

# Streamlining Steel Truss Bridge and Gusset Plate Rating

2023 AASHTO RADBUG Meeting  
Madison, WI  
August 8-9, 2023

Load Rating Branch, Structure Maintenance & Investigation

California Department of Transportation

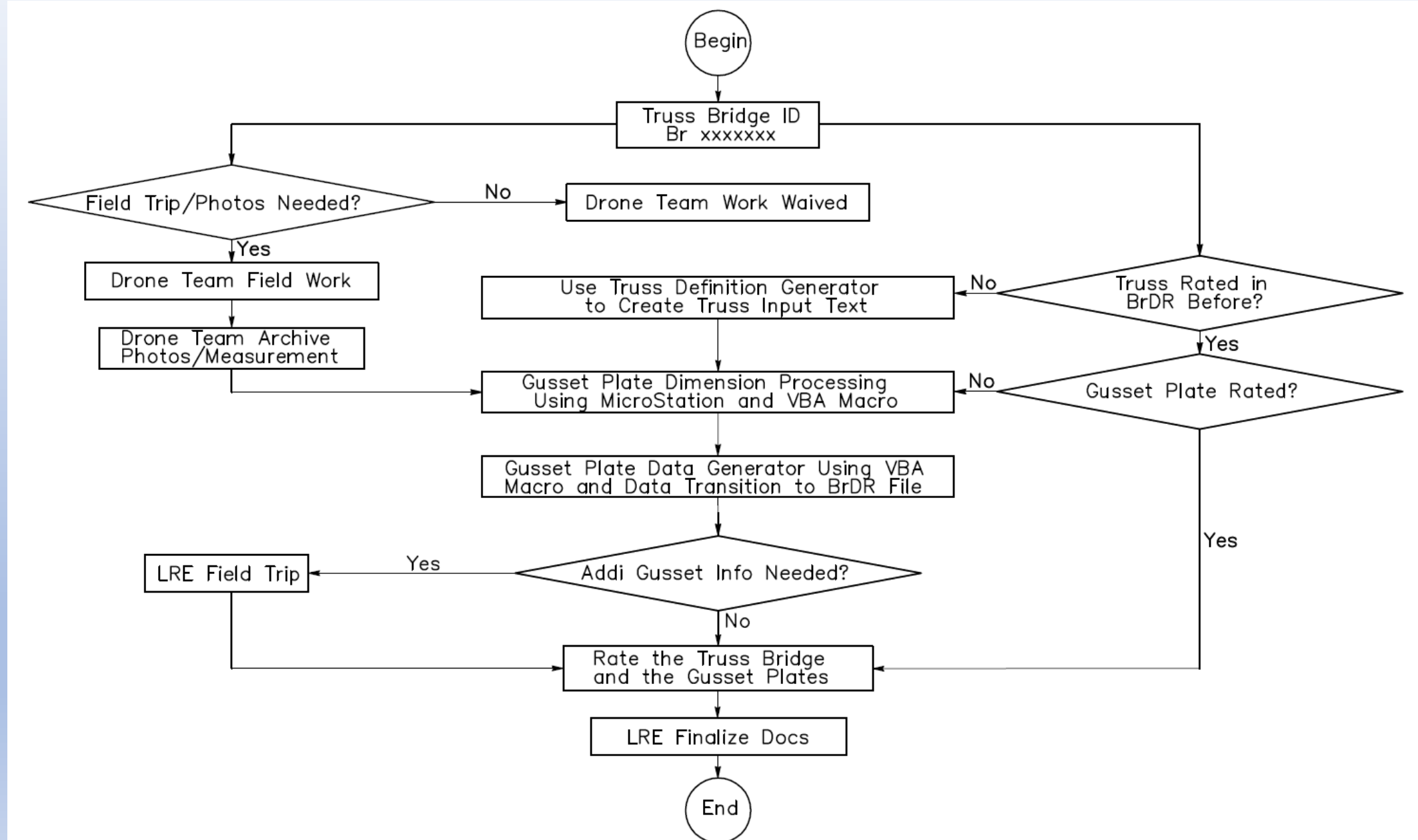


# Current Status of Truss Bridge Rating in CA

- CA has more than 250 steel truss bridges (200+ local bridges, 40+ state-owned bridges), Most have been rated by using hand calculations, rating software, and other methods
- 171 truss bridges have been rated by using AASHTOWare BrDR for bridge members EXCEPT that not all analyses have included the gusset plate rating
- Currently, only a few truss bridges have been rated for bridge members AND the connections with gusset/splice plates by using AASHTOWare BrDR



