enter any of the output commands (OIN, OSP, OCN, OAN and OSC commands) to produce the output tables that are designated as the default output tables.

The recommended order of the commands is shown in Table 1. The commands are shown in alphabetical order in Table 2. The section headings in these tables refer to the section number of this chapter where these commands are described. Figure 1 shows the overall view of a typical input file with these commands.

## Chapter 5 Input Description

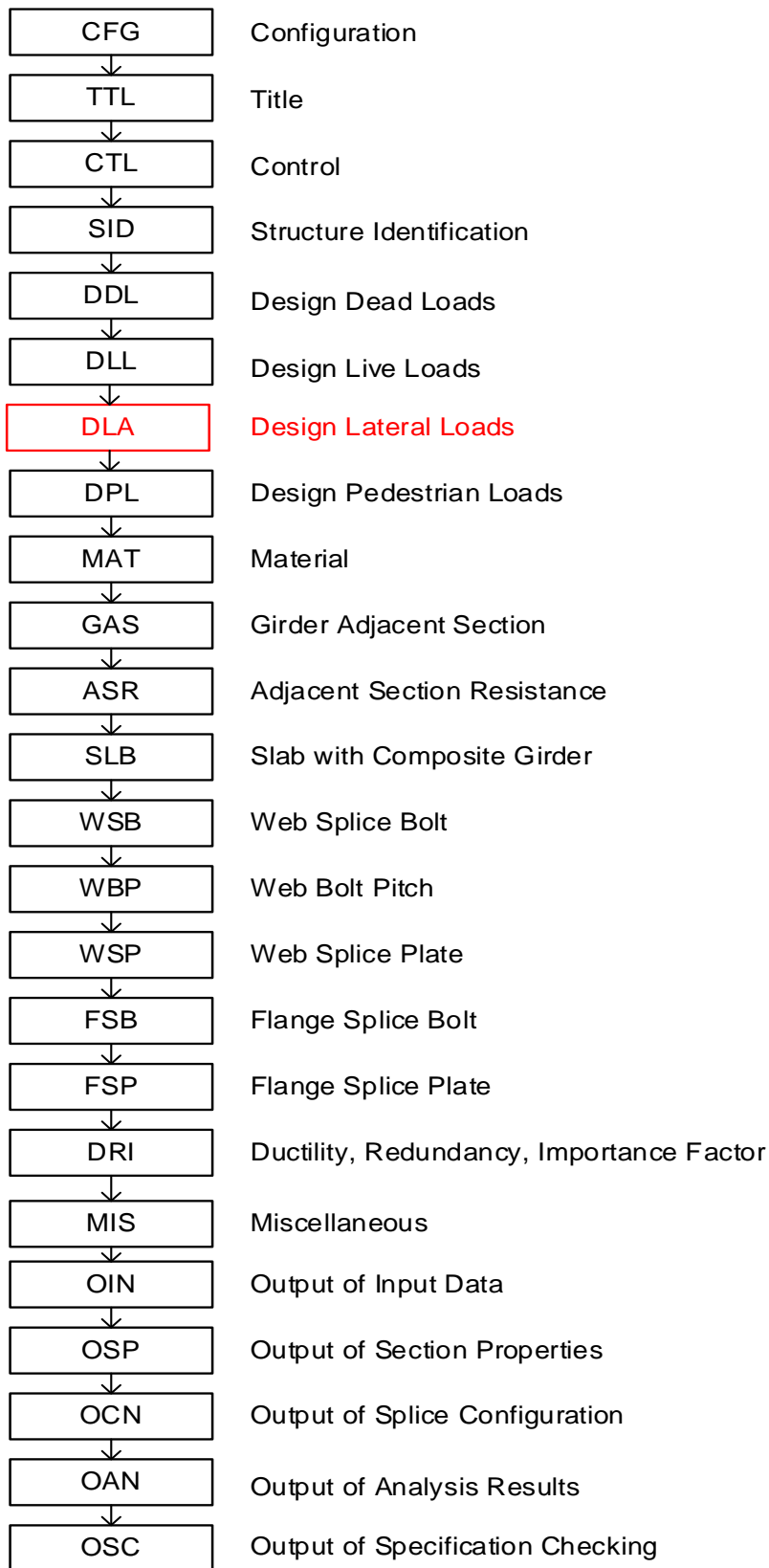


Figure 5.2-1 Overall View of Input File

## Chapter 5 Input Description

Table 5.2-1 Recommended Order of Commands

Keyword	Command Description	Comments	Section
CFG	Configuration	Optional for both design and analysis	5.3
TTL	Title	At least one TTL command is required for both design and analysis	5.4
CTL	Control	Required before other commands (other than CFG and TTL commands) for both design and analysis	5.5
SID	Structure Identification	Required only for APRAS runs	5.6
DDL	Design Dead Loads	Required for both design and analysis	5.7
DLL	Design Live Loads	Required for both design and analysis	5.8
<b>DLA</b>	<b>Design Lateral Loads</b>	<b>Required for both design and analysis</b>	<b>5.9</b>
DPL	Design Pedestrian Loads	Optional for both design and analysis	5.10
MAT	Material	Required for both design and analysis	5.11
GAS	Girder Adjacent Section	Required for both design and analysis	5.12
ASR	Adjacent Section Resistance	Required for both design and analysis	5.13
SLB	Slab with Composite Girder	Required for both design and analysis for a composite section; not used for non-composite section	5.14
WSB	Web Splice Bolt	Required for both design and analysis of web splice bolts	5.15
WBP	Web Bolt Pitch	Required for analysis of web splice bolts; not used for design of web splice bolts	5.16
WSP	Web Splice Plate	Required for both design and analysis of web splice plates	5.17
FSB	Flange Splice Bolt	Required for both design and analysis of flange splice bolts (for top flange and bottom flange)	5.18
FSP	Flange Splice Plate	Required for both design and analysis of flange splice plates (for top flange and bottom flange)	5.19
DRI	Ductility, Redundancy, Importance Factor	Required for both design and analysis	5.20
MIS	Miscellaneous	Required for both design and analysis	5.21
OIN	Output of Input Data	Optional for both design and analysis	5.22
OSP	Output of Section Properties	Optional for both design and analysis	5.23
OCN	Output of Splice Configuration	Optional for both design and analysis	5.24
OAN	Output of Analysis Results	Optional for both design and analysis	5.25
OSC	Output of Specification Checking	Optional for both design and analysis	5.26

## Chapter 5 Input Description

Table 5.2-2 Commands in Alphabetical Order

Keyword	Command Description	Comments	Section
ASR	Adjacent Section Resistance	Required for both design and analysis	5.13
CFG	Configuration	Optional for both design and analysis	5.3
CTL	Control	Required before other commands (other than CFG and TTL commands) for both design and analysis	5.5
DDL	Design Dead Loads	Required for both design and analysis	5.7
<b>DLA</b>	<b>Design Lateral Loads</b>	<b>Required for both design and analysis</b>	<b>5.9</b>
DLL	Design Live Loads	Required for both design and analysis	5.8
DPL	Design Pedestrian Loads	Optional for both design and analysis	5.10
DRI	Ductility, Redundancy, Importance Factor	Required for both design and analysis	5.20
FSB	Flange Splice Bolt	Required for both design and analysis of flange splice bolts (for top flange and bottom flange)	5.18
FSP	Flange Splice Plate	Required for both design and analysis of flange splice plates (for top flange and bottom flange)	5.19
GAS	Girder Adjacent Section	Required for both design and analysis	5.12
MAT	Material	Required for both design and analysis	5.11
MIS	Miscellaneous	Required for both design and analysis	5.21
OAN	Output of Analysis Results	Optional for both design and analysis	5.25
OCN	Output of Splice Configuration	Optional for both design and analysis	5.24
OIN	Output of Input Data	Optional for both design and analysis	5.22
OSC	Output of Specification Checking	Optional for both design and analysis	5.26
OSP	Output of Section Properties	Optional for both design and analysis	5.23
SID	Structure Identification	Required only for APRAS runs	5.6
SLB	Slab with Composite Girder	Required for both design and analysis for a composite section; not used for non-composite section	5.14
TTL	Title	At least one TTL command is required for both design and analysis	5.4
WBP	Web Bolt Pitch	Required for analysis of web splice bolts; not used for design of web splice bolts	5.16
WSB	Web Splice Bolt	Required for both design and analysis of web splice bolts	5.15
WSP	Web Splice Plate	Required for both design and analysis of web splice plates	5.17

## Chapter 5 Input Description

### 5.3 CFG - CONFIGURATION COMMAND

KEYWORD	COMMAND DESCRIPTION
CFG	CONFIGURATION - This command is used for configuring the program output from a given PC and printer setup. Only one CFG command may be used. If this command is not entered, each parameter listed below will be automatically set to its default value.

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
1. Number of Lines Per Page	Enter the number of printable lines per output page.	--	50 (W)	<b>83</b> (W)	<b>83</b>
2. Number of Top Blank Lines	Enter the number of lines to be left blank at the top of each output page.	--	0 (E)	5 (W)	0

## Chapter 5 Input Description

### 5.4 TTL - TITLE COMMAND

KEYWORD	COMMAND DESCRIPTION
TTL	TITLE - As many as ten TTL commands may be entered by the user. The first TTL command is printed in the header at the top of each output page. A maximum of ten TTL commands are printed on the first page of the output. The input file must have at least one TTL command.

PARAMETER	DESCRIPTION
1. Title	Enter any descriptive information about the project. Title information can be entered anywhere between Column 4 and Column 79.

## Chapter 5 Input Description

### 5.5 CTL - CONTROL COMMAND

KEYWORD	COMMAND DESCRIPTION
CTL	CONTROL - This command is used to set the control parameters for the input. The input file must have one and only one CTL command. The CTL command must be entered before any other structure command other than the CFG and TTL commands.

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
1. System of Units	Enter type of units: US - U.S. customary units.	--	US (E)	--	US
2. Composite/ Non-composite	Enter the option for composite or non-composite section: C - For composite section. N - For non-composite section.	--	C, N (E)	--	--
3. Design/ Analysis for Web Splice Plates	Enter the design/analysis option for web splice plates: A - Analysis of applicable loadings and specification checking for web splice plates. D - Design of web splice plate thickness for applicable loadings in accordance with the LRFD Specifications.	--	A, D (E)	--	--
4. Design/ Analysis for Web Splice Bolts	Enter the design/analysis option for web splice bolts: A - Analysis of applicable loadings and specification checking for web splice bolts. D - Design of web splice bolts for applicable loadings in accordance with the LRFD Specifications.	--	A, D (E)	--	--
5. Threads of Web Bolts in Shear Plane	Enter the option for including web bolt threads in shear plane: Y - If the threads are included in the shear plane for web bolts. N - If threads are not included.	--	Y, N (E)	--	N
6. Increase Plate or Bolts for Web Splice	Enter the option for incrementing web splice plate thickness before increasing number of bolts in a situation where either could be done (in case of a bearing failure) for web splice: P - To increment plate thickness. B - To increase number of bolts. Note: If parameters 3 and 4 are not both set to 'D', this parameter will be ignored and should be left blank.	--	P, B (E)	--	--

Chapter 5 Input Description

5.5 CTL - CONTROL COMMAND (Cont.)

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
7. Design/ Analysis for Top Flange Splice Plates	Enter the design/analysis option for top flange splice plates: A - Analysis of applicable loadings and specification checking for flange splice plates. D - Design of flange splice plate thickness for applicable loadings in accordance with the LRFD Specifications.	--	A, D (E)	--	--
8. Design/ Analysis for Top Flange Splice Bolts	Enter the design/analysis option for top flange splice bolts: A - Analysis of applicable loadings and specification checking for flange splice bolts. D - Design of flange splice bolts for applicable loadings in accordance with the LRFD Specifications.	--	A, D (E)	--	--
9. Threads of Top Flange Bolts in Shear Plane	Enter the option for including top flange splice bolt threads in shear plane: Y - If the threads are included in the shear plane for flange bolts. N - If threads are not included.	--	Y, N (E)	--	N
10. Increase Plate or Bolts for Top Flange Splice	Enter the option for incrementing top flange splice plate thickness before increasing number of bolts in a situation where either could be done (in case of a bearing failure) for flange splice: P - To increment plate thickness. B - To increase number of bolts. Note: If parameters 7 and 8 are not both set to 'D', this parameter will be ignored and should be left blank.	--	P, B (E)	--	--
11. Design/ Analysis for Bottom Flange Splice Plates	Enter the design/analysis option for bottom flange splice plates: A - Analysis of applicable loadings and specification checking for flange splice plates. D - Design of flange splice plate thickness for applicable loadings in accordance with the LRFD Specifications.	--	A, D (E)	--	--

Chapter 5 Input Description

5.5 CTL - CONTROL COMMAND (Cont.)

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
12. Design/ Analysis for Bottom Flange Splice Bolts	Enter the design/analysis option for bottom flange splice bolts: A - Analysis of applicable loadings and specification checking for flange splice bolts. D - Design of flange splice bolts for applicable loadings in accordance with the LRFD Specifications.	--	A, D (E)	--	--
13. Threads of Bottom Flange Bolts in Shear Plane	Enter the option for including bottom flange splice bolt threads in shear plane: Y - If the threads are included in the shear plane for flange bolts. N - If threads are not included.	--	Y, N (E)	--	N
14. Increase Plate or Bolts for Bottom Flange Splice	Enter the option for incrementing bottom flange splice plate thickness before increasing number of bolts in a situation where either could be done (in case of a bearing failure) for flange splice: P - To increment plate thickness. B - To increase number of bolts. Note: If parameters 11 and 12 are not both set to 'D', this parameter will be ignored and should be left blank.	--	P, B (E)	--	--
15. Top Flange Splice Configuration	Enter the number of plates in the top flange splice configuration: 1 - One plate (one outer) is used. 2 - Two plates (two inner) are used. 3 - Three plates (one outer, two inner) are used.	--	1 (E)	3 (E)	3
16. Bottom Flange Splice Configuration	Enter the number of plates in the bottom flange splice configuration: 1 - One plate (one outer) is used. 2 - Two plates (two inner) are used. 3 - Three plates (one outer, two inner) are used.	--	1 (E)	3 (E)	3
17. Staggered/ Non-staggered Top Flange	Enter the bolt pattern option for the top flange: S - If top flange splice bolts are staggered. N - If top flange splice bolts are not staggered.	--	S, N (E)	--	N

Chapter 5 Input Description

5.5 CTL - CONTROL COMMAND (Cont.)

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
18. Staggered/ Non- staggered Bottom Flange	Enter the bolt pattern option for the bottom flange: S - If bottom flange splice bolts are staggered. N - If bottom flange splice bolts are not staggered.	--	S, N (E)	--	N
19. Bolt Connection Type	Enter the option for splice connection type: F - Friction type connection. B - Bearing type connection. Note: If designing any splice element, user input for this parameter will be ignored and default value will be used. Bearing type connections are not permitted for any new design. Bearing type connections require approval by the Chief Bridge Engineer.	--	F, B (C)	--	F
20. Check Plate Fatigue	Enter the option for performing fatigue checks on plate elements: Y - Perform fatigue check. N - Do not perform fatigue check.	--	Y, N (E)	--	N
21. Pedestrian Loading	Enter the option for considering pedestrian loading: Y - Consider pedestrian loading. N - Do not consider pedestrian loading.  If pedestrian loading is being considered, the DPL command must be entered and the type 'S' live load must be specified on the DLL command.	--	Y, N (E)	--	N

**Chapter 5 Input Description**

**5.6 SID - STRUCTURE IDENTIFICATION COMMAND**

KEYWORD	COMMAND DESCRIPTION
SID	STRUCTURE IDENTIFICATION - This command is used to pass parameters to APRAS (Automated Permit Routing Analysis System) for processing a permit load. The input file must have this command if this data file is to be processed by APRAS. This command is optional for other data files. Only one SID command can be used.

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
1. Program Identification	Enter "=SPLRFD" to identify that this data file is for the LRFD Steel Girder Splice Design and Analysis program.	--	=SPLRFD (E)	--	=SPLRFD
2. County	Enter the county number as per the Bridge Management System (the 2 digit subfield of item number A01).	--	1 (E)	99 (E)	--
3. State Route	Enter the state route number as per the Bridge Management System (the 4 digit subfield of item number A01).	--	0 (E)	9999 (E)	--
4. Segment	Enter the segment number as per the Bridge Management System (the 4 digit subfield of item number A01).	--	0 (E)	9999 (E)	--
5. Offset	Enter the offset distance as per the Bridge Management System (the 4 digit subfield of item number A01).	--	0 (E)	9999 (E)	--
6. Span Identification	Enter the 4 digit alphanumeric Span Identification number as per the APRAS system.	--	--	--	--

Chapter 5 Input Description

5.7 DDL - DESIGN DEAD LOADS COMMAND

KEYWORD	COMMAND DESCRIPTION
DDL	DESIGN DEAD LOADS - This command is used to enter the unfactored moments and shears in the girder at the splice centerline due to dead loads.

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
1. DC1 Moment	Enter the non-composite dead load moment for splice plates and bolts, beam self-weight, slab, haunch, and forms.	k-ft	--	--	--
2. DC2 Moment	Enter the composite dead load moment for parapets, sidewalks, and any other structural components and nonstructural attachments. Note: This should not include sidewalks. Sidewalk DC2 moment should be entered on the DPL command.	k-ft	--	--	--
3. FWS Moment	Enter the composite dead load moment for future wearing surface on the bridge assuming that no sidewalks are present. Note: If the bridge will have sidewalks, then enter the additional FWS moment on the DPL command to subtract the portion of the FWS where the sidewalks will be located.	k-ft	--	--	--
4. DC1 Shear	Enter the non-composite dead load shear for splice plates and bolts, beam self-weight, slab, haunch, and forms.	kips	--	--	--
5. DC2 Shear	Enter the composite dead load shear for parapets, sidewalks, and any other structural components and nonstructural attachments. Note: This should not include sidewalks. Sidewalk DC2 shear should be entered on the DPL command.	kips	--	--	--
6. FWS Shear	Enter the composite dead load shear for future wearing surface on the bridge assuming that no sidewalks are present. Note: If the bridge will have sidewalks, then enter the additional FWS shear on the DPL command to subtract the portion of the FWS where the sidewalks will be located.	kips	--	--	--

## Chapter 5 Input Description

### 5.8 DLL - DESIGN LIVE LOADS COMMAND

KEYWORD	COMMAND DESCRIPTION
DLL	<p>DESIGN LIVE LOADS - This command is used to enter the unfactored moments and shears in the girder at the splice centerline due to live loads. Values entered in this command should include dynamic load allowance (impact) and live load distribution factors.</p> <p><b>A maximum of 16 design live loads (four commands with four design live loads per command) can be entered. Note that only the first fatigue live load in the input file will be considered by the program.</b></p>

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
1. Type of Live Load	<p>Enter the type of live load:</p> <p>D - Design live load (normally PHL-93 loading).</p> <p>P - Permit live load (normally P-82 loading).</p> <p>F - Fatigue live load.</p> <p>S - Design live load for pedestrian loads (normally PHL-93 loading).</p> <p>Note: If fatigue checks are not to be performed, 'F' type loads will be ignored. Only enter "S" type loads when parameter 21, Pedestrian Loading, in the CTL command is entered as 'Y'.</p>	--	D, P, F (E)	--	--
2. Live Load Number	<p>Enter the number to be associated with this live load. Different types of live load may have the same numbers, but no two live loads of the same type can have the same number. For example, there can be a Live Load 1 of type 'D' and a Live Load 1 of type 'P'; Live Load 1 of type 'D' and Live Load 2 of type 'D' are also possible. Only one fatigue live load can be entered.</p>	--	1 (E)	4 (E)	1
3. Positive Moment	<p>Enter the positive maximum moment for this live load (including dynamic load allowance).</p>	k-ft	0. (E)	--	--
4. Negative Moment	<p>Enter the negative maximum moment for this live load (including dynamic load allowance). Input as a negative value. (Leave blank for simple spans).</p>	k-ft	--	0. (E)	--
5. Positive Shear	<p>Enter the positive maximum shear for this live load (including dynamic load allowance).</p>	kips	0. (E)	--	--
6. Negative Shear	<p>Enter the negative maximum shear for this live load (including dynamic load allowance). Input as a negative value.</p>	kips	--	0. (E)	--

Chapter 5 Input Description

5.9 DLA - DESIGN LATERAL STRESSES COMMAND

KEYWORD	COMMAND DESCRIPTION
DLA	<p><b>DESIGN LATERAL STRESSES</b> - This command is used to specify the lateral unfactored stresses due to cross frames or other lateral bending or torsional effects; see LRFD Specifications Article 6.10.1.6.</p> <p>For girders that are composite in the final state, the top flange lateral bending stresses may be set to zero for composite loads since the top flange is considered fully braced.</p> <p>Note that for severely skewed girders, other effects may need to be taken into account for major-axis analysis.</p> <p>Input for this command can be found in STLRFD program output for girders that have lateral loads specified. In versions 2.4.0.0 and earlier of STLRFD, these input values can be found on the USER INPUT LATERAL STRESSES output report. For versions after 2.4.0.0, these values should be included with the SPLRFD INPUT INFORMATION output report.</p>

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
<b>Bottom Flange – Composite and Non-Composite Beams</b>					
1. Unfactored DC1 stress, bottom flange	Enter the unfactored lateral stress due to all noncomposite (DC1) loads in the bottom flange.	ksi	0.0 (E)	--	--
2. Unfactored DC2 stress, bottom flange	Enter the unfactored lateral stress due to composite (DC2) loads in the bottom flange.	ksi	0.0 (E)	--	--
3. Unfactored FWS stress, bottom flange	Enter the unfactored lateral stress due to FWS loads in the bottom flange.	ksi	0.0 (E)	--	--
4. Unfactored Design LL stress, bottom flange	Enter the unfactored lateral stress due to live loads in the bottom flange. (Do not include the stress due to Permit live load). Note that this stress will be combined with stresses due to each live load, so this value should be an "envelope" or maximum live load stress due to all of the live loads considered for this girder.	ksi	0.0 (E)	--	--
5. Unfactored Permit LL stress, bottom flange	Enter the unfactored lateral stress due to the Permit live load in the bottom flange. Do not enter this value for runs without the Permit load.	ksi	0.0 (E)	--	--

Chapter 5 Input Description

5.9 DLA - DESIGN LATERAL LOADS COMMAND (Cont.)

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
<b>Top Flange – Composite and Non-Composite Beams</b>					
6. Unfactored DC1 stress, top flange	Enter the unfactored lateral stress due to all noncomposite (DC1) loads in the top flange.	ksi	0.0 (E)	--	--
<b>Top Flange – Non-Composite Beams Only</b>					
7. Unfactored DC2 stress, top flange	Enter the unfactored lateral stress due to composite (DC2) loads in the top flange.  NOTE: This value must only be entered for girders that are noncomposite in the final state.	ksi	0.0 (E)	--	--
8. Unfactored FWS stress, top flange	Enter the unfactored lateral stress due to FWS loads in the top flange.  NOTE: This value must only be entered for girders that are noncomposite in the final state	ksi	0.0 (E)	--	--
9. Unfactored Design LL stress, top flange	Enter the unfactored lateral stress due to live loads in the top flange. (Do not include the stress due to Permit live load). Note that this stress will be combined with stresses due to each live load, so this value should be an "envelope" or maximum live load stress due to all of the live loads considered for this girder.  NOTE: This value must only be entered for girders that are noncomposite in the final state	ksi	0.0 (E)	--	--
10. Unfactored Permit LL stress, top flange	Enter the unfactored lateral stress due to the Permit live load in the top flange. Do not enter this value for runs without the Permit load.  NOTE: This value must only be entered for girders that are noncomposite in the final state	ksi	0.0 (E)	--	--

**Chapter 5 Input Description**

**5.10 DPL - DESIGN PEDESTRIAN LOADS COMMAND**

KEYWORD	COMMAND DESCRIPTION
DPL	DESIGN PEDESTRIAN LOADS - This command is used to enter the unfactored moments and shears in the girder at the splice centerline due to pedestrian loads. Enter this command only if parameter 21, Pedestrian Loading, in the CTL command is entered as 'Y'. If pedestrian loading is being considered, the program must be run twice, once with pedestrian loading and once without pedestrian loading.

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
1. Pedestrian Live Load Positive Moment	Enter the positive maximum moment for pedestrian load.	k-ft	0. (E)	--	--
2. Pedestrian Live Load Negative Moment	Enter the negative maximum moment for pedestrian load. Input as a negative value. (Leave blank for simple spans).	k-ft	--	0. (E)	--
3. Pedestrian Live Load Positive Shear	Enter the positive maximum shear for pedestrian load.	kips	0. (E)	--	--
4. Pedestrian Live Load Negative Shear	Enter the negative maximum shear for pedestrian load. Input as a negative value.	kips	--	0. (E)	--
5. Sidewalk DC2 Moment	Enter the sidewalk DC2 dead load moment. The sidewalk DC2 dead load moment is defined as all DC2 dead load moment that is present when the sidewalks are present and is not present when the sidewalks are not present.	k-ft	--	--	--
6. Sidewalk DC2 Shear	Enter the sidewalk DC2 dead load shear. The sidewalk DC2 dead load shear is defined as all DC2 dead load shear that is present when the sidewalks are present and is not present when the sidewalks are not present.	k-ft	--	--	--

**Chapter 5 Input Description**

**5.10 DPL - DESIGN PEDESTRIAN LOADS COMMAND (Cont.)**

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
7. Additional FWS Moment	Enter the additional FWS moment. Note: The FWS moment on the DDL command assumes that no sidewalks are present. The additional FWS moment is entered to subtract the portion of the FWS where the sidewalks will be located. If the FWS dead load moment decreases when the sidewalks are present, a value opposite in sign of the FWS moment (DDL command) should be entered.	k-ft	--	--	--
8. Additional FWS Shear	Enter the additional FWS shear. Note: The FWS shear on the DDL command assumes that no sidewalks are present. The additional FWS shear is entered to subtract the portion of the FWS where the sidewalks will be located. If the FWS dead load shear decreases when the sidewalks are present, a value opposite in sign of the FWS shear (DDL command) should be entered.	k-ft	--	--	--

## Chapter 5 Input Description

### 5.11 MAT - MATERIAL COMMAND

KEYWORD	COMMAND DESCRIPTION
MAT	MATERIAL - This command is used to specify the yield strength and tensile strength of the splice plates and the tensile strength of the bolts.

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
1. Web Splice Plate Yield Strength	Enter the minimum yield strength of the web splice plates. For web splice plate design, this input will be ignored and the web splice plate yield strength will be assumed to be equal to the minimum (left or right) girder web yield strength (parameter 2 of GAS command).	ksi	30. (W)	100. (W)	36. <sup>1</sup>
2. Web Splice Plate Tensile Strength	Enter the minimum tensile strength of the web splice plates. For web splice plate design, this input will be ignored and the web splice plate tensile strength will be assumed to be equal to the minimum (left or right) girder web tensile strength (parameter 3 of GAS command).	ksi	50. (W)	110. (W)	--1. <sup>2</sup>
3. Web Splice Bolts Tensile Strength	Enter the minimum tensile strength of the web splice bolts.	ksi	60. (W)	150. (C)	120.
4. Top Flange Splice Plate Yield Strength	Enter the minimum yield strength of the top flange splice plates. For top flange splice plate design, this input will be ignored and the top flange splice plate yield strength will be assumed to be equal to the minimum (left or right) girder top flange yield strength (parameter 6 of GAS command).	ksi	30. (W)	100. (W)	36. <sup>1</sup>
5. Top Flange Splice Plate Tensile Strength	Enter the minimum tensile strength of the top flange splice plates. For top flange splice plate design, this input will be ignored and the top flange splice plate tensile strength will be assumed to be equal to the minimum (left or right) girder top flange tensile strength (parameter 7 of GAS command).	ksi	50. (W)	110. (W)	--1. <sup>2</sup>
6. Top Flange Splice Bolts Tensile Strength	Enter the minimum tensile strength of the top flange splice bolts.	ksi	60. (W)	150. (C)	120.

Chapter 5 Input Description

5.11 MAT - MATERIAL COMMAND (Cont.)

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
7. Bottom Flange Splice Plate Yield Strength	Enter the minimum yield strength of the bottom flange splice plates. For bottom flange splice plate design, this input will be ignored and the bottom flange splice plate yield strength will be assumed to be equal to the minimum (left or right) girder bottom flange yield strength (parameter 10 of GAS command).	ksi	30. (W)	100. (W)	36. <sup>1</sup>
8. Bottom Flange Splice Plate Tensile Strength	Enter the minimum tensile strength of the bottom flange splice plates. For bottom flange splice plate design, this input will be ignored and the bottom flange splice plate tensile strength will be assumed to be equal to the minimum (left or right) girder bottom flange tensile strength (parameter 11 of GAS command).	ksi	50. (W)	110. (W)	-- <sup>1,2</sup>
9. Bottom Flange Splice Bolts Tensile Strength	Enter the minimum tensile strength of the bottom flange splice bolts.	ksi	60. (W)	150. (C)	120.

Notes:

- <sup>1</sup> The default values presented in this table are for analysis only. For design, the program sets this parameter equal to the minimum (left or right) girder corresponding strength value, as entered by the user in the GAS command.
- <sup>2</sup> **Defaults to 58 ksi when the yield strength for the component is 36 ksi; otherwise no default value.**

## Chapter 5 Input Description

### 5.12 GAS - GIRDER ADJACENT SECTION COMMAND

KEYWORD	COMMAND DESCRIPTION
GAS	<p>GIRDER ADJACENT SECTION - This command is used to input the section and material properties of the girder sections framing into the splice.</p> <p><b>Data must be entered for the girder sections on both the left and the right of the centerline of splice (one command with both sides entered on the command).</b></p>

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
1. Left/Right	<p>Enter the location of girder section with respect to the centerline of splice:</p> <p>L - If the girder section is on the left of the centerline of splice.</p> <p>R - If the girder section is on the right of the centerline of splice.</p>	--	L, R (E)	--	--
2. Web Yield Strength	Enter the minimum yield strength of the web steel.	ksi	30. (W)	100. (W)	36.
3. Web Tensile Strength	Enter the minimum tensile strength of the web steel.	ksi	50. (W)	110. (W)	-- <sup>1</sup>
4. Web Thickness	Enter the thickness of the web plate.	in	0.25 (W)	2. (W)	--
5. Web Depth	Enter the depth of the web plate. Both adjacent sections (on left and right) must have the same web depth.	in	18. (W)	144. (W)	--
6. Top Flange Yield Strength	Enter the minimum yield strength of the top flange steel.	ksi	30. (W)	100. (W)	36.
7. Top Flange Tensile Strength	Enter the minimum tensile strength of the top flange steel.	ksi	50. (W)	110. (W)	-- <sup>1</sup>
8. Top Flange Width	Enter the width of the top flange.	in	12. (W)	50. (W)	--
9. Top Flange Thickness	Enter the thickness of the top flange.	in	0.75 (W)	4. (C)	--

Chapter 5 Input Description

5.12 GAS - GIRDER ADJACENT SECTION COMMAND (Cont.)

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
10. Bottom Flange Yield Strength	Enter the minimum yield strength of the bottom flange steel.	ksi	30. (W)	100. (W)	36.
11. Bottom Flange Tensile Strength	Enter the minimum tensile strength of the bottom flange steel.	ksi	50. (W)	110. (W)	-- <sup>1</sup>
12. Bottom Flange Width	Enter the width of the bottom flange.	in	12. (W)	50. (W)	--
13. Bottom Flange Thickness	Enter the thickness of the bottom flange.	in	0.75 (W)	4. (C)	--
14. Positive Factored Flexural Resistance	<b>Note: This parameter is no longer used.</b> Enter the flexural resistance on the ASR command instead.	--	--	--	--
15. Negative Factored Flexural Resistance	<b>Note: This parameter is no longer used.</b> Enter the flexural resistance on the ASR command instead.	--	--	--	--
16. Factored Shear Resistance	Enter the factored shear resistance of the girder section framing into the splice for Strength I limit state.	kips	0. (E)	--	--
17. Web Edge Type	Enter the type of edge for the web: R - If the web plate has a rolled edge. S - If the web plate has a sheared or gas-cut edge.	--	R, S (E)	--	S
18. Top Flange Edge Type	Enter the type of edge for the top flange: R - If the top flange plate has a rolled edge. S - If the top flange plate has a sheared or gas-cut edge.	--	R, S (E)	--	S
19. Bottom Flange Edge Type	Enter the type of edge for the bottom flange: R - If the bottom flange plate has a rolled edge. S - If the bottom flange plate has a sheared or gas-cut edge.	--	R, S (E)	--	S

Notes:

<sup>1</sup> Defaults to 58 ksi when the yield strength for the component is 36 ksi; otherwise no default value.

## Chapter 5 Input Description

### 5.13 ASR - ADJACENT SECTION RESISTANCE COMMAND

KEYWORD	COMMAND DESCRIPTION
ASR	<p>ADJACENT SECTION RESISTANCE - This command is used to input the stress flexural resistances and hybrid factors of the girder sections framing into the splice.</p> <p>The parameters and the command must be repeated to enter data for the girder sections on both the left and right of the centerline of splice <b>(two commands with one side on each command)</b>.</p> <p>Note that all input values for flexural resistance (Fr) must have a magnitude less than or equal to the yield stress (Fy) of the corresponding flange.</p>

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
1. Left/Right	Enter the location of girder section with respect to the centerline of splice: L- If the girder section is on the left of the centerline of splice. R- If the girder section is on the right of the centerline of splice.	--	L, R (E)	--	--
2. Top Flange Strength-I Positive Fr	Enter the stress flexural resistance of the top flange for Strength-I positive bending. This parameter should be entered as a negative value.	ksi	-100. (W)	-30 (W)	--
3. Top Flange Strength-I Negative Fr	Enter the stress flexural resistance of the top flange for Strength-I negative bending. Leave this value blank for simple spans.	ksi	30. (W)	100. (W)	--
4. Top Flange Strength-IP Positive Fr	Enter the stress flexural resistance of the top flange for Strength-IP positive bending. Leave this value blank if there is no pedestrian loading. This parameter should be entered as a negative value.	ksi	-100. (W)	-30 (W)	--
5. Top Flange Strength-IP Negative Fr	Enter the stress flexural resistance of the top flange for Strength-IP negative bending. Leave this value blank for simple spans or if there is no pedestrian loading.	ksi	30. (W)	100. (W)	--
6. Top Flange Strength-II Positive Fr	Enter the stress flexural resistance of the top flange for Strength-II positive bending. This parameter should be entered as a negative value.	ksi	-100. (W)	-30 (W)	--
7. Top Flange Strength-II Negative Fr	Enter the stress flexural resistance of the top flange for Strength-II negative bending. Leave this value blank for simple spans.	ksi	30. (W)	100. (W)	--
8. Bottom Flange Strength-I Positive Fr	Enter the stress flexural resistance of the bottom flange for Strength-I positive bending.	ksi	30. (W)	1000 (W)	--

Chapter 5 Input Description

5.13 ASR - ADJACENT SECTION RESISTANCE (Cont.)

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
9. Bottom Flange Strength-I Negative Fr	Enter the stress flexural resistance of the bottom flange for Strength-I negative bending. Leave this value blank for simple spans. This parameter should be entered as a negative value.	ksi	-100. (W)	-30. (W)	--
10. Bottom Flange Strength-IP Positive Fr	Enter the stress flexural resistance of the bottom flange for Strength-IP positive bending. Leave this value blank if there is no pedestrian loading.	ksi	30. (W)	100. (W)	--
11. Bottom Flange Strength-IP Negative Fr	Enter the stress flexural resistance of the bottom flange for Strength-IP negative bending. Leave this value blank for simple spans or if there is no pedestrian loading. This parameter should be entered as a negative value.	ksi	-100. (W)	-300. (W)	--
12. Bottom Flange Strength-II Positive Fr	Enter the stress flexural resistance of the bottom flange for Strength-II positive bending.	ksi	30. (W)	100. (W)	--
13. Bottom Flange Strength-II Negative Fr	Enter the stress flexural resistance of the bottom flange for Strength-II negative bending. Leave this value blank for simple spans. This parameter should be entered as a negative value.	ksi	-100. (W)	-30. (W)	--
14. Strength-I Positive Rh	Enter the hybrid factor (Rh) of the section for Strength-I positive bending.	--	0.1 (E)	2.0 (W)	--
15. Strength-I Negative Rh	Enter the hybrid factor (Rh) of the section for Strength-I negative bending. Leave this value blank for simple spans.	--	0.1 (E)	2.0 (W)	--
16. Strength-IP Positive Rh	Enter the hybrid factor (Rh) of the section for Strength-I positive bending. Leave this value blank if there is no pedestrian loading.	--	0.1 (E)	2.0 (W)	--
17. Strength-IP Negative Rh	Enter the hybrid factor (Rh) of the section for Strength-I negative bending. Leave this value blank for simple spans or if there is no pedestrian loading.	--	0.1 (E)	2.0 (W)	--
18. Strength-II Positive Rh	Enter the hybrid factor (Rh) of the section for Strength-II positive bending.	--	0.1 (E)	2.0 (W)	--
19. Strength-II Negative Rh	Enter the hybrid factor (Rh) of the section for Strength-II negative bending. Leave this value blank for simple spans.	--	0.1 (E)	2.0 (W)	--
20. Service-II Positive Rh	Enter the hybrid factor (Rh) of the section for Service-II positive bending.	--	0.1 (E)	2.0 (W)	--

## Chapter 5 Input Description

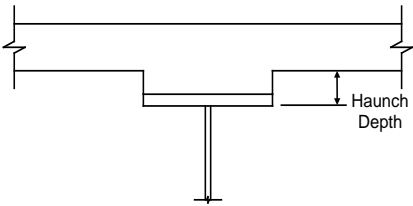
### 5.13 ASR - ADJACENT SECTION RESISTANCE (Cont.)

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
21. Service-II Negative Rh	Enter the hybrid factor (Rh) of the section for Service-II negative bending. Leave this value blank for simple spans.	--	0.1 (E)	2.0 (W)	--
22. Service-IIB Positive Rh	Enter the hybrid factor (Rh) of the section for Service-IIB positive bending.	--	0.1 (E)	2.0 (W)	--
23. Service-IIB Negative Rh	Enter the hybrid factor (Rh) of the section for Service-IIB negative bending. Leave this value blank for simple spans.	--	0.1 (E)	2.0 (W)	--

Chapter 5 Input Description

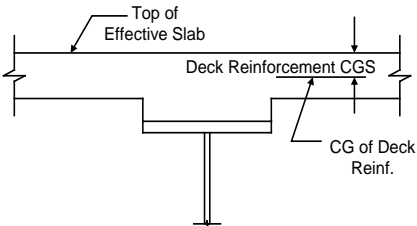
5.14 SLB - SLAB WITH COMPOSITE GIRDER COMMAND

KEYWORD	COMMAND DESCRIPTION
SLB	SLAB WITH COMPOSITE GIRDER - This command is used to input the section properties of the slab present in a composite girder section. Enter this command only if parameter 2, Composite/Non-composite, in the CTL command is set to 'C'.

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
1. Effective Slab Thickness	Enter the effective structural thickness of the slab.	in	4. (W)	12. (W)	--
2. Effective Slab Width	Enter the effective structural width of the slab.	in	0. (E)	180. (C)	--
3. Haunch Depth	 <p>Enter the depth of the haunch. The haunch depth is measured from the top of the web to the bottom of the deck slab.</p> <p>For design of any splice element, this parameter will be ignored and should be left blank. The program will set the haunch depth equal to the top flange thickness of the girder adjacent section being considered.</p> <p>For analysis, the program will issue a warning if the inputted haunch depth is not equal to the top flange thickness of at least one of the two girder adjacent sections.</p>	in	0. (E)	10. (W)	TFT <sup>1</sup>
4. Deck Reinforcement Area	Enter the area of steel reinforcement parallel to the plate girder per unit width of the deck.	in <sup>2</sup> /ft	0. (E)	3. (W)	0.

Chapter 5 Input Description

5.14 SLB - SLAB WITH COMPOSITE GIRDER COMMAND (Cont.)

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
5. Deck Reinforcement CGS	 <p>Enter the distance from the center of gravity of deck reinforcement to the top of the effective slab.</p>	in	0. (E)	16. (W)	0.
6. Steel to Concrete Modular Ratio	Enter the girder steel to slab concrete modular ratio.	--	3 (W)	20 (W)	8

Notes:

- For analysis, the default for the haunch depth equals the top flange thickness of the girder adjacent section being considered.

Chapter 5 Input Description

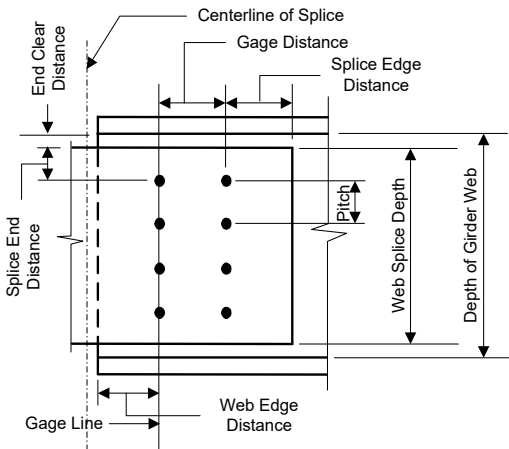
5.15 WSB – WEB SPLICE BOLT COMMAND

KEYWORD	COMMAND DESCRIPTION
WSB	WEB SPLICE BOLT - This command is used for entering the various dimensional parameters related to the web splice bolts.

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
1. Diameter of Web Splice Bolts	Enter the diameter of the bolts to be used with the web splice plates.	in	0.625 (E)	1.375 (W)	0.875
2. Diameter of Web Splice Bolt Holes	<p>Enter the diameter of the web splice bolt holes. The value must be greater than or equal to the standard hole and less than or equal to the maximum oversize hole, as per LRFD Specifications 6.13.2.4.2-1. If the value entered is larger than a standard hole, then Chief Bridge Engineer Approval is required.</p> <p>If the value entered is smaller than a standard hole diameter it will be reset to a standard hole diameter.</p> <p>If the value entered is larger than the oversize hole diameter it will be reset to an oversize hole diameter.</p> <p>Standard and oversize hole diameters are defined in LRFD Specifications Table 6.13.2.4.2-1.</p> <p>If this parameter is not entered the program will set it to the value corresponding to a standard hole.</p>	in	0.75 <sup>1</sup> (E)	1.5 <sup>1</sup> (W)	-- <sup>2</sup>

Chapter 5 Input Description

5.15 WSB – WEB SPLICE BOLT COMMAND (Cont.)

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
3. Splice End Distance	 <p>Enter the end distance from end of web splice plates to centerline of nearest bolt in the direction of pitch.            For design, enter the minimum splice end distance. The program will set the splice end distance at the top of the web splice plate equal to that at the bottom.            For analysis, enter the actual splice end distance at the top of the web splice plate only. The program will compute the value at the bottom of the web splice plate based on this and other inputted parameters.</p>	in	0.875 (E)	5.0 (W)	--
4. End Clear Distance	Enter the distance from the top of the girder web to the top of the web splice plate.	in	1.0 (W)	10. (W)	--
5. Splice Edge Distance	Enter the edge distance from edge of web splice plates to the gage line farthest from centerline of splice.	in	0.875 (E)	5.0 (W)	--
6. Web Edge Distance	Enter the edge distance from edge of girder web to the gage line closest to the centerline of splice.	in	0.875 (E)	3.4375 (W)	--
7. Gage Distance	Enter the typical gage distance of the web splice bolts. For PennDOT's preferred minimum distances between centers of bolts in standard holes, refer to Table 3.2-5.	in	1.875 (E)	7. (W)	3.
8. Number of Gage Lines	Enter the number of gage lines on one side of the web splice. For design of web splice bolts, this parameter will be ignored and should be left blank.	--	2 (E)	10 (W)	2

Chapter 5 Input Description

5.15 WSB – WEB SPLICE BOLT COMMAND (Cont.)

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
9. Bolts per Gage Line	<p><b>For design of web splice bolts, enter the minimum number of bolts per gage line. This parameter is optional for design of web splice bolts.</b></p> <p><b>If left blank for the design of web splice bolts, the program will calculate the initial minimum number of bolts based upon the absolute maximum allowable spacing for sealing of 7.0 in as per AASHTO 6.13.2.6.2-1 and 6.13.2.6.2-2.</b></p> <p><b>For analysis of web splice bolts, enter the actual number of bolts per gage line. This parameter must be entered for analysis of web splice bolts.</b></p>	--	2 (E)	81 (E)	--
10. Minimum Bolt Pitch	Enter the minimum bolt pitch for design of web splice bolts. For PennDOT's preferred minimum distances between centers of bolts in standard holes, refer to Table 3.2-5. For analysis of web splice bolts, this parameter will be ignored and should be left blank.	in	1.875 (E)	7. (W)	3.
11. Gap at Splice Center	Enter the edge to edge clear distance between the two adjacent girder sections framing into the splice.	in	0. (E)	0.5 (W)	0.125
12. Edge or End Distance Increase	Enter the value up to which edge or end distance would be allowed to increase before increasing the number of bolts or plate thickness. This input is only for design option and will only be used if web edge distance, web splice end distance or web splice edge distance controls the bearing failure.	in	0 (E)	2.75 (W)	0
13. Bolt Pitch Correction	<p>Enter the option for bolt pitch correction</p> <p>Y - Enable bolt pitch correction if applicable.</p> <p>N - Disable bolt pitch correction.</p> <p>If bolt pitch correction is enabled ('Y'), the program will check that the greatest/least WSPL pitch dimensions are less than the maximum allowable pitch (set from the plate thickness). The program will then increment the thickness until these pitch dimensions are below the maximum allowable WSPL pitch.</p> <p>This parameter is for design runs only and should be left blank if an analysis run is performed.</p>	--	Y, N (E)	--	Y

## Chapter 5 Input Description

### Notes:

- <sup>1</sup> If the value entered is smaller than a standard hole diameter it will be reset to a standard hole diameter, **based on the bolt diameter**. If the value entered is larger than the oversize hole diameter it will be reset to an oversize hole diameter. Standard and oversize hole diameters are defined in LRFD Specifications Table 6.13.2.4.2-1.
- <sup>2</sup> If this parameter is not entered the program will set it to the value corresponding to a standard hole for the bolt diameter specified. **For bolts less than or equal to 1 inch in diameter, a standard hole is equal to the bolt diameter + 1/16". For bolts greater than 1 inch in diameter, a standard hole is equal to the bolt diameter + 1/8".**

Chapter 5 Input Description

5.16 WBP - WEB BOLT PITCH COMMAND

KEYWORD	COMMAND DESCRIPTION
WBP	<p>WEB BOLT PITCH - This command is used to specify the pitch distances for the analysis only of web splice bolts.</p> <p>For design of web splice bolts (<b>parameter 4 of the CTL command</b>), this command should not be entered. <b>For analysis of web splice bolts, this command must be entered.</b></p> <p>The maximum number of pitch distances that can be entered is (NBOLTS - 1), where NBOLTS is the total number of bolts per gage line of the web splice (parameter 9 of the WSB command). Any missing pitch distances will be assumed to be equal to the previous pitch distance that is entered.</p> <p>This command is repeatable (<b>8 commands with 10 pitch numbers and distances per command</b>) starting with parameter 1.</p>

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
1. Web Splice Bolt Pitch Number	Enter the ordinal number of the pitch distance to be entered. Pitch distance 1 is measured between the first and second bolts from the top, pitch distance 2 is measured between the second and third bolts from the top, and so forth.	--	1 (E)	<b>80</b> <b>(E)</b>	--
2. Web Splice Bolt Pitch Distance	Enter the distance for the pitch number entered in parameter 1. For PennDOT's preferred minimum distances between centers of bolts in standard holes, refer to Table 3.2-5.	in	1.875 (E)	7. (W)	--

## Chapter 5 Input Description

### 5.17 WSP - WEB SPLICE PLATE COMMAND

KEYWORD	COMMAND DESCRIPTION
WSP	WEB SPLICE PLATE - This command is used to enter the dimensions and properties of web splice plates.