# Flow Chart for Rating A Truss Bridge & Its Gusset Plates



# Gusset Plate Information Collection

- As-built plans, shop drawings, and other archived files
- Drone photos
- Field measurement
- Bridge design/construction specifications, manuals, and other code regulations when the bridge was designed and built



# Drone in the Air



Skydio 2 drone



# Drone Photo for Gusset Plate



# Dimension Measurements in the Field



# LRE Field Measurements/Investigations





# Gusset Plate Height Measurement

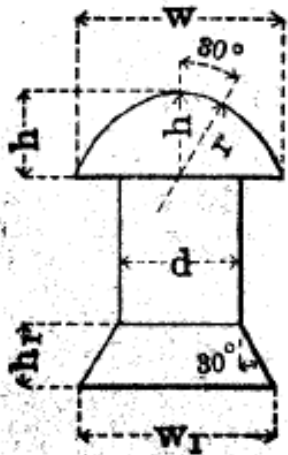


# Rivet Head Diameter Measurement



# Rivet Diameter Derived from Head Size

**Dimensions of Structural Rivets**



	Diameter of Rivet, d, Inches									
	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1	$1\frac{1}{8}$	$1\frac{1}{4}$	$1\frac{3}{8}$	$1\frac{1}{2}$
<b>w</b>	$\frac{11}{16}$	$\frac{7}{8}$	$1\frac{1}{16}$	$1\frac{1}{4}$	$1\frac{7}{16}$	$1\frac{5}{8}$	$1\frac{13}{16}$	2	$2\frac{3}{16}$	$2\frac{3}{8}$
<b>h</b>	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{11}{16}$	$\frac{3}{4}$	$\frac{7}{8}$	$\frac{15}{16}$	1
<b>r</b>	$\frac{7}{16}$	$\frac{9}{16}$	$\frac{11}{16}$	$\frac{13}{16}$	$\frac{15}{16}$	1	$1\frac{1}{8}$	$1\frac{1}{4}$	$1\frac{3}{8}$	$1\frac{1}{2}$
<b>w<sub>1</sub></b>	$\frac{9}{16}$	$\frac{3}{4}$	1	$1\frac{3}{16}$	$1\frac{3}{8}$	$1\frac{9}{16}$	$1\frac{3}{4}$	2	$2\frac{3}{16}$	$2\frac{3}{8}$
<b>h<sub>1</sub></b>	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{11}{16}$	$\frac{3}{4}$

$$w = 1\frac{1}{2}d + \frac{1}{8}''$$

$$h = 0.425 w$$

$$r = 1\frac{1}{2} h.$$



# Plate Thickness Measurement



# Truss Definition Text Input Generator



# BrDR Truss Definition Text Generation

- Currently, Truss Input text (shown on right) can only be composed by LREs manually in BrDR 7.4
- Caltrans has developed an In-house tool – Truss Definition Generator (an excel file coded with VBA Macro)
- By using the Truss Definition Generator, truss input texts can be created by inputting control parameters

Truss

Name:  Link with:

Description

Default rating method:

```
Truss "Truss 1"

Unit
Force kips
Length ft
Properties in

DefaultSysUnitType US

DefaultStructSteel "Fy= 30 ksi (Assigned for 1935 steel)"

DefaultEndConnection
Riveted

MaterialType
Steel1 = "Fy= 30 ksi (Assigned for 1935 steel)"

//%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

MemberCrossSection
Rolled = Section1
Beam "10WF 15 CB102@31#" //Lower Chords & Upper Chords

Rolled = Section2
Beam "10WF 17 CB103N@49#" //Lower Chords & Upper Chords

Rolled = Section3
Beam "10WF 17 CB102N@33#" //End Posts

Rolled = Section4
Beam "10WF 18 CB102@41#" //Verticals

Rolled = Section5
Beam "10WF 17 CB101N@21#" //Verticals and Diagonls

Rolled = Section6
Beam "10WF 15 CB101@21#" //Diagonls

//%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

PanelPoint
L0 Lower 0 0
L1 Lower 6.3325 0
L2 Lower 12.666 0
L3 Lower 18.9995 0
L4 Lower 25.333 0
L5 Lower 31.6665 0
```