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
1. Web Splice Depth	Enter the depth of the web splice plate.	in	10. (E)	141.75 (W)	--
2. Web Splice Thickness	Enter the thickness of each web splice plate. For design of web splice plates, leave this parameter blank.	in	0.25 (E)	2.0 (W)	--
3. Web Splice Plate Edge Type	Enter the type of edge for web splice plates: R - If the web splice plates have a rolled edge. S - If the web splice plates have a sheared or gas-cut edge.	--	R, S (E)	--	S

## Chapter 5 Input Description

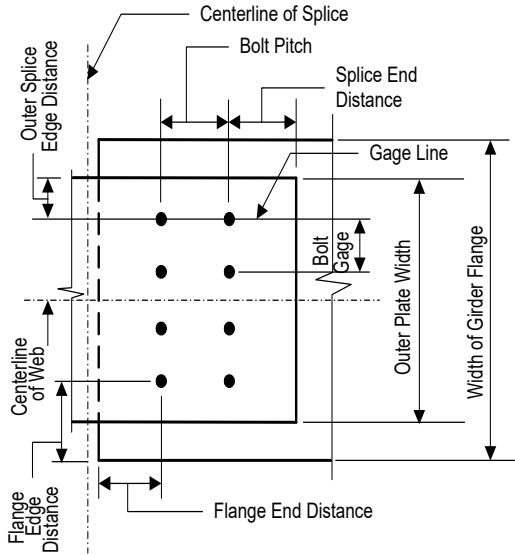
### 5.18 FSB - FLANGE SPLICE BOLT COMMAND

KEYWORD	COMMAND DESCRIPTION
FSB	<p>FLANGE SPLICE BOLT - This command is used to enter the dimensional parameters related to flange splice bolts.</p> <p>Flange splice bolt data must be entered twice, once for the top flange and once for the bottom flange <b>(one command with both top and bottom entered on the command)</b>.</p>

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
1. Top/Bottom	Enter the flange identifier: T - For top flange splice. B - For bottom flange splice.	--	T, B (E)	--	--
2. Diameter of Bolts	Enter the diameter of the flange splice bolts.	in	0.625 (E)	1.375 (W)	0.875
3. Diameter of Bolt Holes	<p>Enter the diameter of the flange splice bolt holes. The value must be greater than or equal to the standard hole and less than or equal to the maximum oversize hole, as per LRFD Specifications Table 6.13.2.4.2-1. If the value entered is larger than a standard hole, then Chief Bridge Engineer Approval is required.</p> <p>If the value entered is smaller than a standard hole diameter it will be reset to a standard hole diameter.</p> <p>If the value entered is larger than the oversize hole diameter it will be reset to an oversize hole diameter.</p> <p>If this parameter is not entered the program will set it to the value corresponding to a standard hole.</p>	in	0.75 <sup>1</sup> (E)	1.5 <sup>1</sup> (W)	-- <sup>2</sup>

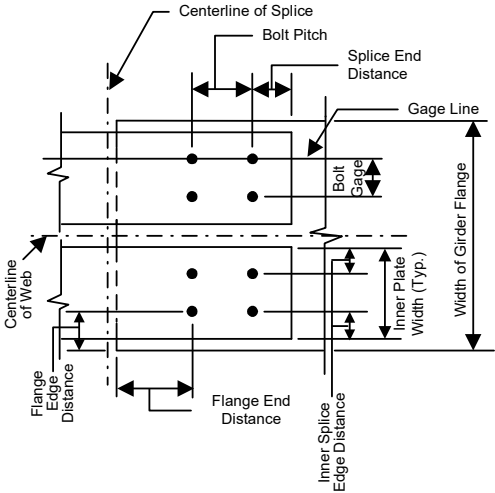
Chapter 5 Input Description

5.18 FSB – FLANGE SPLICE BOLT COMMAND (Cont.)

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
4. Least Splice End Distance	<p>Enter the least distance from end of flange splice plate to the centerline of nearest bolts in the direction of gage line.</p> 	in	0.875 (E)	2.375 (W)	--
5. Greatest Splice End Distance	<p>For a staggered bolt pattern, enter the greatest distance from end of flange splice plate to the centerline of nearest bolts in the direction of gage line. If this parameter is left blank, it will be assumed to be equal to the Least Splice End Distance (parameter 4). For a non-staggered bolt pattern, this parameter will be ignored and should be left blank.</p>	in	0.875 (E)	5.0 (E)	Least Splice End Distance
6. Least Flange End Distance	<p>Enter the least distance from end of girder flange to the centerline of nearest bolts in the direction of gage line.</p>	in	0.875 (E)	2.375 (W)	--
7. Greatest Flange End Distance	<p>For a staggered bolt pattern, enter the greatest distance from end of girder flange to the centerline of nearest bolts in the direction of gage line. If this parameter is left blank, it will be assumed to be equal to the Least Flange End Distance (parameter 6). For a non-staggered bolt pattern, this parameter will be ignored and should be left blank.</p>	in	0.875 (E)	5.0 (E)	Least Flange End Distance
8. Outer Splice Edge Distance	<p>Enter the edge distance of bolts for the outer flange splice plate.</p>	in	0.875 (E)	5.0 (E)	--

Chapter 5 Input Description

5.18 FSB – FLANGE SPLICE BOLT COMMAND (Cont.)

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
9. Inner Splice Least Edge Distance	<p>Enter the least edge distance of bolts for the inner flange splice plate.</p> 	in	0.875 (E)	2.375 (W)	--
10. Inner Splice Greatest Edge Distance	<p>For a staggered bolt pattern, enter the greatest edge distance of bolts for the inner flange splice plate. If this parameter is left blank, it will be assumed to be equal to the Inner Splice Least Edge Distance (parameter 9). For a non-staggered bolt pattern, this parameter will be ignored and should be left blank.</p>	in	0.875 (E)	5.0 (E)	Inner Splice Least Edge Distance
11. Left Flange Edge Distance	<p>Enter the edge distance of bolts for girder flange plate on left of centerline of splice.</p>	in	0.875 (E)	8.0 (E)	--
12. Right Flange Edge Distance	<p>Enter the edge distance of bolts for girder flange plate on right of centerline of splice.</p>	in	0.875 (E)	8.0 (E)	--
13. Minimum Bolt Pitch	<p>For a staggered bolt pattern, enter the minimum pitch distance of bolts in the direction parallel to the gage line. For a non-staggered bolt pattern, enter the pitch distance of bolts in the direction parallel to the gage line. For PennDOT's preferred minimum distances between centers of bolts in standard holes, refer to Table 3.2-5.</p>	in	1.875 (E)	4.125 (W)	3.0
14. Maximum Bolt Pitch	<p>For a staggered bolt pattern, enter the maximum pitch distance of bolts in the direction parallel to the gage line. If this parameter is left blank, it will be assumed to be equal to the Minimum Bolt Pitch (parameter 13). For a non-staggered bolt pattern, this parameter will be ignored and should be left blank.</p>	in	1.875 (E)	7.0 (E)	Minimum Bolt Pitch

Chapter 5 Input Description

5.18 FSB – FLANGE SPLICE BOLT COMMAND (Cont.)

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
15. Bolt Gage	Enter the distance between two bolt gage lines in the flange splice. For PennDOT's preferred minimum distances between centers of bolts in standard holes, refer to Table 3.2-5.	in	1.875 (E)	7.0 (W)	3.0
16. Number of Gage Lines	Enter the total number of bolt gage lines on the flange splice plate. This parameter must be entered as an even number.	--	2 (E)	12 (W)	--
17. Total Number of Bolts	Enter the total number of bolts on <b>one</b> side of the centerline of splice. <b>Refer to Figures 6.18-7 and 6.18-8 for how to define this value.</b>  <b>The TOTAL NUMBER OF BOLTS must be a multiple of the number of gage lines (i.e. each gage line must have the same number of bolts). The program will stop with an error if this is not the case.</b>  For design of flange splice bolts, this parameter will be ignored and should be left blank.	--	2 (E)	100 (W)	--
18. Maximum Bolt Distance	Enter the maximum distance between extreme bolts across gage lines between the bolt closest to the centerline of splice and the bolt farthest from the centerline of splice. <b>Refer to Figures 6.18-7 and 6.18-8 for how to define this value.</b>  <b>NOTE: This value is only used when calculating the shear resistance of the bolts to calculate the length between extreme fasteners. In LRFD Specifications Article 6.13.2.7, if the length between extreme fasteners measured parallel to the line of action of the force is greater than 50 inches, then the resistance is taken as 0.80 times the value given by equations 6.13.2.7-1 or 6.13.2.7-2.</b>  For design of flange splice bolts, this parameter will be ignored and should be left blank.	in	1.875 (E)	343.0 (W)	--

Notes:

<sup>1</sup> If the value entered is smaller than a standard hole diameter it will be reset to a standard hole diameter, **based on the bolt diameter**. If the value entered is larger than the oversize hole diameter it will be reset to an oversize hole diameter. Standard and oversize hole diameters are defined in LRFD Specifications Table 6.13.2.4.2-1.

<sup>2</sup> If this parameter is not entered the program will set it to the value corresponding to a standard hole for the bolt diameter specified. **For bolts less than or equal to 1 inch in diameter, a standard hole is equal to the bolt diameter + 1/16". For bolts greater than 1 inch in diameter, a standard hole is equal to the bolt diameter + 1/8".**

## Chapter 5 Input Description

### 5.19 FSP - FLANGE SPLICE PLATE COMMAND

KEYWORD	COMMAND DESCRIPTION
FSP	<p>FLANGE SPLICE PLATE - This command is used to enter the dimensional parameters related to the flange splice plates.</p> <p>Flange splice plate data must be entered twice, once for the top flange and once for the bottom flange <b>(one command with both top and bottom entered on the command)</b>.</p>

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
1. Top/Bottom	<p>Enter the flange identifier:</p> <p>T - For top flange splice. B - For bottom flange splice.</p>	--	T, B (E)	--	--
2. Outer Plate Width	<p>Enter the width of the outer flange splice plate.</p> <p><b>Do not enter this value if Flange Splice Configuration 2 has been chosen on the CTL command.</b></p>	in	12. (W)	50. (W)	--
3. Outer Plate Thickness	<p>Enter the thickness of the outer flange splice plate.</p> <p>For design of flange splice plates, this parameter will be ignored and should be left blank.</p> <p><b>Do not enter this value if Flange Splice Configuration 2 has been chosen on the CTL command.</b></p>	in	0.375 (W)	2. (W)	--
4. Inner Plates Width	<p>Enter the width of each inner flange splice plate.</p> <p><b>Do not enter this value if Flange Splice Configuration 1 has been chosen on the CTL command.</b></p>	in	1.75 (W)	25. (W)	--
5. Inner Plates Thickness	<p>Enter the thickness of each inner flange splice plate.</p> <p>For design of flange splice plates, this parameter will be ignored and should be left blank.</p> <p><b>Do not enter this value if Flange Splice Configuration 1 has been chosen on the CTL command.</b></p>	in	0.375 (W)	2. (W)	--
6. Flange Splice Plate Edge Type	<p>Enter the type of edge for flange splice plates:</p> <p>R - If the flange splice plates have a rolled edge. S - If the flange splice plates have a sheared or gas-cut edge.</p>	--	R, S (E)	--	S

Chapter 5 Input Description

5.20 DRI - DUCTILITY, REDUNDANCY, IMPORTANCE FACTOR COMMAND

KEYWORD	COMMAND DESCRIPTION
DRI	DUCTILITY, REDUNDANCY, IMPORTANCE FACTOR - This command is used to enter the general load factors related to ductility, redundancy and importance of the girder being spliced.

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
1. Strength Ductility Factor	Enter the general load factor related to ductility to be applied to the strength limit states. As per DM-4 Section 1.3.4, a factor other than 1.0 is not permitted by PennDOT.	--	0.95 (E)	1.05 (W)	1.0
2. Strength Redundancy Factor	Enter the general load factor related to redundancy to be applied to the strength limit states. As per DM-4 Section 1.3.5, a factor other than 1.0 is not permitted by PennDOT.	--	0.95 (E)	1.05 (W)	1.0
3. Strength Importance Factor	Enter the general load factor related to operational importance to be applied to the strength limit states. As per DM-4 Section 1.3.3, a factor other than 1.0 is not permitted by PennDOT.  As per DM-4 Section 1.3.2.1, the product of ductility, redundancy and importance factors must be 1.0. If this product is less than 1.0 or exceeds 1.16, the program will reset its value to the appropriate limit (either 1.0 or 1.16) and issue a warning message.	--	1.0 (E)	2.0 (W)	1.0

Chapter 5 Input Description

5.21 MIS - MISCELLANEOUS COMMAND

KEYWORD	COMMAND DESCRIPTION
MIS	MISCELLANEOUS - This command is used to enter miscellaneous input data.

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
1. Surface	<p>Enter the surface condition class for the splice which is used for slip critical connections. Surface conditions allowed are:</p> <p>A - For Class A.                      B - For Class B.                      C - For Class C.</p> <p>If Bolt Connection Type (parameter 19 of the CTL command) is entered as 'B', then this parameter will be ignored and should be left blank.</p>	--	A, B, C (E)	--	A
2. Web Hole Size Factor	<p>Enter the web hole size factor. This parameter must be set equal to 1.0 for standard holes, and 0.85 for oversize holes. If Bolt Connection Type (parameter 19 of the CTL command) is entered as 'B', then this parameter will be ignored and should be left blank.</p>	--	0. (E)	1.0 (E)	1.0 <sup>1</sup>
3. Web Nominal Fatigue Resistance	<p>Enter the nominal fatigue resistance to be used to check fatigue resistance of web splice.</p> <p>If this parameter is left blank, and fatigue checks are to be performed (parameter 20 of the CTL command), a category B detail and Fatigue I load combination will be assumed.</p> <p>If a value is entered here, a Fatigue II load combination will be assumed. (in general, if the (ADTT)<sub>SL</sub> is less than 645, a value should be calculated and entered here)</p> <p>If fatigue checks are not to be performed, this parameter will be ignored and should be left blank.</p>	ksi	1.3 (W)	24. (E)	16.

Chapter 5 Input Description

5.21 MIS - MISCELLANEOUS COMMAND (Cont.)

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
4. Top Flange Nominal Fatigue Resistance	<p>Enter the nominal fatigue resistance to be used to check fatigue resistance of top flange splice.</p> <p>If this parameter is left blank, and fatigue checks are to be performed (parameter 20 of the CTL command), a category B detail and Fatigue I load combination will be assumed.</p> <p>If a value is entered here, a Fatigue II load combination will be assumed. (in general, if the (ADTT)<sub>SL</sub> is less than 645, a value should be calculated and entered here)</p> <p>If fatigue checks are not to be performed, this parameter will be ignored and should be left blank.</p>	ksi	1.3 (W)	24. (E)	16.
5. Bottom Flange Nominal Fatigue Resistance	<p>Enter the nominal fatigue resistance to be used to check fatigue resistance of bottom flange splice.</p> <p>If this parameter is left blank, and fatigue checks are to be performed (parameter 20 of the CTL command), a category B detail and Fatigue I load combination will be assumed.</p> <p>If a value is entered here, a Fatigue II load combination will be assumed. (in general, if the (ADTT)<sub>SL</sub> is less than 645, a value should be calculated and entered here)</p> <p>If fatigue checks are not to be performed, this parameter will be ignored and should be left blank.</p>	ksi	1.3 (W)	24. (E)	16.
6. Pennsylvania Traffic Factor	Enter the Pennsylvania traffic factor for fatigue for vehicles on the national highway system, priority commercial network, or agricultural network.	--	1.0 (W)	2.0 (W)	1.2
7. Minimum Web Bolt Tension	Enter the minimum tension required for the web bolts.	kips	19. (W)	148. (W)	39.
8. Minimum Top Flange Bolt Tension	Enter the minimum tension required for the top flange bolts.	kips	19. (W)	148. (W)	39.
9. Minimum Bottom Flange Bolt Tension	Enter the minimum tension required for the bottom flange bolts.	kips	19. (W)	148. (W)	39.

Chapter 5 Input Description

5.21 MIS - MISCELLANEOUS COMMAND (Cont.)

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
10. Top Flange Hole Size Factor	Enter the top flange hole size factor. This parameter must be set equal to 1.0 for standard holes and 0.85 for oversize holes. If Bolt Connection Type (parameter 19 of the CTL command) is entered as 'B', then this parameter will be ignored and should be left blank.	--	0. (E)	1.0 (E)	-- <sup>1</sup>
11. Bottom Flange Hole Size Factor	Enter the bottom flange hole size factor. This parameter must be set equal to 1.0 for standard holes and 0.85 for oversize holes. If Bolt Connection Type (parameter 19 of the CTL command) is entered as 'B', then this parameter will be ignored and should be left blank.	--	0. (E)	1.0 (E)	-- <sup>1</sup>
<b>12. Resistance factor for bolts in shear</b>	<b>Enter the resistance factor to use for bolts in shear (<math>\phi_s</math>), as per the LRFD Specifications Article 6.5.4.2.</b>  <b>Enter 0.75 for A307 bolts or 0.80 for A325 and A490 bolts.</b>	--	<b>0.75 (E)</b>	<b>0.80 (E)</b>	<b>0.80</b>

Notes:

<sup>1</sup> If this parameter is not entered based on a standard hole, the program will set it to either 1.0 for a standard hole, or 0.85 for an oversize hole based on the hole diameter entered on the WSB or FSB commands.

## Chapter 5 Input Description

### 5.22 OIN - OUTPUT OF INPUT DATA COMMAND

KEYWORD	COMMAND DESCRIPTION
OIN	OUTPUT OF INPUT DATA - This command allows the user to control the output of the input data. Only one OIN command can be used.

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
1. Input File Echo	Enter: 0 - Do not print input file echo. 1 - Print input file echo.	--	0 (E)	1 (E)	0
2. Input Commands	Enter: 0 - Do not print input commands. 1 - Print input commands.	--	0 (E)	1 (E)	0
3. Input Summary	Enter: 0 - Do not print input summary. 1 - Print input summary.	--	0 (E)	1 (E)	1

## Chapter 5 Input Description

### 5.23 OSP - OUTPUT OF SECTION PROPERTIES COMMAND

KEYWORD	COMMAND DESCRIPTION
OSP	OUTPUT OF SECTION PROPERTIES - This command controls the section property output tables generated in the output file. Only one OSP command can be used.

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
1. Gross Section Properties	Enter: 0 - Do not print gross section properties. 1 - Print gross section properties.	--	0 (E)	1 (E)	*1
2. Net Section Properties	Enter: 0 - Do not print net section properties. 1 - Print net section properties.	--	0 (E)	1 (E)	*

Notes:

- <sup>1</sup> The default values for every parameter on this command are determined based on the type of run (analysis or design). The defaults for all output commands are detailed in Chapter 6.

**Chapter 5 Input Description**

**5.24 OCN - OUTPUT OF SPLICE CONFIGURATION COMMAND**

KEYWORD	COMMAND DESCRIPTION
OCN	OUTPUT OF SPLICE CONFIGURATION - This command controls the splice configuration output tables generated in the output file. Only one OCN command can be used.

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
1. Final or Given Configuration	Enter: 0 - Do not print the final or given splice configuration. 1 - Print the final or given splice configuration.	--	0 (E)	1 (E)	*1
2. Design Trials	Enter: 0 - Do not print the splice sections that were tried during the design optimization. 1 - Print the splice sections that were tried during the design optimization.	--	0 (E)	1 (E)	*

Notes:

<sup>1</sup> The default values for every parameter on this command are determined based on the type of run (analysis or design). The defaults for all output commands are detailed in Chapter 6.

## Chapter 5 Input Description

### 5.25 OAN - OUTPUT OF ANALYSIS RESULTS COMMAND

KEYWORD	COMMAND DESCRIPTION
OAN	OUTPUT OF ANALYSIS RESULTS - This command controls the analysis result output tables generated in the output file. Only one OAN command can be used.

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
1. Factored Loads	Enter: 0 - Do not print the factored loads for each applicable limit state. 1 - Print the factored loads for each applicable limit state.  This output includes splice design moments, and design shears	--	0 (E)	1 (E)	*1
2. Web Stresses	Enter: 0 - Do not print the web stresses for each applicable limit state. 1 - Print the web stresses for each applicable limit state.	--	0 (E)	1 (E)	*
3. Web Bolt Forces	Enter: 0 - Do not print the web bolt forces for each applicable limit state. 1 - Print the web bolt forces for each applicable limit state.	--	0 (E)	1 (E)	*
4. Top Flange Plate Stresses	Enter: 0 - Do not print the top flange plate stresses for each applicable limit state. 1 - Print the top flange plate stresses for each applicable limit state.	--	0 (E)	1 (E)	*
5. Top Flange Bolt Forces	Enter: 0 - Do not print the top flange bolt forces for each applicable limit state. 1 - Print the top flange bolt forces for each applicable limit state.	--	0 (E)	1 (E)	*
6. Top Flange Total Plate Forces	Enter: 0 - Do not print the top flange total plate forces for each applicable limit state. 1 - Print the top flange total plate forces for each applicable limit state.	--	0 (E)	1 (E)	*
7. Bottom Flange Plate Stresses	Enter: 0 - Do not print the bottom flange plate stresses for each applicable limit state. 1 - Print the bottom flange plate stresses for each applicable limit state.	--	0 (E)	1 (E)	*

**Chapter 5 Input Description**

**5.25 OAN - OUTPUT OF ANALYSIS RESULTS COMMAND (Cont.)**

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
8. Bottom Flange Bolt Forces	Enter: 0 - Do not print the bottom flange bolt forces for each applicable limit state. 1 - Print the bottom flange bolt forces for each applicable limit state.	--	0 (E)	1 (E)	*
9. Bottom Flange Total Plate Forces	Enter: 0 - Do not print the bottom flange total plate forces for each applicable limit state. 1 - Print the bottom flange total plate forces for each applicable limit state.	--	0 (E)	1 (E)	*

Notes:

- <sup>1</sup> The default values for every parameter on this command are determined based on the type of run (analysis or design). The defaults for all output commands are detailed in Chapter 6.

Chapter 5 Input Description

5.26 OSC - OUTPUT OF SPECIFICATION CHECKING COMMAND

KEYWORD	COMMAND DESCRIPTION
OSC	OUTPUT OF SPECIFICATION CHECKING - This command controls the specification checking output tables generated in the output file. Only one OSC command can be used.

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
1. Flexural Stresses in Web Splice	Enter: 0 - Do not print the results of the flexural stress specification checks in the web splice. 1 - Print the results of the flexural stress specification checks in the web splice.	--	0 (E)	1 (E)	*1
2. Shear Forces in Web Splice	Enter: 0 - Do not print the results of the shear force specification checks for the web splice. 1 - Print the results of the shear force specification checks for the web splice.	--	0 (E)	1 (E)	*
3. Net Section Tensile Fracture in Flanges	Enter: 0 - Do not print the results of the axial tensile stress specification checks based on net section fracture in the top and bottom flanges. 1 - Print the results of the axial tensile stress specification checks based on net section fracture in the top and bottom flanges.	--	0 (E)	1 (E)	*
4. Gross Section Tensile Yielding in Flanges	Enter: 0 - Do not print the results of the axial tensile stress specification checks based on gross section yielding in the top and bottom flanges. 1 - Print the results of the axial tensile stress specification checks based on gross section yielding in the top and bottom flanges.	--	0 (E)	1 (E)	*
5. Gross Section Compressive Yielding in Flanges	Enter: 0 - Do not print the results of the axial compressive stress specification checks based on gross section yielding in the top and bottom flanges. 1 - Print the results of the axial compressive stress specification checks based on gross section yielding in the top and bottom flanges.	--	0 (E)	1 (E)	*

Chapter 5 Input Description

5.26 OSC - OUTPUT OF SPECIFICATION CHECKING COMMAND (Cont.)

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
6. Fatigue Checks for Web Splice	Enter: 0 - Do not print the results of the fatigue specification checks for the web splice. 1 - Print the results of the fatigue specification checks for the web splice.	--	0 (E)	1 (E)	*
7. Fatigue Checks for Flange Splices	Enter: 0 - Do not print the results of the fatigue specification checks for the top and bottom flange splices. 1 - Print the results of the fatigue specification checks for the top and bottom flange splices.	--	0 (E)	1 (E)	*
8. Bolt Bearing Strength in Web	Enter: 0 - Do not print the results of the bolt bearing strength specification checks in the web. 1 - Print the results of the bolt bearing strength specification checks in the web.	--	0 (E)	1 (E)	*
9. Bolt Bearing Strength in Flanges	Enter: 0 - Do not print the results of the bolt bearing strength specification checks in the top and bottom flanges. 1 - Print the results of the bolt bearing strength specification checks in the top and bottom flanges.	--	0 (E)	1 (E)	*
10. Bolt Shear Strength in Web	Enter: 0 - Do not print the results of the bolt shear strength specification checks in the web. 1 - Print the results of the bolt shear strength specification checks in the web.	--	0 (E)	1 (E)	*
11. Bolt Shear Strength in Flanges	Enter: 0 - Do not print the results of the bolt shear strength specification checks in the top and bottom flanges. 1 - Print the results of the bolt shear strength specification checks in the top and bottom flanges.	--	0 (E)	1 (E)	*

Chapter 5 Input Description

5.26 OSC - OUTPUT OF SPECIFICATION CHECKING COMMAND (Cont.)

PARAMETER	DESCRIPTION	UNITS	LOWER LIMIT	UPPER LIMIT	Default
12. Bolt Slip Resistance in Web	Enter: 0 - Do not print the results of the bolt slip resistance specification checks in the web. 1 - Print the results of the bolt slip resistance specification checks in the web.	--	0 (E)	1 (E)	*
13. Bolt Slip Resistance in Flanges	Enter: 0 - Do not print the results of the bolt slip resistance specification checks in the top and bottom flanges. 1 - Print the results of the bolt slip resistance specification checks in the top and bottom flanges.	--	0 (E)	1 (E)	*
14. Bolt Spacing Checks for Web	Enter: 0 - Do not print the results of the bolt spacing checks for the web. 1 - Print the results of the bolt spacing checks for the web.	--	0 (E)	1 (E)	*
15. Bolt Spacing Checks for Flanges	Enter: 0 - Do not print the results of the bolt spacing checks for the top and bottom flanges. 1 - Print the results of the bolt spacing checks for the top and bottom flanges.	--	0 (E)	1 (E)	*
16. Block Shear Prevention Checks	Enter: 0 - Do not print the results of the block shear prevention checks. 1 - Print the results of the block shear prevention checks.	--	0 (E)	1 (E)	*

Notes:

- The default values for every parameter on this command are determined based on the type of run (analysis or design). The defaults for all output commands are detailed in Chapter 6.



# ***DETAILED INPUT DESCRIPTION***

This chapter provides a detailed description of some of the input parameters which were described in Chapter 5, but may need further explanation or commentary. The numbering scheme used in this chapter is as follows. The section number for a command corresponds to the same section number in Chapter 5. The parameter being described is preceded by a section number, whose last extension number refers to the parameter number in the corresponding command in Chapter 5. For example, 6.5.2 Composite/Non-composite corresponds to Section 5.5 CTL - Control Command, parameter 2. Only the commands and parameters for which detailed description is given are included in this chapter.

## **6.5 CTL - CONTROL COMMAND**

### **6.5.2 Composite/Non-composite**

The girder adjacent sections on the left and right of the splice must either both be composite or both be non-composite. One girder adjacent section can't be composite and the other non-composite.

### **6.5.3 Design/Analysis for Web Splice Plates**

This parameter is independent of parameter 4, Design/Analysis for Web Splice Bolts. Parameters 3 and 4 do not have to agree. If parameters 3 and 4 are both input as 'D', then the program uses the input from parameter 6 to determine if the web splice plate thickness or the number of web splice bolts should be increased first in case there is a bearing failure.

### **6.5.4 Design/Analysis for Web Splice Bolts**

This parameter is independent of parameter 3, Design/Analysis for Web Splice Plates. Parameters 3 and 4 do not have to agree. If parameters 3 and 4 are both input as 'D', then the program uses the input from parameter 6 to determine if the web splice plate thickness or the number of web splice bolts should be increased first in case there is a bearing failure.

### **6.5.6 Increase Plate or Bolts for Web Splice**

The program uses this parameter only if parameters 3 and 4 are both input as 'D'. The program uses this parameter to determine if the web splice plate thickness or the number of web splice bolts should be increased first in case there is a bearing failure.

## Chapter 6 - Detailed Input Description

This parameter has no meaning for an analysis problem and should be left blank. (In order to run the program without entering this parameter for an analysis problem, the program attributes changeability to this parameter, and user input is no longer required.)

### 6.5.7 Design/Analysis for Top Flange Splice Plates

This parameter is independent of parameter 8, Design/Analysis for Top Flange Splice Bolts. Parameters 7 and 8 do not have to agree. If parameters 7 and 8 are both input as 'D', then the program uses the input from parameter 10 to determine if the top flange splice plate thickness or the number of top flange splice bolts should be increased first in case there is a bearing failure.

### 6.5.8 Design/Analysis for Top Flange Splice Bolts

This parameter is independent of parameter 7, Design/Analysis for Top Flange Splice Plates. Parameters 7 and 8 do not have to agree. If parameters 7 and 8 are both input as 'D', then the program uses the input from parameter 10 to determine if the top flange splice plate thickness or the number of top flange splice bolts should be increased first in case there is a bearing failure.

### 6.5.10 Increase Plate or Bolts for Top Flange Splice

The program uses this parameter only if parameters 7 and 8 are both input as 'D'. The program uses this parameter to determine if the top flange splice plate thickness or the number of top flange splice bolts should be increased first in case there is a bearing failure.

This parameter has no meaning for an analysis problem and should be left blank. (In order to run the program without entering this parameter for an analysis problem, the program attributes changeability to this parameter, and user input is no longer required.)

### 6.5.11 Design/Analysis for Bottom Flange Splice Plates

This parameter is independent of parameter 12, Design/Analysis for Bottom Flange Splice Bolts. Parameters 11 and 12 do not have to agree. If parameters 11 and 12 are both input as 'D', then the program uses the input from parameter 14 to determine if the bottom flange splice plate thickness or the number of bottom flange splice bolts should be increased first in case there is a bearing failure.

### 6.5.12 Design/Analysis for Bottom Flange Splice Bolts

This parameter is independent of parameter 11, Design/Analysis for Bottom Flange Splice Plates. Parameters 11 and 12 do not have to agree. If parameters 11 and 12 are both input as 'D', then the program uses the input from parameter 14 to determine if the bottom flange splice plate thickness or the number of bottom flange splice bolts should be increased first in case there is a bearing failure.

## Chapter 6 - Detailed Input Description

### 6.5.14 Increase Plate or Bolts for Bottom Flange Splice

The program uses this parameter only if parameters 11 and 12 are both input as 'D'. The program uses this parameter to determine if the bottom flange splice plate thickness or the number of bottom flange splice bolts should be increased first in case there is a bearing failure.

This parameter has no meaning for an analysis problem and should be left blank. (In order to run the program without entering this parameter for an analysis problem, the program attributes changeability to this parameter, and user input is no longer required.)

### 6.5.15 Top Flange Splice Configuration

The top flange splice configuration can consist of either one outer plate only or two inner plates only or one outer plate and two inner plates. These three options for the top flange splice configuration are presented in Figure 1. For analysis of the top flange splice plates, the user must enter the width and thickness of these splice plates using the FSP command. For design of the top flange splice plates, the user must enter only the width of these splice plates using the FSP command.

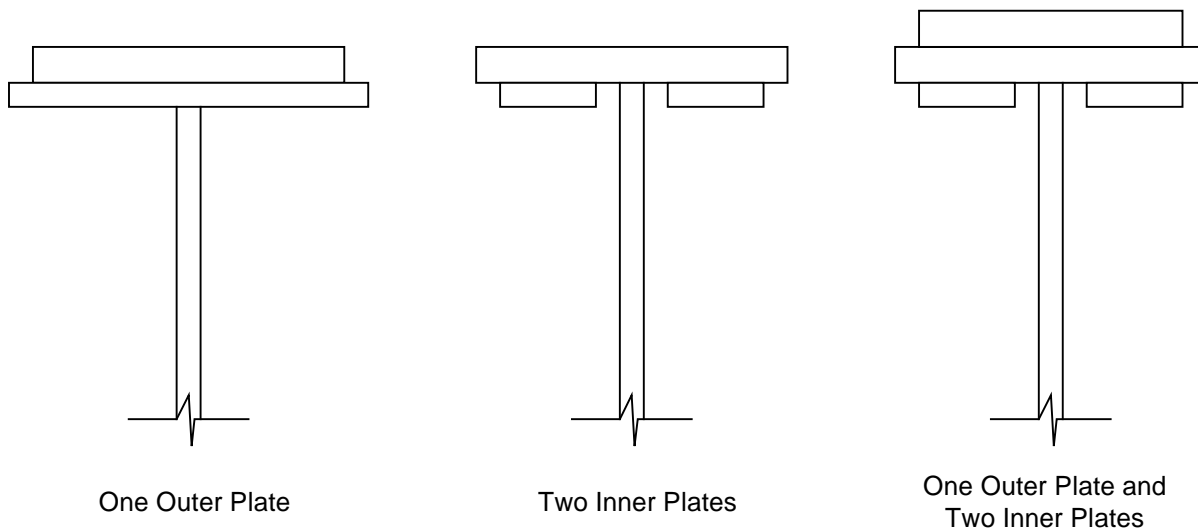


Figure 6.5-1 Top Flange Splice Configuration

### 6.5.16 Bottom Flange Splice Configuration

The bottom flange splice configuration can consist of either one outer plate only or two inner plates only or one outer plate and two inner plates. These three options for the bottom flange splice configuration are presented in Figure 2. For analysis of the bottom flange splice plates, the user must enter the width and thickness of these splice plates using the FSP command. For design of the bottom flange splice plates, the user must enter only the width of these splice plates using the FSP command.

## Chapter 6 - Detailed Input Description

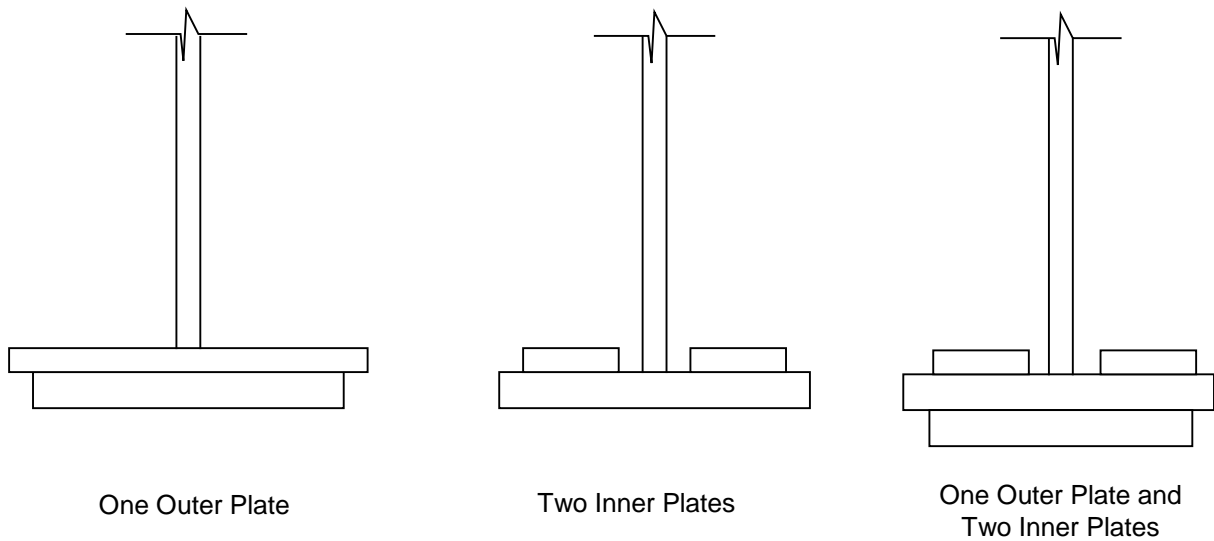


Figure 6.5-2 Bottom Flange Splice Configuration

### 6.5.17 Staggered/Non-staggered Top Flange

This parameter affects the following computations:

- Minimum clear bolt distance in the direction of the force for both the girder flange and the flange splice plates
- Least net plate area used for the axial tension checks
- Largest total net width of bolt holes, for each inner and outer plate, to be used to compute net plate section properties
- Minimum and maximum allowable bolt pitch

A non-staggered bolt configuration is presented in Figure 3, and staggered bolt configurations are presented in Figures 4 through 8.

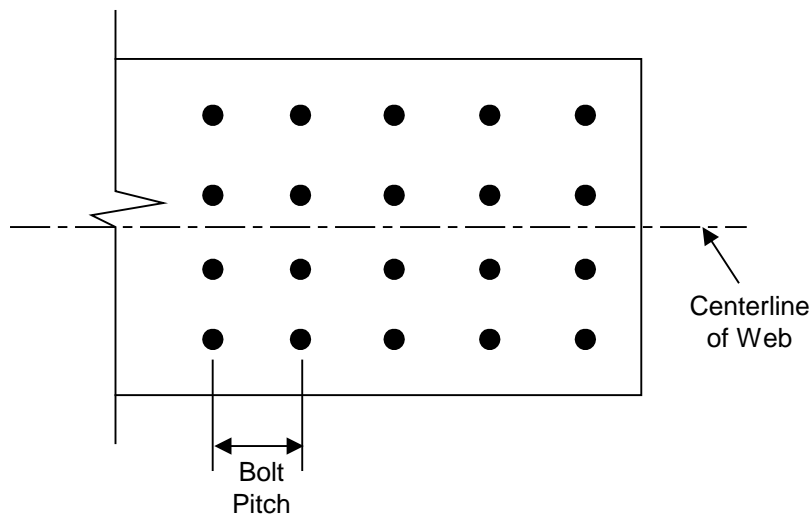


Figure 6.5-3 Non-staggered Bolt Configuration

Chapter 6 - Detailed Input Description

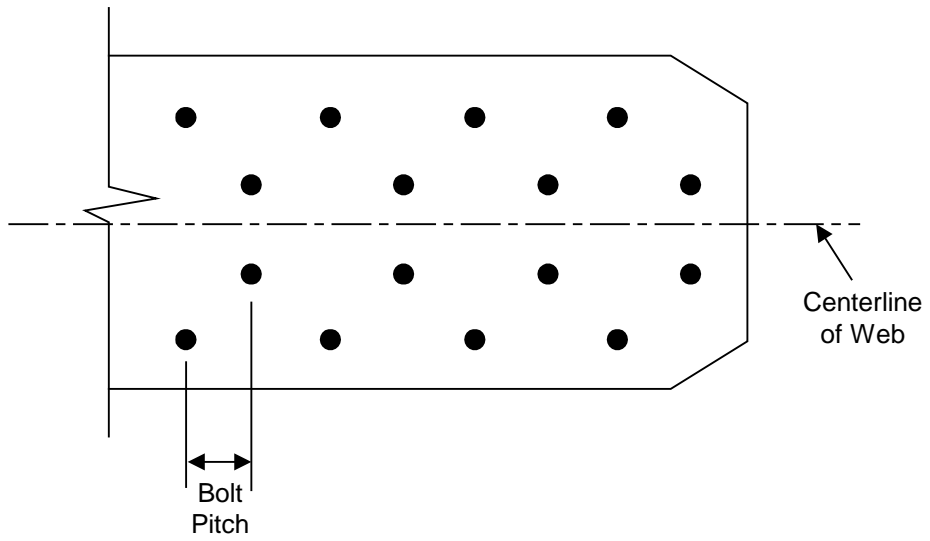


Figure 6.5-4 Staggered Bolt Configuration with Four Gage Lines

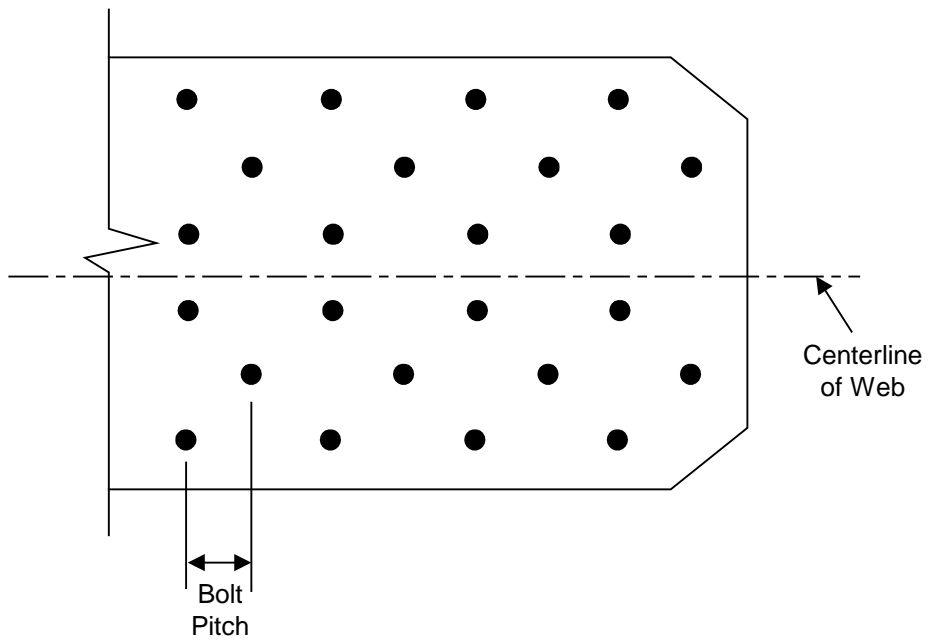


Figure 6.5-5 Staggered Bolt Configuration with Six Gage Lines

Chapter 6 - Detailed Input Description

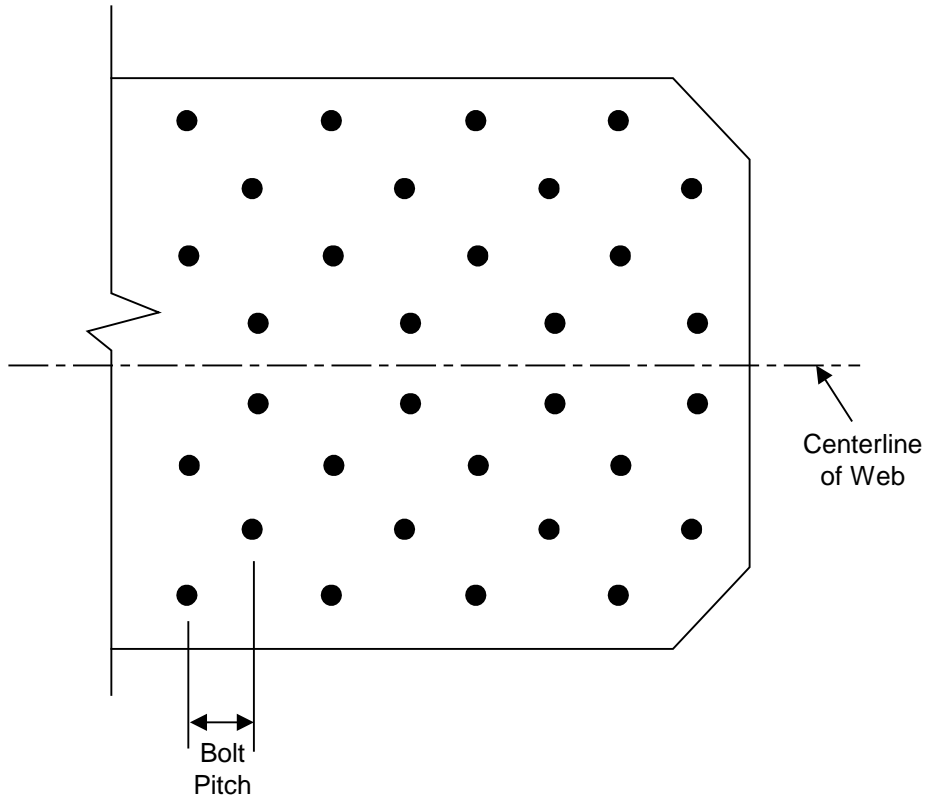


Figure 6.5-6 Staggered Bolt Configuration with Eight Gage Lines

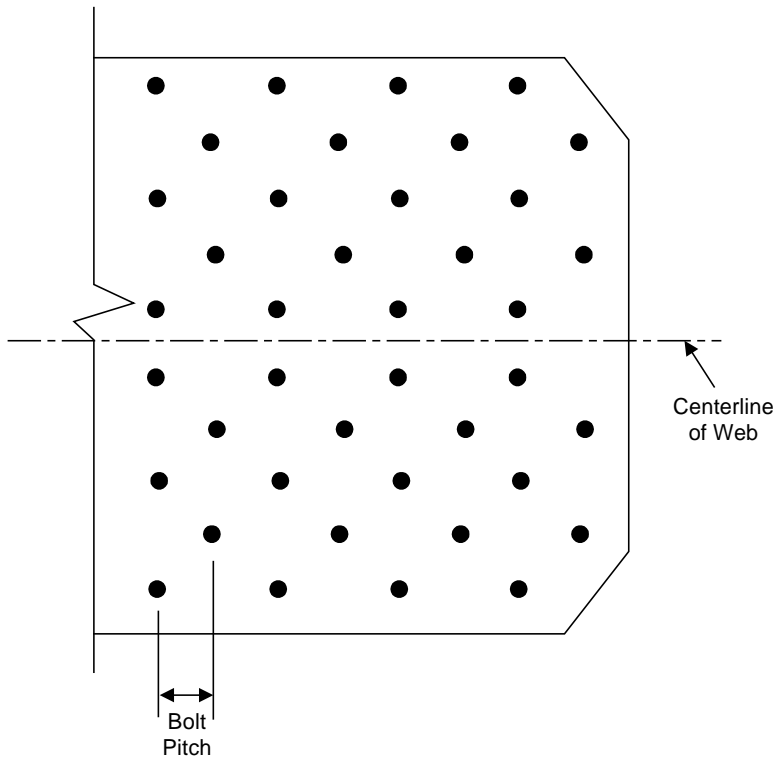


Figure 6.5-7 Staggered Bolt Configuration with Ten Gage Lines

## Chapter 6 - Detailed Input Description

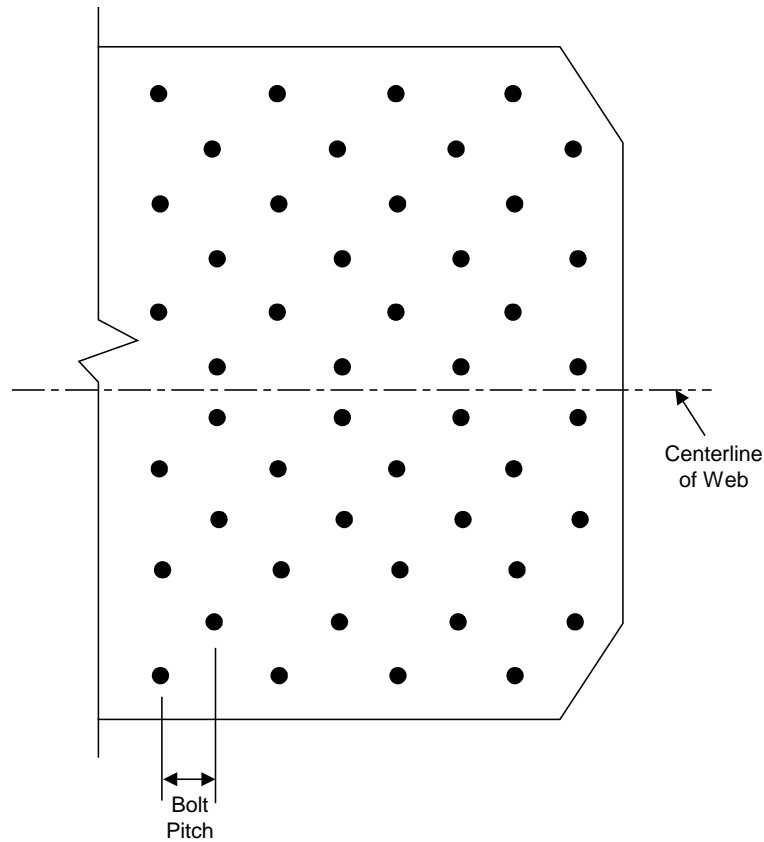


Figure 6.5-8 Staggered Bolt Configuration with Twelve Gage Lines

### 6.5.18 Staggered/Non-staggered Bottom Flange

For a detailed input description of the program's use of staggered and non-staggered bolt patterns, refer to Section 6.5.17.

### 6.5.19 Bolt Connection Type

The program uses the bolt connection type chosen in this parameter for all splice components. For design, the program ignores this parameter and assumes a friction type connection. For analysis, bearing type connections require approval by the Chief Bridge Engineer.

For a friction type connection, the program checks the service moments, service shears, and slip resistance for the splice design. For a bearing type connection, the program does not check the service moments, service shears, and slip resistance.

### 6.5.21 Pedestrian Loading

This parameter is used to define whether the program is to consider pedestrian loading. If 'Y' is entered, then the user must enter the DPL command. If 'N' is entered, then the user should not enter the DPL command.

## Chapter 6 - Detailed Input Description

If 'Y' is entered for this parameter, then Strength IP limit state is computed as an additional limit state.

If pedestrian loading is being considered, the program will compute the Strength I limit state without pedestrian loading. For Strength IP limit state with pedestrian loading, the inputted additional DC2 loads and additional FWS loads when sidewalks are present on the bridge must be entered on the DPL command. In addition, the inputted design live loads must account for the change in roadway width when sidewalks are present on the bridge and should be entered on the DLL command as live load type 'S'.

For a run with pedestrian loading, only Strength IP limit state should be considered by the user. All other limit states should be ignored due to incorrect dead load and live load.

## Chapter 6 - Detailed Input Description

### 6.7 DDL - DESIGN DEAD LOADS COMMAND

SPLRFD does not include an analysis engine. Therefore, all dead load moments and shears acting on the girder at the splice location must be entered by the user. The parameters entered on this command are used to define the dead load moments and shears.

#### 6.7.1 DC1 Moment

The program divides the DC1 moment by the steel-only section moduli to compute the DC1 stresses. For this parameter, the user should enter the moment for all non-composite dead loads, including splice plates and bolts, beam self-weight, slab, haunch, and forms.

#### 6.7.2 DC2 Moment

The program divides the DC2 moment by the long-term (3n section) composite section moduli to compute the DC2 stresses. For this parameter, the user should enter the moment for all composite dead loads for which the DC load factor is applied, including parapets, and any other structural components and nonstructural attachments. Note: This should not include sidewalks. Sidewalk DC2 moment should be entered on the DPL command.

#### 6.7.3 FWS Moment

The program divides the FWS moment by the long-term (3n section) composite section moduli to compute the FWS stresses. For this parameter, the user should assume that no sidewalks are present and enter the moment for all composite dead loads for which the DW load factor is applied. For SPLRFD, this load consists of the future wearing surface only. The user must enter the appropriate value assuming that no sidewalks exist.. Note: If the bridge will have sidewalks, then enter the additional FWS moment on the DPL command to subtract the portion of the FWS where the sidewalks will be located.

#### 6.7.4 DC1 Shear

For this parameter, the user should enter the shear for all non-composite dead loads, including for splice plates and bolts, beam self-weight, slab, haunch, and forms.

#### 6.7.5 DC2 Shear

For this parameter, the user should enter the shear for all composite dead loads for which the DC load factor is applied, including parapets, and any other structural components and nonstructural attachments. Note: This should not include sidewalks. Sidewalk DC2 moment should be entered on the DPL command.

## Chapter 6 - Detailed Input Description

### 6.7.6 FWS Shear

For this parameter, the user should assume that no sidewalks are present and enter the shear for all composite dead loads for which the DW load factor is applied. For SPLRFD, this load consists of the future wearing surface only. The user must enter the appropriate value assuming that no sidewalks exist. Note: If the bridge will have sidewalks, then enter the additional FWS shear on the DPL command to subtract the portion of the FWS where the sidewalks will be located.

## Chapter 6 - Detailed Input Description

### 6.8 DLL - DESIGN LIVE LOADS COMMAND

SPLRFD does not include an analysis engine. Therefore, all live load moments and shears acting on the girder at the splice location must be entered by the user. The parameters entered on this command are used to define the live load moments and shears.

The parameters of this command are maximum moments and maximum shears. For all calculations, the program assumes that maximum moments and maximum shears occur simultaneously under the same loading conditions.

The user must enter the appropriate design live load values corresponding with the presence or absence of a sidewalk.

#### 6.8.1 Type of Live Load

This parameter is used to define the type of live load for which parameters 2 through 6 are defined.

If the user enters 'D', then the program uses the values for parameters 2 through 6 as design live load values. Design live load values normally correspond with PHL-93 loading and are used for the specification checks for Strength I and Service II limit states.

If the user enters 'P', then the program uses the values for parameters 2 through 6 as permit live load values. Permit live load values normally correspond with P-82 loading and are used for the specification checks for Strength II and Service IIB limit states.

If the user enters 'F', then the program uses the values for parameters 2 through 6 as fatigue live load values.

For design or analysis, the user must enter at least one 'D' live load and at least one 'P' live load. If the user does not do so, the program will issue an error message and the run will terminate.

If the user enters 'Y' in parameter 21 of the CTL command, then this command must be entered with Type of Live Load set to 'S'. The program uses the values for parameters 2 through 6 as design live load values. Design live load values normally correspond with PHL-93 loading and are used for the specification checks for the Strength IP limit state.

#### 6.8.2 Live Load Number

This parameter allows the user to enter more than one set of live load values for a given live load type. For example, if the user desires to perform specification checks for PHL-93 and HL-93, the user could enter one set of values with parameter 1 defined as 'D' and parameter 2 defined as 1. The user could then enter

## **Chapter 6 - Detailed Input Description**

the other set of values with parameter 1 defined as 'D' and parameter 2 defined as 2. The program will then use both sets of values for the specification checks for Strength I and Strength IP limit states.

For strength limit states, the program considers all live load numbers that are entered by the user. For service limit states, the program considers only live load number 1.

## Chapter 6 - Detailed Input Description

### 6.10 DPL - DESIGN PEDESTRIAN LOADS COMMAND

SPLRFD does not include an analysis engine. Therefore, all pedestrian load moments and shears acting on the girder at the splice location must be entered by the user. The parameters entered on this command are used to define the pedestrian load moments and shears. These values are given in the output of the STLRFD program.

If the user enters 'Y' in parameter 21 of the CTL command, then this command must be entered, and the DLL command must be entered with a Type of Live Load set to 'S'. If the user enters 'N' in parameter 21 of the CTL command, then this command should not be entered.

The parameters of this command are maximum moments and maximum shears. For all calculations, the program assumes that maximum moments and maximum shears occur simultaneously under the same loading conditions.

Figure 1 shows a sketch of the sidewalk area that the sidewalk dead loads and additional future wearing surface loads should be entered for. Note: the additional FWS is actually the portion of FWS that would be subtracted where the sidewalks will be located. If the total FWS dead load moment/shear decreases when the sidewalks are present, a value opposite in sign of the FWS moment/shear (DDL command) should be entered.

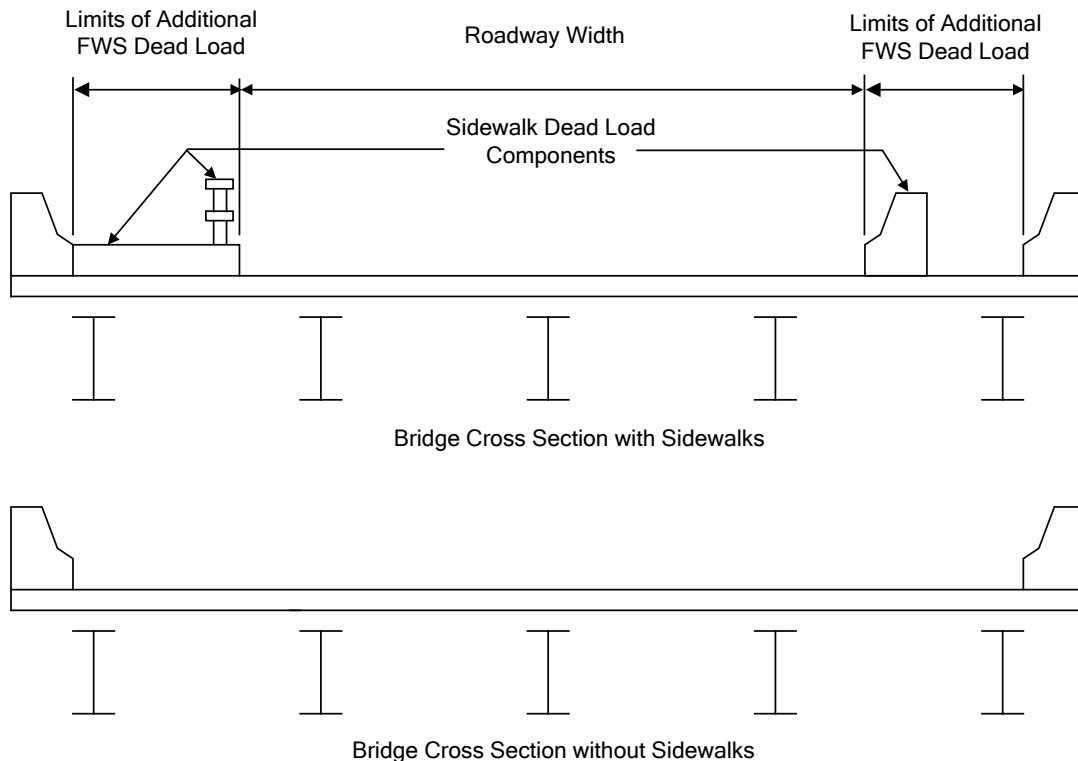


Figure 6.10-1 Sidewalk Loads

For additional information about the program's use of pedestrian loading, refer to Section 6.5.21.

## **Chapter 6 - Detailed Input Description**

### **6.11 MAT - MATERIAL COMMAND**

For splice plate design, the program ignores the splice plate yield strength and splice plate tensile strength parameters of this command and assumes that the splice plate material properties are equal to the corresponding girder plate material properties (minimum value of left and right girder adjacent sections).

#### **6.11.2 Web Splice Plate Tensile Strength**

The program uses the web splice plate tensile strength to check the block shear prevention criteria.

#### **6.11.5 Top Flange Splice Plate Tensile Strength**

The program uses the top flange splice plate tensile strength to check the axial tensile stresses based on net section fracture and to check the block shear prevention criteria.

#### **6.11.8 Bottom Flange Splice Plate Tensile Strength**

The program uses the bottom flange splice plate tensile strength to check the axial tensile stresses based on net section fracture and to check the block shear prevention criteria.

## Chapter 6 - Detailed Input Description

### 6.12 GAS - GIRDER ADJACENT SECTION COMMAND

#### 6.12.1 Left/Right

This parameter is used to define if the values presented in parameters 2 through 19 correspond with the adjacent girder section immediately to the left of the centerline of splice or the adjacent girder section immediately to the right of the centerline of splice. These two options (left and right) are illustrated in Figure 1.

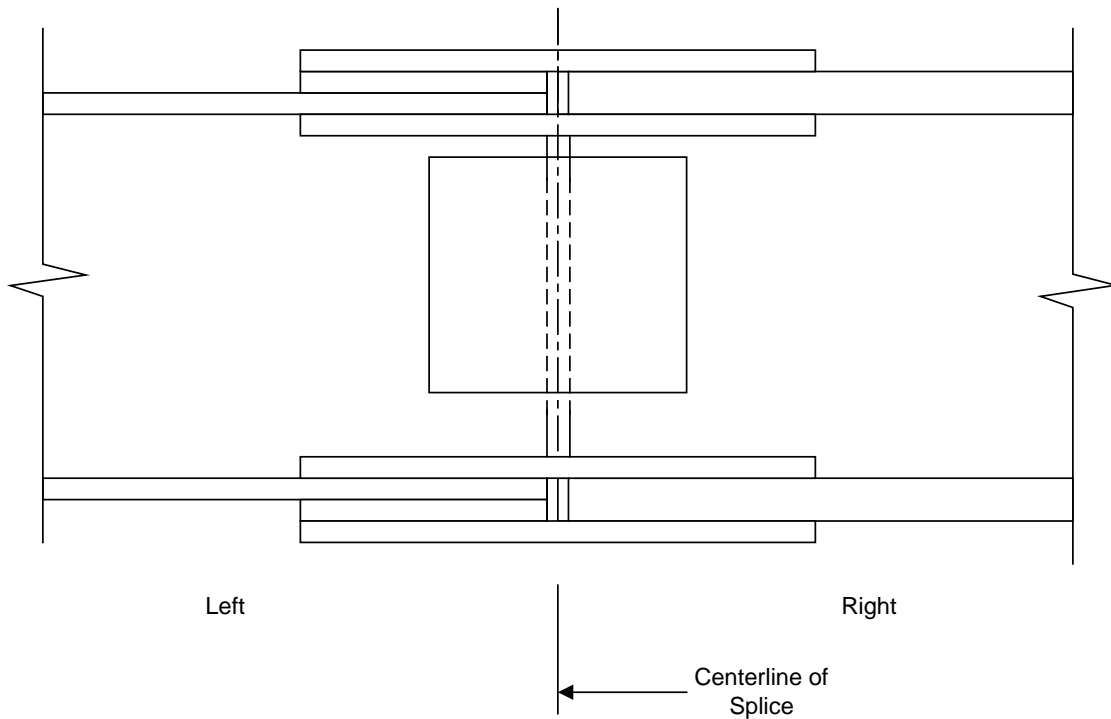


Figure 6.12-1 Location of Girder Section

#### 6.12.2 Web Yield Strength

For web splice plate design, the program ignores the web splice plate yield strength (parameter 1 of the MAT command) and assumes that the web splice plate yield strength is equal to the minimum of the web yield strengths (this parameter) for the left and right girder adjacent sections.

#### 6.12.3 Web Tensile Strength

For web splice plate design, the program ignores the web splice plate tensile strength (parameter 2 of the MAT command) and assumes that the web splice plate tensile strength is equal to the minimum of the web tensile strengths (this parameter) for the left and right girder adjacent sections.

#### 6.12.5 Web Depth

The web depth for the left girder section must equal the web depth for the right girder section. If the left and right girder section web depths are not equal, the program will give an error message and stop immediately.

## Chapter 6 - Detailed Input Description

The validity of this parameter is checked against the inputted values of web splice depth and end clear distance.

### 6.12.6 Top Flange Yield Strength

For top flange splice plate design, the program ignores the top flange splice plate yield strength (parameter 4 of the MAT command) and assumes that the top flange splice plate yield strength is equal to the minimum of the top flange yield strengths (this parameter) for the left and right girder adjacent sections.

### 6.12.7 Top Flange Tensile Strength

For top flange splice plate design, the program ignores the top flange splice plate tensile strength (parameter 5 of the MAT command) and assumes that the top flange splice plate tensile strength is equal to the minimum of the top flange tensile strengths (this parameter) for the left and right girder adjacent sections.

### 6.12.10 Bottom Flange Yield Strength

For bottom flange splice plate design, the program ignores the bottom flange splice plate yield strength (parameter 7 of the MAT command) and assumes that the bottom flange splice plate yield strength is equal to the minimum of the bottom flange yield strengths (this parameter) for the left and right girder adjacent sections.

### 6.12.11 Bottom Flange Tensile Strength

For bottom flange splice plate design, the program ignores the bottom flange splice plate tensile strength (parameter 8 of the MAT command) and assumes that the bottom flange splice plate tensile strength is equal to the minimum of the bottom flange tensile strengths (this parameter) for the left and right girder adjacent sections.

### 6.12.16 Factored Shear Resistance

The factored shear resistance is based on the Strength I (or Strength IP) limit state and is used to compute the required factored shear resistance of the splice. This parameter should be entered as a positive value. The value of this parameter should be obtained from the design or analysis of the girder at an analysis point which is at the splice location.

### 6.12.17 Web Edge Type

The program uses the web edge type as one of the criteria in computing the minimum and maximum allowable bolt end and edge distances, in accordance with LRFD Specifications Articles 6.13.2.6.2 and 6.13.2.6.3, as well as the corresponding sections of DM-4.

## **Chapter 6 - Detailed Input Description**

### **6.12.18 Top Flange Edge Type**

The program uses the top flange edge type as one of the criteria in computing the minimum and maximum allowable bolt end and edge distances, in accordance with LRFD Specifications Articles 6.13.2.6.2 and 6.13.2.6.3, as well as the corresponding sections of DM-4.

### **6.12.19 Bottom Flange Edge Type**

The program uses the bottom flange edge type as one of the criteria in computing the minimum and maximum allowable bolt end and edge distances, in accordance with LRFD Specifications Articles 6.13.2.6.2 and 6.13.2.6.3, as well as the corresponding sections of DM-4.

## Chapter 6 - Detailed Input Description

### 6.14 SLB - SLAB WITH COMPOSITE GIRDER COMMAND

#### 6.14.1 Effective Slab Thickness

The effective slab thickness is illustrated in Figure 1. The program uses the effective slab thickness to compute composite section properties.

Since the integral wearing surfaces and overlays are included in the dead load calculations but generally are not included in the section property calculations, the user should subtract the thickness of integral wearing surfaces and overlays from the actual slab thickness when computing the effective slab thickness.

The actual slab thickness is not entered by the user, since the slab dead load is included in parameters 1 and 4 of the DDL command.

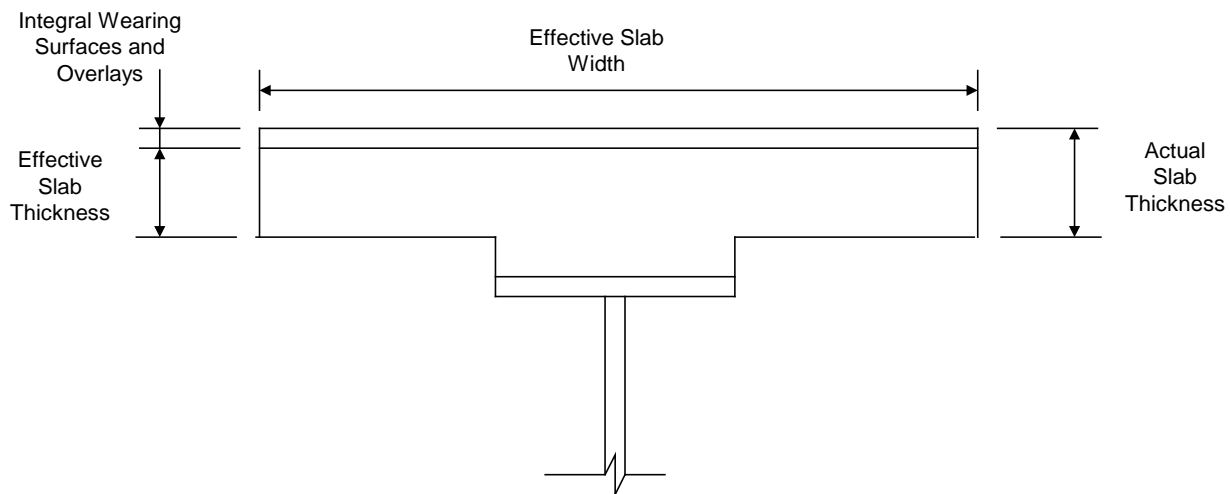


Figure 6.14-1 Effective Slab Thickness and Width

#### 6.14.2 Effective Slab Width

The effective slab width is illustrated in Figure 1. The program uses the effective slab width to compute composite section properties.

The user should compute the effective slab width in accordance with LRFD Specifications Article 4.6.2.6.1, **one-half of the distance to the adjacent girder on each side of interior girders, or one-half the distance to the adjacent girder plus the full overhang width for exterior girders.**

#### 6.14.3 Haunch Depth

A haunch detail is presented in Figure 2. Haunch depth is measured from the top of the girder web to the bottom of the deck slab for all section types.

## Chapter 6 - Detailed Input Description

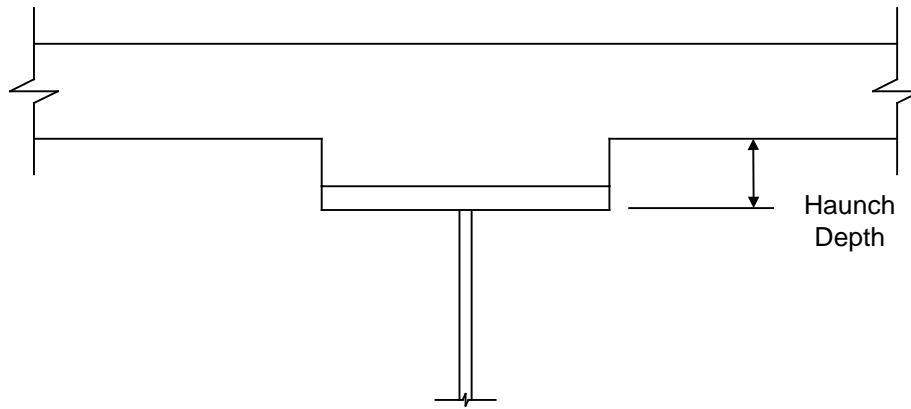


Figure 6.14-2 Haunch Detail

The program uses the haunch depth to compute composite section properties. For a design run, the program ignores this parameter and assumes that the vertical distance from the bottom of the deck slab to the top of the top flange is zero. For an analysis run, the user should input a haunch depth equal to the top flange thickness (left or right girder adjacent section). For analysis, the default for the haunch depth equals the top flange thickness of the girder adjacent section being considered.

For additional information about the haunch depth, refer to DM-4 Article 5.6.1.

### 6.14.4 Deck Reinforcement Area

This parameter should include the total of all layers of reinforcing steel parallel to the girder.

The value entered is multiplied by the effective slab width to compute the total area of reinforcement for the calculation of the composite girder section properties for negative flexure.

### 6.14.5 Deck Reinforcement CGS

This parameter should be based on all layers of deck reinforcing steel.

### 6.14.6 Steel to Concrete Modular Ratio

The program uses the steel to concrete modular ratio to compute composite section properties. This parameter is defined as the modulus of elasticity of the girder steel divided by the modulus of elasticity of the deck slab concrete.

## Chapter 6 - Detailed Input Description

### 6.15 WSB - WEB SPLICE BOLT COMMAND

#### 6.15.3 Splice End Distance

For a design run, this parameter defines the minimum splice end distance, and the program sets the splice end distance at the top of the web splice plate equal to that at the bottom. To determine the required bolt pitch, the program initially sets the splice end distance equal to the value entered in this parameter. The program then determines the required bolt configuration based on strength requirements, as well as the inputted minimum bolts per gage line and minimum bolt pitch. The program then rounds the required bolt pitch down to the nearest 1/16 inch, it adjusts the splice end distance accordingly, and it then rechecks the resulting web bolt configuration.

For an analysis run, this parameter defines the actual splice end distance at the top of the web splice plate only. The program computes the value at the bottom of the web splice plate based on this parameter, as well as the web splice depth (parameter 1 of the WSP command) and the web splice bolt pitch distances (parameter 2 of the WBP command).

#### 6.15.9 Bolts per Gage Line

The program issues an error message if this parameter and the minimum bolt pitch are not compatible. For a description of the rounding methodology used by the program, refer to Section 6.14.3.

#### 6.15.10 Minimum Bolt Pitch

For design of web splice bolts, the program uses the minimum bolt pitch to determine the maximum number of bolts that can be accommodated in a gage line. The program issues an error message if this parameter and the bolts per gage line are not compatible.

For a description of the rounding methodology used by the program, refer to Section 6.14.3.

Minimum bolt pitch should be entered for web splice bolt design only. This parameter has no meaning for an analysis problem and should be left blank.

#### 6.15.11 Gap at Splice Center

The program uses the gap at splice center to compute the web bolt pattern section properties. This parameter is defined as the edge to edge clear distance between the left and right adjacent girders framing into the splice. The gap at splice center is illustrated in Figure 1.

## Chapter 6 - Detailed Input Description

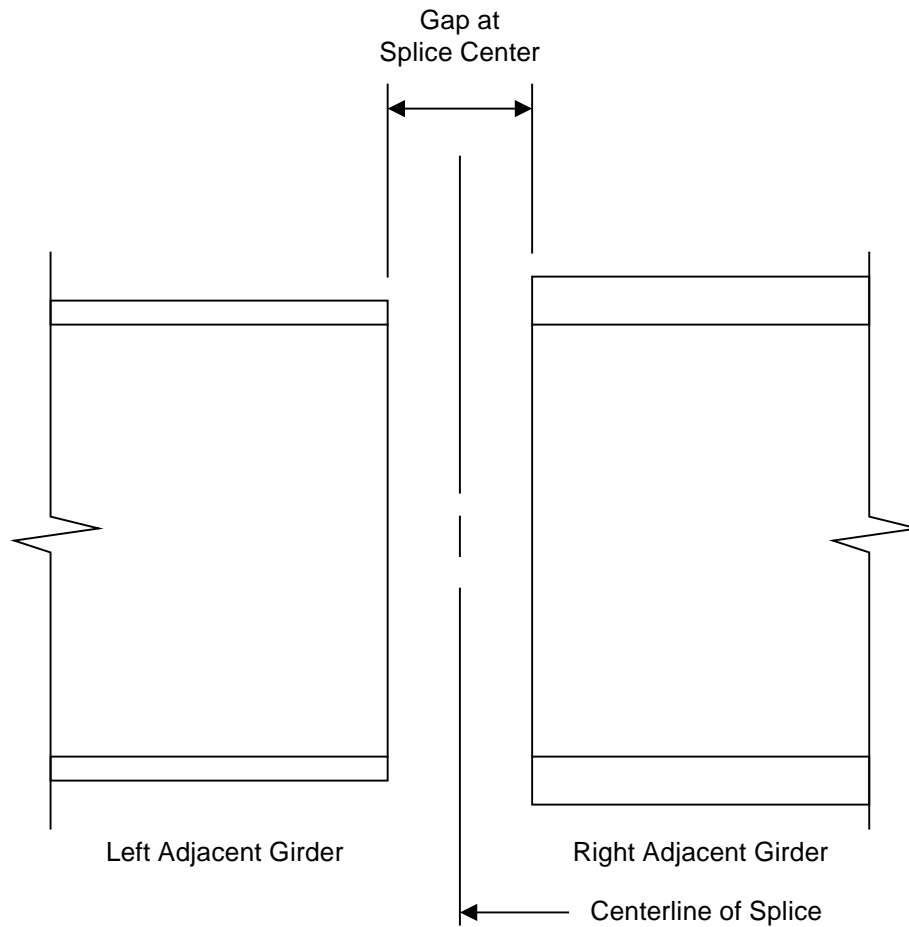


Figure 6.15-1 Gap at Splice Center

### 6.15.12 Edge or End Distance Increase

The program uses this parameter for the design option only and it will only be used if the web edge distance, web splice end distance or web splice edge distance controls the bearing failure (Figure 2). The program uses this parameter to determine if the edge and end distances should be increased first and up to what value in case there is a bearing failure. The parameter has no meaning for an analysis problem and should be left blank. Under no circumstances will the program increase the edge or end distance to more than  $(2 \times \text{bolt diameter})$ . Increasing the clear bearing distance either equal to or greater than  $(2 \times \text{bolt diameter})$  will not increase the bearing resistance (LRFD Specifications Article 6.13.2.9). Entering '0' for this parameter indicates that the edge and end distances will not be modified.

## Chapter 6 - Detailed Input Description

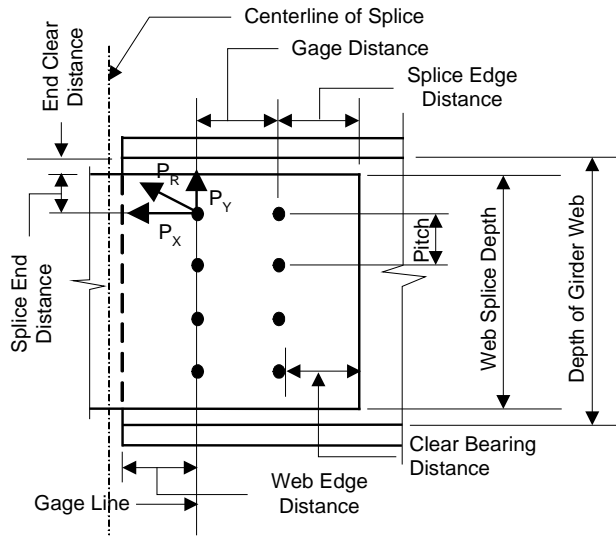


Figure 6.15-2 Bearing Distances

## Chapter 6 - Detailed Input Description

### 6.16 WBP - WEB BOLT PITCH COMMAND

#### 6.16.1 Web Splice Bolt Pitch Number

The web splice bolt pitch number defines the location of the web splice bolt pitch distance given in parameter 2 of this command. Web splice bolt pitch  $i$  corresponds with the distance between web splice bolt  $i$  and web splice bolt  $i+1$ , where web splice bolt 1 corresponds with the bolts in the top pitch line. This numbering scheme is illustrated in Figure 1.

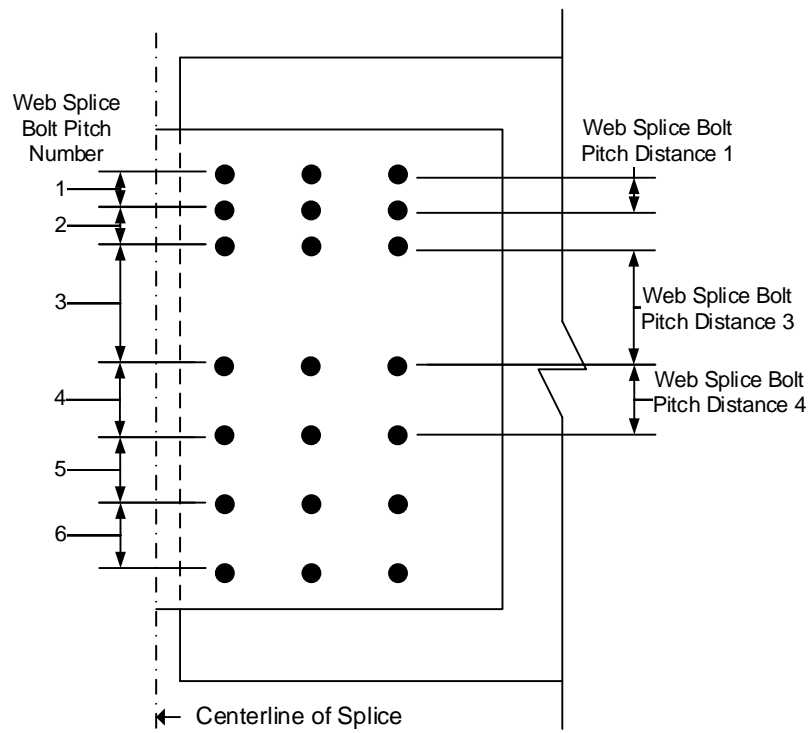


Figure 6.16-1 Web Splice Bolt Pitch

#### 6.16.2 Web Splice Bolt Pitch Distance

The web splice bolt pitch distance defines the vertical distance corresponding with the web splice bolt pitch number given in parameter 1 of this command. The web splice bolt pitch distance is illustrated in Figure 1.

**As an example, assume that in Figure 1, Web Splice Bolt Pitch Distance 1 is 2 inches, Distance 3 is 4 inches and Distance 4 is 3 inches. The input command for this situation would be:**

**WBP 1, 2.0, 3, 4.0, 4, 3.0**

**This command indicates to the program that 2" should be used for Web Splice Bolt Pitch Numbers 1 and 2, 4" inches for Pitch Number 3 and 3" for Pitch Numbers 4 - 6.**

## Chapter 6 - Detailed Input Description

### 6.17 WSP - WEB SPLICE PLATE COMMAND

#### 6.17.1 Web Splice Depth

For web splice plate analysis, the program checks the validity of this parameter against the entered values of the splice end distance (parameter 3 of the WSB command) and the pitch distances (WBP command).

In addition, for web splice plate design or analysis, the program checks that this parameter does not exceed the entered value of the web depth (parameter 5 of the GAS command) minus the end clear distance (parameter 4 of the WSB command).

#### 6.17.2 Web Splice Thickness

Web splice thickness should be entered for web splice plate analysis only. This parameter has no meaning for a design problem and should be left blank. (In order to run the program without entering this parameter for a design problem, the program attributes changeability to this parameter, and user input is no longer required.)

#### 6.17.3 Web Splice Plate Edge Type

The program uses the web splice plate edge type as one of the criteria in computing the minimum and maximum allowable bolt end and edge distances, in accordance with LRFD Specifications Articles 6.13.2.6.2 and 6.13.2.6.3, as well as the corresponding sections of DM-4.

## Chapter 6 - Detailed Input Description

### 6.18 FSB - FLANGE SPLICE BOLT COMMAND

The parameters on this command are used to define the dimensional characteristics of the flange splice bolts. The parameters identified as “least” and “greatest” do not represent a range of possible values. Rather, they specify actual dimensions, as illustrated in Figures 1, 2, and 5.

#### 6.18.4 Least Splice End Distance

For a staggered bolt pattern, this parameter should be entered as shown in Figure 1. **The difference between the least and greatest splice end distances must be equal to either the minimum or maximum bolt pitch (parameters 13 and 14 of this command).**

For a non-staggered bolt pattern, the least splice end distance has the same value as the greatest splice end distance. The splice end distance should be entered for this parameter.

## Chapter 6 - Detailed Input Description

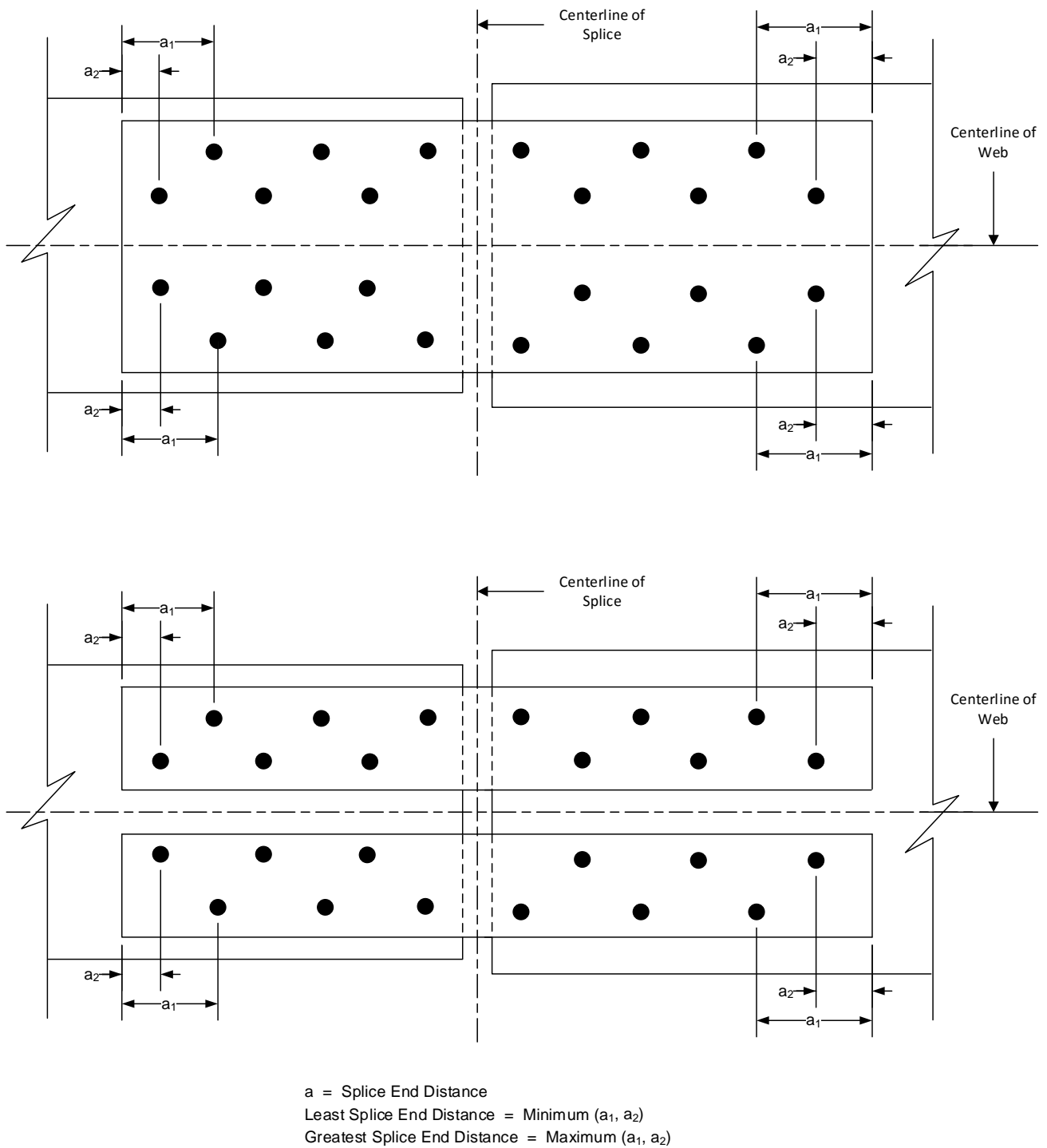


Figure 6.18-1 Splice End Distance

### 6.18.5 Greatest Splice End Distance

For a staggered bolt pattern, this parameter should be entered as shown in Figure 1. **The difference between the least and greatest splice end distances must be equal to either the minimum or maximum bolt pitch (parameters 13 and 14 of this command).**

## Chapter 6 - Detailed Input Description

For a non-staggered bolt pattern, the least splice end distance has the same value as the greatest splice end distance. This parameter will be ignored and should be left blank.

### 6.18.6 Least Flange End Distance

For a staggered bolt pattern, this parameter should be entered as shown in Figure 2. **The difference between the least and greatest flange end distances must be equal to either the minimum or maximum bolt pitch (parameters 13 and 14 of this command).**



## Chapter 6 - Detailed Input Description

For a non-staggered bolt pattern, the least flange end distance has the same value as the greatest flange end distance. The flange end distance should be entered for this parameter.

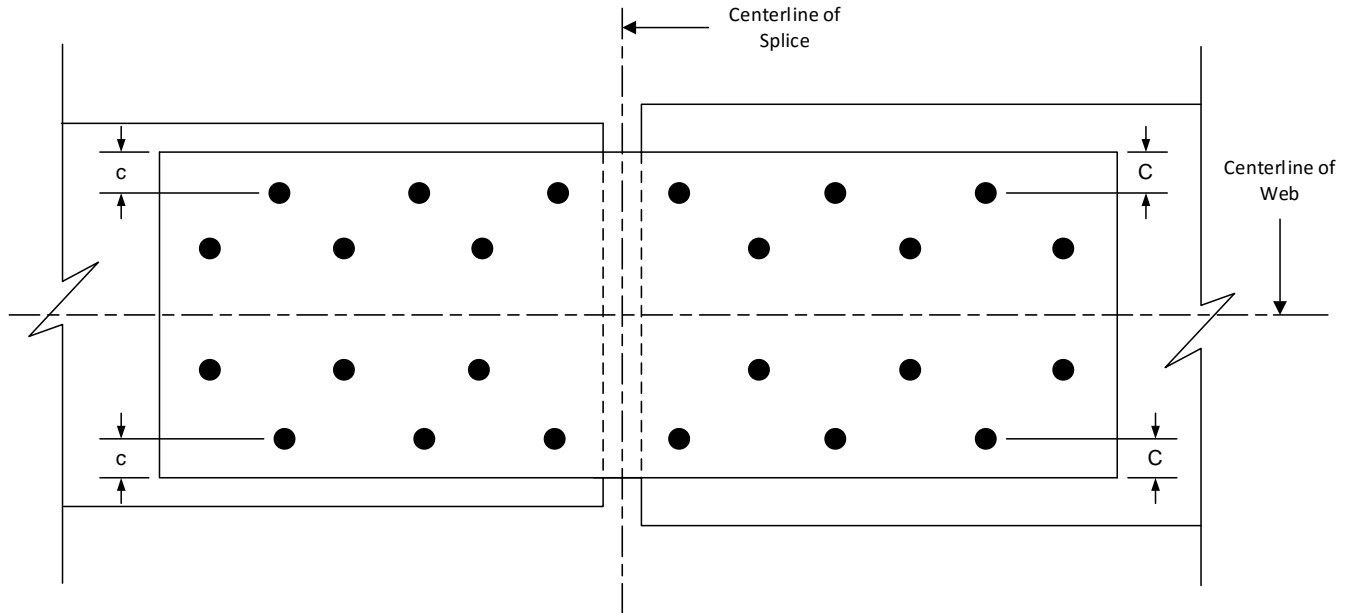
### 6.18.7 Greatest Flange End Distance

For a staggered bolt pattern, this parameter should be entered as shown in Figure 2. **The difference between the least and greatest flange end distances must be equal to either the minimum or maximum bolt pitch (parameters 13 and 14 of this command).**

For a non-staggered bolt pattern, the least flange end distance has the same value as the greatest flange end distance. This parameter will be ignored and should be left blank.

### 6.18.8 Outer Splice Edge Distance

For a staggered bolt pattern, this parameter should be entered as shown in Figure 3.



c = Outer Splice Edge Distance

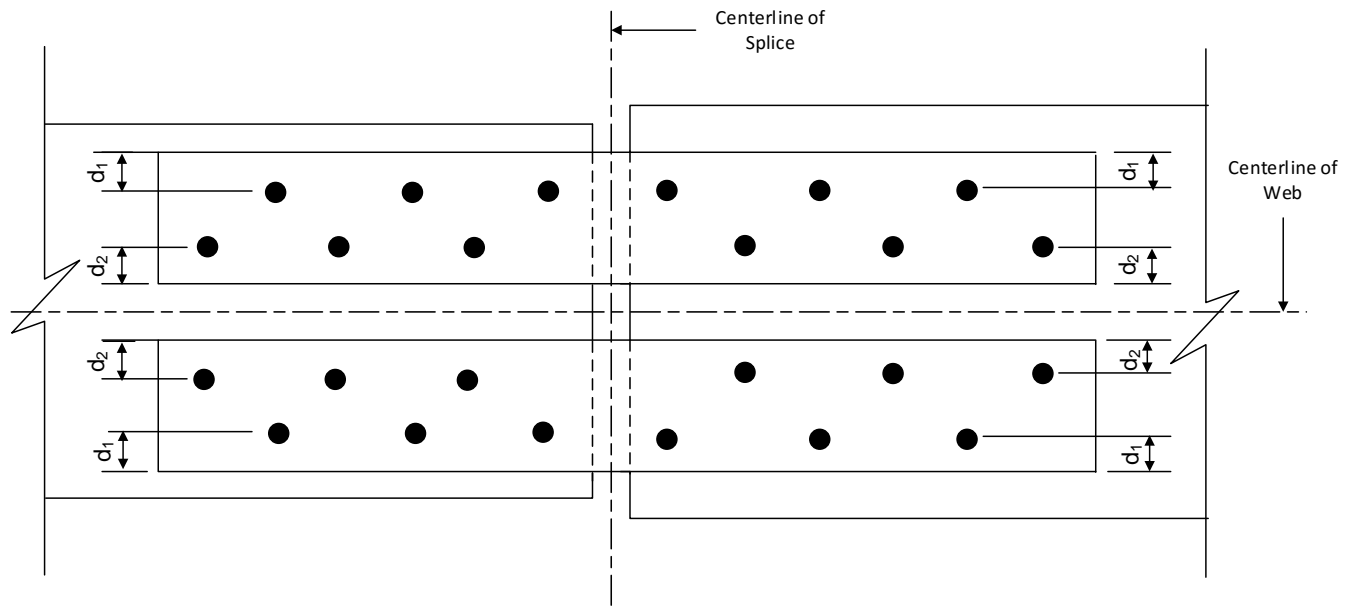
Figure 6.18-3 Outer Splice Edge Distance

For a non-staggered bolt pattern, this parameter should be entered in a similar manner to that shown in Figure 3.

### 6.18.9 Inner Splice Least Edge Distance

For a staggered bolt pattern, this parameter should be entered as shown in Figure 4.

## Chapter 6 - Detailed Input Description



$d$  = Inner Splice Edge Distance  
Inner Splice Least Edge Distance = Minimum ( $d_1, d_2$ )  
Inner Splice Greatest Edge Distance = Maximum ( $d_1, d_2$ )

Figure 6.18-4 Inner Splice Edge Distance

For a non-staggered bolt pattern, this parameter should be entered in a similar manner to that shown in Figure 4.