Line number:



# In-House Truss Text Input Generator 1

## Procedures of Input Generator:

1. define nodes, and the connectivity
2. Define materials property
3. Define cross section (seen next slide)

User Entry required

User Entry optional

Green in-cell drop down list

Reset Sheet

Reset Active Table

Copy Active Table / Row

Delete Active Table / Row

Create Truss Def

# of NODES
9

Node Name	End Node for Members Connecting to the Joint (Maximum number of members is 8)				
	Connected Node 1	Connected Node 2	Connected Node 3	Connected Node 4	Connected Node 5
1 L0	L1	U1			
2 U1	L0	U2	L2	L1	
3 L2	L1	L3	U1	U2	
4 U2	U1	U3	L3	L2	
5 L3	L2	L4	U2	U3	U4
6 U3	U2	U4	L4	L3	
7 L1	L0	L2	U1		
8 U4	U3	U5	L5	L4	L3
9 L4	L3	L5	U3	U4	U5

Default Database	SMI_local74	
Bridge BID	19	TrussTrainingExample
Superstructure ID	1	Pony Truss Example
Truss	Truss 2	
Unit	Force	kips
	Length	ft
	Properties	in
DefaultSysUnitType	US	
DefaultStructSteel	1905 to 1936 Steel	
DefaultEndConnection	Riveted	<k_value>
DefaultMemConnection	Riveted	
UniversalMillPlateNotPresent		



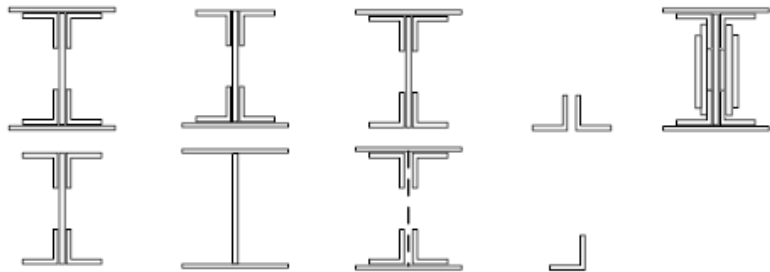
# In-House Truss Text Input Generator 2

The following types of cross sections can be described.

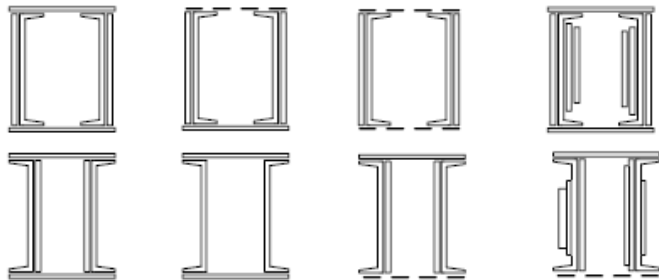
## 6.9.1 Rolled Section



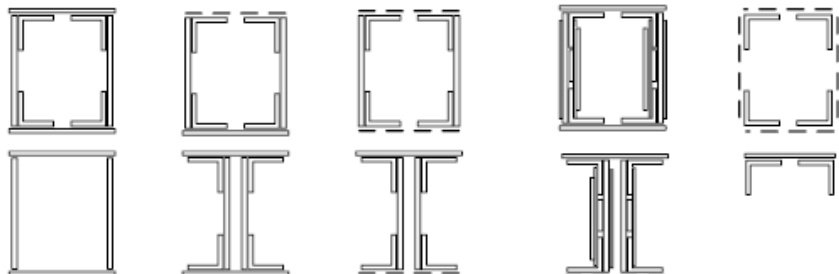
## 6.9.2 Builtup Section



## 6.9.3 Channel Box Section



## 6.9.4 Angle Box Section



1	ChannelBox	CB1	<comment>			
	TopFlangePlate	18	0.75	M1		
	BottomFlangePlate	18	0.75	M1		
	LeftWebPlate	15	1.5	M1		
	RightWebPlate	15	1.5	M1		
	LeftWebPlate2	1.5	8	M1		
	RightWebPlate2	1.5	8	M1		
	Channels	C 15x45	Outward		10	<material_name#>
	Connection	Riveted	10.25			
	Lacing	Bottom				