### 6.18.10 Inner Splice Greatest Edge Distance

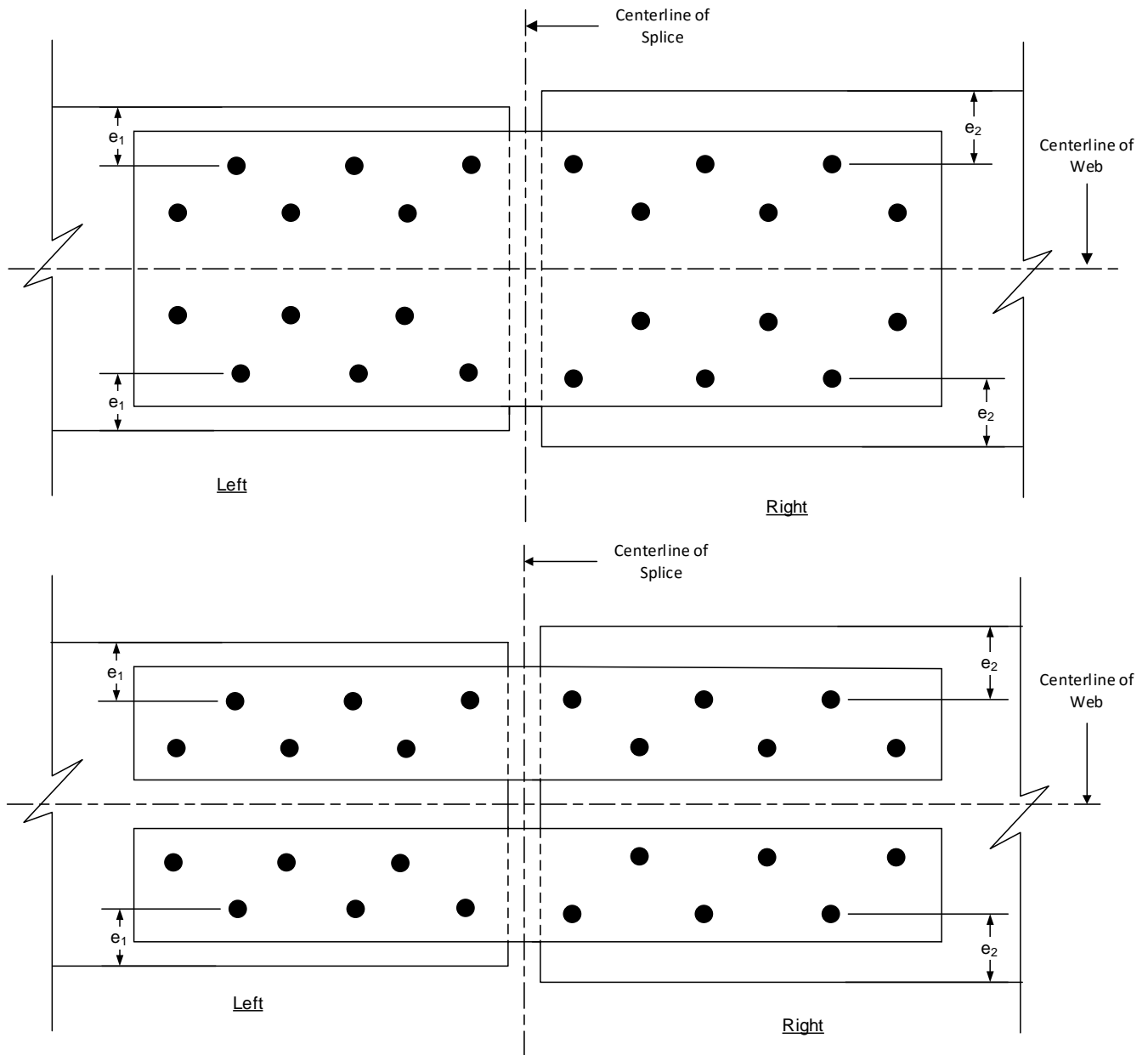
For a staggered bolt pattern, this parameter should be entered as shown in Figure 4.

For a non-staggered bolt pattern, this parameter should be entered in a similar manner to that shown in Figure 4.

### 6.18.11 Left Flange Edge Distance

For a staggered bolt pattern, this parameter should be entered as shown in Figure 5.

## Chapter 6 - Detailed Input Description



$e$  = Flange Edge Distance  
Left Flange Edge Distance =  $e_1$   
Right Flange Edge Distance =  $e_2$

Figure 6.18-5 Flange Edge Distance

For a non-staggered bolt pattern, this parameter should be entered in a similar manner to that shown in Figure 5.

### 6.18.12 Right Flange Edge Distance

For a staggered bolt pattern, this parameter should be entered as shown in Figure 5.

## Chapter 6 - Detailed Input Description

For a non-staggered bolt pattern, this parameter should be entered in a similar manner to that shown in Figure 5.

### 6.18.13 Minimum Bolt Pitch

For a staggered bolt pattern, this parameter should be entered as shown in Figure 6. **The difference between the least and greatest splice end distances (parameters 4 and 5 of this command) and the difference between the least and greatest flange end distances (parameters 6 and 7) must be equal to either the minimum or maximum bolt pitch.**

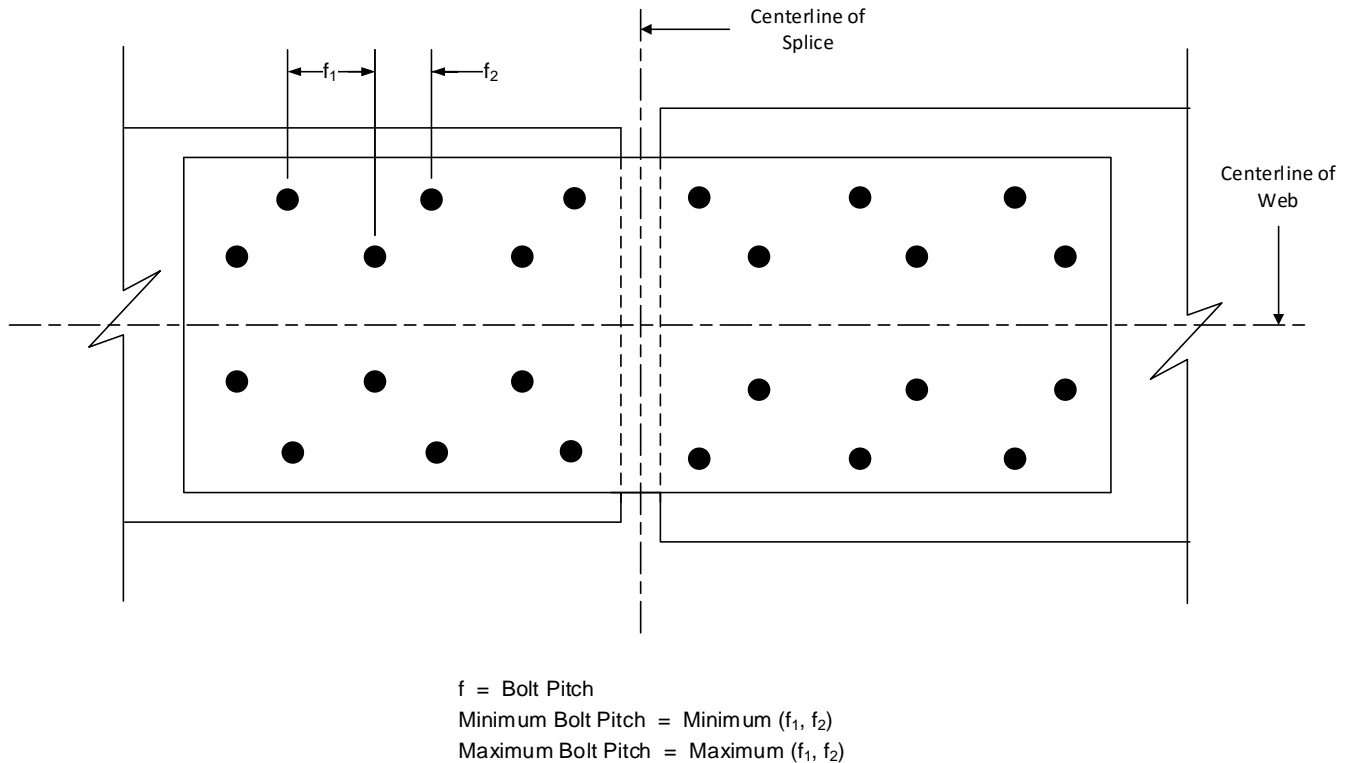


Figure 6.18-6 Bolt Pitch for Staggered Bolt Configuration

For a non-staggered bolt pattern, the bolt pitch for both design and analysis is assumed to be constant. Therefore, the minimum bolt pitch has the same value as the maximum bolt pitch. The bolt pitch should be entered for this parameter, as shown in Figure 7.

## Chapter 6 - Detailed Input Description

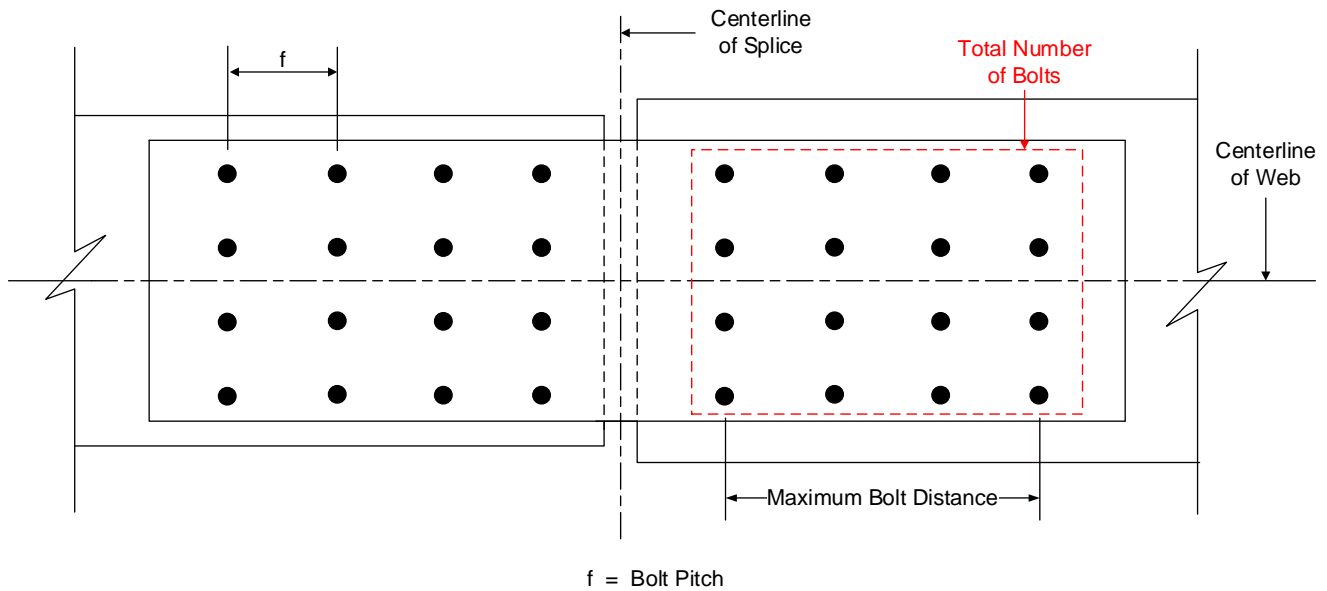


Figure 6.18-7 Bolt Pitch for Non-staggered Bolt Configuration

### 6.18.14 Maximum Bolt Pitch

For a staggered bolt pattern, this parameter should be entered as shown in Figure 6. **The difference between the least and greatest splice end distances (parameters 4 and 5 of this command) and the difference between the least and greatest flange end distances (parameters 6 and 7) must be equal to either the minimum or maximum bolt pitch.**

For a non-staggered bolt pattern, the minimum bolt pitch has the same value as the maximum bolt pitch. This parameter will be ignored and should be left blank.

### 6.18.16 Number of Gage Lines

The program terminates with an error message if an odd number is entered.

### 6.18.17 Total Number of Bolts

**The total number of bolts on one side of the flange splice, as shown in Figures 7 and 8.**

### 6.18.18 Maximum Bolt Distance

Maximum bolt distance should be entered for flange splice bolt analysis problems only. This parameter has no meaning for a design problem because the maximum distance will be calculated automatically, therefore it should be left blank. See Figure 7 for non-staggered bolts.

For staggered bolts, the maximum bolt distance is the extreme distance between bolts which may occur on different gage lines. See Figure 8.

Chapter 6 - Detailed Input Description

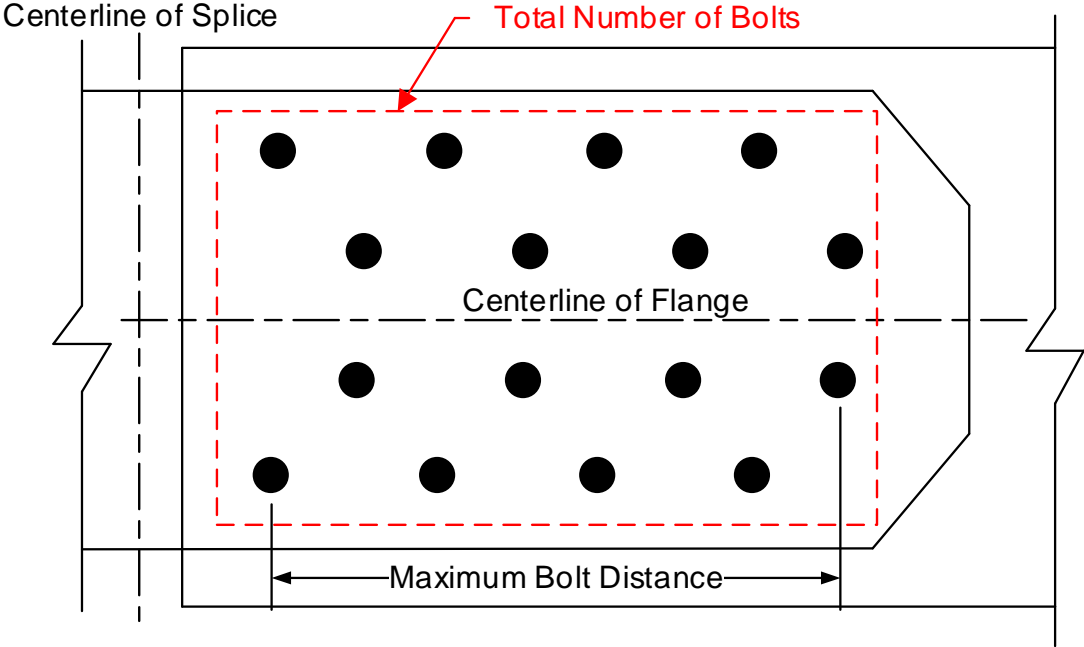


Figure 6.18-8 Maximum Bolt Distance for Staggered Bolt Configuration

## Chapter 6 - Detailed Input Description

### 6.19 FSP - FLANGE SPLICE PLATE COMMAND

#### 6.19.2 Outer Plate Width

The program uses the outer plate width to compute the flange splice plate section properties.

#### 6.19.3 Outer Plate Thickness

Outer plate thickness should be entered for flange splice plate analysis only. This parameter has no meaning for a design problem and should be left blank. (In order to run the program without entering this parameter for a design problem, the program attributes changeability to this parameter, and user input is no longer required.)

#### 6.19.4 Inner Plates Width

The program uses the inner plates width to compute the flange splice plate section properties. The program checks the validity of this parameter against the entered values of the inner splice edge distance (parameters 9 and 10 of the FSB command), the bolt gage (parameter 15 of the FSB command), and the number of gage lines (parameter 16 of the FSB command).

#### 6.19.5 Inner Plates Thickness

Inner plates thickness should be entered for flange splice plate analysis only. This parameter has no meaning for a design problem and should be left blank. (In order to run the program without entering this parameter for a design problem, the program attributes changeability to this parameter, and user input is no longer required.)

#### 6.19.6 Flange Splice Plate Edge Type

The program uses the flange splice plate edge type as one of the criteria in computing the minimum and maximum allowable bolt end and edge distances, in accordance with LRFD Specifications Articles 6.13.2.6.2 and 6.13.2.6.3, as well as the corresponding sections of DM-4.

## Chapter 6 - Detailed Input Description

### 6.21 MIS - MISCELLANEOUS COMMAND

#### 6.21.1 Surface

The program uses this parameter to select the proper surface condition factor,  $K_s$ , based on the given surface condition. The program sets the value of  $K_s$  in accordance with LRFD Specifications Table 6.13.2.8-3. The default for this parameter is Class A, as specified in DM-4.

#### 6.21.2 Web Hole Size Factor

The program uses the web hole size factor to compute the maximum slipping force. If this value is not entered, the program will set it to either 1.0 for a standard hole, or 0.85 for an oversize hole based on the hole diameter entered on the WSB command.

#### 6.21.7 Minimum Web Bolt Tension

The program uses the minimum web bolt tension to check slip resistance of the web splice bolts.

#### 6.21.8 Minimum Top Flange Bolt Tension

The program uses the minimum top flange bolt tension to check slip resistance of the top flange splice bolts.

#### 6.21.9 Minimum Bottom Flange Bolt Tension

The program uses the minimum bottom flange bolt tension to check slip resistance of the bottom flange splice bolts.

#### 6.21.10 Top Flange Hole Size Factor

The program uses the top flange hole size factor to compute the maximum slipping force. If this value is not entered, the program will set it to either 1.0 for a standard hole, or 0.85 for an oversize hole based on the hole diameter entered on the FSB command.

#### 6.21.11 Bottom Flange Hole Size Factor

The program uses the bottom flange hole size factor to compute the maximum slipping force. If this value is not entered, the program will set it to either 1.0 for a standard hole, or 0.85 for an oversize hole based on the hole diameter entered on the FSB command.

**Chapter 6 - Detailed Input Description**

**6.22 OIN - OUTPUT OF INPUT DATA COMMAND**

A summary of the defaults for this command is presented in Table 1. Also presented in Table 1 is a list of the output tables printed with each parameter.

Table 6.22-1 Summary of Defaults for OIN Command

PARAMETER	OUTPUT TABLES INCLUDED	DEFAULTS	
		ANALYSIS RUN	DESIGN RUN
1. Input File Echo	INPUT DATA FILE ECHO	0	0
2. Input Commands	COMMAND LINE INPUT	0	0
3. Input Summary	CONTROL PARAMETERS DESIGN DEAD LOAD DESIGN LIVE LOAD <b>DESIGN LATERAL LOADS</b> DESIGN PEDESTRIAN LOAD MATERIAL PROPERTIES (SET 1) MATERIAL PROPERTIES (SET 2) GIRDER ADJACENT SECTIONS (SET 1) GIRDER ADJACENT SECTIONS (SET 2) GIRDER ADJACENT SECTIONS (SET 3) ADJACENT SECTION RESISTANCE DECK DATA WEB SPLICE BOLT DATA (SET 1) WEB SPLICE BOLT DATA (SET 2) WEB BOLT PITCH DATA WEB SPLICE PLATE DATA FLANGE SPLICE BOLT DATA (SET 1) FLANGE SPLICE BOLT DATA (SET 2) FLANGE SPLICE BOLT DATA (SET 3) FLANGE SPLICE BOLT DATA (SET 4) FLANGE SPLICE PLATE DATA DUCTILITY, REDUNDANCY, IMPORTANCE FACTORS MISCELLANEOUS DATA (SET 1) MISCELLANEOUS DATA (SET 2)	1	1

**Chapter 6 - Detailed Input Description**

**6.23 OSP - OUTPUT OF SECTION PROPERTIES COMMAND**

A summary of the defaults for this command is presented in Table 1. Also presented in Table 1 is a list of the output tables printed with each parameter.

Table 6.23-1 Summary of Defaults for OSP Command

PARAMETER	OUTPUT TABLES INCLUDED	DEFAULTS	
		ANALYSIS RUN	DESIGN RUN
1. Gross Section Properties	GIRDER GROSS SECTION PROPERTIES - LEFT SIDE OF SPLICE GIRDER GROSS SECTION PROPERTIES - RIGHT SIDE OF SPLICE GIRDER GROSS PLATE AREAS - LEFT SIDE OF SPLICE GIRDER GROSS PLATE AREAS - RIGHT SIDE OF SPLICE	1	1
2. Net Section Properties	GIRDER NET PLATE AREAS - LEFT SIDE OF SPLICE GIRDER NET PLATE AREAS - RIGHT SIDE OF SPLICE	0	0

**Chapter 6 - Detailed Input Description**

**6.24 OCN - OUTPUT OF SPLICE CONFIGURATION COMMAND**

The defaults for this command are dependent on whether an analysis or design run is being generated. A summary of the defaults is presented in Table 1. Also presented in Table 1 is a list of the output tables printed with each parameter.

Table 6.24-1 Summary of Defaults for OCN Command

PARAMETER	OUTPUT TABLES INCLUDED	DEFAULTS	
		ANALYSIS RUN	DESIGN RUN
1. Final or Given Configuration	WEB SPLICE PLATE DIMENSIONS (FINAL or GIVEN) WEB SPLICE BOLT CONFIGURATION (FINAL or GIVEN) TOP FLANGE SPLICE PLATE DIMENSIONS (FINAL or GIVEN) TOP FLANGE SPLICE BOLT CONFIGURATION (FINAL or GIVEN) BOTTOM FLANGE SPLICE PLATE DIMENSIONS (FINAL or GIVEN) BOTTOM FLANGE SPLICE BOLT CONFIGURATION (FINAL or GIVEN)	1	1
2. Design Trials	TRIAL ii: WEB SPLICE PLATE DESIGN TRIAL ii: WEB SPLICE BOLT CONFIGURATION DESIGN TRIAL ii: TOP FLANGE SPLICE PLATE DESIGN TRIAL ii: TOP FLANGE SPLICE BOLT DESIGN TRIAL ii: BOTTOM FLANGE SPLICE PLATE DESIGN TRIAL ii: BOTTOM FLANGE SPLICE BOLT DESIGN	Not applicable	0

**Chapter 6 - Detailed Input Description**

**6.25 OAN - OUTPUT OF ANALYSIS RESULTS COMMAND**

The defaults for this command are dependent on whether an analysis or design run is being generated. A summary of the defaults is presented in Table 1. Also presented in Table 1 is a list of the output tables printed with each parameter.

Table 6.25-1 Summary of Defaults for OAN Command

PARAMETER	OUTPUT TABLES INCLUDED	DEFAULTS	
		ANALYSIS RUN	DESIGN RUN
1. Factored Loads	LOAD FACTORS AND COMBINATIONS LOAD MODIFIER RESISTANCE FACTORS SUMMARY OF UNFACTORED MOMENTS AT CENTERLINE OF SPLICE SUMMARY OF FACTORED MOMENTS AT CENTERLINE OF SPLICE SUMMARY OF UNFACTORED SHEARS AT CENTERLINE OF SPLICE SUMMARY OF FACTORED SHEARS AT CENTERLINE OF SPLICE	0	0
2. Web Stresses	SECTION PROPERTIES FOR WEB SPLICE PLATE FLEXURE - LEFT SIDE OF SPLICE WEB SPLICE PLATES - FATIGUE STRESSES - LEFT SIDE OF SPLICE SECTION PROPERTIES FOR WEB SPLICE PLATE FLEXURE - RIGHT SIDE OF SPLICE WEB SPLICE PLATES - FATIGUE STRESSES - RIGHT SIDE OF SPLICE	1	1

Chapter 6 - Detailed Input Description

Table 6.25-1 Summary of Defaults for OAN Command (Cont.)

PARAMETER	OUTPUT TABLES INCLUDED	DEFAULTS	
		ANALYSIS RUN	DESIGN RUN
3. Web Bolt Forces	SECTION PROPERTIES OF WEB SPLICE BOLTS - LEFT SIDE OF SPLICE WEB SPLICE BOLTS - TOTAL SHEAR FORCES - LEFT SIDE OF SPLICE WEB SPLICE BOLTS - TOTAL SLIP FORCES - LEFT SIDE OF SPLICE SECTION PROPERTIES OF WEB SPLICE BOLTS - RIGHT SIDE OF SPLICE WEB SPLICE BOLTS - TOTAL SHEAR FORCES - RIGHT SIDE OF SPLICE WEB SPLICE BOLTS - TOTAL SLIP FORCES - RIGHT SIDE OF SPLICE	1	1
4. Top Flange Plate Stresses	TOP GIRDER FLANGE PLATES: MOMENTS AND SECTION MODULI TO MID-FLANGE (LEFT or RIGHT) <b>TOP GIRDER FLANGE PLATES: LATERAL STRESSES (LEFT or RIGHT)</b> TOP GIRDER FLANGE PLATES: <b>FLEXURAL</b> STRESSES (LEFT or RIGHT) TOP FLANGE SPLICE PLATES: CROSS-SECTIONAL AREAS	1	1
5. Top Flange Bolt Forces	<b>TOP FLANGE SPLICE BOLTS: ECCENTRICITIES</b> <b>TOP FLANGE SPLICE BOLTS: SECTION PROPERTIES</b> TOP FLANGE SPLICE BOLTS: SHEAR FORCES ( <b>LEFT or RIGHT</b> ) TOP FLANGE SPLICE BOLTS: SLIP FORCES ( <b>LEFT or RIGHT</b> )	1	1
6. Top Flange Total Plate Forces	TOP GIRDER FLANGE PLATES: AXIAL FORCES (LEFT or RIGHT)	0	0
7. Bottom Flange Plate Stresses	BOTTOM GIRDER FLANGE PLATES: MOMENTS AND SECTION MODULI TO MID-FLANGE (LEFT or RIGHT) <b>BOTTOM GIRDER FLANGE PLATES: LATERAL STRESSES (LEFT or RIGHT)</b> BOTTOM GIRDER FLANGE PLATES: <b>FLEXURAL</b> STRESSES (LEFT or RIGHT) BOTTOM FLANGE SPLICE PLATES: CROSS-SECTIONAL AREAS	1	1
8. Bottom Flange Bolt Forces	<b>BOTTOM FLANGE SPLICE BOLTS: ECCENTRICITIES</b> <b>BOTTOM FLANGE SPLICE BOLTS: SECTION PROPERTIES</b> BOTTOM FLANGE SPLICE BOLTS - SHEAR FORCES ( <b>LEFT or RIGHT</b> ) BOTTOM FLANGE SPLICE BOLTS - SLIP FORCES ( <b>LEFT or RIGHT</b> )	1	1
9. Bottom Flange Total Plate Forces	BOTTOM GIRDER FLANGE PLATES: AXIAL FORCES (LEFT or RIGHT)	0	0

**Chapter 6 - Detailed Input Description**

**6.26 OSC - OUTPUT OF SPECIFICATION CHECKING COMMAND**

The defaults for this command are dependent on whether an analysis or design run is being generated. A summary of the defaults is presented in Table 1. Also presented in Table 1 is a list of the output tables printed with each parameter.

Table 6.26-1 Summary of Defaults for OSC Command

PARAMETER	OUTPUT TABLES INCLUDED	DEFAULTS	
		ANALYSIS RUN	DESIGN RUN
1. Flexural Stresses in Web Splice	WEB SPLICE PLATES FLEXURE (LEFT) WEB SPLICE PLATES: FLEXURE (RIGHT)	1	1
2. Shear Forces in Web Splice	WEB SPLICE PLATES: SHEAR STRENGTH	0	0
3. Net Section Tensile Fracture in Flanges	TOP FLANGE SPLICE PLATES: NET SECTION FRACTURE (LEFT or RIGHT) - OUTER PLATE and INNER PLATES (as applicable) BOTTOM FLANGE SPLICE PLATES: NET SECTION FRACTURE (LEFT or RIGHT) - OUTER PLATE and INNER PLATES (as applicable)	1	1
4. Gross Section Tensile Yielding in Flanges	TOP FLANGE SPLICE PLATES: GROSS SECTION TENSION YIELD (LEFT or RIGHT) - OUTER PLATE and INNER PLATES (as applicable) BOTTOM FLANGE SPLICE PLATES: GROSS SECTION TENSION YIELD (LEFT or RIGHT) - OUTER PLATE and INNER PLATES (as applicable)	1	1
5. Gross Section Compressive Yielding in Flanges	TOP FLANGE SPLICE PLATES: GROSS SECTION COMPRESSION (LEFT or RIGHT) - OUTER PLATE and INNER PLATES (as applicable) BOTTOM FLANGE SPLICE PLATES: GROSS SECTION COMPRESSION (LEFT or RIGHT) - OUTER PLATE and INNER PLATES (as applicable)	1	1
6. Fatigue Checks for Web Splice	WEB SPLICE PLATES: FATIGUE (LEFT) WEB SPLICE PLATES: FATIGUE (RIGHT)	1	1
7. Fatigue Checks for Flange Splices	TOP FLANGE SPLICE PLATES: FATIGUE BOTTOM FLANGE SPLICE PLATES: FATIGUE	1	1

**Chapter 6 - Detailed Input Description**

Table 6.26-1 Summary of Defaults for OSC Command (continued)

PARAMETER	OUTPUT TABLES INCLUDED	DEFAULTS	
		ANALYSIS RUN	DESIGN RUN
8. Bolt Bearing Strength in Web	WEB SPLICE BOLTS: BEARING ON WEB MATERIAL (LEFT) WEB SPLICE BOLTS: BEARING ON SPLICE MATERIAL (LEFT) WEB SPLICE BOLTS: BEARING ON WEB MATERIAL (RIGHT) WEB SPLICE BOLTS: BEARING ON SPLICE MATERIAL (RIGHT)	1	1
9. Bolt Bearing Strength in Flanges	TOP FLANGE SPLICE BOLTS: BEARING ON MATERIAL BOTTOM FLANGE SPLICE BOLTS: BEARING ON MATERIAL	1	0
10. Bolt Shear Strength in Web	WEB SPLICE BOLTS: SHEAR STRENGTH (LEFT) WEB SPLICE BOLTS: SHEAR STRENGTH (RIGHT)	1	0
11. Bolt Shear Strength in Flanges	TOP FLANGE SPLICE BOLTS: SHEAR STRENGTH BOTTOM FLANGE SPLICE BOLTS: SHEAR STRENGTH	1	0
12. Bolt Slip Resistance in Web	WEB SPLICE BOLTS: SLIP RESISTANCE (LEFT) WEB SPLICE BOLTS: SLIP RESISTANCE (RIGHT)	1	0
13. Bolt Slip Resistance in Flanges	TOP FLANGE SPLICE BOLTS: SLIP RESISTANCE BOTTOM FLANGE SPLICE BOLTS: SLIP RESISTANCE	1	0
14. Bolt Spacing Checks for Web	WEB SPLICE BOLT SPACING CHECKS (LEFT) WEB SPLICE BOLT SPACING CHECKS (RIGHT)	1	1
15. Bolt Spacing Checks for Flanges	TOP FLANGE SPLICE BOLT SPACING CHECKS (LEFT FLANGE and RIGHT FLANGE) - CHECKING AGAINST FLANGE PLATES TOP FLANGE SPLICE BOLT SPACING CHECKS (SPLICE PLATE) - CHECKING AGAINST SPLICE PLATES BOTTOM FLANGE SPLICE BOLT SPACING CHECKS (LEFT FLANGE and RIGHT FLANGE) - CHECKING AGAINST FLANGE PLATES BOTTOM FLANGE SPLICE BOLT SPACING CHECKS (SPLICE PLATE) - CHECKING AGAINST SPLICE PLATES	1	1
16. Block Shear Prevention Checks	BLOCK SHEAR CHECK	1	1

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# OUTPUT DESCRIPTION

## 7.1 GENERAL OUTPUT INFORMATION

In this section, information is provided for describing output table controls, page format, page numbering, and page header. In general, the page format is built into the program and cannot be changed by the user for either the .OUT output file or the .PDF output file. The one exception is that the user can specify the number of blank lines to be printed at the top of each page before the page header is printed. This formatting change will be reflected in both .OUT and .PDF output files accordingly.

### 7.1.1 Output Table Controls

The output table controls are specified using a number of input commands and parameters to control which output reports will be printed. These controls are specified using five different input commands, according to which kind of output they represent. These five kinds of output are: input data, section properties, splice configuration, analysis results, and specification checking. The commands and their defaults are discussed in Sections 6.20 through 6.24.

### 7.1.2 Page Format

There is a maximum of **99** columns in the output files. Column 1 has been left blank to provide a margin on the left side of the page. This has been done to make the output files less dependent on the output device capabilities. The output is therefore limited to **98** characters, column **2** to column **99**. The user can specify the number of lines to be left blank at the top of the page with the CFG command.

### 7.1.3 Page Numbering

The program assigns page numbers and determines when a new page should begin. There are certain rules built into the program to determine when a new page should begin. The program will attempt to fit up to the number of lines specified on the CFG command on each page. Internally, the program keeps track of how many lines are left on the page and adjusts according to the number of lines in the heading of the output table and a minimum number of data lines required after the heading.

### 7.1.4 Page Header

After the cover page, header information is printed at the top of each page. A sample header is shown in Figure 1.

## Chapter 7 Output Description

```
LRFD Steel Girder Splice Design and Analysis, Version 1.6.0.0          PAGE 2
Input File: ex1.dat                                                    03/28/2016  14:10:34
-----
LRFD Steel Girder Splice Example # 1
INPUT
-----
```

Figure 7.1-1 Page Header

Information printed in the header includes:

1. Program Title, Version Number - the program name and version number is located at the top left corner of the header.
2. Page Number - the page number appears at the top right corner of the header.
3. Input File - the name of the input data file used to create this output is shown at the beginning of the second line.
4. Date and Time - the date and time of the program execution for this problem is printed at the right side of the second line.
5. A separator line is printed between program specific header information and user specified header information.
6. The next header line contains the first title line input by the user via the TTL command. This should be a general descriptive line used to describe the problem to be run.
7. The next header line contains the type of output specified by the user.
8. The final header line is another separator line.

### 7.1.5 Units

For each value presented in the output, the corresponding units are provided. The units are presented in the column headings directly below the column description. The system of units is entered by the user on the CTL command. As result of a decision by the AASTHO Subcommittee on Bridges and Structures to longer publish SI unit specifications, the program only supports US customary (US) units. Presented in Table 1 is a summary of the basic units of measure used by this program.

## Chapter 7 Output Description

Table 7.1-1 Units

Variable	Unit of Measure (U.S. Customary Units)
AREA	inches <sup>2</sup>
AXIAL FORCE	kips
AXIAL STRESS	ksi
BOLT FORCE	kips
BOLT GAGE DISTANCE	inches
BOLT GROUP MOMENT OF INERTIA	inches <sup>2</sup>
BOLT PITCH DISTANCE	inches
BOLT RESISTANCE	kips
BOLT SIZE (DIAMETER)	inches
BOLT SPACING	inches
BOLT TENSION	kips
CLEAR DISTANCE	inches
DEPTH	inches
DESIGN STRESS	ksi
DIAMETER	inches
DISTANCE	inches
DISTANCE TO NEUTRAL AXIS	inches
EDGE DISTANCE	inches
END DISTANCE	inches
FACTORED RESISTANCE	ksi
FATIGUE RESISTANCE	ksi
FATIGUE STRESS	ksi
FATIGUE STRESS RANGE	ksi
FLEXURAL RESISTANCE	k-ft
FLEXURAL STRESS	ksi
FORCE	kips
GAGE DISTANCE	inches
HOLE SIZE (DIAMETER)	inches
LENGTH	inches
MOMENT	k-ft
MOMENT OF INERTIA	inches <sup>4</sup>
SECTION MODULUS	inches <sup>3</sup>
SHEAR FORCE	kips
SHEAR RESISTANCE	kips
STEEL GRADE	ksi
STRESS	ksi
TENSILE STRENGTH	ksi
THICKNESS	inches
WIDTH	inches
YIELD STRENGTH	ksi

### 7.1.6 Sign Conventions

Presented in Table 2 is a summary of the sign conventions used by this program.

## Chapter 7 Output Description

Table 7.1-2 Sign Conventions

Variable	Sign Convention
MOMENT	A moment that causes a compressive stress in the extreme top fiber of the girder is positive.
LOAD	A load acting in the downward direction is positive.
SHEAR	A shearing force acting downward on the right face of the free body in equilibrium is positive.
AXIAL FORCE	A force causing tension is positive.
STRESS	A tensile stress is positive.

## Chapter 7 Output Description

### 7.2 COVER PAGE

The first page of the output is the cover page. The following information is shown at the top of the cover page:

1. Program Title - LRFD Steel Girder Splice Design and Analysis
2. Program Name - SPLRFD
3. Version - ii.nn, where ii represents the numeric designation for major revisions and enhancements to the program and nn represents the numeric designation for minor revisions.
4. Last Updated - this is the date the program was last revised.
5. Documentation - this is the date the User's Manual was last revised.
6. License Number - this is a unique number assigned to all licensees per the License Agreement.

The middle section of the cover page is reserved for the first 10 TTL commands input by the user. This information typically should describe the bridge, location of bridge, location of splice, and any other information the user would need to identify the output.

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## Chapter 7 Output Description

### 7.3 INPUT DATA

The input data consists of an echo of the input file, summary of input commands, and input summary tables. Each of these can individually be turned on or off. A summary of the output tables included is given in Section 6.20.

#### 7.3.1 Input File Echo

The input file echo (parameter 1) is a listing of the input commands and comments as entered by the user. The user can refer to this section to trace input errors and warnings by comparing the input data to the input descriptions provided in Chapter 5. The input file can contain 256 characters in a single line, but the output is limited to 75 characters on a single line. If the input line contains more than 75 characters, the input file echo will be wrapped to the next row. Other than this limitation, the echo of the input file should appear the same as the input data file.

#### 7.3.2 Input Commands

This section (parameter 2) is a summary that includes a detailed description of each input parameter for all input commands entered by the user. The summary of input commands is in a vertical format. Two examples of the input commands are shown in Figure 1.

The summary of input commands includes the following information:

1. Command keyword.
2. Input parameter description.
3. Value of the input parameter as entered or the default value as stored in the program. The value is displayed to the same number of significant figures as entered by the user or as stored in the input parameter file. The word (default) is placed to the right of the units when default values are used. An asterisk (\*) indicates the input value is optional and was not entered.
4. Units if applicable.
5. Any warnings or errors encountered with respect to the input data.

Input values may be optional or required. Required input is input that is entered by the user or set to the default value stored in the program. Default values are indicated with the text (default) placed to the right of the units. If there is no default value stored in the program and the user does not enter a value, an error message is displayed.

## Chapter 7 Output Description

COMMAND: CTL			
SYSTEM OF UNITS	US		
COMPOSITE/NONCOMPOSITE	C		
DES./ANAL. WEB SPL. PLATE	D		
DES./ANAL. WEB SPL. BOLTS	D		
THREAD OF WEB BOLT IN SHR	Y		
INCR. PLATE/BOLT WEB SPL.	P		
DES./ANAL. TOP FSPL. PL.	D		
DES./ANAL. TOP FSPL. BOLT	D		
THREAD OF TOP FSPL. BOLT	Y		
INCR. PL./BOLT TOP FSPL.	P		
DES./ANAL. BOT FSPL. PL.	D		
DES./ANAL. BOT FSPL. BOLT	D		
THREAD OF BOT FSPL. BOLT	Y		
INCR. PL./BOLT BOT FSPL.	P		
TOP FSPL. CONFIGURATION	3		
BOT FSPL. CONFIGURATION	3		
STAG./NON-STAG. TOP FLNG.	N		
STAG./NON-STAG. BOT FLNG.	N		
BOLT CONNECTION TYPE	F		
CHECK PLATE FATIGUE	N		
PEDESTRIAN LOADING	Y		
COMMAND: FSP			
TOP/BOTTOM	T		
OUTER PLATE WIDTH	18 in		
OUTER PLATE THICKNESS	* in		(computed, if necessary)
INNER PLATES WIDTH	7.25 in		
INNER PLATES THICKNESS	* in		(computed, if necessary)
FLNG. SPL. PL. EDGE TYPE	R		
TOP/BOTTOM	B		
OUTER PLATE WIDTH	18 in		
OUTER PLATE THICKNESS	* in		(computed, if necessary)
INNER PLATES WIDTH	7.25 in		
INNER PLATES THICKNESS	* in		(computed, if necessary)
FLNG. SPL. PL. EDGE TYPE	R		

Figure 7.3-1 CTL and FSP Summary of Input Commands

Optional input does not need to be entered by the user. An asterisk (\*) is printed for the value indicating the input value is optional. In some cases when input is not entered, the program sets the value. An example of an optional input parameter set by the program is the diameter of bolt holes. Some input is optional because it is not required for the particular problem being run. For example, the flange splice outer plate thickness is not required for a flange splice plate design. For more information regarding specific input requirements, refer to Chapter 5.

Any warnings or errors encountered while processing the input data will be reflected with the appropriate input command under the summary of input commands. If this level of input data output is turned off, the warnings will still appear, though without the added benefit of the warnings and errors being grouped with the corresponding input command. After encountering warnings or errors, the program also prints a message to the screen advising the user to review the output file for explanations of the warnings and errors.

## Chapter 7 Output Description

### 7.3.3 Input Summary

The input summary consists of tables that include summaries of all input parameters in horizontal tabular format. The input summary tables also include all processed input. Processed input is input that gets computed by the program based on other input items, including program set optional input values. A more complete description of all input items can be found in Chapters 5 and 6. Processed input items include the splice plate material properties for a design run and the haunch depth for a design run.

Two examples of input summary tables are shown in Figure 2.

CONTROL PARAMETERS					
Units	Composite/ Noncomposite	Design/Analysis for Web Splice Plates	Threads of Web Bolts in Shear Plane	Threads of Web Bolts in Shear Plane	Increase Plate or Bolts for Web Splice
US	C	D	D	Y	P
Design/Analysis for Top Flange Splice					
	Plates	Bolts	Threads of Top Flange Bolts in Shear Plane	Threads of Top Flange Bolts in Shear Plane	Increase Plate or Bolts for Top Flange Splice
	D	D	Y	Y	P
Design/Analysis for Bottom Flange Splice					
	Plates	Bolts	Threads of Bot. Flange Bolts in Shear Plane	Threads of Bot. Flange Bolts in Shear Plane	Increase Plate or Bolts for Bot. Flange Splice
	D	D	Y	Y	P
Splice Configuration					
	Top Flange	Bottom Flange	Staggered/ Top Flange	Nonstaggered/ Bottom Flange	
	3	3	N	N	
Bolt Connection Type					
	F		Check Plate Fatigue	Pedestrian Live Load	
			N	Y	
FLANGE SPLICE PLATE DATA					
Top/ Bottom	Outer Plate Width (in)	Outer Plate Thickness (in)	Inner Plate Width (in)	Inner Plate Thickness (in)	Splice Plate Edge Type
T	18.000	--	7.2500	--	R
B	18.000	--	7.2500	--	R
-- To be designed					

Figure 7.3-2 CTL and FSP Input Summary

## Chapter 7 Output Description

The input summary tables contain the following information:

1. A description of the input data.
2. Input parameter header containing an abbreviated parameter description and units.
3. Input parameter values. The input values are shown to a fixed number of decimal places because of the tabular format. The actual input value may be rounded to fit the output format. Refer to the summary of input commands for the actual value input by the user.

## Chapter 7 Output Description

### 7.4 SPLICE CONFIGURATION OUTPUT

The splice configuration output consists of the web splice plate dimensions and bolt configuration, the top flange splice plate dimensions and bolt configuration, and the bottom flange splice plate dimensions and bolt configuration. For analysis, the given splice configuration is presented. For design, the final splice configuration and the design trial splice configurations are presented. A summary of the output tables for each control is given in Section 6.22. The user can suppress all splice configuration output by setting every parameter to zero.

#### 7.4.1 Web Splice Plate Dimensions (Final or Given)

The following information is reported in the WEB SPLICE PLATE DIMENSIONS (FINAL or GIVEN) output table. The word "FINAL" is used for a design run, and the word "GIVEN" is used for an analysis run.

1. Thickness of Each Plate - thickness of each of the two web splice plates.
2. Length (Longitudinal) - total length, in the longitudinal direction, of each of the two web splice plates.
3. Depth (Vertical) - depth, in the vertical direction, of each of the two web splice plates.
4. WSPL CG to Top of Web - vertical distance from the center of gravity of the web splice plate to the top of the girder web.

#### 7.4.2 Web Splice Bolt Configuration (Final or Given)

The following information is reported in the WEB SPLICE BOLT CONFIGURATION (FINAL or GIVEN) output table. The word "FINAL" is used for a design run, and the word "GIVEN" is used for an analysis run.

For a design run, the following information is reported:

1. Total ii Gage Lines Per Side of CL Splice @ - total number of gage lines per side of centerline splice and the typical spacing between gage lines.
2. Distance from CL Splice to First Gage Line - horizontal distance from the centerline splice to the gage line closest to the centerline splice.
3. Total ii Bolts Per Gage Line @ - total number of bolts per gage line and the typical spacing between pitch lines.
4. Distance from Top Row of Bolts to Top of Web - vertical distance between the top row of bolts and the top of the web.
5. Distance from Bottom Row of Bolts to Bottom of Web - vertical distance between the bottom row of bolts and the bottom of the web.
6. Top and Bottom Splice End Distance - vertical distance between the top row of bolts and the top of the web splice plate and vertical distance between the bottom row of bolts and the bottom of the web splice plate.
7. Design web edge distance - Web edge distance used during the design to check bearing failure.

## Chapter 7 Output Description

8. Design web splice edge distance - Web splice edge distance used during the design to check bearing failure.
9. Design web splice end distance - Web splice end distance used during the design to check bearing failure.

Below the output table, the following information is also presented:

Note:

- \* Web edge distance was increased to xx.x from the original xx.x to overcome bearing failure.
- \* Web splice edge distance was increased to xx.x from the original xx.x to overcome bearing failure.
- \* Web splice end distance was increased to xx.x from the original xx.x to overcome bearing failure.

The above note provides the information about the changed bearing distance that was used to check bearing failure as compared to user entered bearing distances in the input. This note is provided only when the input parameter 12 on WSB command is set to a value other than zero and incremented bearing distances have been used in an attempt to overcome bearing failure.

For an analysis run, the following information is reported:

1. Gage Lines, Gage Line Number - number of the gage line for which the horizontal distance is presented. Gage line 1 is closest to the centerline splice.
2. Gage Lines, Horizontal Distance from Centerline Splice - horizontal distance from the centerline splice to the gage line corresponding to the gage line number presented in the previous column.
3. Pitch Lines, Pitch Line Number - number of the pitch line for which the vertical distance from top of web is presented. Pitch line 1 is closest to the top of web.
4. Pitch Lines, Vertical Distance from Top of Web - vertical distance from the top of web to the pitch line corresponding to the pitch line number presented in the previous column.
5. Pitch Lines, Bolt Pitch Spacing - vertical distance between this bolt pitch line and the preceding bolt pitch line.

For an analysis run, the following information is also presented below the output table:

1. Distance from Bottom Row of Bolts to Bottom of Web - vertical distance between the bottom row of bolts and the bottom of the web.
2. Top Splice End Distance - vertical distance between the top row of bolts and the top of the web splice plate.
3. Bottom Splice End Distance - vertical distance between the bottom row of bolts and the bottom of the web splice plate.

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### 7.4.3 Top Flange Splice Plate Dimensions (Final or Given)

The following information is reported in the TOP FLANGE SPLICE PLATE DIMENSIONS (FINAL or GIVEN) output table. The word "FINAL" is used for a design run, and the word "GIVEN" is used for an analysis run.

1. Outer Plate, Width - width of the outer splice plate (above the top flange). This column is presented only if an outer splice plate is being used.
2. Outer Plate, Thickness - thickness of the outer splice plate (above the top flange). This column is presented only if an outer splice plate is being used.
3. Inner Plates, Width - width of each of the inner splice plates (beneath the top flange). This column is presented only if inner splice plates are being used.
4. Inner Plates, Thickness - thickness of each of the inner splice plates (beneath the top flange). This column is presented only if inner splice plates are being used.

### 7.4.4 Top Flange Splice Bolt Configuration (Final or Given)

The following information is reported in the TOP FLANGE SPLICE BOLT CONFIGURATION (FINAL or GIVEN) output table. The word "FINAL" is used for a design run, and the word "GIVEN" is used for an analysis run.

1. Total Number of Bolts per Side - total number of bolts in the flange splice bolt configuration on each side of the centerline splice, without considering the effect of filler plates. The program does not specify the pattern of the flange splice bolts. (The staggered/non-staggered bolt pattern option is as specified by the user in the CTL command.)
2. Total Number of Gage Lines - this is an echo of the input value entered in the FSB command.
3. Maximum Pitch of Bolts - this is an echo of the input value entered in the FSB command.
4. Minimum Pitch of Bolts - this is an echo of the input value entered in the FSB command.
5. Greatest Bolt Gage Distance - greatest bolt gage distance, as computed by the program. This is presented only if the greatest bolt gage distance does not equal the least bolt gage distance.
6. Least Bolt Gage Distance - least bolt gage distance, as computed by the program. This is presented only if the least bolt gage distance does not equal the greatest bolt gage distance.
7. Bolt Gage Distance - bolt gage distance, as computed by the program. This is presented only if the least bolt gage distance equals the greatest bolt gage distance.
8. Greatest Flange End Distance - this is an echo of the input value entered in the FSB command.
9. Least Flange End Distance - this is an echo of the input value entered in the FSB command.
10. Left Flange Edge Distance - this is an echo of the input value entered in the FSB command.
11. Right Flange Edge Distance - this is an echo of the input value entered in the FSB command.
12. Greatest Splice End Distance - this is an echo of the input value entered in the FSB command.

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13. Least Splice End Distance - this is an echo of the input value entered in the FSB command.
14. Outer Splice Edge Distance - this is an echo of the input value entered in the FSB command.
15. Inner Splice Least Edge Distance - this is an echo of the input value entered in the FSB command.
16. Inner Splice Greatest Edge Distance - this is an echo of the input value entered in the FSB command.

### 7.4.5 Bottom Flange Splice Plate Dimensions (Final or Given)

The same information as described in section 7.4.3 is printed on the BOTTOM FLANGE SPLICE PLATE DIMENSIONS (FINAL or GIVEN) output table except that this table provides the information for the bottom flange. The word "FINAL" is used for a design run, and the word "GIVEN" is used for an analysis run.

### 7.4.6 Bottom Flange Splice Bolt Configuration (Final or Given)

The same information as described in section 7.4.4 is printed on the BOTTOM FLANGE SPLICE BOLT CONFIGURATION (FINAL or GIVEN) output table except that this table provides the information for the bottom flange. The word "FINAL" is used for a design run, and the word "GIVEN" is used for an analysis run.

### 7.4.7 Trial ii: Web Splice Plate Design

The following information is reported in the TRIAL ii: WEB SPLICE PLATE DESIGN output table. The number in the title increases by one for each design trial output table. The word "(FINAL)" is added to the title if the output table presents the final web splice plate design.

1. Thickness of Each Plate - thickness of each of the two web splice plates.
2. Length (Longitudinal) - total length, in the longitudinal direction, of each of the two web splice plates.
3. Depth (Vertical) - depth, in the vertical direction, of each of the two web splice plates.
4. WSPL CG to Top of Web - vertical distance from the center of gravity of the web splice plate to the top of the girder web.

Below the output table, the following information is also presented:

1. Total ii Gage Lines Per Side of CL Splice @ - total number of gage lines per side of centerline splice and the typical spacing between gage lines.
2. Distance from CL Splice to First Gage Line - horizontal distance from the centerline splice to the gage line closest to the centerline splice.
3. Total ii Bolts Per Gage Line @ - total number of bolts per gage line and the typical spacing between pitch lines.
4. Distance from Top Row of Bolts to Top of Web - vertical distance between the top row of bolts and the top of the web.

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5. Distance from Bottom Row of Bolts to Bottom of Web - vertical distance between the bottom row of bolts and the bottom of the web.
6. Design web edge distance – Web edge distance used to check bearing failure.
7. Design web splice edge distance - Web splice edge distance used to check bearing failure.
8. Design web splice end distance - Web splice end distance used to check bearing failure.

In addition, the following information is also presented for the design trial:

1. Mode of failure or success - the program presents whether the design trial failed or succeeded, it presents the mode of failure (such as flexural resistance or shear resistance), and it presents the maximum design value and the factored resistance value.
2. Controlling Limit State - limit state corresponding with the failure or success data.
3. Left/Right of Splice CL - side of the splice centerline (left or right) corresponding with the failure or success data.
4. Live Load Number - live load number corresponding with the failure or success data and corresponding with the live load type of the controlling limit state.
5. Moment Direction - moment direction (POS for positive and NEG for negative) corresponding with the failure or success data.
6. Shear Direction - shear direction (POS for positive and NEG for negative) corresponding with the failure or success data.
7. Stress Location - location (TOP for top of web splice plates and BOT for bottom of web splice plates) corresponding with the failure or success data.

### 7.4.8 Trial ii: Web Splice Bolt Configuration Design

The following information is reported in the TRIAL ii: WEB SPLICE BOLT CONFIGURATION DESIGN output table. The number in the title increases by one for each design trial output table. The word “(FINAL)” is added to the title if the output table presents the final web splice bolt configuration design.

1. Thickness of Each Plate - thickness of each of the two web splice plates.
2. Length (Longitudinal) - total length, in the longitudinal direction, of each of the two web splice plates.
3. Depth (Vertical) - depth, in the vertical direction, of each of the two web splice plates.
4. WSPL CG to Top of Web - vertical distance from the center of gravity of the web splice plate to the top of the girder web.

Below the output table, the following information is also presented:

1. Total ii Gage Lines Per Side of CL Splice @ - total number of gage lines per side of centerline splice and the typical spacing between gage lines.

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2. Distance from CL Splice to First Gage Line - horizontal distance from the centerline splice to the gage line closest to the centerline splice.
3. Total ii Bolts Per Gage Line @ - total number of bolts per gage line and the typical spacing between pitch lines.
4. Distance from Top Row of Bolts to Top of Web - vertical distance between the top row of bolts and the top of the web.
5. Distance from Bottom Row of Bolts to Bottom of Web - vertical distance between the bottom row of bolts and the bottom of the web.
6. Design web edge distance – Web edge distance used to check bearing failure.
7. Design web splice edge distance - Web splice edge distance used to check bearing failure.
8. Design web splice end distance - Web splice end distance used to check bearing failure.

In addition, the following information is also presented for the design trial:

1. Mode of failure or success - the program presents whether the design trial failed or succeeded, it presents the mode of failure (such as bolt shear force or bolt bearing force), and it presents the maximum design value and the factored resistance value. For bearing checks it presents the controlling bearing distance.
2. Controlling Limit State - limit state corresponding with the failure or success data.
3. Left/Right of Splice CL - side of the splice centerline (left or right) corresponding with the failure or success data.
4. Live Load Number - live load number corresponding with the failure or success data and corresponding with the live load type of the controlling limit state.
5. Moment Direction - moment direction (POS for positive and NEG for negative) corresponding with the failure or success data.
6. Shear Direction - shear direction (POS for positive and NEG for negative) corresponding with the failure or success data.
7. Bolt Location from WSPL CG - bolt location, relative to the center of gravity of the web splice plate (WSPL CG), corresponding with the failure or success data. The value labeled "Horiz" is the horizontal distance from the controlling bolt to the center of gravity of the web splice plate, and the value labeled "Vert" is the vertical distance from the controlling bolt to the center of gravity of the web splice plate. The location of the WSPL CG is presented in this table.

### 7.4.9 Trial ii: Top Flange Splice Plate Design

The following information is reported in the TRIAL ii: TOP FLANGE SPLICE PLATE DESIGN output table. The number in the title increases by one for each design trial output table. The word "(FINAL)" is added to the title if the output table presents the final top flange splice plate design.

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1. Outer Plate, Width - width of the outer splice plate (above the top flange). This column is presented only if an outer splice plate is being used.
2. Outer Plate, Thickness - thickness of the outer splice plate (above the top flange). This column is presented only if an outer splice plate is being used.
3. Inner Plates, Width - width of each of the inner splice plates (beneath the top flange). This column is presented only if inner splice plates are being used.
4. Inner Plates, Thickness - thickness of each of the inner splice plates (beneath the top flange). This column is presented only if inner splice plates are being used.

Below the output table, the following information is also presented:

1. Total Number of Bolts per Side - total number of bolts in the flange splice bolt configuration on each side of the centerline splice, without considering the effect of filler plates. The program does not specify the pattern of the flange splice bolts. (The staggered/non-staggered bolt pattern option is as specified by the user in the CTL command.)

In addition, the following information is also presented for the design trial:

1. Mode of failure or success - the program presents whether the design trial failed or succeeded, it presents the mode of failure (such as net tension or plate stress), and it presents the maximum design value and the factored resistance value.
2. Controlling Limit State - limit state corresponding with the failure or success data.
3. Live Load Number - live load number corresponding with the failure or success data and corresponding with the live load type of the controlling limit state.
4. Moment Direction - moment direction (POS for positive and NEG for negative) corresponding with the failure or success data.
5. Outer/Inner Plate - splice plate (outer or inner) corresponding with the failure or success data.

### 7.4.10 Trial ii: Top Flange Splice Bolt Design

The following information is reported in the TRIAL ii: TOP FLANGE SPLICE BOLT DESIGN output table. The number in the title increases by one for each design trial output table. The word "(FINAL)" is added to the title if the output table presents the final top flange splice bolt design.

1. Outer Plate, Width - width of the outer splice plate (above the top flange). This column is presented only if an outer splice plate is being used.
2. Outer Plate, Thickness - thickness of the outer splice plate (above the top flange). This column is presented only if an outer splice plate is being used.

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3. Inner Plates, Width - width of each of the inner splice plates (beneath the top flange). This column is presented only if inner splice plates are being used.
4. Inner Plates, Thickness - thickness of each of the inner splice plates (beneath the top flange). This column is presented only if inner splice plates are being used.

Below the output table, the following information is also presented:

1. Total Number of Bolts per Side - total number of bolts in the flange splice bolt configuration on each side of the centerline splice, without considering the effect of filler plates. The program does not specify the pattern of the flange splice bolts. (The staggered/non-staggered bolt pattern option is as specified by the user in the CTL command.)

In addition, the following information is also presented for the design trial:

1. Mode of failure or success - the program presents whether the design trial failed or succeeded, it presents the mode of failure (such as bolt shear force or bolt bearing force), and it presents the maximum design value and the factored resistance value.
2. Controlling Limit State - limit state corresponding with the failure or success data.
3. Live Load Number - live load number corresponding with the failure or success data and corresponding with the live load type of the controlling limit state.
4. Moment Direction - moment direction (POS for positive and NEG for negative) corresponding with the failure or success data.

### 7.4.11 Trial ii: Bottom Flange Splice Plate Design

The same information as described in section 7.4.9 is printed on the TRIAL ii: BOTTOM FLANGE SPLICE PLATE DESIGN output table except that this table provides the information for the bottom flange. The number in the title increases by one for each design trial output table. The word "(FINAL)" is added to the title if the output table presents the final bottom flange splice plate design.

### 7.4.12 Trial ii: Bottom Flange Splice Bolt Design

The same information as described in section 7.4.10 is printed on the TRIAL ii: BOTTOM FLANGE SPLICE BOLT DESIGN output table except that this table provides the information for the bottom flange. The number in the title increases by one for each design trial output table. The word "(FINAL)" is added to the title if the output table presents the final bottom flange splice bolt design.

## 7.5 SECTION PROPERTIES OUTPUT

The section property output consists of the girder gross section properties, the girder gross plate areas, the girder net section properties, and the girder net plate areas. This output is presented for both the left and right side of

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splice. A summary of the output tables for each control is given in Section 6.21. The user can suppress all section property output by setting every parameter to zero.

### 7.5.1 Girder Gross Section Properties - Left Side of Splice

These are the section properties for the left girder adjacent section that are required to perform the splice design or analysis. The properties are based on the gross section (without considering bolt holes). The program uses the gross section properties corresponding with the adjacent girder section that has the smaller **product of moment of inertia for the noncomposite steel section and the smallest minimum flange yield strength on the side of the splice under consideration**. Presented in the title is the haunch depth used by the program. The haunch depth is defined as the distance from the top of the web to the bottom of the slab, as used by the program. The following information is reported in the GIRDER GROSS SECTION PROPERTIES - LEFT SIDE OF SPLICE output table.

1. Flexure Direction - POS for positive flexure or NEG for negative flexure.
2. Load Component - defines the loading with which the section properties are used. DC1 represents section properties associated with noncomposite dead load, DC2 represents section properties associated with composite dead loads other than future wearing surface, FWS represents section properties associated with composite dead load due to future wearing surface, DC2\_P represents section properties associated with composite dead loads due to sidewalks, FWS\_P represents section properties associated with composite dead loads due to the removal of future wearing surface under sidewalks, LLIM represents section properties associated with live load with dynamic load allowance (impact), and PL represents section properties associated with pedestrian live load. DC2 and FWS section properties are identical, and LLIM and PL section properties are also identical.
3. Area - cross sectional area of the girder.
4. Bottom of Girder to Neutral Axis - vertical distance from the horizontal neutral axis of the girder to the bottom of the girder.
5. Moment of Inertia - moment of inertia of the girder about its horizontal neutral axis.
6. Web Moment of Inertia about Girder Neutral Axis - moment of inertia of the web only about the horizontal neutral axis of the girder.
7. **Lateral Flange Section Modulus, Top - the lateral section modulus of the top flange, used with lateral stress input.**
8. **Lateral Flange Section Modulus, Bottom - the lateral section modulus of the bottom flange, used with lateral stress input.**

**If the left side is the smaller section, the following note will print under this output report:**

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**"NOTE: The SMALLER section is the LEFT side. (based on the product of noncomposite moment of inertia and the minimum flange yield strength on the side of the splice under consideration)"**

### 7.5.2 Girder Gross Section Properties - Right Side of Splice

The same information as described in section 7.5.1 is printed on the GIRDER GROSS SECTION PROPERTIES - RIGHT SIDE OF SPLICE output table except that these are the section properties for the right girder adjacent section that are required to perform the splice design or analysis.

**If the right side is the smaller section, the following note will print under this output report:**

**"NOTE: The SMALLER section is the RIGHT side. (based on the product of noncomposite moment of inertia and the minimum flange yield strength on the side of the splice under consideration)"**

### 7.5.3 Girder Gross Plate Areas - Left Side of Splice

These are the plate areas of the top flange, web, and bottom flange for the left girder adjacent section. The properties are based on the gross section (without considering bolt holes). These are used to compute the moment of inertia and to compute the total force in the flanges. The following information is reported in the GIRDER GROSS PLATE AREAS - LEFT SIDE OF SPLICE output table.

1. Top Flange - area of the top flange.
2. Web - area of the web.
3. Bottom Flange - area of the bottom flange.

### 7.5.4 Girder Gross Plate Areas - Right Side of Splice

The same information as described in section 7.5.3 is printed on the GIRDER GROSS PLATE AREAS - RIGHT SIDE OF SPLICE output table except that these are the plate areas of the top flange, web, and bottom flange for the right girder adjacent section.

### 7.5.5 Girder Net Plate Areas - Left Side of Splice

These are the plate areas of the top flange, web, and bottom flange for the left girder adjacent section. The net section properties are based on the total net section. These are used to compute the neutral axis of the net girder section. The following information is reported in the GIRDER NET PLATE AREAS - LEFT SIDE OF SPLICE output table.

1. Top Flange - net area of the top flange.

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2. Web - net area of the web.
3. Bottom Flange - net area of the bottom flange.

### 7.5.6 Girder Net Plate Areas - Right Side of Splice

The same information as described in section 7.5.6 is printed on the GIRDER NET PLATE AREAS - RIGHT SIDE OF SPLICE output table except that these are the plate areas of the top flange, web, and bottom flange for the right girder adjacent section.

## Chapter 7 Output Description

### 7.6 ANALYSIS RESULTS AND SPECIFICATION CHECKING OUTPUT

A summary of the analysis results and specification checking output tables for each parameter is given in Sections 6.23 and 6.24. The user can suppress analysis results and specification checking output by entering zero for the output parameters. These output parameters apply for both design and analysis runs. Unless otherwise specified, all output values corresponding with a specified loading (such as DC1, DC2, FWS, Live Load, Pedestrian Live Load, and Total) are factored. For a run with pedestrian loading, only Strength IP limit state should be considered by the user. All other limit states should be ignored due to incorrect dead load and live load.

#### 7.6.1 Load Factors and Combinations

This table presents all of the load factors used by the program. Maximum load factors and minimum load factors are presented. For a description of how the program uses maximum and minimum load factors, refer to Section 3.2.3 of this manual. The following information is presented in the LOAD FACTORS AND COMBINATIONS output table.

##### Maximum Load Factors

1. Limit State - limit state for which the load factors will be used.
2. DC1 - load factor used with non-composite dead loads.
3. DC2 - load factor used with composite dead loads, excluding future wearing surface.
4. FWS - load factor used for future wearing surface dead loads.
5. DC2\_P - load factor used for composite dead loads due to sidewalks
6. FWS\_P - load factor used for future wearing surface removal under sidewalks
7. LL - load factor used for vehicular live loads.
8. PL - load factor used for pedestrian live loads.
9. Live Loading - live loading (Design, Permit, or HS20-30) corresponding with the specified limit state.

##### Minimum Load Factors

1. Limit State - limit state for which the load factors will be used.
2. DC1 - load factor used with non-composite dead loads.
3. DC2 - load factor used with composite dead loads, excluding future wearing surface.
4. FWS - load factor used for future wearing surface dead loads.
5. DC2\_P - load factor used for composite dead loads due to sidewalks
6. FWS\_P - load factor used for future wearing surface removal under sidewalks
7. LL - load factor used for vehicular live loads.
8. PL - load factor used for pedestrian live loads.
9. Live Loading - live loading (Design, Permit, or HS20-30) corresponding with the specified limit state.

## Chapter 7 Output Description

### 7.6.2 Load Modifier

The following information is reported in the LOAD MODIFIER output table.

1. Limit State - limit state for which the load modifiers will be used.
2. Importance Factor,  $N_i$  - importance factor of the bridge.
3. Ductility Factor,  $N_d$  - ductility factor of the girder adjacent sections being spliced.
4. Redundancy Factor,  $N_r$  - redundancy factor of the girder adjacent sections being spliced.
5. Load Modifier Calculated,  $N_i*N_d*N_r$  - cumulative eta factor found by multiplying the three other eta factors together.
6. Load Modifier Used - actual cumulative eta factor used by the program for regular loads. This factor depends on limits imposed by DM-4 and the LRFD Specifications.

The following may print on the table:

Value(s) of  $N_i*N_d*N_r$  outside allowable bounds. Resetting load modifier(s) to x.xxx - this prints if the product of the factors is outside of the specified bounds. The product is reset to the bound which is exceeded.

The following may also print on the table:

As per PennDOT DM-4 Sections 1.3.2 through 1.3.5, ETA factors other than 1.0 are not permitted by PennDOT - this prints if any of the ETA factors are not equal to 1.0.

#### Resistance Factors

The resistance factors are used by the program to modify the nominal resistances. The following information is reported in the RESISTANCE FACTORS output table.

1. Plate Flexure - resistance factor for flexure in the splice plate.
2. Plate Shear - resistance factor for shear in the splice plate.
3. Plate Axial Compression - resistance factor for axial compression in the splice plate.
4. Plate Axial Net Tension - resistance factor for axial net tension in the splice plate.
5. Plate Axial Gross Yield - resistance factor for axial gross yield in the splice plate.
6. Bolt Bearing - resistance factor for bearing against the bolts or plate material.
7. Bolt Shear - resistance factor for shear in the bolts.
8. Shear Rupture in Connection Element - resistance factor for shear rupture in connection element.

### 7.6.3 Summary of Unfactored Moments at Centerline of Splice

This table presents a summary of the unfactored moments entered by the user in the DDL, DLL, and DPL commands. The following information is presented in the SUMMARY OF UNFACTORED MOMENTS AT CENTERLINE OF SPLICE output table.

## Chapter 7 Output Description

1. Loading - loading corresponding with the unfactored moment values.
2. LL # - live load number corresponding with the unfactored live load moment values. For dead loads and pedestrian live load, "N/A" is presented in this column.
3. Unfactored Moment, Positive Moment - unfactored positive moment entered by the user for the specified loading. If only negative moments were entered by the user, "N/A" is presented in this column.
4. Unfactored Moment, Negative Moment - unfactored negative moment entered by the user for the specified loading. If only positive moments were entered by the user, "N/A" is presented in this column.

### 7.6.4 Summary of Factored Moments at Centerline of Splice

This table presents a summary of the factored moments at the centerline of splice, which are computed based on the unfactored moments and the load factors. Output for each limit state is presented twice, once for positive direction and once for negative direction. The following information is presented in the SUMMARY OF FACTORED MOMENTS AT CENTERLINE OF SPLICE output table.

1. Limit State - limit state for the given factored moment values.
2. LL # - live load number for the given factored live load moment values.
3. Direction - moment direction (POS for positive and NEG for negative) of the given factored live load moment values.
4. DC1 - factored moment for non-composite dead load, corresponding with the specified limit state.
5. DC2 - factored moment for composite dead load, excluding future wearing surface, corresponding with the specified limit state.
6. FWS - factored moment for future wearing surface, corresponding with the specified limit state.
7. DC2\_P - factored moment for composite dead loads due to sidewalks
8. FWS\_P - factored moment for future wearing surface dead load removal under sidewalks.
9. Live Load - factored moment for live load and dynamic load allowance (impact), corresponding with the specified limit state, live load number, and moment direction.
10. Pedestrian Live Load - factored moment for pedestrian live load, corresponding with the specified limit state and moment direction.
11. Total - total factored moment corresponding with the specified limit state, live load number, and moment direction.

### 7.6.5 Summary of Unfactored Shears at Centerline of Splice

This table presents a summary of the unfactored shears entered by the user in the DDL, DLL, and DPL commands. The following information is presented in the SUMMARY OF UNFACTORED SHEARS AT CENTERLINE OF SPLICE output table.

## Chapter 7 Output Description

1. Loading - loading corresponding with the unfactored shear values.
2. LL # - live load number corresponding with the unfactored live load shear values. For dead loads and pedestrian live load, "N/A" is presented in this column.
3. Unfactored Shear, Positive Shear - unfactored positive shear entered by the user for the specified loading. If only negative shears were entered by the user, "N/A" is presented in this column.
4. Unfactored Shear, Negative Shear - unfactored negative shear entered by the user for the specified loading. If only positive shears were entered by the user, "N/A" is presented in this column.

### 7.6.6 Summary of Factored Shears at Centerline of Splice

This table presents a summary of the factored shears at the centerline of splice, which are computed based on the unfactored shears and the load factors. Output for each limit state is presented twice, once for positive direction and once for negative direction. The following information is presented in the SUMMARY OF FACTORED SHEARS AT CENTERLINE OF SPLICE output table.

1. Limit State - limit state for the given factored shear values.
2. LL # - live load number for the given factored live load shear values.
3. Direction - shear direction (POS for positive and NEG for negative) of the given factored live load shear values.
4. DC1 - factored shear for non-composite dead load, corresponding with the specified limit state.
5. DC2 - factored shear for composite dead load, excluding future wearing surface, corresponding with the specified limit state.
6. FWS - factored shear for future wearing surface, corresponding with the specified limit state.
7. DC2\_P - factored shear for composite dead loads due to sidewalks.
8. FWS\_P - factored shear for future wearing surface dead load removal under sidewalks.
9. Live Load - factored shear for live load and dynamic load allowance (impact), corresponding with the specified limit state, live load number, and shear direction.
10. Pedestrian Live Load - factored shear for pedestrian live load, corresponding with the specified limit state and shear direction.
11. Total - total factored shear corresponding with the specified limit state, live load number, and shear direction. For splices in simple span girders, the total shear for fatigue is based on live load shear only. For splices in multi span girders, the total shear includes dead load as well as live load shear in order to compute the fatigue design stresses.

### 7.6.7 Section Properties for Web Splice Plate Flexure - Left Side of Splice

This table presents the section moduli used to compute the flexural stresses for designing the web splice plates on the left side of the centerline splice. The following information is presented in the SECTION PROPERTIES FOR WEB SPLICE PLATE FLEXURE - LEFT SIDE OF SPLICE output table.

## Chapter 7 Output Description

1. Section Type - section type (GROSS) for the given section properties.
2. Moment Direction - moment direction (POS for positive and NEG for negative) used to determine the given section properties.
3. Location - location (TOP or BOT) on the web splice plates corresponding with the section properties.
4. Moment of Inertia, I - total moment of inertia of web splice plates.
5. Distance to Extreme Fiber, c - distance from web splice plate neutral axis to the extreme fiber of the web splice plates.
6. Section Modulus, S - section modulus to the extreme fiber of the web splice plates
7. Plate area, A - total cross-sectional area of the web splice plates

### 7.6.8 Web Splice Plates - Fatigue Stresses - Left Side of Splice

This table presents the fatigue stresses in the web splice plates on the left side of the centerline splice. The following information is presented in the WEB SPLICE PLATES - FATIGUE STRESSES - LEFT SIDE OF SPLICE output table.

1. Limit State - limit state for the given fatigue stresses.
2. LL # - live load number for the given fatigue stresses.
3. Moment Direction - moment direction (POS for positive and NEG for negative) of the given fatigue stresses.
4. Location - location (TOP or BOT) on the web splice plates corresponding with the fatigue stresses.
5. Design Moment, Muw - the design moment taken by the web splice plates
6. Force Resultant, Huw - the resultant force in the web splice plate induced by the design moment.
7. Eccentric Shear Moment - the moment taken by the web splice plate induced by the design shear force.
8. Design Stress - total stress at the extreme fiber of the web splice plates. For **all** splices, the design stress is based on live load stresses only.

### 7.6.9 Section Properties of Web Splice Bolts - Left Side of Splice

This table presents various section properties of the web splice bolt group used to design the web splice bolts on the left side of the centerline splice. The following information is presented in the SECTION PROPERTIES OF WEB SPLICE BOLTS - LEFT SIDE OF SPLICE output table.

1. Section Type - section type (GROSS) of the specified section properties.
2. Location - location (TOP or BOT) corresponding with the section properties.
3. Gage Line - gage line number, with gage line 1 being closest to the centerline splice.
4. Xdist - horizontal distance from the centroid of the bolt group to the specified bolt.
5. Ydist - vertical distance from the centroid of the bolt group to the specified bolt.
6. **Eccentricity, X - horizontal distance from centerline of splice to centroid of the web bolt group**

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7. **Eccentricity, Y - vertical distance from top of girder web to centroid of the web bolt group**
8. IXbolt - moment of inertia of the bolt group about the horizontal neutral axis of the bolt group.
9. IYbolt - moment of inertia of the bolt group about the vertical neutral axis of the bolt group.
10. Jbolt - polar moment of inertia of the bolt group.

### 7.6.10 Web Splice Bolts - Total Shear Forces - Left Side of Splice

This table presents the total shear forces in the web splice bolts on the left side of the centerline splice. Output is presented for strength limit states only. The following information is presented in the WEB SPLICE BOLTS - TOTAL SHEAR FORCES - LEFT SIDE OF SPLICE output table.

1. Limit State - limit state for the given shear forces.
2. LL # - live load number for the given shear forces.
3. Moment Direction - moment direction (POS for positive and NEG for negative) of the given shear forces.
4. Gage Line - gage line number, with gage line 1 being closest to the centerline splice.
5. Location - location (TOP or BOT) corresponding with the pitch line in which the shear forces are located.
6. Design Moment, Muw - the design moment taken by the web splice plates
7. Force Resultant, Huw - the resultant force in the web splice plate induced by the design moment.
8. Eccentric Shear Moment - the moment taken by the web splice plate induced by the design shear force.
9. Horizontal Force - total horizontal shear force in the bolt corresponding with the specified limit state, live load number, direction, gage line, and location.
10. Vertical Force - total vertical shear force in the bolt corresponding with the specified limit state, live load number, direction, gage line, and location.
11. Resultant Force - total resultant shear force in the bolt corresponding with the specified limit state, live load number, direction, gage line, and location.

### 7.6.11 Web Splice Bolts - Total Slip Forces - Left Side of Splice

This table presents the total slip forces in the web splice bolts on the left side of the centerline splice. Output is presented for service limit states only. The following information is presented in the WEB SPLICE BOLTS - TOTAL SLIP FORCES - LEFT SIDE OF SPLICE output table.

1. Limit State - limit state for the given slip forces.
2. LL # - live load number for the given slip forces.
3. Moment Direction - moment direction (POS for positive and NEG for negative) of the given slip forces.
4. Gage Line - gage line number, with gage line 1 being closest to the centerline splice.
5. Location - location (TOP or BOT) corresponding with the pitch line in which the slip forces are located.
6. Design Moment, Muw - the design moment taken by the web splice plates
7. Force Resultant, Huw - the resultant force in the web splice plate induced by the design moment.
8. Eccentric Shear Moment - the moment taken by the web splice plate induced by the design shear force.

## Chapter 7 Output Description

9. Horizontal Force - total horizontal slip force in the bolt corresponding with the specified limit state, live load number, direction, gage line, and location.
10. Vertical Force - total vertical slip force in the bolt corresponding with the specified limit state, live load number, direction, gage line, and location.
11. Resultant Force - total resultant slip force in the bolt corresponding with the specified limit state, live load number, direction, gage line, and location.

### 7.6.12 Web Splice Plates: Flexure (Left)

This table presents the flexural specification checks for the web splice plates on the left side of the centerline splice. Output is presented for strength limit states only. The following information is presented in the WEB SPLICE PLATES: FLEXURE (LEFT) output table.

1. Limit State - limit state for the given flexural specification checks.
2. LL # - live load number for the given flexural specification checks.
3. Moment Direction - moment direction (POS for positive and NEG for negative) of the given flexural specification checks.
4. Location - location (TOP or BOT) on the web splice plates of the given flexural specification checks.
5. Design Moment, Muw - the design moment taken by the web splice plates
6. Force Resultant, Huw - the resultant force in the web splice plate induced by the design moment.
7. Eccentric Shear Moment - the moment taken by the web splice plate induced by the design shear force.
8. Design Flexural Stress - total design flexural stress in the web splice plates corresponding with the specified limit state, live load number, direction, and location.
9. Factored Flexural Resistance - factored flexural resistance in the web splice plates.
10. \* If Code Failure - if the design flexural stress exceeds the factored flexural resistance, then an asterisk (\*) is presented in this column to designate a code failure. If the design flexural stress is less than or equal to the factored flexural resistance, then this column is left blank.

### 7.6.13 Web Splice Plates: Shear Strength

This table presents the shear strength specification checks for the web splice plates. This table applies to both the left and right side of the centerline splice. Output is presented for strength limit states only. The following information is presented in the WEB SPLICE PLATES: SHEAR STRENGTH output table.

1. Limit State - limit state for the given shear force specification checks.
2. LL # - live load number for the given shear force specification checks.
3. Moment Direction - moment direction (POS for positive and NEG for negative) of the given shear force specification checks.
4. Web Splice Area, Gross - gross cross sectional area of the web splice plate
5. Web Splice Area, Net - net cross sectional area of the web splice plate

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6. Design Shear Force - total design shear force in the web splice plates corresponding with the specified limit state, live load number, and direction.
7. Factored Resistance, Yielding - factored shear yielding resistance of the web splice plates.
8. Factored Resistance, Rupture - factored shear rupture resistance of the web splice plates.
9. \* If Code Failure - if the design force exceeds the factored resistance, then an asterisk (\*) is presented in this column to designate a code failure. If the design force is less than or equal to the factored resistance, then this column is left blank.

### 7.6.14 Web Splice Plates: Fatigue (Left)

This table presents the fatigue specification checks for the web splice plates on the left side of the centerline splice. The following information is presented in the WEB SPLICE PLATES: FATIGUE (LEFT) output table.

1. Limit State - limit state for the given specification checks.
2. LL # - live load number for the given fatigue specification checks.
3. Location - location (TOP or BOT) on the web splice plates of the given fatigue specification checks.
4. Live Load Stress Range - total live load fatigue stress range in the web splice plates corresponding with the specified live load number and location.
5. Nominal Fatigue Resistance - nominal fatigue resistance in the web splice plates.
6. \* If Code Failure - if the live load stress range exceeds the nominal factored resistance, then an asterisk (\*) is presented in this column to designate a code failure. If the live load stress range is less than or equal to the nominal factored resistance, then this column is left blank.

### 7.6.15 Web Splice Bolts: Bearing on Web Material (Left)

This table presents the bearing specification checks for the web splice bolts on the left side of the centerline splice. Output is presented for strength limit states only. The following information is presented in the WEB SPLICE BOLTS: BEARING ON WEB MATERIAL (LEFT) output table.

1. Limit State - limit state for the given bearing specification checks.
2. LL # - live load number for the given bearing specification checks.
3. Moment Direction - moment direction (POS for positive and NEG for negative) of the given bearing specification checks.
4. Gage Line - gage line number, with gage line 1 being closest to the centerline splice.
5. Location - location (TOP or BOT) corresponding with the pitch line in which the bearing forces are located.
6. Design Bolt Force Horizontal. – horizontal component of the total design bolt force in the web splice bolts corresponding with the specified limit state, live load number, direction, gage line, and location.
7. Design Bolt Force Vertical – vertical component of the total design bolt force in the web splice bolts corresponding with the specified limit state, live load number, direction, gage line, and location.

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8. Factored Web Bearing Resistance Horizontal - factored bolt resistance for bearing between the bolt and the girder web in the horizontal direction.
9. Factored Web Bearing Resistance Vertical - factored bolt resistance for bearing between the bolt and the girder web in the vertical direction.
10. \* If Code Failure - if the design bolt force exceeds either the factored web bolt resistance, then an asterisk (\*) is presented in this column to designate a code failure. If the design bolt force is less than or equal to the factored web bolt resistance, then this column is left blank.

Below the output table, the following information is also presented:

1. Minimum Clear Bolt Distance for Web is Bearing Distance - the minimum clear bolt distance for the girder web.
2. Warning: - the warning message informs that:
  - The bearing failure is the controlling failure criteria for the analysis.
  - Bearing failure has occurred for design.
  - The possibility of increasing the controlling bearing distance to overcome bearing failure.

The following warning message for the analysis informs that bearing has controlled the failure criteria and that there is an option of increasing the clear bearing distances to overcome the bearing failure.

WARNING:

Bearing criterion controlled the web splice bolt specification check based on a controlling clear distance of X.XXX in. for the (web edge) (pitch) (gage). (web edge) (pitch) (gage) distance could be increased up to 2\*diameter XX.X in. of the bolt to increase the bearing resistance (2010 AASHTO LRFD 6.13.2.9).

The following warning message for the analysis informs that bearing has controlled the failure criteria and that option of increasing the clear bearing distances to overcome the bearing failure is not applicable.

WARNING:

Bearing criterion controlled the web splice bolt specification check based on a controlling clear distance of X.XXX in. for the (web edge) (pitch) (gage). Bearing resistance cannot be increased by increasing the clear bolt distance (2010 AASHTO LRFD 6.13.2.9) for the given bolt configuration.

The following warning message for the design informs that bearing failure has occurred and that there is an option of increasing the clear bearing distances to overcome the bearing failure.

WARNING:

Bearing criterion for the web splice bolts resulted in an increase in the total number of bolts required in the pattern due to a limitation placed on the clear (web edge) (pitch) (gage) distance. (web edge) (pitch) (gage) distance could be

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increased up to  $2 \times \text{diameter}$  (xx.xx in) of the bolt to increase the bearing resistance (2010 AASHTO LRFD 6.13.2.9).

The following warning message for the design informs that bearing failure has occurred and the option of increasing the clear bearing distances to overcome the bearing failure is not applicable.

WARNING:

Bearing criterion for the web splice bolts resulted in an increase in the total number of bolts required in the pattern due to a limitation placed on the clear (web edge) (pitch) (gage) distance. Bearing resistance cannot be increased by increasing the clear bolt distance (2010 AASHTO LRFD 6.13.2.9) for the given bolt configuration.

### 7.6.16 Web Splice Bolts: Bearing on Splice Material (Left)

This table presents the bearing specification checks for the web splice bolts on the left side of the centerline splice. Output is presented for strength limit states only. The following information is presented in the WEB SPLICE BOLTS: BEARING ON SPLICE MATERIAL (LEFT) output table.

1. Limit State - limit state for the given bearing specification checks.
2. LL # - live load number for the given bearing specification checks.
3. Moment Moment - moment direction (POS for positive and NEG for negative) of the given bearing specification checks.
4. Gage Line - gage line number, with gage line 1 being closest to the centerline splice.
5. Location - location (TOP or BOT) corresponding with the pitch line in which the bearing forces are located.
6. Design Bolt Force Horizontal – horizontal component of the total design bolt force in the web splice bolts corresponding with the specified limit state, live load number, direction, gage line, and location.
7. Design Bolt Force Vertical – vertical component of the total design bolt force in the web splice bolts corresponding with the specified limit state, live load number, direction, gage line, and location.
8. Factored Splice Bearing Resistance Horizontal - factored bolt resistance for bearing between the bolt and the web splice plate in the horizontal direction.
9. Factored Splice Bearing Resistance Vertical - factored bolt resistance for bearing between the bolt and the web splice plate in the vertical direction.
10. \* If Code Failure - if the design bolt force exceeds the factored splice bolt resistance then an asterisk (\*) is presented in this column to designate a code failure. If the design bolt force is less than or equal to the factored splice bolt resistance, then this column is left blank.

Below the output table, the following information is also presented:

1. Minimum Clear Bolt Distance for Web Splice is Bearing Distance - the minimum clear bolt distance for the web splice plate.

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2. Warning: - the warning message informs that:
  - The bearing failure is the controlling failure criteria for the analysis.
  - Bearing failure has occurred for design.
  - The possibility of increasing controlling bearing distance to overcome bearing failure.

The following warning message for the analysis informs that bearing has controlled the failure criteria and that there is an option of increasing the clear bearing distances to overcome the bearing failure.

WARNING:

Bearing criterion controlled the web splice bolt specification check based on a controlling clear distance of X.XXX in. for the (web splice edge) (web splice end)(pitch)(gage). (web splice edge) (web splice end) (pitch) (gage) distance could be increased up to 2\*diameter xx.xx in of the bolt to increase the bearing resistance (2010 AASHTO LRFD 6.13.2.9).

The following warning message for the analysis informs that bearing has controlled the failure criteria and that option of increasing the clear bearing distances to overcome the bearing failure is not applicable.

WARNING:

Bearing criterion controlled the web splice bolt specification check based on a controlling clear distance of xx.xx in for the (web splice edge) (web splice end) (pitch) (gage). Bearing resistance cannot be increased by increasing the clear bolt distance (2010 AASHTO LRFD 6.13.2.9) for the given bolt configuration.

The following warning message for the design informs that bearing failure has occurred and that there is an option of increasing the clear bearing distances to overcome the bearing failure.

WARNING:

Bearing criterion for the web splice bolts resulted in an increase (of web splice plate thickness) (in the total number of bolts required in the pattern) due to a limitation placed on the clear (web splice edge) (web splice end) (pitch) (gage) distance. (web splice edge) (web splice end) (pitch) (gage) distance could be increased up to 2\*diameter (xx.xx in) of the bolt to increase the bearing resistance (2010 AASHTO LRFD 6.13.2.9).

The following warning message for the design informs that bearing failure has occurred and the option of increasing the clear bearing distances to overcome the bearing failure is not applicable.

WARNING:

Bearing criterion for the web splice bolts resulted in an increase (of web splice plate thickness) (in the total number of bolts required in the pattern) due to a limitation placed on the clear (web splice edge) (web splice end) (pitch) (gage) distance. Bearing resistance cannot be increased by increasing the clear bolt distance (2010 AASHTO LRFD 6.13.2.9) for the given bolt configuration.

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### 7.6.17 Web Splice Bolts: Shear Strength (Left)

This table presents the shear strength specification checks for the web splice bolts on the left side of the centerline splice. Output is presented for strength limit states only. The following information is presented in the WEB SPLICE BOLTS: SHEAR STRENGTH (LEFT) output table.

1. Limit State - limit state for the given shear strength specification checks.
2. LL # - live load number for the given shear strength specification checks.
3. Moment Direction - moment direction (POS for positive and NEG for negative) of the given shear strength specification checks.
4. Gage Line - gage line number, with gage line 1 being closest to the centerline splice.
5. Location - location (TOP or BOT) corresponding with the pitch line in which the shear strength forces are located.
6. Design Bolt Force - total design bolt force in the web splice bolts corresponding with the specified limit state, live load number, direction, gage line, and location.
7. Factored Bolt Resistance - factored bolt resistance for shear strength.
8. \* If Code Failure - if the design bolt force exceeds the factored bolt resistance, then an asterisk (\*) is presented in this column to designate a code failure. If the design bolt force is less than or equal to the factored bolt resistance, then this column is left blank.

### 7.6.18 Web Splice Bolts: Slip Resistance (Left)

This table presents the slip resistance specification checks for the web splice bolts on the left side of the centerline splice. Output is presented for service limit states only. The following information is presented in the WEB SPLICE BOLTS: SLIP RESISTANCE (LEFT) output table.

1. Limit State - limit state for the given slip resistance specification checks.
2. LL # - live load number for the given slip resistance specification checks.
3. Moment Direction - moment direction (POS for positive and NEG for negative) of the given slip resistance specification checks.
4. Gage Line - gage line number, with gage line 1 being closest to the centerline splice.
5. Location - location (TOP or BOT) corresponding with the pitch line in which the slip resistance forces are located.
6. Design Bolt Force - total design bolt force in the web splice bolts corresponding with the specified limit state, live load number, direction, gage line, and location.
7. Factored Bolt Resistance - factored bolt resistance for slip resistance.
8. \* If Code Failure - if the design bolt force exceeds the factored bolt resistance, then an asterisk (\*) is presented in this column to designate a code failure. If the design bolt force is less than or equal to the factored bolt resistance, then this column is left blank.

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### 7.6.19 Web Splice Bolt Spacing Checks (Left)

This table presents the spacing checks for the web splice bolts on the left side of the centerline splice. The following information is presented in the WEB SPLICE BOLT SPACING CHECKS (LEFT) output table.

1. Quantity - the following spacing checks are presented:
  - A. Least WSPL Pitch (versus WEB limits) - compares the least web splice plate pitch (as entered by the user) with the minimum and maximum allowable dimensions for the girder web (as computed by the program).
  - B. Greatest WSPL Pitch (versus WEB limits) - compares the greatest web splice plate pitch (as entered by the user) with the minimum and maximum allowable dimensions for the girder web (as computed by the program).
  - C. Least WSPL Gage (versus WEB limits) - compares the least web splice plate gage (as entered by the user) with the minimum and maximum allowable dimensions for the girder web (as computed by the program).
  - D. Greatest WSPL Gage (versus WEB limits) - compares the greatest web splice plate gage (as entered by the user) with the minimum and maximum allowable dimensions for the girder web (as computed by the program).
  - E. Least Web Pitch (versus WEB limits) - compares the least girder web pitch (as entered by the user) with the minimum and maximum allowable dimensions for the girder web (as computed by the program).
  - F. Greatest Web Pitch (versus WEB limits) - compares the greatest girder web pitch (as entered by the user) with the minimum and maximum allowable dimensions for the girder web (as computed by the program).
  - G. Least Web Gage (versus WEB limits) - compares the least girder web gage (as entered by the user) with the minimum and maximum allowable dimensions for the girder web (as computed by the program).
  - H. Greatest Web Gage (versus WEB limits) - compares the greatest girder web gage (as entered by the user) with the minimum and maximum allowable dimensions for the girder web (as computed by the program).
  - I. Least Web End Distance (versus WEB limits) - compares web end distance (as entered by the user) with the minimum and maximum allowable dimensions for the girder web (as computed by the program)
  - J. Least Web Edge Distance (versus WEB limits) – compares the least web edge distance (as entered by the user) with the minimum and maximum allowable dimensions for the girder (as computed by the program)
  - K. Greatest Web Edge Distance (versus WEB limits) - compares the greatest web edge distance (as entered by the user) with the minimum and maximum allowable dimensions for the girder web (as computed by the program).

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- L. Least WSPL Pitch (versus WSPL limits) - compares the least web splice plate pitch (as entered by the user) with the minimum and maximum allowable dimensions for the web splice plate (as computed by the program).
  - M. Greatest WSPL Pitch (versus WSPL limits) - compares the greatest web splice plate pitch (as entered by the user) with the minimum and maximum allowable dimensions for the web splice plate (as computed by the program).
  - N. Least WSPL Gage (versus WSPL limits) - compares the least web splice plate gage (as entered by the user) with the minimum and maximum allowable dimensions for the web splice plate (as computed by the program).
  - O. Greatest WSPL Gage (versus WSPL limits) - compares the greatest web splice plate gage (as entered by the user) with the minimum and maximum allowable dimensions for the web splice plate (as computed by the program).
  - P. Least WSPL End Distance (versus WSPL limits) - compares the least web splice plate end distance (as entered by the user) with the minimum and maximum allowable dimensions for the web splice plate (as computed by the program).
  - Q. Greatest WSPL End Distance (versus WSPL limits) - compares the greatest web splice plate end distance (as entered by the user) with the minimum and maximum allowable dimensions for the web splice plate (as computed by the program).
  - R. Least WSPL Edge (versus WSPL limits) - compares the least web splice plate edge distance (as entered by the user) with the minimum and maximum allowable dimensions for the web splice plate (as computed by the program).
  - S. Greatest WSPL Edge (versus WSPL limits) - compares the greatest web splice plate edge distance (as entered by the user) with the minimum and maximum allowable dimensions for the web splice plate (as computed by the program).
2. Actual Dimension - actual dimension, as entered by the user in the program input.
  3. Minimum Allowable Dimension - minimum allowable dimension, as computed by the program.
  4. Maximum Allowable Dimension - maximum allowable dimension, as computed by the program.
  5. \* If Code Failure - if the actual dimension is less than the minimum allowable dimension or is greater than the maximum allowable dimension, then an asterisk (\*) is presented in this column to designate a code failure. If the actual dimension is within the limits of the minimum and maximum allowable dimensions, then this column is left blank.