1	AngleBox	AB1	<comment>			
	TopFlangePlate	25.25	0.625	M1		
	BottomFlangePlate	13.25	0.625	M1		
	LeftWebPlate	36	1.125	M1		
	RightWebPlate	36	1.125	M1		
	LeftWebPlate2	0.625	12.875	M1		
	RightWebPlate2	0.625	12.875	M1		
	TopAngles	L 3x2x1/4	Horizontal		Inward	<material_name#>
	BottomAngles	L 3x2x1/4	Horizontal		Inward	<material_name#>
	BackToBack	24.75	36			
	Connection	Bolted	19.125			
	Lacing	Right				
	WebLacing					

1	NonDetailed	<nickname>	<comment>				
	Gross Area, in2	Net_Area, in2	Material Name	Section Modulus zz, in3>	Section Modulus yy, in3	Section Modulus zz, in3	Section Modulus yy, in3
	20.05	15.78	M1	154.5	<yyy#, in3>	<szz#, in3>	<yyy#, in3>

Symmetry Even

PanelPoint

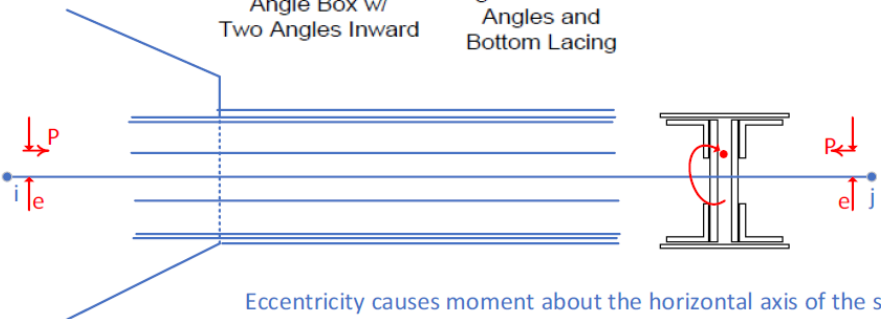
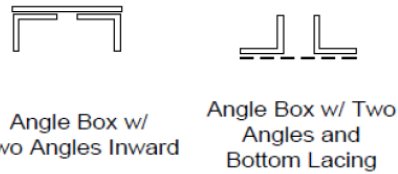
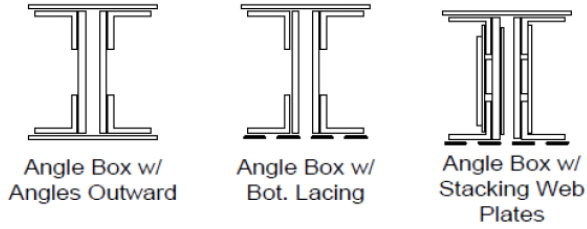
1	Panel Point ID	Panel Point Type	X Coordinate, ft	Y Coordinate, ft
	L0	Lower	0	0





# Generate Truss Definition Text

These angle box truss members are assumed to be attached to the gusset plate connections along the vertical legs of the angles.



AutoSave On | xx xxxx Gusset Plate DesignRating\_060123 example1.xlsm | Search (Alt+Q)

File Home Insert Page Layout Formulas Data Review View Help Acrobat

Reset Sheet | Reset Active Table | Copy Active Table / | Delete Active Table / | Create Truss Def

PanelPoint				
	Panel Point ID	Panel Point Type	X Coordinate, ft	Y Coordinate, ft
1	L0	Lower	0	0
2	U1	Upper	1	1
3	L2	Lower	2	0
4	U2	Upper	2	1
5	L3	Lower	3	0
6	U3	Upper	3	1
7	L1	Lower	1	0
8	U4	Upper	4	1
9	L4	Lower	4	0