### 7.6.20 Section Properties for Web Splice Plate Flexure - Right Side of Splice

The same information as described in section 7.6.7 is printed on the SECTION PROPERTIES FOR WEB SPLICE PLATE FLEXURE - RIGHT SIDE OF SPLICE output table except that this table presents the section properties used to compute the flexural stresses for designing the web splice plates on the right side of the centerline splice.

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### 7.6.21 Web Splice Plates - Fatigue Stresses - Right Side of Splice

The same information as described in section 7.6.8 is printed on the WEB SPLICE PLATES - FATIGUE STRESSES - RIGHT SIDE OF SPLICE output table except that this table presents the fatigue stresses in the web splice plates on the right side of the centerline splice.

### 7.6.22 Section Properties of Web Splice Bolts - Right Side of Splice

The same information as described in section 7.6.9 is printed on the SECTION PROPERTIES OF WEB SPLICE BOLTS - RIGHT SIDE OF SPLICE output table except that this table presents various section properties of the web splice bolt group used to design the web splice bolts on the right side of the centerline splice.

### 7.6.23 Web Splice Bolts - Total Shear Forces - Right Side of Splice

The same information as described in section 7.6.10 is printed on the WEB SPLICE BOLTS - TOTAL SHEAR FORCES - RIGHT SIDE OF SPLICE output table except that this table presents the total shear forces in the web splice bolts on the right side of the centerline splice. Output is presented for strength limit states only.

### 7.6.24 Web Splice Bolts - Total Slip Forces - Right Side of Splice

The same information as described in section 7.6.11 is printed on the WEB SPLICE BOLTS - TOTAL SLIP FORCES - RIGHT SIDE OF SPLICE output table except that this table presents the total slip forces in the web splice bolts on the right side of the centerline splice. Output is presented for service limit states only.

### 7.6.25 Web Splice Plates: Flexure (Right)

The same information as described in section 7.6.12 is printed on the WEB SPLICE PLATES: FLEXURE (RIGHT) output table except that this table presents the flexural specification checks for the web splice plates on the right side of the centerline splice. Output is presented for strength limit states only.

### 7.6.26 Web Splice Plates: Fatigue (Right)

The same information as described in section 7.6.14 is printed on the WEB SPLICE PLATES: FATIGUE (RIGHT) output table except that this table presents the fatigue specification checks for the web splice plates on the right side of the centerline splice.

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### 7.6.27 Web Splice Bolts: Bearing on Web Material (Right)

The same information as described in section 7.6.15 is printed on the WEB SPLICE BOLTS: BEARING ON WEB MATERIAL (RIGHT) output table except that this table presents the bearing specification checks for the web splice bolts on the right side of the centerline splice. Output is presented for strength limit states only.

### 7.6.28 Web Splice Bolts: Bearing on Splice Material (Right)

The same information as described in section 7.6.16 is printed on the WEB SPLICE BOLT SPECIFICATION CHECKS - BEARING ON SPLICE MATERIAL (RIGHT) output table except that this table presents the bearing specification checks for the web splice bolts on the right side of the centerline splice. Output is presented for strength limit states only.

### 7.6.29 Web Splice Bolts: Shear Strength (Right)

The same information as described in section 7.6.17 is printed on the WEB SPLICE BOLTS: SHEAR STRENGTH (RIGHT) output table except that this table presents the shear strength specification checks for the web splice bolts on the right side of the centerline splice. Output is presented for strength limit states only.

### 7.6.30 Web Splice Bolts: Slip Resistance (Right)

The same information as described in section 7.6.18 is printed on the WEB SPLICE BOLTS: SLIP RESISTANCE (RIGHT) output table except that this table presents the slip resistance specification checks for the web splice bolts on the right side of the centerline splice. Output is presented for service limit states only.

### 7.6.31 Web Splice Bolt Spacing Checks (Right)

The same information as described in section 7.6.19 is printed on the WEB SPLICE BOLT SPACING CHECKS (RIGHT) output table except that this table presents the spacing checks for the web splice bolts on the right side of the centerline splice.

### 7.6.32 Top Girder Flange Plates: Moments and Section Moduli to Mid-Flange

This table presents the moments in the girder, as well as the girder section moduli at the center of the girder top flange. These values are used to compute the top flange splice axial forces required to design or analyze the top flange splice plates and bolts. This table is presented for either the left girder adjacent section or the right girder adjacent section, whichever is the **smaller** section, as defined in Section 3.5.7. The following

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information is presented in the TOP GIRDER FLANGE PLATES: MOMENTS AND SECTION MODULI TO MID-FLANGE output table.

1. Limit State - limit state for the given parameter values.
2. LL # - live load number for the given parameter values.
3. Moment Direction - moment direction (POS for positive and NEG for negative) of the given parameter values.
4. Parameter Listed - parameters for which values are presented in the DC1, DC2, FWS, Live Load, and Pedestrian Live Load columns. Parameters listed include the following:
  - A. M - moment in the specified girder.
  - B. SG - girder section modulus, based on gross section properties, at the center of the girder top flange.
5. DC1 - parameter value corresponding with non-composite dead load.
6. DC2 - parameter value corresponding with composite dead load, excluding future wearing surface.
7. FWS - parameter value corresponding with future wearing surface.
8. DC2\_P - parameter value corresponding with composite dead load due to sidewalks.
9. FWS\_P - parameter value corresponding with future wearing surface dead load due to removal of FWS under sidewalks.
10. Live Load - parameter value corresponding with live load and dynamic load allowance (impact).
11. Pedestrian Live Load - parameter value corresponding with pedestrian live load.

### 7.6.33 Top Girder Flange Plates: Lateral Stresses

**This table presents the lateral stresses in the girder top flange. These values are combined with the flexural stresses and are then used to compute the top flange splice axial forces required to design or analyze the top flange splice plates and bolts. This table is presented for either the left girder adjacent section or the right girder adjacent section, whichever is the smaller section, as defined in Section 3.5.7. The following information is presented in the TOP GIRDER FLANGE PLATES: LATERAL STRESSES output table.**

1. Limit State - limit state for the given axial stresses.
2. LL # - live load number for the given axial stresses.
3. Moment Direction - moment direction (POS for positive and NEG for negative) of the given lateral stresses.
4. Location - location of the lateral stresses. For this table, TOP is always presented to designate top flange.
5. DC1 – non-composite dead load lateral stress corresponding with the specified limit state.
6. DC2 - composite dead load (excluding future wearing surface) lateral stress corresponding with the specified limit state.

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7. **FWS - future wearing surface lateral stress corresponding with the specified limit state.**
8. **Live Load - live load and dynamic load allowance (impact) axial stress corresponding with the specified limit state, live load number, and moment direction.**
9. **Total Lateral Stress - the total lateral stress acting on the flange plates for this limit state, live load, and state of flexure.**

**If the user does not enter any lateral stresses with the DLA command, the name of the report will print with a note stating that no lateral stresses were entered on the DLA command so this report is not necessary.**

### 7.6.34 Top Girder Flange Plates: **Flexural** Stresses

This table presents the **flexural** stresses in the girder top flange. These values are used to compute the top flange splice axial forces required to design or analyze the top flange splice plates and bolts. This table is presented for either the left girder adjacent section or the right girder adjacent section, whichever is the **smaller** section, as defined in Section 3.5.7. The following information is presented in the TOP GIRDER FLANGE PLATES: AXIAL STRESSES output table.

1. Limit State - limit state for the given axial stresses.
2. LL # - live load number for the given axial stresses.
3. Moment Direction - moment direction (POS for positive and NEG for negative) of the given axial stresses.
4. Location - location of the axial stresses. For this table, TOP is always presented to designate top flange.
5. DC1 – non-composite dead load axial stress corresponding with the specified limit state.
6. DC2 - composite dead load (excluding future wearing surface) axial stress corresponding with the specified limit state.
7. FWS - future wearing surface axial stress corresponding with the specified limit state.
8. DC2\_P - composite dead load due to sidewalks axial stress with the specified limit state.
9. FWS\_P - future wearing surface dead load axial stress due to removal of FWS under sidewalks with the specified limit state.
10. Live Load - live load and dynamic load allowance (impact) axial stress corresponding with the specified limit state, live load number, and moment direction.
11. Pedestrian Live Load - pedestrian live load axial stress corresponding with the specified limit state and moment direction.
12. Total Flexural Stress - the total flexural stress acting on the flange plates for this limit state, live load, and state of flexure.

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### 7.6.35 Top Girder Flange Plates: Axial Forces

This table presents the axial forces in the top **girder** flange plates. These values are used to design or analyze the top flange splice plates and bolts. This table is presented based on either the left girder adjacent section or the right girder adjacent section, whichever is the **smaller** section, as defined in Section 3.5.7. The following information is presented in the TOP FLANGE SPLICE PLATES: AXIAL FORCES output table.

1. Limit State - limit state for the given axial forces.
2. LL # - live load number for the given axial forces.
3. Moment Direction - moment direction (POS for positive and NEG for negative) of the given axial forces.
4. Location - location of the axial forces. For this table, TOP is always presented to designate top flange splice plates.
5. Controlling Flange? - designates if the top flange is the controlling flange or not
6. **Rg - flange resistance modification factor**
7. Design Stress - the design stress for the top flange. For strength limit states, the design stress is either  $F_{cf}$  (if controlling flange) or  $F_{ncf}$  (if noncontrolling flange) as per LRFD Specifications Equation 6.13.6.1.4c-1 or -4. For service limit states, the design stress is  $F_s$  (AASHTO Equation 6.13.6.1.4c-6). For fatigue limit states, the design stress is the factored live load stress in the flange.
8. Area - for strength limit states, if the flange is in tension, the area is the effective flange area, calculated as per LRFD Specifications 6.13.6.1.4c-2. For strength limit states in compression, all service limit states and fatigue limit states, the area is the gross flange area.
9. **Flexural Force - total design force in the top flange splice plates due to major-axis bending, corresponding with the specified limit state, live load number, and moment direction.**
10. **Lateral Force - total design force in the top flange splice plates due to lateral bending, corresponding with the specified limit state, live load number, and moment direction.**
11. Total Force - total design force in the top flange splice plates corresponding with the specified limit state, live load number, and moment direction.

### 7.6.36 Top Flange Splice Bolts: Eccentricities

This table presents the eccentricities of the extreme bolts in each gage line of the flange bolts. The following information is presented in the TOP FLANGE SPLICE BOLTS: ECCENTRICITIES output table.

1. **Gage Line - gage line for the given eccentricities**
2. **X Distance - the longitudinal distance from the center of gravity of the bolt group to an extreme bolt of the gage line**
3. **Y Distance - the transverse distance from the center of gravity of the bolt group to an extreme bolt of the gage line**

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### 7.6.37 Top Flange Splice Bolts: Section Properties

This table presents the section properties of the flange splice bolt group. The following information is presented in the TOP FLANGE SPLICE BOLTS: SECTION PROPERTIES output table.

1. **Eccentricity, X** - the longitudinal distance from the centerline of splice to the center of gravity of the flange bolt group.
2. **Eccentricity, Y** - the transverse distance from the centerline of web to the center of gravity of the flange bolt group
3. **IX, Bolt** - the moment of inertia about a longitudinal axis through the center of gravity of the flange bolt group
4. **IY, Bolt** - the moment of inertia about a transverse axis through the center of gravity of the flange bolt group
5. **J, Bolt** - the polar moment of inertia of the flange bolt group.

### 7.6.38 Top Flange Splice Bolts: Shear Forces

This table presents the shear forces in the bolts of the top flange splice. Output is presented for strength limit states only. The following information is presented in the TOP FLANGE SPLICE BOLTS: SHEAR FORCES output table.

1. **Limit State** - limit state for the given shear forces.
2. **LL #** - live load number for the given shear forces.
3. **Moment Direction** - moment direction (POS for positive and NEG for negative) of the given shear forces.
4. **Total Flexural Force** - total shear force acting on all bolts corresponding with the specified limit state, live load number, and moment direction, **induced by major-axis bending**.
5. **Number of Bolts** - number of bolts in the flange splice
6. **Flexural Force Per Bolt** - Total **flexural** force divided by the number of bolts
7. **Lateral Moment** - the moment acting about the center of gravity of the flange bolt group induced by lateral forces.
8. **Gage Line** - the gage line for the given forces
9. **Bolt Number** - the location of the bolt in the given gage line
10. **Forces due to Lateral Moment, Longitudinal** - the longitudinal shear force in the given bolt, induced by the lateral moment.
11. **Forces due to Lateral Moment, Transverse** - the transverse shear force in the given bolt, induced by the lateral moment.
12. **Total Resultant Force** - the total resultant force in the given bolt, including flexural and lateral forces.

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### 7.6.39 Top Flange Splice Bolts: Slip Forces

This table presents the slip forces in the bolts of the top flange splice. Output is presented for service limit states only. The following information is presented in the TOP FLANGE SPLICE BOLTS: SLIP FORCES output table.

1. Limit State - limit state for the given slip forces.
2. LL # - live load number for the given slip forces.
3. Moment Direction - moment direction (POS for positive and NEG for negative) of the given slip forces.
4. Total **Flexural** Force - total slip force corresponding with the specified limit state, live load number, and moment direction, **induced by major-axis bending.**
5. Number of Bolts - number of bolts in the flange splice
6. **Flexural** Force Per Bolt - Total **flexural** force divided by the number of bolts
7. **Lateral Moment - the moment acting about the center of gravity of the flange bolt group induced by lateral forces.**
8. **Gage Line - the gage line for the given forces**
9. **Bolt Number - the location of the bolt in the given gage line**
10. **Forces due to Lateral Moment, Longitudinal - the longitudinal shear force in the given bolt, induced by the lateral moment.**
11. **Forces due to Lateral Moment, Transverse - the transverse shear force in the given bolt, induced by the lateral moment.**
12. **Total Resultant Force - the total resultant force in the given bolt, including flexural and lateral forces.**

### 7.6.40 Top Flange Splice Plates: Cross-sectional Areas

This table presents the gross area, net area, and area ratio for the outer and inner top flange splice plates. The following information is presented in the TOP FLANGE SPLICE PLATES: CROSS-SECTIONAL AREAS output table.

1. Location - the location (OUTER for outer splice plate and INNER for inner splice plates) of the specified areas.
2. Gross Area - gross area of the specified splice plate (without considering bolt holes). For inner splice plates, the gross area is the area of a single inner splice plate.
3. Net Area - net area of the specified splice plate. For inner splice plates, the net area is the area of a single inner splice plate.
4. Area Ratio - ratio of the specified (outer or inner) gross plate area to the total gross plate area. For inner splice plates, the area ratio is the ratio of a single inner splice plate to the total splice plate area.

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### 7.6.41 Top Flange Splice Plates: Net Section Fracture

This table presents the specification checks related to fracture applied to the top flange splice plate net section. This table is presented based on either the left girder adjacent section or the right girder adjacent section, whichever is the **smaller** section, as defined in Section 3.5.7. This table is presented once for OUTER PLATE and again for INNER PLATES, as applicable. The following information is presented in the TOP FLANGE SPLICE PLATES: NET SECTION FRACTURE output table.

1. Limit State - limit state for the given net section fracture specification checks.
2. LL # - live load number for the given net section fracture specification checks.
3. Moment Direction - moment direction (POS for positive and NEG for negative) of the given net section fracture specification checks.
4. Location - location of the axial stresses. For this table, TOP is always presented to designate top flange.
5. Area Ratio - ratio of the specified (outer or inner) gross plate area to the total gross plate area. For inner splice plates, the area ratio is the ratio of a single inner splice plate to the total splice area.
6. Design Force - total net section fracture design force in the top flange splice plate corresponding with the specified plate (outer or inner), limit state, live load number, moment direction, and location.
7. Factored Resistance - factored resistance corresponding with net section fracture.
8. \* If Code Failure - if the design force exceeds the factored resistance, then an asterisk (\*) is presented in this column to designate a code failure. If the design stress is less than or equal to the factored resistance, then this column is left blank.

### 7.6.42 Top Flange Splice Plates: Gross Section Tension Yield

This table presents the specification checks related to tension applied to the top flange splice plate gross section. This table is presented based on either the left girder adjacent section or the right girder adjacent section, whichever is the **smaller** section, as defined in Section 3.5.7. This table is presented once for OUTER PLATE and again for INNER PLATES, as applicable. The following information is presented in the TOP FLANGE SPLICE PLATES: GROSS SECTION TENSION YIELD output table.

1. Limit State - limit state for the given gross section tension yield specification checks.
2. LL # - live load number for the given gross section tension yield specification checks.
3. Moment Direction - moment direction (POS for positive and NEG for negative) of the given gross section tension yield specification checks.
4. Location - location of the specification checks. For this table, TOP is always presented to designate top flange.
5. Area Ratio - ratio of the specified (outer or inner) gross plate area to the total gross plate area. For inner splice plates, the area ratio is the ratio of a single inner splice plate to the total splice area..
6. Design Force - total gross section tension design force in the top flange splice plate corresponding with the specified plate (outer or inner), limit state, live load number, moment direction, and location.

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7. Factored Resistance - factored resistance corresponding with gross section tension yielding.
8. \* If Code Failure - if the design force exceeds the factored resistance, then an asterisk (\*) is presented in this column to designate a code failure. If the design stress is less than or equal to the factored resistance, then this column is left blank.

### 7.6.43 Top Flange Splice Plates: Gross Section Compression

This table presents the specification checks related to compression applied to the top flange splice plate gross section. This table is presented based on either the left girder adjacent section or the right girder adjacent section, whichever is the **smaller** section, as defined in Section 3.5.7. This table is presented once for OUTER PLATE and again for INNER PLATES, as applicable. The following information is presented in the TOP FLANGE SPLICE PLATES: GROSS SECTION COMPRESSION output table.

1. Limit State - limit state for the given gross section compression specification checks.
2. LL # - live load number for the given gross section compression specification checks.
3. Moment Direction - moment direction (POS for positive and NEG for negative) of the given gross section compression specification checks.
4. Location - location of the specification checks. For this table, TOP is always presented to designate top flange.
5. Area Ratio - ratio of the specified (outer or inner) gross plate area to the total gross plate area. For inner splice plates, the area ratio is the ratio of a single inner splice plate to the total splice area.
6. Design Force - total gross section compression design force in the top flange splice plate corresponding with the specified plate (outer or inner), limit state, live load number, moment direction, and location.
7. Factored Resistance - factored resistance corresponding with gross section compression.
8. \* If Code Failure - if the design force exceeds the factored resistance, then an asterisk (\*) is presented in this column to designate a code failure. If the design stress is less than or equal to the factored resistance, then this column is left blank.

### 7.6.44 Top Flange Splice Plates: Fatigue

This table presents the specification checks related to fatigue in the top flange splice plates. The following information is presented in the TOP FLANGE SPLICE PLATES: FATIGUE output table.

1. Limit State - limit state for the given fatigue specification checks.
2. LL # - live load number for the given fatigue specification checks.
3. Inner or Outer - location (INNER for inner plates and OUTER for outer plate) for which fatigue specification check information is presented.
4. Moment Direction - moment direction (POS for positive and NEG for negative) of the given fatigue specification checks.

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5. Live Load Stress Range - live load stress range in the top flange splice plate corresponding with the specified live load number, plate (outer or inner), and moment direction.
6. Nominal Fatigue Resistance - nominal fatigue resistance of the splice plate.
7. \* If Code Failure - if the live load stress range exceeds the nominal fatigue resistance, then an asterisk (\*) is presented in this column to designate a code failure. If the live load stress range is less than or equal to the nominal fatigue resistance, then this column is left blank.

### 7.6.45 Top Flange Splice Bolts: Bearing on Material

This table presents the specification checks related to bearing on material for the top flange splice bolts. Output is presented for strength limit states only. The following information is presented in the TOP FLANGE SPLICE BOLTS: BEARING ON MATERIAL output table.

1. Limit State – all applicable strength limit states for the specification check of bearing on material.
2. LL # - live load number for the given bearing on material specification checks.
3. Moment Direction - moment direction (POS for positive and NEG for negative) of the given bearing on material specification checks.
4. Bearing Against - material against which the bolts are bearing for the specified values. GIRDER FLANGE designates girder top flange, OUTER PLATE designates outer splice plate, and INNER PLATES designates inner splice plates.
5. Design Bolt Force - the design bolt force for bearing on material, in the top flange splice bolts corresponding with the specified limit state, live load number, moment direction, and bearing material.
6. Factored Bolt Resistance - factored bolt resistance corresponding with bearing on material.
7. \* If Code Failure - if the design bolt force exceeds the factored bolt resistance, then an asterisk (\*) is presented in this column to designate a code failure. If the design bolt force is less than or equal to the factored bolt resistance, then this column is left blank.

Below the output table, the following information is also presented:

1. Minimum Clear Bolt Distance (FLANGE) - the minimum clear bolt distance for the girder flange, used to compute the factored flange bolt resistance.
2. Minimum Clear Bolt Distance (SPL. PL.) - the minimum clear bolt distance for the flange splice plate, used to compute the factored splice bolt resistance.

### 7.6.46 Top Flange Splice Bolts: Shear Strength

This table presents the specification checks related to shear strength for the top flange splice bolts. Output is presented for strength limit states only. The following information is presented in the TOP FLANGE SPLICE BOLTS: SHEAR STRENGTH output table.

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1. Limit State – all applicable strength limit states for the specification check of shear strength.
2. LL # - live load number for the given shear strength specification checks.
3. Moment Direction - moment direction (POS for positive and NEG for negative) of the given shear strength specification checks.
4. Shear Plane - the shear plane being checked, either the plane between outer splice plate and flange or the plane between the inner splice plates and flange.
5. Design Bolt Force - the design bolt force for shear strength in the top flange splice bolts corresponding with the specified limit state, live load number, and moment direction.
6. Factored Bolt Resistance - factored bolt resistance corresponding with shear strength. When required the factored bolt resistance is reduced by the filler plate reduction factor and a footnote is displayed. Refer to Section 3.7.2 for further details.
7. \* If Code Failure - if the design bolt force exceeds the factored bolt resistance, then an asterisk (\*) is presented in this column to designate a code failure. If the design bolt force is less than or equal to the factored bolt resistance, then this column is left blank.

### 7.6.47 Top Flange Splice Bolts: Slip Resistance

This table presents the specification checks related to slip resistance for the top flange splice bolts. Output is presented for service limit states only. The following information is presented in the TOP FLANGE SPLICE BOLTS: SLIP RESISTANCE output table.

1. Limit State – all applicable service limit states for the specification check of slip resistance.
2. LL # - live load number for the given slip resistance specification checks.
3. Moment Direction - moment direction (POS for positive and NEG for negative) of the given slip resistance specification checks.
4. Design Bolt Force - the design bolt force for slip resistance in the top flange splice bolts corresponding with the specified limit state, live load number, and moment direction.
5. Factored Bolt Resistance - factored bolt resistance corresponding with slip resistance.
6. \* If Code Failure - if the design bolt force exceeds the factored bolt resistance, then an asterisk (\*) is presented in this column to designate a code failure. If the design bolt force is less than or equal to the factored bolt resistance, then this column is left blank

### 7.6.48 Top Flange Splice Bolt Spacing Checks (Left Flange) Checking Against Flange Plates

This table presents the spacing checks for the top flange splice bolts on the left side of the centerline splice. Spacing checks are based on the girder top flange limits. The following information is presented in the TOP FLANGE SPLICE BOLT SPACING CHECKS (LEFT FLANGE) CHECKING AGAINST FLANGE PLATES output table.

1. Quantity - the following spacing checks are presented:

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- A. Least FSPL Pitch (versus FLANGE limits) - compares the least flange splice plate pitch (as entered by the user) with the minimum and maximum allowable dimensions for the girder flange (as computed by the program).
- B. Greatest FSPL Pitch (versus FLANGE limits) - compares the greatest flange splice plate pitch (as entered by the user) with the minimum and maximum allowable dimensions for the girder flange (as computed by the program).
- C. Least FSPL Gage (versus FLANGE limits) - compares the least flange splice plate gage (as entered by the user) with the minimum and maximum allowable dimensions for the girder flange (as computed by the program).
- D. Greatest FSPL Gage (versus FLANGE limits) - compares the greatest flange splice plate gage (as entered by the user) with the minimum and maximum allowable dimensions for the girder flange (as computed by the program).
- E. Least Flange End (versus FLANGE limits) - compares the least flange end distance (as entered by the user) with the minimum and maximum allowable dimensions for the girder flange (as computed by the program).
- F. Greatest Flange End (versus FLANGE limits) - compares the greatest flange end distance (as entered by the user) with the minimum and maximum allowable dimensions for the girder flange (as computed by the program).
- G. Least Flange Edge (versus FLANGE limits) - compares the least flange edge distance (as entered by the user) with the minimum and maximum allowable dimensions for the girder flange (as computed by the program). Note: This check is only performed on the left or right side flange with the smallest width.

When the actual dimension of LEAST FSPL GAGE is less than the minimum allowable dimension then for a staggered bolt pattern the following message will be printed:

```
** : For Staggered pattern only.  
    Actual Gage = xxx.xxx  
    Hole Spacing along the diagonal = xxx.xxx  
    xxx.xxx should be compared with allowable dimensions
```

This message lets the user know that the bolt spacing for the minimum gage for staggered bolt patterns should be measured along the diagonal (hypotenuse) and be compared with the allowable dimension.

- 2. Actual Dimension - actual dimension, as entered by the user in the program input.
- 3. Minimum Allowable Dimension - minimum allowable dimension, as computed by the program.
- 4. Maximum Allowable Dimension - maximum allowable dimension, as computed by the program.
- 5. \* If Code Failure - if the actual dimension is less than the minimum allowable dimension or is greater than the maximum allowable dimension, then an asterisk (\*) is presented in this column to designate a code failure. If the actual dimension is within the limits of the minimum and maximum allowable dimensions, then this column is left blank.

## Chapter 7 Output Description

### 7.6.49 Top Flange Splice Bolt Spacing Checks (Right Flange) Checking Against Flange Plates

This table presents the spacing checks for the top flange splice bolts on the right side of the centerline splice. Spacing checks are based on the girder top flange limits. The following information is presented in the TOP FLANGE SPLICE BOLT SPACING CHECKS (RIGHT FLANGE) CHECKING AGAINST FLANGE PLATES output table.

1. Quantity - the following spacing checks are presented:
  - A. Least FSPL Pitch (versus FLANGE limits) - compares the least flange splice plate pitch (as entered by the user) with the minimum and maximum allowable dimensions for the girder flange (as computed by the program).
  - B. Greatest FSPL Pitch (versus FLANGE limits) - compares the greatest flange splice plate pitch (as entered by the user) with the minimum and maximum allowable dimensions for the girder flange (as computed by the program).
  - C. Least FSPL Gage (versus FLANGE limits) - compares the least flange splice plate gage (as entered by the user) with the minimum and maximum allowable dimensions for the girder flange (as computed by the program).
  - D. Greatest FSPL Gage (versus FLANGE limits) - compares the greatest flange splice plate gage (as entered by the user) with the minimum and maximum allowable dimensions for the girder flange (as computed by the program).
  - E. Least Flange End (versus FLANGE limits) - compares the least flange end distance (as entered by the user) with the minimum and maximum allowable dimensions for the girder flange (as computed by the program).
  - F. Greatest Flange End (versus FLANGE limits) - compares the greatest flange end distance (as entered by the user) with the minimum and maximum allowable dimensions for the girder flange (as computed by the program).
  - G. Least Flange Edge (versus FLANGE limits) - compares the least flange edge distance (as entered by the user) with the minimum and maximum allowable dimensions for the girder flange (as computed by the program). Note: This check is only performed on the left or right side flange with the smallest width.

When the actual dimension of LEAST FSPL GAGE is less than the minimum allowable dimension then for a staggered bolt pattern the following message will be printed:

```
** : For Staggered pattern only.  
    Actual Gage = xxx.xxx  
    Hole Spacing along the diagonal = xxx.xxx  
    xxx.xxx should be compared with allowable dimensions
```

This message lets the user know that the bolt spacing for the minimum gage for staggered bolt patterns should be measured along the diagonal (hypotenuse) and be compared with the allowable dimension.

## Chapter 7 Output Description

2. Actual Dimension - actual dimension, as entered by the user in the program input.
3. Minimum Allowable Dimension - minimum allowable dimension, as computed by the program.
4. Maximum Allowable Dimension - maximum allowable dimension, as computed by the program.
5. \* If Code Failure - if the actual dimension is less than the minimum allowable dimension or is greater than the maximum allowable dimension, then an asterisk (\*) is presented in this column to designate a code failure. If the actual dimension is within the limits of the minimum and maximum allowable dimensions, then this column is left blank.

### 7.6.50 Top Flange Splice Bolt Spacing Checks (Splice Plate) Checking Against Splice Plates

This table presents the spacing checks for the top flange splice bolts based on the splice plate limits. The following information is presented in the TOP FLANGE SPLICE BOLT SPACING CHECKS (SPLICE PLATE) CHECKING AGAINST SPLICE PLATES output table.

1. Quantity - the following spacing checks are presented:
  - A. Least FSPL Pitch (versus OUTPL limits) - compares the least flange splice plate pitch (as entered by the user) with the minimum and maximum allowable dimensions for the outer splice plate (as computed by the program).
  - B. Greatest FSPL Pitch (versus OUTPL limits) - compares the greatest flange splice plate pitch (as entered by the user) with the minimum and maximum allowable dimensions for the outer splice plate (as computed by the program).
  - C. Least FSPL Pitch (versus INPL limits) - compares the least flange splice plate pitch (as entered by the user) with the minimum and maximum allowable dimensions for the inner splice plates (as computed by the program).
  - D. Greatest FSPL Pitch (versus INPL limits) - compares the greatest flange splice plate pitch (as entered by the user) with the minimum and maximum allowable dimensions for the inner splice plates (as computed by the program).
  - E. Least FSPL Gage (versus OUTPL limits) - compares the least flange splice plate gage (as entered by the user) with the minimum and maximum allowable dimensions for the outer splice plate (as computed by the program).
  - F. Greatest FSPL Gage (versus OUTPL limits) - compares the greatest flange splice plate gage (as entered by the user) with the minimum and maximum allowable dimensions for the outer splice plate (as computed by the program).
  - G. FSPL Gage (versus INPL limits) - compares the least flange splice plate gage (as entered by the user) with the minimum and maximum allowable dimensions for the inner splice plates (as computed by the program).
  - H. Least FSPL End Distance (versus OUTPL limits) - compares the least flange end distance (as entered by the user) with the minimum and maximum allowable dimensions for the outer splice plate (as computed by the program).

## Chapter 7 Output Description

- I. Greatest FSPL End Distance (versus OUTPL limits) - compares the greatest flange end distance (as entered by the user) with the minimum and maximum allowable dimensions for the outer splice plate (as computed by the program).
- J. Least FSPL End Distance (versus INPL limits) - compares the least flange end distance (as entered by the user) with the minimum and maximum allowable dimensions for the inner splice plates (as computed by the program).
- K. Greatest FSPL End Distance (versus INPL limits) - compares the greatest flange end distance (as entered by the user) with the minimum and maximum allowable dimensions for the inner splice plates (as computed by the program).
- L. Least OUTPL Edge (versus OUTPL limits) - compares the least outer splice plate edge distance (as entered by the user) with the minimum and maximum allowable dimensions for the outer splice plate (as computed by the program).
- M. Greatest OUTPL Edge (versus OUTPL limits) - compares the greatest outer splice plate edge distance (as entered by the user) with the minimum and maximum allowable dimensions for the outer splice plate (as computed by the program).
- N. Least INPL Edge Distance (versus INPL limits) - compares the least inner splice plate edge distance (as entered by the user) with the minimum and maximum allowable dimensions for the inner splice plates (as computed by the program).
- O. Greatest INPL Edge Distance (versus INPL limits) - compares the greatest inner splice plate edge distance (as entered by the user) with the minimum and maximum allowable dimensions for the inner splice plates (as computed by the program).

When the actual dimension of LEAST FSPL GAGE is less than the minimum allowable dimension then for a staggered bolt pattern the following message will be printed:

```
**: For Staggered pattern only.  
   Actual Gage = xxx.xxx  
   Hole Spacing along the diagonal = xxx.xxx  
   xxx.xxx should be compared with allowable dimensions
```

This message lets the user know that the bolt spacing for the minimum gage for staggered bolt patterns should be measured along the diagonal (hypotenuse) and be compared with the allowable dimension.

- 2. Actual Dimension - actual dimension, as entered by the user in the program input.
- 3. Minimum Allowable Dimension - minimum allowable dimension, as computed by the program.
- 4. Maximum Allowable Dimension - maximum allowable dimension, as computed by the program.
- 5. \* If Code Failure - if the actual dimension is less than the minimum allowable dimension or is greater than the maximum allowable dimension, then an asterisk (\*) is presented in this column to designate a code failure. If the actual dimension is within the limits of the minimum and maximum allowable dimensions, then this column is left blank.

## Chapter 7 Output Description

### 7.6.51 Bottom Girder Flange Plates: Moments and Section Moduli to Mid-Flange

The same information as described in section 7.6.32 is printed on the BOTTOM GIRDER FLANGE PLATES: MOMENTS AND SECTION MODULI TO MID-FLANGE output table except that this table presents the moments in the girder, as well as the girder section moduli at the center of the girder bottom flange.

### 7.6.52 Bottom Girder Flange Plates: Lateral Stresses

The same information as described in section 7.6.33 is printed on the BOTTOM GIRDER FLANGE PLATES: LATERAL STRESSES output table except that this table presents the lateral stresses in the girder bottom flange.

### 7.6.53 Bottom Girder Flange Plates: Flexural Stresses

The same information as described in section 7.6.34 is printed on the BOTTOM GIRDER FLANGE PLATES: FLEXURAL STRESSES output table except that this table presents the flexural stresses in the girder bottom flange.

### 7.6.54 Bottom Girder Flange Plates: Axial Forces

The same information as described in section 7.6.35 is printed on the BOTTOM GIRDER FLANGE PLATES: AXIAL FORCES output table except that this table presents the axial forces in the bottom girder flange plates.

### 7.6.55 Bottom Flange Splice Bolts: Eccentricities

The same information as described in section 7.6.36 is printed on the BOTTOM FLANGE SPLICE BOLTS: ECCENTRICITIES output table except that this table presents the eccentricities of bolts in the bottom girder splice.

### 7.6.56 Bottom Flange Splice Bolts: Section Properties

The same information as described in section 7.6.37 is printed on the BOTTOM FLANGE SPLICE BOLTS: SECTION PROPERTIES output table except that this table presents the section properties of bolts in the bottom girder splice.

## Chapter 7 Output Description

### 7.6.57 Bottom Flange Splice Bolts: Shear Forces

The same information as described in section 7.6.38 is printed on the BOTTOM FLANGE SPLICE BOLTS - SHEAR FORCES output table except that this table presents the shear forces in the bolts of the bottom flange splice. Output is presented for strength limit states only.

### 7.6.58 Bottom Flange Splice Bolts: Slip Forces

The same information as described in section 7.6.39 is printed on the BOTTOM FLANGE SPLICE BOLTS: SLIP FORCES output table except that this table presents the slip forces in the bolts of the bottom flange splice. Output is presented for service limit states only.

### 7.6.59 Bottom Flange Splice Plates: Cross-sectional Areas

The same information as described in section 7.6.40 is printed on the BOTTOM FLANGE SPLICE PLATES: CROSS-SECTIONAL AREAS output table except that this table presents the gross area, net area, and area ratio for the outer and inner bottom flange splice plates.

### 7.6.60 Bottom Flange Splice Plates: Net Section Fracture

The same information as described in section 7.6.41 is printed on the BOTTOM FLANGE SPLICE PLATES: NET SECTION FRACTURE output table except that this table presents the specification checks related to fracture applied to the bottom flange splice plate net section.

### 7.6.61 Bottom Flange Splice Plates: Gross Section Tension Yield

The same information as described in section 7.6.42 is printed on the BOTTOM FLANGE SPLICE PLATES: GROSS SECTION TENSION YIELD output table except that this table presents the specification checks related to tension applied to the bottom flange splice plate gross section.

### 7.6.62 Bottom Flange Splice Plates: Gross Section Compression

The same information as described in section 7.6.43 is printed on the BOTTOM FLANGE SPLICE PLATES: GROSS SECTION COMPRESSION output table except that this table presents the specification checks related to compression applied to the bottom flange splice plate gross section.

### 7.6.63 Bottom Flange Splice Plates: Fatigue

The same information as described in section 7.6.44 is printed on the BOTTOM FLANGE SPLICE PLATES: FATIGUE output table except that this table presents the specification checks related to fatigue in the bottom flange splice plates.

## Chapter 7 Output Description

### 7.6.64 Bottom Flange Splice Bolts: Bearing on Material

The same information as described in section 7.6.45 is printed on the BOTTOM FLANGE SPLICE BOLTS: BEARING ON MATERIAL output table except that this table presents the specification checks related to bearing on material for the bottom flange splice bolts. Output is presented for strength limit states only.

### 7.6.65 Bottom Flange Splice Bolts: Shear Strength

The same information as described in section 7.6.46 is printed on the BOTTOM FLANGE SPLICE BOLTS: SHEAR STRENGTH output table except that this table presents the specification checks related to shear strength for the bottom flange splice bolts. Output is presented for strength limit states only.

### 7.6.66 Bottom Flange Splice Bolts: Slip Resistance

The same information as described in section 7.6.47 is printed on the BOTTOM FLANGE SPLICE BOLTS: SLIP RESISTANCE output table except that this table presents the specification checks related to slip resistance for the bottom flange splice bolts. Output is presented for service limit states only.

### 7.6.67 Bottom Flange Splice Bolt Spacing Checks (Left Flange) Checking Against Flange Plates

The same information as described in section 7.6.48 is printed on the BOTTOM FLANGE SPLICE BOLT SPACING CHECKS (LEFT FLANGE) CHECKING AGAINST FLANGE PLATES output table except that this table presents the spacing checks for the bottom flange splice bolts on the left side of the centerline splice. Spacing checks are based on the girder bottom flange limits.

### 7.6.68 Bottom Flange Splice Bolt Spacing Checks (Right Flange) Checking Against Flange Plates

The same information as described in section 7.6.49 is printed on the BOTTOM FLANGE SPLICE BOLT SPACING CHECKS (RIGHT FLANGE) CHECKING AGAINST FLANGE PLATES output table except that this table presents the spacing checks for the bottom flange splice bolts on the right side of the centerline splice. Spacing checks are based on the girder bottom flange limits.

### 7.6.69 Bottom Flange Splice Bolt Spacing Checks (Splice Plate) Checking Against Splice Plates

The same information as described in section 7.6.50 is printed on the BOTTOM FLANGE SPLICE BOLT SPACING CHECKS (SPLICE PLATE) CHECKING AGAINST SPLICE PLATES output table except that this table presents the spacing checks for the bottom flange splice bolts based on the splice plate limits.

## Chapter 7 Output Description

### 7.6.70 Block Shear Check

This table presents the various calculations used to determine if block shear fails. For detailed information about the program's checks for block shear, refer to Section 3.5.11 of this manual. The following information is presented in the BLOCK SHEAR CHECK output table.

#### Flanges

1. Ngl – Number of gage lines on one side of the centerline of the splice.
2. Npl – Number of pitches lines on one side of the centerline of the splice.
3. BLTPL – Number of bolts along a gage line on one side of the centerline of the splice.
4. Gage – Distance between the gage lines.
5. Pitch – Distance between the pitch lines.
6. Bolt Hole Diameter – Diameter of the bolt hole.
7. Locn – Name of component being checked for block shear.
8. Block Shear Path – Describes block shear failure path being investigated (L-L, U-U, or L), also the condition (1 or 2) and tension path (S or Z) information is shown for Staggered bolts.
9. Num Bolt Holes Shear – Number of bolt holes within the shear failure plane.
10. Num Bolt Holes Tension – Number of bolt holes within the tension failure plane.
11. Calc. End Distance – Distance from the end of the component to the first bolt hole based on equations in section 3.5.11 of the User's Manual.
12. Edge Dist – Distance from the edge of the component to first bolt hole.
13. T – thickness of the component.
14. Shear Path Gross Area – Area of the gross shear failure plane.
15. Shear Path Net Area – Area of the net shear failure plane.
16. Tens Path Net Area – Area of the net tension failure plane.
17.  $R_r(A_{vn})$  – Block shear resistance based on the net shear area.
18.  $R_r(A_{vg})$  – Block shear resistance based on the gross shear area.
19. Location – Name of component being checked for block shear.
20. Limit State - limit state for the given factored design force values.
21. LL # - live load number for the given factored design force values.
22. Mom Dir - moment direction (POS for positive and NEG for negative) of the given design forces.
23. Controlling Shear Path – Controlling path of block shear failure.
24. Controlling Factored  $R_r$  – Controlling factored block shear resistance.
25. Design Force – Design force taken by the current component.

#### Web

1. Ngl – Number of gage lines on one side of the centerline of the splice.
2. Npl – Number of pitches lines on one side of the centerline of the splice.

## Chapter 7 Output Description

3. BLTPL – Number of bolts along a gage line on one side of the centerline of the splice.
4. Gage – Distance between the gage lines.
5. Pitch – Distance between the pitch lines.
6. Bolt Hole Diameter – Diameter of the bolt hole.
7. Locn – Name of component being checked for block shear.
8. Block Shear Path – Describes block shear failure path being investigated.
9. Num Bolt Holes Shear – Number of bolt holes within the shear failure plane.
10. Num Bolt Holes Tension – Number of bolt holes within the tension failure plane.
11. End Distance – Distance from the end of the component to the first bolt hole.
12. Edge Dist – Distance from the edge of the component to first bolt hole.
13. T – thickness of the component.
14. Shear Path Gross Area – Area of the gross shear failure plane.
15. Shear Path Net Area – Area of the net shear failure plane .
16. Tens Path Net Area – Area of the net tension failure plane.
17.  $R_r(A_{vn})$  – Block shear resistance based on the net shear area.
18.  $R_r(A_{vg})$  – Block shear resistance based on the gross shear area.
19. Location – Name of component being checked for block shear.
20. Limit State - limit state for the given factored design force values.
21. LL # - live load number for the given factored design force values.
22. Dir - moment direction (POS for positive and NEG for negative) of the given design forces.
23. Controlling Shear Path – Controlling path of block shear failure.
24. Controlling Factored  $R_r$  – Controlling factored block shear resistance.
25. Design Force – Design force taken by the current component.

## Chapter 7 Output Description

### 7.7 FORMATTED OUTPUT TABLES

The following pages contain the format (i.e. the title, output parameters, units, field width, and decimal locations) for each output table described in this chapter, in the order listed in this chapter. On each table, the character "a" represents a character value for that column, and the number of "a" characters shows the number of characters possible there. The character "i" represents an integer value for that column, and the character "x" represents a real value for that column, with the decimal location indicated. The output available for every run of the program may not include all of the output tables shown. Depending on such items as the live loadings, type of run, specifications checked, and output commands and parameters chosen, the program will print different combinations of these output reports.

Example of Input File Echo:

```
                                design.dat
                                -----
TTL LRFD Steel Girder Splice Example # 1
TTL A design of plate girder splice.
! Date: Nov. 10, 1997
CFG ,
CTL US,C,D,D,Y,P,D,D,Y,P,D,D,Y,P,3,3,N,N,F,N,Y
SID=SPLRFD,10,40,100,200,300
DDL -500.4, -16.7, -21.7, -105.58, -11.88, -15.41
DLL D, 1, 2197.8, -2290.1, 14.44, -108.3
DLL D, 2, 1000, -2000, 300, -400
DLL D, 3, 500, -400, 30, -20
DLL D, 4, 40, -30, 20, -10
DLL P, 1, 3436.5, -2584, 21.68, -170.91
DLL P, 2, 1000, -2000, 300, -400
DLL P, 3, 500, -400, 30, -20
DLL F, 1, 724.2, -522.0, 5.38, -37.53
DLL F, 2, 500, -400, 300, -200
DPL 200,-100,20,-10
!MAT ,58.0,120.0,,58.0,120.0,,58.0,120.0
MAT ,,,
GAS L,36,58,0.6875,84,50,65,18,1.875,50,65,18,1.25,16802.3,-12254.1,-
    510.44,s,s,s,R,37,59,0.6875,84,49,64,24,1.375,52,67,24,1.25,19427.3,-
    -14220.7,510.44,s,s,s
SLB 8.5,96,0.314,0.775,4.25, 8.0
WSB 1.0,1.125,1.5625,4,1.5625,1.5625,3, ,16,2.34,0.375,1
WBP 1, 3
WSP 76,,R
FSB T,1,1.125,1.5625,,1.5625,,2.0,1.5625,,1.5625,1.5625,3,,4,4,,B,0.875,-
    1.0,1.5625,,1.5625,,2.0,1.5625,,1.5625,1.5625,3,,4,4,,
FSP T,18,,7.25,,R,B,18,,7.25,,R
DRI 1,1,1
MIS A,0.99, , , ,1.2,51,51,39
OIN 1,1,1
OSP 1,1
OCN 1,1
OAN 1,1,1,1,1,1,1,1,1,1
OSC 1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
```

## Chapter 7 Output Description

Example of Input Commands:

### INPUT COMMANDS

```
-----  
COMMAND:  CFG  
  NUMBER OF LINES PER PAGE          83          (default)  
  NO. OF TOP BLANK LINES            0          (default)  
  
COMMAND:  CTL  
  SYSTEM OF UNITS                    US  
  COMPOSITE/NONCOMPOSITE             C  
  DES./ANAL. WEB SPL. PLATE          D  
  DES./ANAL. WEB SPL. BOLTS          D  
  THREAD OF WEB BOLT IN SHR          Y  
  INCR. PLATE/BOLT WEB SPL.          P  
  DES./ANAL. TOP FSPL. PL.           D  
  DES./ANAL. TOP FSPL. BOLT          D  
  THREAD OF TOP FSPL. BOLT           Y  
  INCR. PL./BOLT TOP FSPL.           P  
  DES./ANAL. BOT FSPL. PL.           D  
  DES./ANAL. BOT FSPL. BOLT          D  
  THREAD OF BOT FSPL. BOLT           Y  
  INCR. PL./BOLT BOT FSPL.           P  
  TOP FSPL. CONFIGURATION            3  
  BOT FSPL. CONFIGURATION            3  
  STAG./NON-STAG. TOP FLNG.          N  
  STAG./NON-STAG. BOT FLNG.          N  
  BOLT CONNECTION TYPE                F  
  CHECK PLATE FATIGUE                 N  
  PEDESTRIAN LOADING                 Y  
  
COMMAND:  SID  
  PROGRAM IDENTIFICATION              =SPLRFD  
  COUNTY                              10  
  STATE ROUTE                          40  
  SEGMENT                              100  
  OFFSET                               200  
  SPAN IDENTIFICATION                 300  
  
COMMAND:  DDL  
  DC1 MOMENT                          -500.4 kip*ft  
  DC2 MOMENT                          -16.7 kip*ft  
  FWS MOMENT                          -21.7 kip*ft  
  DC1 SHEAR                           -105.58 kip  
  DC2 SHEAR                           -11.88 kip  
  FWS SHEAR                           -15.41 kip  
  
COMMAND:  DLL  
  TYPE OF LIVE LOAD                    D  
  LIVE LOAD NUMBER                     1  
  POSITIVE MOMENT                      2197.8 kip*ft  
  NEGATIVE MOMENT                     -2290.1 kip*ft  
  POSITIVE SHEAR                       14.44 kip  
  NEGATIVE SHEAR                      -108.3 kip
```

## Chapter 7 Output Description

Formatted Output Tables:

CONTROL PARAMETERS							
-----							
Units	Composite/ Noncomposite	Design/Analysis for Web Splice Plates	Analysis Bolts	Threads of Web Bolts in Shear Plane	Threads of Web Bolts in Shear Plane	Increase Plate or Bolts for Web Splice	Increase Plate or Bolts for Web Splice
aa	a	a	a	a	a	a	a
	Design/Analysis for Top Flange Splice Plates	Bolts	Threads of Top Flange Bolts in Shear Plane	Threads of Top Flange Bolts in Shear Plane	Increase Plate or Bolts for Top Flange Splice	Increase Plate or Bolts for Top Flange Splice	
	a	a	a	a	a	a	
	Design/Analysis for Bottom Flange Splice Plates	Bolts	Threads of Bot. Flange Bolts in Shear Plane	Threads of Bot. Flange Bolts in Shear Plane	Increase Plate or Bolts for Bot. Flange Splice	Increase Plate or Bolts for Bot. Flange Splice	
	a	a	a	a	a	a	
	Splice Configuration		Staggered/Nonstaggered				
	Top Flange	Bottom Flange	Top Flange	Bottom Flange			
	i	i	a	a			
	Bolt Connection Type		Check Plate Fatigue	Pedestrian Live Load			
	a		a	a			
DESIGN DEAD LOAD							
-----							
	DC1 Moment (k-ft)	DC2 Moment (k-ft)	FWS Moment (k-ft)	DC1 Shear (kips)	DC2 Shear (kips)	FWS Shear (kips)	
	xxxxxx.xx	xxxxxx.xx	xxxxxx.xx	xxxxxx.xx	xxxxxx.xx	xxxxxx.xx	
DESIGN LIVE LOAD							
-----							
	Live Load Type	Live Load Number	Positive Moment (k-ft)	Negative Moment (k-ft)	Positive Shear (kips)	Negative Shear (kips)	
	a	i	xxxxxx.xx	xxxxxx.xx	xxxxxx.xx	xxxxxx.xx	
DESIGN PEDESTRIAN LOAD							
-----							
	Positive Moment (k-ft)	Negative Moment (k-ft)	Positive Shear (kips)	Negative Shear (kips)	Sidewalk Moment (k-ft)	Sidewalk Shear (kips)	Add FWS Moment (k-ft)
	xxxx.xx	xxx.xx	xxx.xx	xxx.xx	xxx.xx	xxx.xx	Add FWS Shear (kips) xxx.xx

## Chapter 7 Output Description

### MATERIAL PROPERTIES (SET 1)

```

-----
Web          Web          Web
Spl. Pl.    Spl. Pl.    Spl. Bolt
Yield       Tensile       Tensile
Strength    Strength    Strength
(ksi)       (ksi)        (ksi)
xxxxxxx.xx xxxxxxxx.xx xxxxxxxx.xx

```

### MATERIAL PROPERTIES (SET 2)

```

-----
Top Fl.     Top Fl.     Top Fl.     Bot. Fl.    Bot. Fl.    Bot. Fl.
Spl. Pl.    Spl. Pl.    Spl. Bolt   Spl. Pl.    Spl. Pl.    Spl. Bolt
Yield       Tensile     Tensile     Yield       Tensile     Tensile
Strength    Strength    Strength    Strength    Strength    Strength
(ksi)       (ksi)       (ksi)       (ksi)       (ksi)       (ksi)
xxxxxxx.xx xxxxxxxx.xx xxxxxxxx.xx xxxxxxxx.xx xxxxxxxx.xx xxxxxxxx.xx

```

### GIRDER ADJACENT SECTIONS (SET 1)

```

-----
Left/       Web          Web          Web          Web          Top Fl.     Top Fl.
Right      Yield       Tensile      Thick.       Depth        Yield       Tensile
Strength   Strength    Strength     Strength     Strength    Strength    Strength
(ksi)      (ksi)       (ksi)        (in)         (in)        (ksi)       (ksi)
a          xxxxxxxx.xx xxxxxxxx.xx xxx.xxxx  xxxx.xxx  xxxxx.xx  xxxxxxxx.xx

```

### GIRDER ADJACENT SECTIONS (SET 2)

```

-----
Left/       Top Fl.     Top Fl.     Bot. Fl.    Bot. Fl.
Right      Width       Thick.      Yield       Tensile     Bot. Fl.    Bot. Fl.
Strength   Width       Thick.      Strength    Strength    Width       Thick.
(ksi)      (in)        (in)        (ksi)       (ksi)       (in)        (in)
a          xxx.xxx  xx.xxxx  xxxxxxxx.xx xxxxxxxx.xx xxx.xxx  xx.xxxx

```

### GIRDER ADJACENT SECTIONS (SET 3)

```

-----
Left/       Positive    Negative
Right      Factored    Factored    Factored    Web          Top        Bottom
Flexural   Flexural    Flexural    Shear       Edge         Flange     Flange
Resist.    Resist.     Resistance   Type        Edge         Edge       Edge
(k-ft)     (k-ft)     (kips)      Type        Type        Type
a          N/A*       N/A*       xxxxxxxx.xx S           S           S

```

NOTE: Factored Flexural Resistance values have been replaced by the Factored Stress Resistance values on the ADJACENT SECTION RESISTANCE command.

### ADJACENT SECTION RESISTANCE

```

-----
Left/       Limit
Right      State Flex.      Hybrid      Factored Stress
Factor     Resistance, Fr
Rh         Top        Bottom
(ksi)     (ksi)
a          aaaa  aaa  x.xxx  xxx.x  xxx.x

```

## Chapter 7 Output Description

### DECK DATA

Effec. Slab Thick. (in)	Effec. Slab Width (in)	Haunch Depth (in)	Deck Reinf. Area (in <sup>2</sup> /ft)	Deck Reinf. CGS (in)	Modular Ratio
xx.xxx	xxx.xxx	x.xxxx	xx.xxxx	xx.xxx	xx.xx

### WEB SPLICE BOLT DATA (SET 1)

Diam. of Bolt (in)	Diam. of Bolt Hole (in)	Splice End Distance (in)	End Clear Distance (in)	Splice Edge Distance (in)	Web Edge Distance (in)
xx.xxx	xx.xxx	xx.xxxx	xx.xxxx	xx.xxxx	xx.xxxx

### WEB SPLICE BOLT DATA (SET 2)

Gage Distance (in)	Num. of Gage Lines	Minimum Bolts per Gage Line	Minimum Bolt Pitch (in)	Gap at Splice Center (in)	Edge or End Distance Increase (in)
xxx.xxx	ii	ii	xxx.xxx	xx.xxx	xx.xxx

### WEB BOLT PITCH DATA

Bolt Pitch Number	Bolt Pitch Distance (in)
ii	xxx.xxx

### WEB SPLICE PLATE DATA

Web Splice Depth (in)	Web Splice Thick. (in)	Web Splice Plate Edge Type
xxxx.xxx	xxx.xxx	a

### FLANGE SPLICE BOLT DATA (SET 1)

Top/Bottom	Diam. of Bolt (in)	Diam. of Bolt Hole (in)	Least Splice End Distance (in)	Greatest Splice End Distance (in)	Least Flange End Distance (in)	Greatest Flange End Distance (in)
a	x.xxx	x.xxx	x.xxxx	x.xxxx	x.xxxx	x.xxxx

### FLANGE SPLICE BOLT DATA (SET 2)

Top/Bottom	Outer Splice Edge Distance (in)	Inner Sp. Least Edge Distance (in)	Inner Sp. Greatest Edge Distance (in)	Left Flange Edge Distance (in)
a	xx.xxx	xx.xxxx	xx.xxxx	xx.xxxx

## Chapter 7 Output Description

### FLANGE SPLICE BOLT DATA (SET 3)

	Right Flange Edge	Maximum Bolt Pitch	Minimum Bolt Pitch	Bolt Gage
Top/ Bottom	Distance (in)	(in)	(in)	(in)
a	xx.xxxx	xxx.xxxx	xxx.xxxx	xxx.xxxx

### FLANGE SPLICE BOLT DATA (SET 4)

Top/ Bottom	Num. of Gage Lines	Total Num. Bolts	Maximum Bolt Distance (in)
a	ii	ii	xxx.xxx

### FLANGE SPLICE PLATE DATA

Top/ Bottom	Outer Plate Width (in)	Outer Plate Thickness (in)	Inner Plate Width (in)	Inner Plate Thickness (in)	Splice Plate Edge Type
a	xxx.xxx	xx.xxx	xxx.xxx	xx.xxx	a

### DUCTILITY, REDUNDANCY, IMPORTANCE FACTORS

Strength Ductil.	Strength Redund.	Strength Impor.
1.00	1.00	1.00

### MISCELLANEOUS DATA (SET 1)

Surface Type	Web Hole Size Factor	Nominal Fatigue Resistance				PA Traffic Factor		
		Web		Top Flange			Bottom Flange	
		(ksi)	LS	(ksi)	LS	(ksi)	LS	
a	x.xx	xx.xx	(aaaa)	xx.xx	(aaaa)	xx.xx	(aaaa)	x.xx

### MISCELLANEOUS DATA (SET 2)

Minimum Web Bolt Tension (kips)	Minimum Top Fl. Bolt Tension (kips)	Minimum Bot. Fl. Bolt Tension (kips)	T/Flg Hole Size Factor	B/Flg Hole Size Factor
xxxx.xx	xxxx.xx	xxxx.xx	x.xx	x.xx

### WEB SPLICE PLATE DIMENSIONS (FINAL)

[OR]

### WEB SPLICE PLATE DIMENSIONS (GIVEN)

Thickness of Each Plate (in)	(Longitudinal) (in)	(Vertical) (in)	Length WSPL CG to Top of Web (in)	Depth (in)
x.xxxx	xxx.xxx	xxx.xxx	xxx.xxx	xxx.xxx

## Chapter 7 Output Description

### WEB SPLICE BOLT CONFIGURATION (FINAL)

```

-----
Total ii Gage Lines Per Side of CL Splice @          xxx.xxxx in
Distance from CL Splice to First Gage Line:
Total ii Bolts Per Gage Line @
Distance from Top Row of Bolts to Top of Web:
Distance from Bottom Row of Bolts to Bottom of Web:
Top and Bottom Splice End Distance:
Design web edge distance:                            xx.xxx* in
Design web splice edge distance:
Design web splice end distance:
  
```

Note:

- \* Web edge distance was increased to xx.xxx in from the original xx.xxx in to overcome bearing failure.
- \* Web splice edge distance was increased to xx.xxx in from the original xx.xxx in to overcome bearing failure.
- \* Web splice end distance was increased to xx.xxx in from the original xx.xxx in to overcome bearing failure.

[OR]

### WEB SPLICE BOLT CONFIGURATION (GIVEN)

```

-----
Gage Lines                                     Pitch Lines
  Horiz. Distance                               Vert. Distance   Bolt
Gage Line   from                               from           Pitch
Number      Centerline Splice   Number   Top of Web      Spacing
            (in)                Number     (in)           (in)
  ii          xxx.xxxx           ii         xxx.xxxx       xxx.xxxx
            (in)                ii         xxx.xxxx       xxx.xxxx
  
```

```

Distance from Bottom Row of Bolts to Bottom of Web: xxx.xxxx in
Top Splice End Distance:
Bottom Splice End Distance:
  
```

## Chapter 7 Output Description

```

TOP  FLANGE SPLICE PLATE DIMENSIONS (FINAL)
      [OR]
TOP  FLANGE SPLICE PLATE DIMENSIONS (GIVEN)
-----
BOT. FLANGE SPLICE PLATE DIMENSIONS (FINAL)
      [OR]
BOT. FLANGE SPLICE PLATE DIMENSIONS (GIVEN)
-----
      Outer Plate                Inner Plates
Width      Thickness            Width      Thickness
(in)       (in)                (in)       (in)
xxx.xxx   x.xxxx              xxx.xxx   x.xxxx

      [OR]

              Inner Plates
Width      Thickness
(in)       (in)
xxx.xxx   x.xxxx

      [OR]

              Outer Plate
Width      Thickness
(in)       (in)
xxx.xxx   x.xxxx

TOP  FLANGE SPLICE BOLT CONFIGURATION (FINAL)
      [OR]
TOP  FLANGE SPLICE BOLT CONFIGURATION (GIVEN)
-----
BOT. FLANGE SPLICE BOLT CONFIGURATION (FINAL)
      [OR]
BOT. FLANGE SPLICE BOLT CONFIGURATION (GIVEN)
-----
Total Number of Bolts per side:   ii
Total Number of Gage Lines:      ii
Maximum Pitch of Bolts:          xxx.xxxx in
Minimum Pitch of Bolts:
Greatest Bolt Gage Distance:
Least Bolt Gage Distance:
      [OR]
      Bolt Gage Distance:
Greatest Flange End Dist.:
Least Flange End Dist.:
Left Flange Edge Dist.:
Right Flange Edge Dist.:
Greatest Spl. End Dist.:
Least Splice End Dist.:
Outer Splice Edge Dist.:
Inner Spl. Least Edge Dist.:
Inner Spl. Greatest Edge Dist.:

```

**Chapter 7 Output Description**

TRIAL ii: WEB SPLICE PLATE DESIGN

-----  
[OR]

TRIAL ii: WEB SPLICE PLATE DESIGN (FINAL)

-----  
[OR]

TRIAL ii: WEB SPLICE BOLT CONFIGURATION DESIGN

-----  
[OR]

TRIAL ii: WEB SPLICE BOLT CONFIGURATION DESIGN (FINAL)

-----  

Thickness			Length	Depth
of Each Plate	(Longitudinal)	(Vertical)	WSPL CG to	Top of Web
(in)	(in)	(in)		(in)
x.xxxx	xxx.xxx	xxx.xxx		xxx.xxx

Total ii Gage Lines Per Side of CL Splice @ xxx.xxxx in  
 Distance from CL Splice to First Gage Line:  
 Total ii Bolts Per Gage Line @  
 Distance from Top Row of Bolts to Top of Web:  
 Distance from Bottom Row of Bolts to Bottom of Web:  
 Design web edge distance: xx.xxx in  
 Design web splice edge distance:  
 Design web splice end distance:

Failure: Max. bolt shear force : xxxx.xx (kips) exceeds [OR is  
 less than]

[OR] Factored shear resist. : xxxx.xx (kips) (NG) [OR (OK)]

Success: Controlling Limit State: aaaaa  
 Left/Right of Splice CL: aaaaa  
 Live Load Number : ai  
 Moment Direction : aaa  
 Shear Direction : aaa  
 Bolt Loc. from WSPL CG : Horiz.= xxxx.xxx in, Vert.= xxxx.xxx in  
  
 Stress Location : aaa

Failure: Max. bolt bearing force : xxxx.xx (kips) exceeds  
 Girder(WSPL)bearing resist. : xxxx.xx (kips) (NG)  
 Controlling Brng dist. : xx.xxx in(Bearing Distance)  
 Controlling Limit State: aaaaa  
 Left/Right of Splice CL: aaaaa  
 Live Load Number : ai  
 Moment Direction : aaa  
 Shear Direction : aaa  
 Bolt Loc. from WSPL CG : Horiz.= xxxx.xxx in, Vert.= xxxx.xxx in  
 [OR]

**Chapter 7 Output Description**

```

TRIAL ii: TOP FLANGE SPLICE PLATE DESIGN
-----
[OR]
TRIAL ii: TOP FLANGE SPLICE PLATE DESIGN (FINAL)
-----
[OR]
TRIAL ii: TOP FLANGE SPLICE BOLT DESIGN
-----
[OR]
TRIAL ii: TOP FLANGE SPLICE BOLT DESIGN (FINAL)
-----
TRIAL ii: BOT FLANGE SPLICE PLATE DESIGN
-----
[OR]
TRIAL ii: BOT FLANGE SPLICE PLATE DESIGN (FINAL)
-----
[OR]
TRIAL ii: BOT FLANGE SPLICE BOLT DESIGN
-----
[OR]
TRIAL ii: BOT FLANGE SPLICE BOLT DESIGN (FINAL)
-----

```

Outer Plate		Inner Plates	
Width	Thickness	Width	Thickness
(in)	(in)	(in)	(in)
xxx.xxx	x.xxxx	xxx.xxx	x.xxxx

[OR]

Inner Plates	
Width	Thickness
(in)	(in)
xxx.xxx	x.xxxx

[OR]

Outer Plate	
Width	Thickness
(in)	(in)
xxx.xxx	x.xxxx

Total Number of Bolts per side: iii

```

Success: Maximum Plate Stress : xxxx.xx (ksi) is less than
[OR Failure:] [OR exceeds]
Factored Plate Resist. : xxxx.xx (ksi) (OK) [OR (NG)]
Controlling Limit State: aaaaa
Live Load Number : ai
Moment direction : aaa
Outer/Inner Plate : aaaaa aaaaa

```

## Chapter 7 Output Description

GIRDER GROSS SECTION PROPERTIES - LEFT SIDE OF SPLICE (HAUNCH= xxx.xx aa)

-----  
 GIRDER GROSS SECTION PROPERTIES - RIGHT SIDE OF SPLICE (HAUNCH= xxx.xx aa)

Flexure Direction	Load Component	Area (in <sup>2</sup> )	Bottom of Girder to Neutral Axis (in)	Moment of Inertia (in <sup>4</sup> )	Web Mom. of Inertia about Girder N.A. (in <sup>4</sup> )	Lateral Flange Section Modulus	
						Top (in <sup>3</sup> )	Bottom (in <sup>3</sup> )
aaa	aaaa	xxxxxx.xx	xxxxx.xx	xxxxxx.xxx	xxxxxx.xxx	xxx.x	xxx.x

Flexure Direction	Load Component	Area (in <sup>2</sup> )	Bottom of Girder to Neutral Axis (in)	Moment of Inertia (in <sup>4</sup> )	Web Mom. of Inertia about Girder N.A. (in <sup>4</sup> )	Lateral Flange Section Modulus	
						Top (in <sup>3</sup> )	Bottom (in <sup>3</sup> )
aaa	aaaa	xxxxxx.xx	xxxxx.xx	xxxxxx.xxx	xxxxxx.xxx		

**NOTE: The SMALLER section is the aaaa side. (based on the product of noncomposite moment of inertia and the minimum flange yield strength on the side of the splice under consideration)**

GIRDER GROSS PLATE AREAS - LEFT SIDE OF SPLICE

-----  
 GIRDER GROSS PLATE AREAS - RIGHT SIDE OF SPLICE

Top Flange (in <sup>2</sup> )	Web (in <sup>2</sup> )	Bottom Flange (in <sup>2</sup> )
xxxx.xxx	xxxx.xxx	xxxx.xxx

GIRDER NET SECTION PROPERTIES - LEFT SIDE OF SPLICE (HAUNCH= xxx.xx aa)

-----  
 GIRDER NET SECTION PROPERTIES - RIGHT SIDE OF SPLICE (HAUNCH= xxx.xx aa)

Flexure Direction	Load Component	Area (in <sup>2</sup> )	Bottom of Girder to Neutral Axis (in)	Moment of Inertia (in <sup>4</sup> )	Web Mom. of Inertia about Girder N.A. (in <sup>4</sup> )

GIRDER NET PLATE AREAS - LEFT SIDE OF SPLICE

-----  
 GIRDER NET PLATE AREAS - RIGHT SIDE OF SPLICE

Top Flange (in <sup>2</sup> )	Web (in <sup>2</sup> )	Bottom Flange (in <sup>2</sup> )
xxxx.xxx	xxxx.xxx	xxxx.xxx

LOAD FACTORS AND COMBINATIONS

-----  
 MAXIMUM LOAD FACTORS

[OR]

MINIMUM LOAD FACTORS

Limit State	DC1	DC2	DC2_P	FWS_P	FWS	LL	PL	Live Loading
aaaaaa	x.xx	x.xx	x.xx	x.xx	x.xx	x.xx	x.xx	aaaaaaaaaaaa

## Chapter 7 Output Description

### LOAD MODIFIER

Limit State	Importance Factor	Ductility Factor	Redundancy Factor	Load Modifier Calculated	Load Modifier Used
	Ni	Nd	Nr	Ni*Nd*Nr	
aaaaaa	x.xx	x.xx	x.xx	x.xxx	x.xxx

Value(s) of Ni\*Nd\*Nr outside allowable bounds.  
Resetting load modifier(s) to x.xxx.

As per PennDOT DM-4 Sections 1.3.2 through 1.3.5,  
ETA factors other than 1.0 are not permitted by PennDOT.

### RESISTANCE FACTORS

Plate Flexure	Plate Shear	Plate Axial Compression	Plate Axial Net Tension	Plate Axial Gross Yield	Bolt Bearing	Bolt Shear	Shear Rupture in Connection Element
x.xx	x.xx	x.xx	x.xx	x.xx	x.xx	x.xx	x.xx

### SUMMARY OF UNFACTORED MOMENTS AT CENTERLINE OF SPLICE

Loading	Unfactored Moment	
	LL #	Moment (k-ft)
DC1 Dead Load	N/A	xxxxx.xx
	[OR]	
DC1 Dead Load	N/A	N/A
DC2 Dead Load	N/A	xxxxx.xx
	[OR]	
DC2 Dead Load	N/A	N/A
DC2_P Dead Load	N/A	xxxxx.xx
	[OR]	
DC2_P Dead Load	N/A	N/A
FWS Dead Load	N/A	xxxxx.xx
	[OR]	
FWS Dead Load	N/A	N/A
FWS_P Dead Load	N/A	xxxxx.xx
	[OR]	
FWS_P Dead Load	N/A	N/A
Design Live Load	ai	xxxxx.xx
Permit Live Load	ai	xxxxx.xx
Fatigue Live Load	ai	xxxxx.xx
Pedestrian Live Load	N/A	xxxxx.xx

### SUMMARY OF FACTORED MOMENTS AT CENTERLINE OF SPLICE

Limit State	LL #	Dir.	Factored Moment (k-ft)					Total (k-ft)
			DC1	DC2	FWS	Live Load	Ped. Live Load	
aaaaa	aaa	aaaa	xxxxx.xx	xxxxx.xx	xxxxx.xx	xxxxx.xx	xxxxx.xx	xxxxx.xx
			[OR]					
aaaaa	aaa	aaaa	xxxxx.xx	xxxxx.xx	xxxxx.xx	xxxxx.xx	N/A	xxxxx.xx

## Chapter 7 Output Description

### SUMMARY OF UNFACTORED SHEARS AT CENTERLINE OF SPLICE

Loading	LL #	Unfactored Shear	
		Positive Shear (kips)	Negative Shear (kips)
DC1 Dead Load	N/A	xxxxx.xx	N/A
		[OR]	
DC1 Dead Load	N/A	N/A	xxxxx.xx
DC2 Dead Load	N/A	xxxxx.xx	N/A
		[OR]	
DC2 Dead Load	N/A	N/A	xxxxx.xx
DC2_P Dead Load	N/A	xxxxx.xx	N/A
		[OR]	
DC2_P Dead Load	N/A	N/A	xxxxx.xx
FWS Dead Load	N/A	xxxxx.xx	N/A
		[OR]	
FWS Dead Load	N/A	N/A	xxxxx.xx
FWS_P Dead Load	N/A	xxxxx.xx	N/A
		[OR]	
FWS_P Dead Load	N/A	N/A	xxxxx.xx
Design Live Load	ai	xxxxx.xx	xxxxx.xx
Permit Live Load	ai	xxxxx.xx	xxxxx.xx
Fatigue Live Load	ai	xxxxx.xx	xxxxx.xx
Pedestrian Live Load	N/A	xxxxx.xx	xxxxx.xx

### SUMMARY OF FACTORED SHEARS AT CENTERLINE OF SPLICE

Limit State	LL #	Dir.	DC1 (kips)	DC2 (kips)	FWS (kips)	DC2_P (kips)	FWS_P (kips)	Live Load (kips)	Ped. Live Load (kips)	Total (kips)
aaaa	ai	aaaa	xxxxx.xx	xxxxx.xx	xxxxx.xx	xxxxx.xx	xxxxx.xx	xxxxx.xx	xxxxx.xx	xxx.xx
					[OR]					
aaaa	ai	aaaa	xxxxx.xx	xxxxx.xx	xxxxx.xx	N/A	N/A	xxxxx.xx	N/A	xxx.xx

\*NOTE: For splices in simple span girders, the total shear for fatigue is based on live load shear only. For splices in multi span girders, the total shear includes dead load as well as live load shear.

### SECTION PROPERTIES FOR WEB SPLICE PLATE FLEXURE - LEFT SIDE OF SPLICE

Sect. Type	Mom. Dir.	Loca- tion	Moment of Inertia I (in <sup>4</sup> )	Distance to Extreme Fiber c (in)	Section Modulus S (in <sup>3</sup> )	Plate Area A (in <sup>2</sup> )
aaaaa	aaaa	aaaa	xxxxxxxx.x	xxxx.xxx	xxxxxxxx.x	xxxx.xxx

### WEB SPLICE PLATES - FATIGUE STRESSES - LEFT SIDE OF SPLICE

Limit State	LL #	Mom. Dir.	Loca- tion	Design Moment Muw (kip-ft)	Force Result Huw (kips)	Eccentric Shear Moment (kip-ft)	Design Stress* (ksi)
aaaa	aa	aaa	aaa	xxx.xx	xxx.xx	xxx.xx	xxx.xx

\*NOTE: For all splices, the design stress is based on live load stresses only.

## Chapter 7 Output Description

### SECTION PROPERTIES OF WEB SPLICE BOLTS - LEFT SIDE OF SPLICE

Section Type	Loca- tion	Gage Line	X Dist* (in)	Y Dist* (in)	Eccentricity (in)		IX Bolt* (in^2)	IY Bolt* (in^2)	J Bolt* (in^2)
aaaaa	aaa	ii	xxxx.xx	xxxx.xx	xx.xx	xx.xx	xxxxxxxx.x	xxxxxxxx.x	xxxxxxxx.x

**\*Legend of Section Properties:**

X Dist = Horizontal distance from CG of web bolt group to gage line  
 Y Dist = Vertical distance from CG of web bolt group to location (TOP or BOT)  
 Eccentricity, X = Horizontal distance from centerline of splice to CG of web bolt group  
 Eccentricity, Y = Vertical distance from top of girder web to CG of web bolt group  
 IX, Bolt = Moment of inertia of bolt group about horizontal axis through CG  
 IY, Bolt = Moment of inertia of bolt group about vertical axis through CG  
 J, Bolt = Polar moment of inertia of bolt group

### WEB SPLICE BOLTS - TOTAL SHEAR FORCES - LEFT SIDE OF SPLICE

### WEB SPLICE BOLTS - TOTAL SHEAR FORCES - RIGHT SIDE OF SPLICE

Limit State	LL #	Mom. Dir.	Gage Line	Loca- tion	Design Moment Muw (kip-ft)	Force Result Huw (kips)	Eccentric Shear Moment (kip-ft)	Horizontal Force (kips)	Vertical Force (kips)	Resultant Force (kips)
aaaa	aa	aaa	ii	aaa	xxxx.xx	xxxx.x	xxxx.xx	xxxx.xx	xxxx.xx	xxxx.xx

### WEB SPLICE BOLTS - TOTAL SLIP FORCES - LEFT SIDE OF SPLICE

### WEB SPLICE BOLTS - TOTAL SLIP FORCES - RIGHT SIDE OF SPLICE

Limit State	LL #	Mom. Dir.	Gage Line	Loca- tion	Design Moment Muw (kip-ft)	Force Result Huw (kips)	Eccentric Shear Moment (kip-ft)	Horizontal Force (kips)	Vertical Force (kips)	Resultant Force (kips)
aaaa	aa	aaa	ii	aaa	xxxx.xx	xxxx.x	xxxx.xx	xxx.xx	xxx.xx	xxx.xx

### WEB SPLICE PLATES: FLEXURE (LEFT)

### WEB SPLICE PLATES: FLEXURE (RIGHT)

Limit State	LL #	Mom. Dir.	Location	Design Moment Muw (kip-ft)	Force Result Huw (kips)	Eccentric Shear Moment (kip-ft)	Design Flexural Stress (ksi)	Factored Flexural Resistance (ksi)	* If Failure	Code
aaaaaaa	aa	aaaa	aaaa	xxxxx.xx	xxxxx.x	xxxxx.xx	xxx.xx	xxx.xx		a

### WEB SPLICE PLATES: SHEAR STRENGTH

Limit State	LL #	Mom. Dir.	Web Gross (in^2)	Splice Net (in^2)	Design Shear Force (kips)	Factored Yielding Resistance (kips)	Resistance Rupture (kips)	* If Failure	Code
aaaaa	aa	aaaa	xxxx.x	xxxx.x	xxxxx.xx	xxxxx.xx	xxxxx.xx		a

### WEB SPLICE PLATES: FATIGUE (LEFT)

### WEB SPLICE PLATES: FATIGUE (RIGHT)

Limit State	LL #	Location	Live Load Stress Range (ksi)	Nominal Fatigue Resistance (ksi)	* If Failure	Code
aaaa	ai	aaa	xxxxxx.xx	xxxxxx.xx		a

## Chapter 7 Output Description

WEB SPLICE BOLTS: BEARING ON WEB MATERIAL (LEFT)

-----  
 WEB SPLICE BOLTS: BEARING ON WEB MATERIAL (RIGHT)  
 -----

Limit State	LL #	Mom. Dir.	Gage Line	Location	Design Bolt Force		Factored Web Brg. Resistance		Code Failure
					Horiz. (kips)	Vert. (kips)	Horiz. (kips)	Vert. (kips)	
aaaaaaa	ai	aaaa	ii	aaaa	xxxx.xx	xxxx.xx	xxxx.xx	xxxx.xx	a

Min. Clear Bolt Dist. for web is bearing distance: xxx.xxx in

**WARNING:**

Bearing criterion controlled the web splice bolt specification check based on a controlling clear distance of X.XXX in. for the (web edge)(pitch) (gage). (web edge) (pitch) (gage) distance could be increased up to 2\*diameter XX.X in. of the bolt to increase the bearing resistance (2010 AASHTO LRFD 6.13.2.9).

**WARNING:**

Bearing criterion controlled the web splice bolt specification check based on a controlling clear distance of X.XXX in. for the (web edge)(pitch) (gage). Bearing resistance cannot be increased by increasing the clear bolt distance (2010 AASHTO LRFD 6.13.2.9) for the given bolt configuration.

**WARNING:**

Bearing criterion for the web splice bolts resulted in an increase (in the total number of bolts required in the pattern) due to a limitation placed on the clear (web edge) (pitch) (gage) distance. (web edge) (pitch) (gage) distance could be increased up to 2\*diameter x.xx in. of the bolt to increase the bearing resistance (2010 AASHTO LRFD 6.13.2.9).

**WARNING:**

Bearing criterion for the web splice bolts resulted in an increase (in the total number of bolts required in the pattern) due to a limitation placed on the clear (web edge) (pitch) (gage) distance. Bearing resistance cannot be increased by increasing the clear bolt distance (2010 AASHTO LRFD 6.13.2.9) for the given bolt configuration.

## Chapter 7 Output Description

WEB SPLICE BOLTS: BEARING ON SPLICE MATERIAL (LEFT)

-----  
 WEB SPLICE BOLTS: BEARING ON SPLICE MATERIAL (RIGHT)  
 -----

Limit State	LL #	Mom. Dir.	Gage Line	Location	Design Bolt Force		Factored Splice Brg. Resistance		* If Failure Code
					Horiz. (kips)	Vert. (kips)	Horiz. (kips)	Vert. (kips)	
aaaaaaa	ai	aaaa	ii	aaaa	xxxx.xx	xxxx.xx	xxxx.xx	xxxx.xx	a

Min. Clear Bolt Dist. for web splice is bearing distance: xxx.xxx in

**WARNING:**

Bearing criterion controlled the web splice bolt specification check based on a controlling clear distance of x.xxx in. for the (web splice edge) (web splice end)(pitch)(gage). (web splice edge) (web splice end) (pitch) (gage) distance could be increased up to 2\*diameter xx.x in. of the bolt to increase the bearing resistance (2010 AASHTO LRFD 6.13.2.9).

**WARNING:**

Bearing criterion controlled the web splice bolt specification check based on a controlling clear distance of x.xxx in. for the (web splice edge) (web splice end) (pitch) (gage). Bearing resistance cannot be increased by increasing the clear bolt distance (2010 AASHTO LRFD 6.13.2.9) for the given bolt configuration.

**WARNING:**

Bearing criterion for the web splice bolts resulted in an increase (of web splice plate thickness) (in the total number of bolts required in the pattern) due to a limitation placed on the clear (web splice edge) (web splice end) (pitch) (gage) distance. (web splice edge) (web splice end) (pitch) (gage) distance could be increased up to 2\*diameter x.xx in of the bolt to increase the bearing resistance (2010 AASHTO LRFD 6.13.2.9).

**WARNING:**

Bearing criterion for the web splice bolts resulted in an increase (of web splice plate thickness) (in the total number of bolts required in the pattern) due to a limitation placed on the clear (web splice edge) (web splice end) (pitch) (gage) distance. Bearing resistance cannot be increased by increasing the clear bolt distance (2010 AASHTO LRFD 6.13.2.9) for the given bolt configuration.

## Chapter 7 Output Description

WEB SPLICE BOLTS: SHEAR STRENGTH (LEFT)

-----  
 WEB SPLICE BOLTS: SLIP RESISTANCE (LEFT)

-----  
 WEB SPLICE BOLTS: SHEAR STRENGTH (RIGHT)

-----  
 WEB SPLICE BOLTS: SLIP RESISTANCE (RIGHT)

Limit State	LL #	Mom. Dir.	Gage Line	Location	Design Bolt Force (kips)	Factored Bolt Resistance (kips)	* If Code Failure
aaaaaaa	ai	aaaa	ii	aaaa	xxxx.xx	xxxx.xx	a

WEB SPLICE BOLT SPACING CHECKS (LEFT)

-----  
 WEB SPLICE BOLT SPACING CHECKS (RIGHT)

Quantity	Actual Dimen. (in)	Minimum Allow. Dimen. (in)	Maximum Allow. Dimen. (in)	*If Code Failure
LEAST WSPL PITCH (versus WEB limits)	xxxx.xxx	xxxx.xxx	xxxx.xxx	a
GREATEST WSPL PITCH (versus WEB limits)				
LEAST WSPL GAGE (versus WEB limits)				
GREATEST WSPL GAGE (versus WEB limits)				
LEAST WEB PITCH (versus WEB limits)				
GREATEST WEB PITCH (versus WEB limits)				
LEAST WEB GAGE (versus WEB limits)				
GREATEST WEB GAGE (versus WEB limits)				
LEAST WEB END DIS (versus WEB limits)				
LEAST WEB EDGE DIS (versus WEB limits)				
GREATEST WEB EDGE DIS (versus WEB limits)				
LEAST WSPL PITCH (versus WSPL limits)				
GREATEST WSPL PITCH (versus WSPL limits)				
LEAST WSPL GAGE (versus WSPL limits)				
GREATEST WSPL GAGE (versus WSPL limits)				
LEAST WSPL END DIS (versus WSPL limits)				
GREAT. WSPL END DIS (versus WSPL limits)				
LEAST WSPL EDGE (versus WSPL limits)				
GREATEST WSPL EDGE (versus WSPL limits)				

NOTE: WSPL stands for WEB SPLICE PLATE.

## Chapter 7 Output Description

TOP GIRDER FLANGE PLATES: MOMENTS & SECTION MODULI TO MID-FLANGE(LEFT)  
[OR]

TOP GIRDER FLANGE PLATES: MOMENTS & SECTION MODULI TO MID-FLANGE(RIGHT)

-----  
BOTTOM GIRDER FLANGE PLATES: MOMENTS & SECTION MODULI TO MID-FLANGE(LEFT)  
[OR]

BOTTOM GIRDER FLANGE PLATES: MOMENTS & SECTION MODULI TO MID-FLANGE(RIGHT)  
-----

Limit State	LL #	Mom. Dir.	Parameter Listed	DC1	DC2	FWS	DC2_P	FWS_P	Live Load	Ped. Live Load
aaaaa	ai	aaa	aaaaaaaaaaa	xxxx.xx	xxxx.xx	xxxx.xx	xxxx.xx	xxxx.xx	xxxx.xx	xxxx.xx

Parameter Listed:  
M(k-ft)  
SG(in^3)

Note: SG stands for Section Modulus of Gross Section.

**TOP GIRDER FLANGE PLATES: LATERAL STRESSES (aaaaa)**

-----  
**BOTTOM GIRDER FLANGE PLATES: LATERAL STRESSES (aaaaa)**  
-----

Limit State	LL #	Mom. Dir.	Location	DC1 (ksi)	DC2 (ksi)	FWS (ksi)	Live Load (ksi)	Total Lateral Stress (ksi)
aaaaa	aa	aaa	aaa	xxxx.xx	xxxx.xx	xxxx.xx	xxxx.xx	xxxx.xx

TOP GIRDER FLANGE PLATES: **FLEXURAL STRESSES (aaaaa)**

-----  
BOTTOM GIRDER FLANGE PLATES: **FLEXURAL STRESSES (aaaaa)**  
-----

Limit State	LL #	Mom. Dir.	Location	DC1 (ksi)	DC2 (ksi)	FWS (ksi)	DC2_P (ksi)	FWS_P (ksi)	Live Load (ksi)	Ped. Live Load (ksi)	Total Flexural Stress (ksi)
aaaaa	aa	aaa	aaa	xxxx.xx	xxxx.xx	xxxx.xx	xxxx.xx	xxxx.xx	xxxx.xx	xxxx.xx	xxxx.xx

## Chapter 7 Output Description

TOP GIRDER FLANGE PLATES: AXIAL FORCES (aaaaa)

-----  
 BOTTOM GIRDER FLANGE PLATES: AXIAL FORCES (aaaaa)

Limit State	LL #	Mom. Dir.	Loca- tion	Controlling Flange?	Rg*	Design Stress* (ksi)	Area** (in^2)	Flexural Force (kips)	Lateral Force (kips)	Total Force (kips)
aaaaa	aa	aaa	aaa	aaa	aaaaa	xxxx.xx	xxx.xx	xxxxx.xx	xxxxx.xx	xxxxx.xx

\*NOTE: For strength limit states, the design stress is either F<sub>cf</sub> or F<sub>ncf</sub>, (AASHTO Equation 6.13.6.1.4c-1 or -4).  
**and R<sub>g</sub> is the flange resistance modification factor (Equation 6.13.6.1.4c-3)**

For service limit states, the design stress is F<sub>s</sub> (AASHTO Equation 6.13.6.1.4c-6).

For fatigue limit states, the design stress is the factored live load stress in the flange.

\*\*NOTE: For strength limit states, if the flange is in tension, the area is the effective flange area, calculated as per A6.13.6.1.4c-2.

For strength limit states, if the flange is in compression, the area is the gross flange area.

For service and fatigue limit states, the area is the gross flange area.

TOP FLANGE SPLICE BOLTS: ECCENTRICITIES

Gage Line	X Distance* (in)	Y Distance* (in)
aa	xxx.xx	xxx.xx

\*Legend of Section Properties:

X Distance = Longitudinal distance from CG of flange bolt group to extreme bolt of gage line

Y Distance = Transverse distance from CG of flange bolt group to gage line

TOP FLANGE SPLICE BOLTS: SECTION PROPERTIES

Eccentricity		IX Bolt*	IY Bolt*	J Bolt*
X* (in)	Y* (in)	(in^2)	(in^2)	(in^2)
xx.xx	xx.xx	xxxx.x	xxxx.x	xxxx.x

\*Legend of Section Properties:

Eccentricity, X = Longitudinal distance from centerline of splice to CG of flange bolt group

Eccentricity, Y = Transverse distance from CL of web to CG of flange bolt group

IX, Bolt = Moment of inertia of bolt group about longitudinal axis through CG

IY, Bolt = Moment of inertia of bolt group about transverse axis through CG

J, Bolt = Polar moment of inertia of bolt group

## Chapter 7 Output Description

TOP FLANGE SPLICE BOLTS: SHEAR FORCES (aaaaa)

-----  
 BOTTOM FLANGE SPLICE BOLTS: SHEAR FORCES (aaaaa)

Limit State	LL #	Mom. Dir.	Total Flexural Force* (kips)	# of Bolts	Flexural Force Per Bolt (kips)	Lateral Moment* (kip-ft)	Gage Line*	Bolt #*	Forces due to Lateral Moment		Total Resultant Force* (kips)
			(kips)		(kips)	(kip-ft)			Longit.* (kips)	Transv.* (kips)	(kips)
aaaaa	aa	aaa	xxxx.xx	ii	xxxx.xx	xxxx.xx	ii	ii	xxxx.xx	xxxx.xx	xxxx.xx

**\*Legend:**

Flexural Force = Force induced by major axis bending  
 Lateral Moment = Lateral Stress \* Flange Sy  
 Gage Line = Across splice from left to right edge  
 Bolt # = Along splice from closest to splice CL to furthest  
 Longitudinal and Transverse Forces = Forces induced by lateral bending =  
 $\text{Lateral Moment} * \text{eccentricity} / \text{Polar moment of inertia}$   
 Total Resultant Force =  $\text{sqrt} ( (\text{Longitudinal Force} + \text{Flexural Force})^2 + (\text{Transverse Force})^2 )$

TOP FLANGE SPLICE BOLTS: SLIP FORCES (aaaaa)

-----  
 BOTTOM FLANGE SPLICE BOLTS: SLIP FORCES (aaaaa)

Limit State	LL #	Mom. Dir.	Total Flexural Force* (kips)	# of Bolts	Flexural Force Per Bolt (kips)	Lateral Moment* (kip-ft)	Gage Line*	Bolt #*	Forces due to Lateral Moment		Total Resultant Force* (kips)
			(kips)		(kips)	(kip-ft)			Longit.* (kips)	Transv.* (kips)	(kips)
aaaaa	aa	aaa	xxxx.xx	ii	xxxx.xx	xxxx.xx	ii	ii	xxxx.xx	xxxx.xx	xxxx.xx

**\*Legend:**

Flexural Force = Force induced by major axis bending  
 Lateral Moment = Lateral Stress \* Flange Sy  
 Gage Line = Across splice from left to right edge  
 Bolt # = Along splice from closest to splice CL to furthest  
 Longitudinal and Transverse Forces = Forces induced by lateral bending =  
 $\text{Lateral Moment} * \text{eccentricity} / \text{Polar moment of inertia}$   
 Total Resultant Force =  $\text{sqrt} ( (\text{Longitudinal Force} + \text{Flexural Force})^2 + (\text{Transverse Force})^2 )$

TOP FLANGE SPLICE PLATES: CROSS-SECTIONAL AREAS

-----  
 BOT FLANGE SPLICE PLATES: CROSS-SECTIONAL AREAS

Location	Gross Area (in^2)	Net Area (in^2)	Area Ratio
aaaaa	xxxxxxxx.xx	xxxxxxxx.xx	xx.xxxx
aaaaa	xxxxx.xxxx	xxxxx.xxxx	xx.xxxx

Location:

OUTER

INNER

**Chapter 7 Output Description**

TOP FLANGE SPLICE PLATES: NET SECTION FRACTURE (aaaaa)

-----  
 TOP FLANGE SPLICE PLATES: GROSS SECTION TENSION YIELD (aaaaa)

-----  
 TOP FLANGE SPLICE PLATES: GROSS SECTION COMPRESSION (aaaaa)

-----  
 BOTTOM FLANGE SPLICE PLATES: NET SECTION FRACTURE (aaaaa)

-----  
 BOTTOM FLANGE SPLICE PLATES: GROSS SECTION TENSION YIELD (aaaaa)

-----  
 BOTTOM FLANGE SPLICE PLATES: GROSS SECTION COMPRESSION (aaaaa)

-----  
 OUTER PLATE

-----  
 INNER PLATES

Limit State	LL #	Mom. Dir.	Loca- tion	Area Ratio	Design Stress (ksi)	Factored Resistance (ksi)	*If Code Failure
aaaaa	ai	aaa	aaa	x.xxxx	xxxxx.xx	xxxxx.xx	a

-----  
 TOP FLANGE SPLICE PLATES: FATIGUE

-----  
 BOTTOM FLANGE SPLICE PLATES: FATIGUE

Limit State	LL #	Inner or Outer	Mom. Dir.	Live Load Stress Range (ksi)	Nominal Fatigue Resistance (ksi)	* If Code Failure
aaaa	ai	aaaaa	aaa	xxxx.xx	xxxx.xx	a

-----  
 TOP FLANGE SPLICE BOLTS: BEARING ON MATERIAL

-----  
 BOTTOM FLANGE SPLICE BOLTS: BEARING ON MATERIAL

Limit State	LL #	Mom. Dir.	Bearing Against	Design Bolt Force (kips)	Factored Bolt Resistance (kips)	* If Code Failure
aaaaa	ai	aaa	aaaaaaaaaaaa	xxxxx.xx	xxxxx.xx	a

Min. Clear Bolt Dist. (FLANGE) : xxx.xxx in

Min. Clear Bolt Dist. (SPL. PL.): xxx.xxx in

-----  
 TOP FLANGE SPLICE BOLTS: SHEAR STRENGTH

-----  
 BOTTOM FLANGE SPLICE BOLTS: SHEAR STRENGTH

Limit State	LL #	Mom. Dir.	Shear Plane	Design Bolt Force (kips)	Factored Bolt Resistance (kips)	* If Code Failure
aaaaa	aa	aaa	aaaaaaaaaaaa	xxxxx.xx	xxxxx.xxaa	a

\*\* Note: Factored resistance has been decreased to xxxxx.xx (kips) from xxxxx.xx (kips) due to the filler plate reduction factor as per DM4 6.13.6.1.5

## Chapter 7 Output Description

TOP FLANGE SPLICE BOLTS: SLIP RESISTANCE

-----  
 BOTTOM FLANGE SPLICE BOLTS: SLIP RESISTANCE  
 -----

Limit State	LL #	Mom. Dir.	Design Bolt Force (kips)	Factored Bolt Resistance (kips)	* If Code Failure
aaaaa	aa	aaa	xxxxx.xx	xxxxx.xx	a

TOP FLANGE SPLICE BOLT SPACING CHECKS (LEFT FLANGE)

-----  
 TOP FLANGE SPLICE BOLT SPACING CHECKS (RIGHT FLANGE)  
 -----

BOTTOM FLANGE SPLICE BOLT SPACING CHECKS (LEFT FLANGE)

-----  
 BOTTOM FLANGE SPLICE BOLT SPACING CHECKS (RIGHT FLANGE)  
 -----

\*CHECKING AGAINST FLANGE PLATES\*

Quantity	Actual Dimen. (in)	Minimum	Maximum	*If Code Failure
		Allow. Dimen. (in)	Allow. Dimen. (in)	
LEAST FSPL PITCH (versus FLANGE limits)	xxx.xxx	xxx.xxx	xxx.xxx	a
GREAT. FSPL PITCH (versus FLANGE limits)				
LEAST FSPL GAGE (versus FLANGE limits)**				
GREAT. FSPL GAGE (versus FLANGE limits)				
LEAST FLANGE END (versus FLANGE limits)				
GREAT. FLANGE END (versus FLANGE limits)				
LEAST FLANGE EDGE (versus FLANGE limits)				

\*\* : For Staggered pattern only.