Member					
	Member Name	Panel Point I Name	Panel Point J Name	Truss Section ID	Counter
1	L0L1	L0	L1	CB1	<counter>
2	L0U1	L0	U1	CB1	<counter>
3	L1L2	L1	L2	CB1	<counter>
4	L1U1	L1	U1	AB1	<counter>
5	L2L3	L2	L3	ND1	<counter>
6	L2U2	L2	U2	CB1	<counter>
7	L3L4	L3	L4	ND1	<counter>
8	L3U3	L3	U3	R1	<counter>
9	L3U4	L3	U4	B1	<counter>
10	U1L2	U1	L2	CB1	<counter>
11	U1U2	U1	U2	AB1	<counter>
12	U2L3	U2	L3	CB1	<counter>
13	U2U3	U2	U3	CB1	<counter>
14	U3L4	U3	L4	CB1	<counter>
15	U3U4	U3	U4	CB1	<counter>

# Generated Truss Definition Text for BrDR Input

## TRUSS DEFINITION

Truss "Truss 2"

Unit

Force kips

Length ft

Properties in

DefaultSysUnitType US

DefaultStructSteel "1905 to 1936 Steel"

DefaultEndConnection

Riveted

DefaultMemConnection Riveted

MaterialType

M1 = "1905 to 1936 Steel"

M2 = "M2a"

M3 = "M3a"

M4 = "M4a"

SectionType

S1 = "C 15x33.9"

S2 = "W 12x40"

S3 = "W 9x38.5"

S4 = "L 2x2x1/4"

S5 = "L 3x2x1/4"

MemberCrossSection

Rolled = R1

TopFlangePlate

36.0 1.25 M1

BottomFlangePlate

36.0 1.25 M1

Beam S2 M1

Connection Bolted 14.875

Builtup = B1

TopFlangePlate

18.0 0.5 M1

BottomFlangePlate

18.0 0.5 M1

WebPlate 26.0 0.375 M1

ChannelBox = CB1

TopFlangePlate

18.0 0.75 M1

BottomFlangePlate

18.0 0.75 M1

LeftWebPlate

15.0 1.5 M1

RightWebPlate

15.0 1.5 M1

LeftWebPlate2

1.5 8.0 M1

RightWebPlate2

1.5 8.0 M1

Channels "C 15x45" Outward 10.0

Connection Riveted 10.25

Lacing Bottom

AngleBox = AB1

TopFlangePlate

25.25 0.625 M1

BottomFlangePlate

13.25 0.625 M1

LeftWebPlate

36.0 1.125 M1

RightWebPlate

36.0 1.125 M1

LeftWebPlate2

0.625 12.875 M1

RightWebPlate2

0.625 12.875 M1

TopAngles "L 3x2x1/4" Horizontal Inward

BottomAngles "L 3x2x1/4" Horizontal Inward

BackToBack 24.75 36.0

Connection Bolted 19.125

NonDetailed = NonDetailed1

20.05 15.78 M1 154.5

Symmetry Even

PanelPoint

L0 Lower 0.0 0.0

U1 Upper 1.0 1.0

L2 Lower 2.0 0.0

U2 Upper 2.0 1.0

L3 Lower 3.0 0.0

U3 Upper 3.0 1.0

L1 Lower 1.0 0.0

U4 Upper 4.0 1.0

L4 Lower 4.0 0.0

Member

L0L1 L0 L1 CB1

L0U1 L0 U1 CB1

L1L2 L1 L2 CB1

L1U1 L1 U1 AB1

L2L3 L2 L3 "ND1"

L2U2 L2 U2 CB1

L3L4 L3 L4 "ND1"