Actual Gage = xxx.xxx

Hole Spacing along the diagonal = xxx.xxx

xxx.xxx should be compared with allowable dimensions

## Chapter 7 Output Description

TOP FLANGE SPLICE BOLT SPACING CHECKS (SPLICE PLATE)  
 -----  
 BOTTOM FLANGE SPLICE BOLT SPACING CHECKS (SPLICE PLATE)  
 -----

\*CHECKING AGAINST SPLICE PLATES\*

Quantity	Actual Dimen. (in)	Minimum Allow. Dimen. (in)	Maximum Allow. Dimen. (in)	*If Code Failure
LEAST FSPL PITCH (versus OUTPL limits)	xxx.xxx	xxx.xxx	xxx.xxx	a
GREAT. FSPL PITCH (versus OUTPL limits)				
LEAST FSPL PITCH (versus INPL limits)				
GREAT. FSPL PITCH (versus INPL limits)				
LEAST FSPL GAGE (versus OUTPL limits)				
GREAT. FSPL GAGE (versus OUTPL limits)				
FSPL GAGE (versus INPL limits)				
LEAST FSPL END DIS (versus OUTPL limits)				
GREAT. FSPL END DIS (versus OUTPL limits)				
LEAST FSPL END DIS (versus INPL limits)				
GREAT. FSPL END DIS (versus INPL limits)				
LEAST OUTPL EDGE (versus OUTPL limits)				
GREAT. OUTPL EDGE (versus OUTPL limits)				
LEAST INPL EDGE DIS (versus INPL limits)				
GREAT. INPL EDGE DIS (versus INPL limits)				

NOTE: OUTPL stands for outer splice plate;  
 INPL stands for inner splice plates.

## Chapter 7 - Output Description

### BLOCK SHEAR CHECK

TOP FLANGE - BLOCK SHEAR (AASHTO LRFD 6.13.4)

BOTTOM FLANGE - BLOCK SHEAR (AASHTO LRFD 6.13.4)

Bolt Hole											
Ng1	Npl	BLTPL	Gage	Pitch	Diameter						
			(in)	(in)	(in)						
ii	ii	ii	xx.xx	xx.xx	x.xxx						
=====											
Locn	Block Shear Path	Num Bolt Holes	Num Bolt Holes	Calc. End Dist (in)	Edge Dist (in)	T (in)	Shear Path Gross Area (in <sup>2</sup> )	Shear Path Net Area (in <sup>2</sup> )	Tens Path Net Area (in <sup>2</sup> )	Rr(Avn) (kips)	Rr(Avg) (kips)
aaaaaaa	aaaaaaaaa	xxx.x	xxx.x	xx.xx	xx.xx	x.xxx	xxx.xx	xxx.xx	xxx.xx	xxxxx.xx	xxxxx.xx
	aaaaaaaaa	xxx.x	xxx.x	xx.xx	xx.xx	x.xxx	xxx.xx	xxx.xx	xxx.xx	xxxxx.xx	xxxxx.xx
=====											

Location	Limit State	LL #	Mom Dir	Controlling Shear Path	Controlling Factored Rr (kips)	Design Force (kips)	*If Code Failure
aaaaaaa	aaaa	aa	aaa	aaaaaa	xxxxx.xx	xxxxx.xx	
	aaaa	aa	aaa	aaaaaa	xxxxx.xx	xxxxx.xx	

WARNING: \* - Indicates the limit state has failed for block shear

# - NOTE: The number of bolts entered does not result in an equal number of bolts per gage line. Program will continue block shear checks using indicated BLTPL value.

Note: Only 2 gage lines are present so gage distance is equal to zero.

Note: Number in parenthesis represents the Condition Number documented in the Block Shear Section of the User Manual.

Legend:

- S - Straight Tension Plane
- Z - Staggered Tension Plane

### WEB - BLOCK SHEAR (AASHTO LRFD 6.13.4)

Bolt Hole											
Ng1	Npl	BLTPL	Gage	Pitch	Diameter						
			(in)	(in)	(in)						
ii	ii	ii	xx.xx	xx.xx	x.xxx						
=====											
Locn	Block Shear Path	Num Bolt Holes	Num Bolt Holes	Calc. End Dist (in)	Edge Dist (in)	T (in)	Shear Path Gross Area (in <sup>2</sup> )	Shear Path Net Area (in <sup>2</sup> )	Tens Path Net Area (in <sup>2</sup> )	Rr(Avn) (kips)	Rr(Avg) (kips)
aaaaaaa	aaaaaa	xxx.x	xxx.x	xx.xx	xx.xx	x.xxx	xxx.xx	xxx.xx	xxx.xx	xxxxx.xx	xxxxx.xx
	aaaaaa	xxx.x	xxx.x	xx.xx	xx.xx	x.xxx	xxx.xx	xxx.xx	xxx.xx	xxxxx.xx	xxxxx.xx
=====											

Location	Limit State	LL #	Mom Dir	Controlling Shear Path	Controlling Factored Rr (kips)	Design Force (kips)	*If Code Failure
aaaaaaa	aaaa	aa	aaa	aaaaaa	xxxxx.xx	xxxxx.xx	
	aaaa	aa	aaa	aaaaaa	xxxxx.xx	xxxxx.xx	

WARNING: \* - Indicates the limit state has failed for block

## Chapter 7 - Output Description

### 7.8 SPECIFICATION CHECK WARNINGS

This output table gives a summary of the titles of all of the output tables which contain a specification check warning. Even if a specification checking output table is not printed, if the specification check is done and if a warning occurs, the output table title will appear on this report. This table is printed for both design and analysis runs. It is always printed in the output, even if all other output is turned off.

A sample specification check warning table is shown in Figure 1.

```
LRFD Steel Girder Splice Design and Analysis, Version 1.4.0.0      PAGE 64
Input File: EX1.dat                                             09/10/2012  16:51:01
-----
                        LRFD Steel Girder Splice Example # 1
                        SUMMARY - SPECIFICATION CHECKS
-----

                        SPECIFICATION CHECK WARNINGS
                        -----

The following is a list of output table headings for which the program
encountered one or more specification check warnings. It should be
noted that the program does not perform specification checking
corresponding to commands that have not been input by the user.

THE FOLLOWING TABLES HAVE SPEC. CHECK WARNINGS
-----
WEB SPLICE BOLTS: BEARING ON WEB MATERIAL (LEFT)
WEB SPLICE BOLTS: BEARING ON SPLICE MATERIAL (LEFT)
WEB SPLICE BOLTS: BEARING ON WEB MATERIAL (RIGHT)
WEB SPLICE BOLTS: BEARING ON SPLICE MATERIAL (RIGHT)
```

Figure 7.8-1 Specification Check Warnings Page

## Chapter 7 Output Description

### 7.9 SPECIFICATION CHECK FAILURES

This output table gives a summary of the titles of all of the output tables which contain a specification check failure. Even if a specification checking output table is not printed, if the specification check is done and if a failure occurs, the output table title will appear on this report. This table is printed for both design and analysis runs. It is always printed in the output, even if all other output is turned off.

A sample specification check failure table is shown in Figure 1.

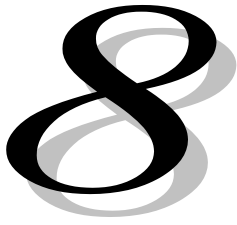
```
LRFD Steel Girder Splice Design and Analysis, Version 1.4.0.0      PAGE  43
Input File: Ex2.dat                                             09/10/2012  16:42:33
-----
                    LRFD Steel Girder Splice Example #2
                    SUMMARY - SPECIFICATION CHECKS (cont.)
-----

                    SPECIFICATION CHECK FAILURES
                    -----

The following is a list of output table headings for which
failures have occurred. It should be noted that the program
does not perform specification checking corresponding to
commands that have not been input by the user.

THE FOLLOWING TABLES HAVE SPEC. CHECK ERRORS
-----
WEB SPLICE BOLT SPACING CHECKS ( LEFT)
WEB SPLICE BOLT SPACING CHECKS ( RIGHT)
TOP FLANGE SPLICE BOLT SPACING CHECKS (LEFT FLANGE)
TOP FLANGE SPLICE BOLT SPACING CHECKS (RIGHT FLANGE)
```

Figure 7.9-1 Specification Check Failures Page



# ***EXAMPLE PROBLEMS***

## **8.1 EXAMPLE PROBLEMS**

This chapter contains the example problems used to test and verify this program. Table 1 shows the example problem matrix, which lists each example problem and the key input items used to differentiate the problems. For each example problem, the following information is given: a brief narrative description of the problem; a sketch which shows the splice configuration; and the input items required to create the input data file. The actual input data file for each example problem is not listed in this manual but is included electronically along with the executable program.

## Chapter 8 - Example Problems

Table 8.1-1 Example Problem Matrix

Input Item	Example Problem	
	1	2
System of Units	US	US
Design or Analysis of Web Splice Plates	Design	Analysis
Design or Analysis of Web Splice Bolts	Design	Analysis
Design or Analysis of Flange Splice Plates	Design	Analysis
Design or Analysis of Flange Splice Bolts	Design	Analysis
Live Load Type	Design Truck	Permit Truck
Composite/Non-composite	Composite	Non-composite
Steel to Concrete Modular Ratio	8	N/A
Steel Strength Web $F_{yw}$	36 ksi	36 ksi
Steel Strength Flange $F_{yf}$	50 ksi	36 ksi
Web Depth	84.0 inches	84 inches
Web Thickness	0.6875 inches	0.875 inches
Effective Slab Width	96 inches	N/A
Effective Slab Thickness	8.5 inches	N/A
End Clear Distance	4.0 inches	1.1875 inches
No. of Gage Lines of Web Splice Bolts (Both Sides)	N/A	6
No. of Gage Lines of Flange Splice Bolts	4	6
Surface Condition	A	C
Check Plate Fatigue	--	Yes

## Chapter 8 - Example Problems

### 8.2 EXAMPLE 1

Example 1 is a design example of a splice between two composite plate girders. A PHL-93 live loading is assumed. The adjacent girder sections are hybrid, with yield strengths of 36 ksi in the web and 50 ksi in the flanges. The number of gage lines of flange splice bolts is four, while the number of gage lines of web splice bolts is determined in the example. A Class A surface condition is assumed. The web has a depth of 84 inches and a thickness of 0.6875 inches. The effective slab width is 96 inches, the effective slab thickness is 8.5 inches, and the steel to concrete modular ratio is 8. The assumed end clear distance is 4 inches. The example problem is based on STLRFD Example 2 at the transition between Sections B and C.

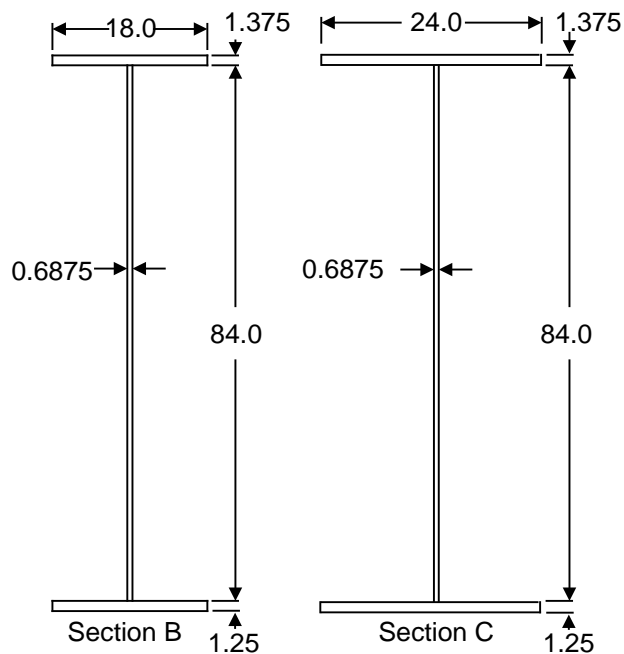


Figure 8.2-1 Example 1 Adjacent Girder Sections



Chapter 8 - Example Problems

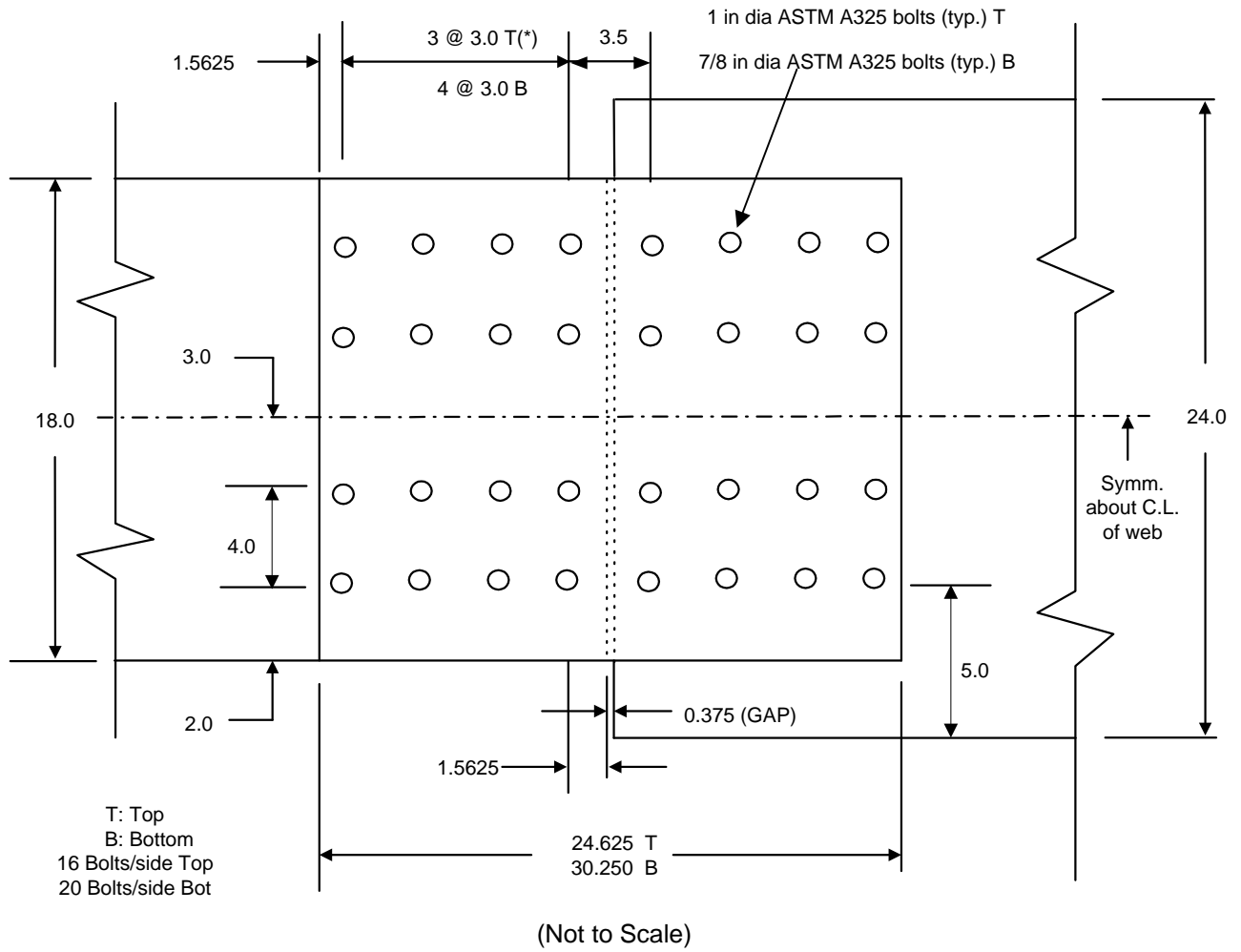
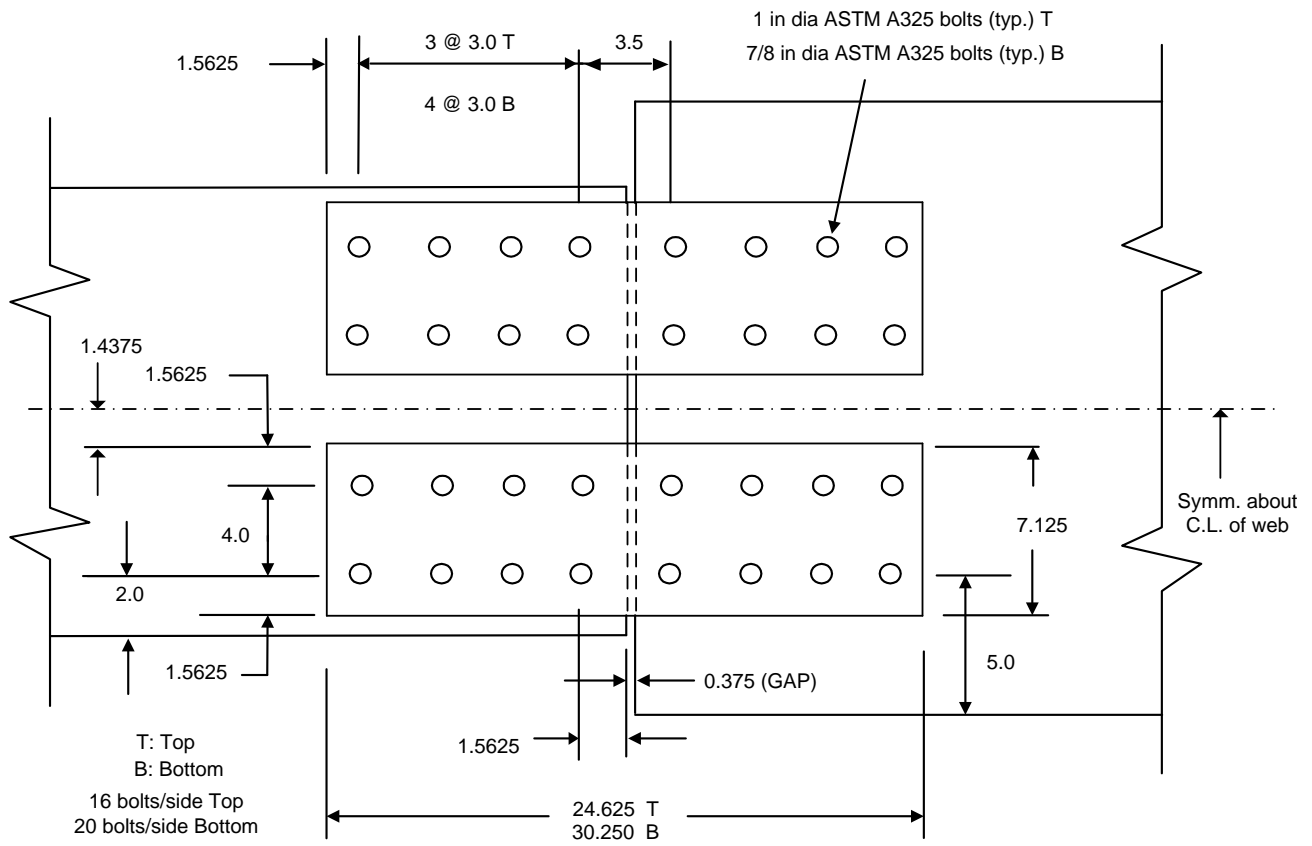


Figure 8.2-3 Example 1 Top and Bottom Flange Splice Configuration (Outer Plate)

**Chapter 8 - Example Problems**



(Girder web is not shown)

(Not to Scale)

Figure 8.2-4 Example 1 Top and Bottom Flange Splice Configuration (Inner Plates)

## Chapter 8 - Example Problems

### INPUT DATA (All input data below are required to perform the necessary computations)

```

                                CONTROL PARAMETERS
                                -----
Units      Composite/          Design/Analysis   Threads of   Increase Plate
US         Noncomposite       for Web Splice   Web Bolts in or Bolts for
          C                   Plates Bolts     Shear Plane  Web Splice
          D                   D               Y             P

Design/Analysis for   Threads of Top   Increase Plate
Top Flange Splice    Flange Bolts in or Bolts for Top
Plates Bolts         Shear Plane     Flange Splice
D                   D               Y             P

Design/Analysis for   Threads of Bot.  Increase Plate
Bottom Flange Splice Flange Bolts in or Bolts for Bot.
Plates Bolts         Shear Plane     Flange Splice
D                   D               Y             P

Splice Configuration   Staggered/Nonstaggered
Top Bottom           Top Bottom
Flange Flange       Flange Flange
3       3             N       N

Bolt Connection       Check Plate       Pedestrian
Type                  Fatigue           Live Load
F                     N                   N

                                DESIGN DEAD LOAD
                                -----
DC1      DC2      FWS      DC1      DC2      FWS
Moment   Moment   Moment   Shear    Shear    Shear
(k-ft)   (k-ft)   (k-ft)   (kips)   (kips)   (kips)
-500.40  -16.70    -21.70  -105.58  -11.88   -15.41

                                DESIGN LIVE LOAD
                                -----
Live Load Type   Live Load Number   Positive Moment (k-ft)   Negative Moment (k-ft)   Positive Shear (kips)   Negative Shear (kips)
D                 1                 2197.80                  -2290.10                  14.44                   -108.30
P                 2                 3436.50                  -2584.00                  21.68                   -170.91
F                 3                 724.20                   -522.00                   5.38                    -37.53

                                MATERIAL PROPERTIES (SET 1)
                                -----
Web Spl. Pl. Yield Strength (ksi)   Web Spl. Pl. Tensile Strength (ksi)   Web Spl. Bolt Tensile Strength (ksi)
36.00 *          58.00 *          120.00

```

\* - This value equals the min. of the corresponding GAS values.

## Chapter 8 - Example Problems

### MATERIAL PROPERTIES (SET 2)

Top Fl. Spl. Fl. Yield Strength (ksi)	Top Fl. Spl. Fl. Tensile Strength (ksi)	Top Fl. Spl. Bolt Tensile Strength (ksi)	Bot. Fl. Spl. Fl. Yield Strength (ksi)	Bot. Fl. Spl. Fl. Tensile Strength (ksi)	Bot. Fl. Spl. Bolt Tensile Strength (ksi)
50.00 *	65.00 *	120.00	50.00 *	65.00 *	120.00

\* - This value equals the min. of the corresponding GAS values.

### GIRDER ADJACENT SECTIONS (SET 1)

Left/ Right	Web Yield Strength (ksi)	Web Tensile Strength (ksi)	Web Thick. (in)	Web Depth (in)	Top Fl. Yield Strength (ksi)	Top Fl. Tensile Strength (ksi)
L	36.00	58.00	0.6875	84.000	50.00	65.00
R	36.00	58.00	0.6875	84.000	50.00	65.00

### GIRDER ADJACENT SECTIONS (SET 2)

Left/ Right	Top Fl. Width (in)	Top Fl. Thick. (in)	Bot. Fl. Yield Strength (ksi)	Bot. Fl. Tensile Strength (ksi)	Bot. Fl. Width (in)	Bot. Fl. Thick. (in)
L	18.000	1.3750	50.00	65.00	18.000	1.2500
R	24.000	1.3750	50.00	65.00	24.000	1.2500

### GIRDER ADJACENT SECTIONS (SET 3)

Left/ Right	Positive Factored Flexural Resist. (k-ft)	Negative Factored Flexural Resist. (k-ft)	Factored Shear Resistance (kips)	Web Edge Type	Top Flange Edge Type	Bottom Flange Edge Type
L	N/A*	N/A*	510.44	R	R	R
R	N/A*	N/A*	510.44	R	R	R

NOTE: Factored Flexural Resistance values have been replaced by the Factored Stress Resistance values on the ADJACENT SECTION RESISTANCE command.

## Chapter 8 - Example Problems

### ADJACENT SECTION RESISTANCE

Left/ Right	Limit State	Flex.	Hybrid Factor Rh	Factored Stress Resistance, Fr	
				Top (ksi)	Bottom (ksi)
L	STR1	POS	0.957	-47.8	47.8
	STR1	NEG	0.966	48.3	-48.3
	STR2	POS	0.957	-47.8	47.8
	STR2	NEG	0.966	48.3	-48.3
	SRV2	POS	0.957		
	SRV2	NEG	0.966		
	SRV2B	POS	0.957		
	SRV2B	NEG	0.966		
R	STR1	POS	0.964	-48.2	48.2
	STR1	NEG	0.973	48.6	-47.7
	STR2	POS	0.964	-48.2	48.2
	STR2	NEG	0.973	48.6	-47.7
	SRV2	POS	0.964		
	SRV2	NEG	0.973		
	SRV2B	POS	0.964		
	SRV2B	NEG	0.973		

NOTE: Factored Stress Resistance values are not input or necessary for service limit states.

### DECK DATA

Effec. Slab Thick. (in)	Effec. Slab Width (in)	Haunch Depth (in)	Deck Reinf. Area (in <sup>2</sup> /ft)	Deck Reinf. CGS (in)	Modular Ratio
8.500	96.000	--	0.7750	4.250	8.00

-- Set equal to top flange thickness.

### WEB SPLICE BOLT DATA (SET 1)

Diam. of Bolt (in)	Diam. of Bolt Hole (in)	Splice End Distance (in)	End Clear Distance (in)	Splice Edge Distance (in)	Web Edge Distance (in)
1.000	1.062	1.5625	4.0000	1.5625	2.1250

### WEB SPLICE BOLT DATA (SET 2)

Gage Distance (in)	Number of Gage Lines	Bolts per Gage Line**	Minimum Bolt Pitch (in)	Gap at Splice Center (in)	Edge or End Distance Increase (in)
3.000	--	16	3.000	0.375	0.00

-- To be designed

\*\* For web bolt design runs, this value is the minimum number of bolts per gage line  
For web bolt analysis runs, this value is the actual number of bolts per gage line

## Chapter 8 - Example Problems

### WEB SPLICE PLATE DATA

Web Splice Depth (in)	Web Splice Thick. (in)	Web Splice Plate Edge Type
76.000	--	R

-- To be designed

### FLANGE SPLICE BOLT DATA (SET 1)

Top/ Bottom	Diam. of Bolt (in)	Diam. of Bolt Hole (in)	Least Splice End Distance (in)	Greatest Splice End Distance (in)	Least Flange End Distance (in)	Greatest Flange End Distance (in)
T	1.000	1.062	1.5625	1.5625	1.5625	1.5625
B	0.875	0.938	1.5625	1.5625	1.5625	1.5625

### FLANGE SPLICE BOLT DATA (SET 2)

Top/ Bottom	Outer Splice Edge Distance (in)	Inner Sp. Least Edge Distance (in)	Inner Sp. Greatest Edge Distance (in)	Left Flange Edge Distance (in)
T	2.000	1.5625	1.5625	2.0000
B	2.000	1.5625	1.5625	2.0000

### FLANGE SPLICE BOLT DATA (SET 3)

Top/ Bottom	Right Flange Edge Distance (in)	Minimum Bolt Pitch (in)	Maximum Bolt Pitch (in)	Bolt Gage (in)
T	5.0000	3.0000	3.0000	4.0000
B	5.0000	3.0000	3.0000	4.0000

### FLANGE SPLICE BOLT DATA (SET 4)

Top/ Bottom	Num. of Gage Lines	Total Num. Bolts	Maximum Bolt Distance (in)
T	4	--	--
B	4	--	--

-- To be designed

### FLANGE SPLICE PLATE DATA

Top/ Bottom	Outer Plate Width (in)	Outer Plate Thickness (in)	Inner Plate Width (in)	Inner Plate Thickness (in)	Splice Plate Edge Type
T	18.000	--	7.1250	--	R
B	18.000	--	7.1250	--	R

-- To be designed

### DUCTILITY, REDUNDANCY, IMPORTANCE FACTORS

Strength Ductil.	Strength Redund.	Strength Impor.
1.00	1.00	1.00

**Chapter 8 - Example Problems**

MISCELLANEOUS DATA (SET 1)

Surface Type	Web Hole Size Factor	Nominal Fatigue Resistance						PA Traffic Factor
		Web		Top Flange		Bottom Flange		
		(ksi)	LS	(ksi)	LS	(ksi)	LS	
A	1.00	N/A	( N/A)	N/A	( N/A)	N/A	( N/A)	1.20

MISCELLANEOUS DATA (SET 2)

Minimum Bolt Tension			Flange Hole Size Factor		Resistance Factor For Bolts in Shear
Web (kips)	Top (kips)	Bottom (kips)	Top	Bottom	
51.00	51.00	39.00	1.00 *	1.00 *	0.80

\* - This input has been changed by the program

## Chapter 8 - Example Problems

### 8.3 EXAMPLE 2

Example 2 is an analysis example of a splice between two non-composite plate girders, computed in US units. A P-82 live loading is assumed. The adjacent girder sections are homogeneous, with a yield strength of 36 ksi. The number of gage lines of flange splice bolts is six, while the number of gage lines of web splice bolts is also six. A Class C surface condition is assumed, and plate fatigue is checked in the example. The web has a depth of 84 inches and a thickness of 0.8125 inches. The assumed end clear distance is 1.1875 inches. The example problem is based on STLRFD Example 3 at the transition point, except that it is converted from a built-up section to a plate girder.

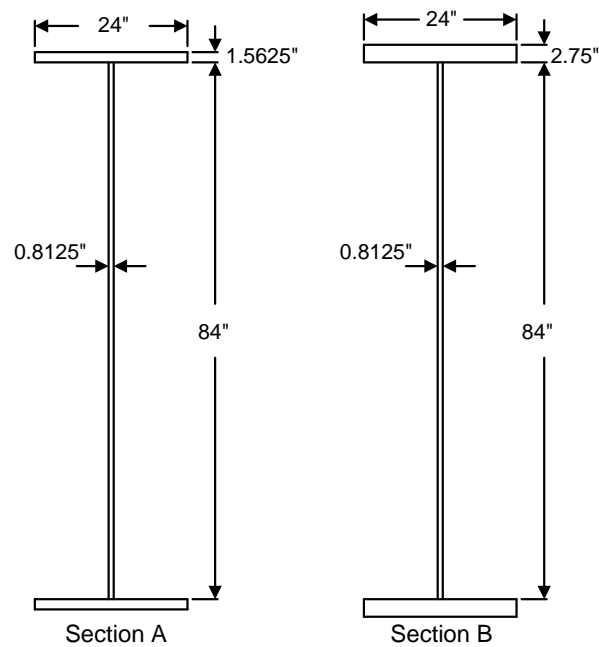


Figure 8.3-1 Example 2 Adjacent Girder Sections

Chapter 8 - Example Problems

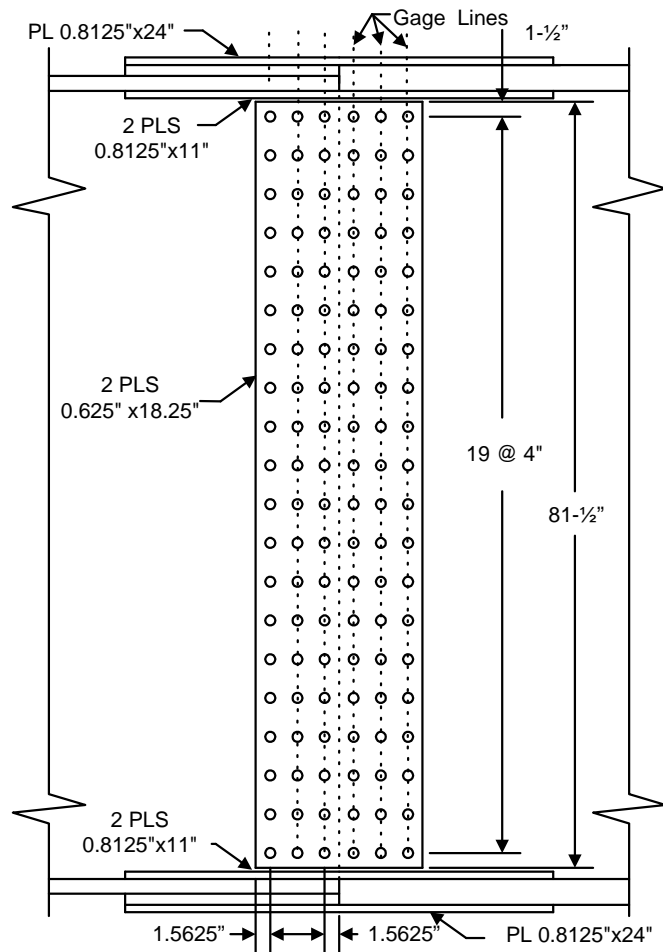
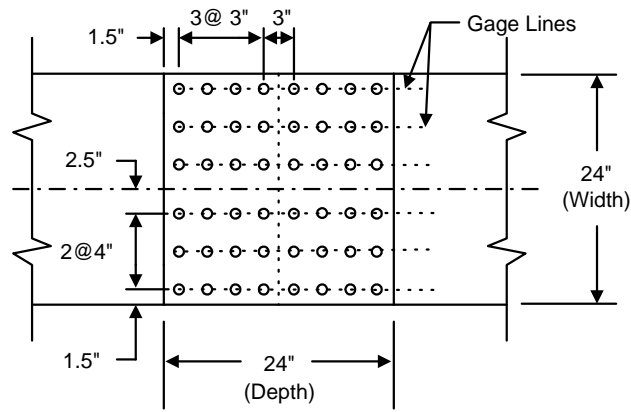
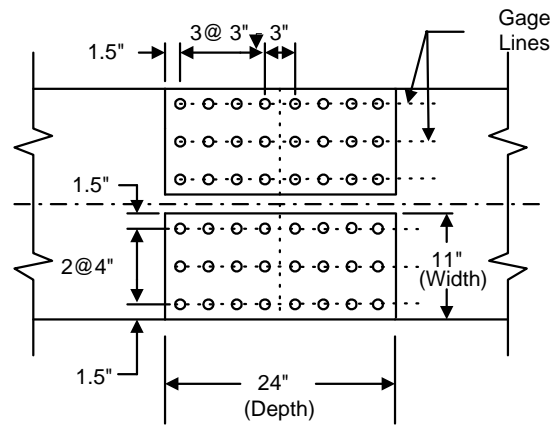


Figure 8.3-2 Example 2 Web Splice Configuration

Chapter 8 - Example Problems



**Outer Plate**



**Inner Plates**

Figure 8.3-3 Example 2 Top and Bottom Flange Splice Configuration

## Chapter 8 - Example Problems

### INPUT DATA (All input data below are required to perform the necessary computations)

#### CONTROL PARAMETERS

```

-----
Units      Composite/  Design/Analysis  Threads of  Increase Plate
           Noncomposite for Web Splice  Web Bolts in  or Bolts for
           N          Plates Bolts  Shear Plane  Web Splice
           US          A          A          Y          N/A

           Design/Analysis for  Threads of Top  Increase Plate
           Top Flange Splice  Flange Bolts in  or Bolts for Top
           Plates Bolts  Shear Plane  Flange Splice
           A          A          Y          N/A

           Design/Analysis for  Threads of Bot.  Increase Plate
           Bottom Flange Splice  Flange Bolts in  or Bolts for Bot.
           Plates Bolts  Shear Plane  Flange Splice
           A          A          Y          N/A

           Splice Configuration  Staggered/Nonstaggered
           Top Bottom  Top Bottom
           Flange Flange  Flange Flange
           3      3      N      N

           Bolt  Check  Pedestrian
           Connection  Plate  Live
           Type  Fatigue  Load
           F      Y      N
    
```

#### DESIGN DEAD LOAD

```

-----
DC1      DC2      FWS      DC1      DC2      FWS
Moment   Moment   Moment   Shear    Shear    Shear
(k-ft)   (k-ft)   (k-ft)   (kips)   (kips)   (kips)
-532.79  0.00     -89.69   -111.53  0.00     -17.43
    
```

#### DESIGN LIVE LOAD

```

-----
Live Load  Live Load  Positive  Negative  Positive  Negative
Type       Number   Moment   Moment   Shear     Shear
           (k-ft)   (k-ft)   (kips)   (kips)
D          1     1148.77  -841.34  11.84     -66.60
P          1     1148.77  -841.34  11.84     -66.60
F          1     530.53   -448.50  5.90      -42.78
    
```

#### MATERIAL PROPERTIES (SET 1)

```

-----
Web      Web      Web
Spl. Pl. Spl. Pl.  Spl. Bolt
Yield    Tensile  Tensile
Strength Strength Strength
(ksi)    (ksi)    (ksi)
36.00    58.00    120.00
    
```

**Chapter 8 - Example Problems**

MATERIAL PROPERTIES (SET 2)

Top Fl. Spl. Pl. Yield Strength (ksi)	Top Fl. Spl. Pl. Tensile Strength (ksi)	Top Fl. Spl. Bolt Tensile Strength (ksi)	Bot. Fl. Spl. Pl. Yield Strength (ksi)	Bot. Fl. Spl. Pl. Tensile Strength (ksi)	Bot. Fl. Spl. Bolt Tensile Strength (ksi)
36.00	58.00	120.00	36.00	58.00	120.00

GIRDER ADJACENT SECTIONS (SET 1)

Left/ Right	Web Yield Strength (ksi)	Web Tensile Strength (ksi)	Web Thick. (in)	Web Depth (in)	Top Fl. Yield Strength (ksi)	Top Fl. Tensile Strength (ksi)
L	36.00	58.00	0.8125	84.000	36.00	58.00
R	36.00	58.00	0.8125	84.000	36.00	58.00

GIRDER ADJACENT SECTIONS (SET 2)

Left/ Right	Top Fl. Width (in)	Top Fl. Thick. (in)	Bot. Fl. Yield Strength (ksi)	Bot. Fl. Tensile Strength (ksi)	Bot. Fl. Width (in)	Bot. Fl. Thick. (in)
L	24.000	1.5625	36.00	58.00	24.000	1.5625
R	24.000	2.7500	36.00	58.00	24.000	2.7500

GIRDER ADJACENT SECTIONS (SET 3)

Left/ Right	Positive Factored Flexural Resist. (k-ft)	Negative Factored Flexural Resist. (k-ft)	Factored Shear Resistance (kips)	Web Edge Type	Top Flange Edge Type	Bottom Flange Edge Type
L	N/A*	N/A*	766.60	R	R	R
R	N/A*	N/A*	766.60	R	R	R

NOTE: Factored Flexural Resistance values have been replaced by the Factored Stress Resistance values on the ADJACENT SECTION RESISTANCE command.

Chapter 8 - Example Problems

ADJACENT SECTION RESISTANCE

Left/ Right	Limit State	Flex.	Hybrid Factor Rh	Factored Stress Resistance, Fr	
				Top (ksi)	Bottom (ksi)
L	STR1	POS	1.000	-36.0	36.0
	STR1	NEG	1.000	36.0	-36.0
	STR2	POS	1.000	-36.0	36.0
	STR2	NEG	1.000	36.0	-36.0
	SRV2	POS	1.000		
	SRV2	NEG	1.000		
R	SRV2B	POS	1.000		
	SRV2B	NEG	1.000		
	STR1	POS	1.000	-36.0	36.0
	STR1	NEG	1.000	36.0	-36.0
	STR2	POS	1.000	-36.0	36.0
	STR2	NEG	1.000	36.0	-36.0
	SRV2	POS	1.000		
	SRV2	NEG	1.000		
	SRV2B	POS	1.000		
	SRV2B	NEG	1.000		

NOTE: Factored Stress Resistance values are not input or necessary for service limit states.

WEB SPLICE BOLT DATA (SET 1)

Diam. of Bolt (in)	Diam. of Bolt Hole (in)	Splice End Distance (in)	End Clear Distance (in)	Splice Edge Distance (in)	Web Edge Distance (in)
0.875	0.938	1.5625	1.1875	1.5625	1.3750

WEB SPLICE BOLT DATA (SET 2)

Gage Distance (in)	Number of Gage Lines	Bolts per Gage Line**	Minimum Bolt Pitch (in)	Gap at Splice Center (in)	Edge or End Distance Increase (in)
3.000	3	20	N/A	0.375	N/A

\*\* For web bolt design runs, this value is the minimum number of bolts per gage line  
For web bolt analysis runs, this value is the actual number of bolts per gage line

WEB BOLT PITCH DATA

Bolt Pitch Number	Bolt Pitch Distance (in)
1	4.000

WEB SPLICE PLATE DATA

Web Splice Depth (in)	Web Splice Thick. (in)	Web Splice Plate Edge Type
81.500	0.625	R

## Chapter 8 - Example Problems

### FLANGE SPLICE BOLT DATA (SET 1)

Top/ Bottom	Diam. of Bolt (in)	Diam. of Bolt Hole (in)	Least Splice End Distance (in)	Greatest Splice End Distance (in)	Least Flange End Distance (in)	Greatest Flange End Distance (in)
T	0.875	0.938	1.5000	1.5000	1.3750	1.3750
B	0.875	0.938	1.5000	1.5000	1.3750	1.3750

### FLANGE SPLICE BOLT DATA (SET 2)

Top/ Bottom	Outer Splice Edge Distance (in)	Inner Sp. Least Edge Distance (in)	Inner Sp. Greatest Edge Distance (in)	Left Flange Edge Distance (in)
T	1.500	1.5000	1.5000	1.5000
B	1.500	1.5000	1.5000	1.5000

### FLANGE SPLICE BOLT DATA (SET 3)

Top/ Bottom	Right Flange Edge Distance (in)	Minimum Bolt Pitch (in)	Maximum Bolt Pitch (in)	Bolt Gage (in)
T	1.5000	3.0000	3.0000	4.0000
B	1.5000	3.0000	3.0000	4.0000

### FLANGE SPLICE BOLT DATA (SET 4)

Top/ Bottom	Num. of Gage Lines	Total Num. Bolts	Maximum Bolt Distance (in)
T	6	24	9.000
B	6	24	9.000

### FLANGE SPLICE PLATE DATA

Top/ Bottom	Outer Plate Width (in)	Outer Plate Thickness (in)	Inner Plate Width (in)	Inner Plate Thickness (in)	Splice Plate Edge Type
T	24.000	0.812	11.000	0.812	R
B	24.000	0.812	11.000	0.812	R

### DUCTILITY, REDUNDANCY, IMPORTANCE FACTORS

Strength Ductil.	Strength Redund.	Strength Impor.
1.00	1.00	1.10

**Chapter 8 - Example Problems**

MISCELLANEOUS DATA (SET 1)

Surface Type	Web Hole Size Factor	Nominal Fatigue Resistance			PA Traffic Factor
		Web		Bottom Flange	
		(ksi) LS	(ksi) LS	(ksi) LS	
C	1.00	8.00 (FAT2)	8.00 (FAT2)	8.00 (FAT2)	1.20

MISCELLANEOUS DATA (SET 2)

Minimum Bolt Tension			Flange Hole Size Factor		Resistance Factor For Bolts in Shear
Web (kips)	Top (kips)	Bottom (kips)	Top	Bottom	
39.00	39.00	39.00	1.00 *	1.00 *	

\* - This input has been changed by the program

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# ***TECHNICAL QUESTIONS AND REVISION REQUEST***

This chapter contains reply forms to make it easier for users to convey their questions, problems or comments to the proper unit within the Department. General procedures for using these forms are given. Users should keep the forms in the manual as master copies that can be reproduced as needed.

## **9.1 TECHNICAL QUESTIONS**

Technical questions related to the interpretations of the design specifications as implemented in this program, why certain assumptions are made, applicability and limitations of this program, and other questions not related to the operation of this program can be directed to the appropriate person in PennDOT using this form or the information provided on this form. Please review the information provided in this User's Manual and the references given in Chapter 1 before submitting this form for processing or calling for assistance. The completed form should be sent to the Bridge Design and Technology Division (see form for complete address).

## **9.2 REVISION REQUEST**

This form is to be used to report suspected program malfunctions that may require revisions to the program. It can also be used to request revisions that may be required due to changes in specifications and for the enhancement of the program. Unexpected or incorrect output, rejection of input data, endless program cycling, and program abortion are examples of program malfunctions. Users are requested to review their input data and the program User's Manual before submitting this form for processing.

This form may also be used to submit suggestions for improving the User's Manual for this program. Suggestions might include typographical error correction, clarification of confusing sections, expansion of certain sections, changes in format, and the inclusion of additional information, diagrams, or examples.

The completed form should be sent to the Engineering Software Section via mail, fax, or e-mail.

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# SPLRFD TECHNICAL QUESTIONS

This form is to be used to ask questions on technical issues related to this engineering program. Questions on the interpretations of the design specifications as implemented in this program, why certain assumptions are made by the program and other questions not related to the operation of this program may be submitted using this form or by calling the telephone number listed in this form. Users are requested to read the User's Manual, LRFD Specifications and DM-4 before submitting this form or calling to ask questions.

CONTACT PERSON: \_\_\_\_\_ DATE: \_\_\_\_\_  
ORGANIZATION: \_\_\_\_\_ PHONE: \_\_\_\_\_  
E-MAIL ADDRESS: \_\_\_\_\_ FAX: \_\_\_\_\_  
PROGRAM VERSION: \_\_\_\_\_

Clearly state your question(s) and attach documentation you feel would be helpful in answering your question(s). If you require more space, use additional 8<sup>1</sup>/<sub>2</sub> x 11 sheets of plain paper.

FORWARD COMPLETED FORM TO: Bridge Design and Technology Division  
Pennsylvania Dept. Of Transportation  
P.O. Box 3560  
Harrisburg, PA 17105-3560  
PHONE: (717) 787-2881  
FAX: (717) 787-2882

RECEIVED BY: \_\_\_\_\_ FOR DEPARTMENT USE ONLY  
ASSIGNED TO: \_\_\_\_\_ DATE: \_\_\_\_\_

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# SPLRFD REVISION REQUEST

This form is to be used to report suspected program malfunctions, or to request revisions to the program or its documentation. Users are requested to review their input data and the program User's Manual before submitting this form.

CONTACT PERSON: \_\_\_\_\_ DATE: \_\_\_\_\_  
ORGANIZATION: \_\_\_\_\_ PHONE: \_\_\_\_\_  
E-MAIL ADDRESS: \_\_\_\_\_ FAX: \_\_\_\_\_  
PROGRAM VERSION: \_\_\_\_\_

Define your problem and attach samples and/or documentation you feel would be helpful in correcting the problem. If the input data is more than 4 or 5 lines, Licensees should provide the input data file on a diskette. If you require more space, use additional 8<sup>1</sup>/<sub>2</sub> x 11 sheets of plain paper.

FORWARD COMPLETED FORM TO: Pennsylvania Department of Transportation  
Bureau of Business Solutions and Services  
Highway/Engineering Applications Division  
Engineering Software Section  
P. O. Box 8213, Harrisburg, PA 17105-8213  
PHONE: (717) 783-8822  
FAX: (717) 705-5529  
E-MAIL: PenndotBisEngineer@pa.gov

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ASSIGNED TO: \_\_\_\_\_ DATE: \_\_\_\_\_

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