L3U3 L3 U3 R1

L3U4 L3 U4 B1

U1L2 U1 L2 CB1

U1U2 U1 U2 AB1

U2L3 U2 L3 CB1

U2U3 U2 U3 CB1

U3L4 U3 L4 CB1

U3U4 U3 U4 CB1

MemberEccen

L0L1 100.0

L0U1 99.0

L1L2 98.0

Support

L0 Pinned

L3 Roller

PanelPointLoad

U1 DC 1.0 3.0

L4 DW 2.0 4.0

AdditionalSelfLoad 1.0 2.0

LLDistribution

OneLane 1.0 2.0

MultiLane 3.0 4.0



# Gusset Plate Dimension Processing Using MicroStation and VBA

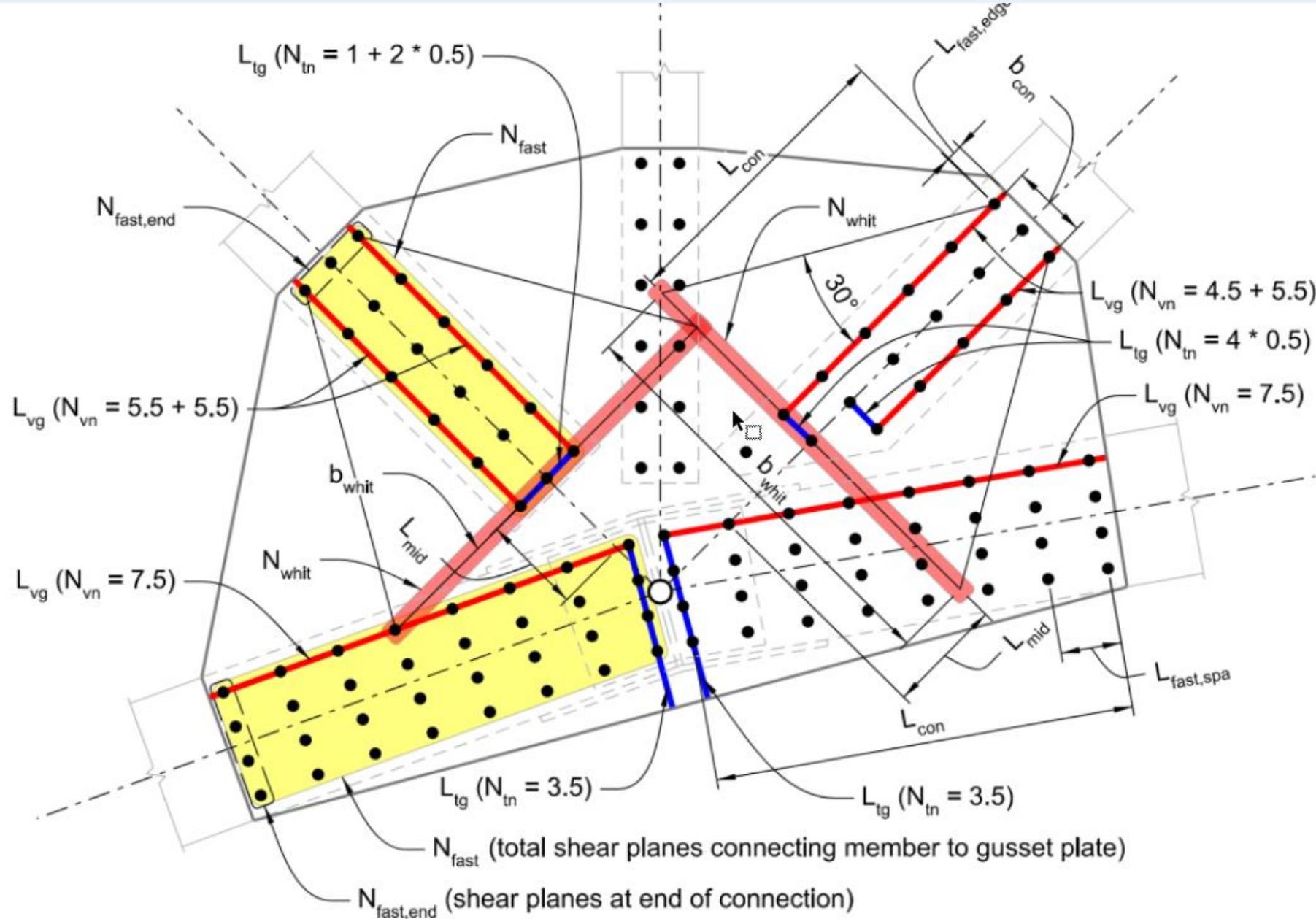


# Gusset Plate Data Generation Procedures

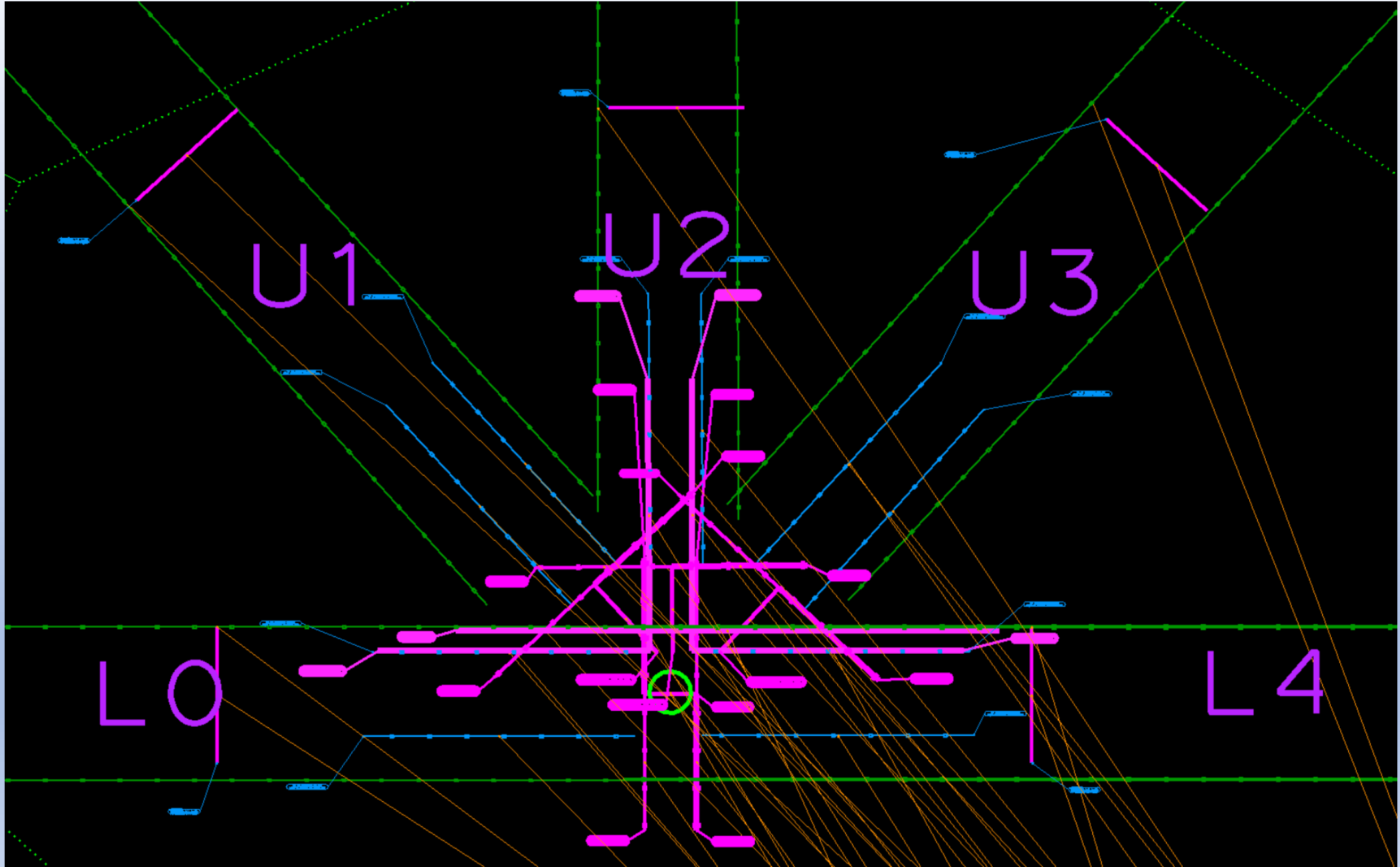
1. Use the MicroStation template to measure the gusset plate from a scaled as-built plan or drone photo
2. Run the MicroStation macro to measure the remaining gusset plate information and write the data to the Excel file
3. Convert the gusset plate data into a format for BrDR Input
4. Transfer the gusset plate data into BrDR model file



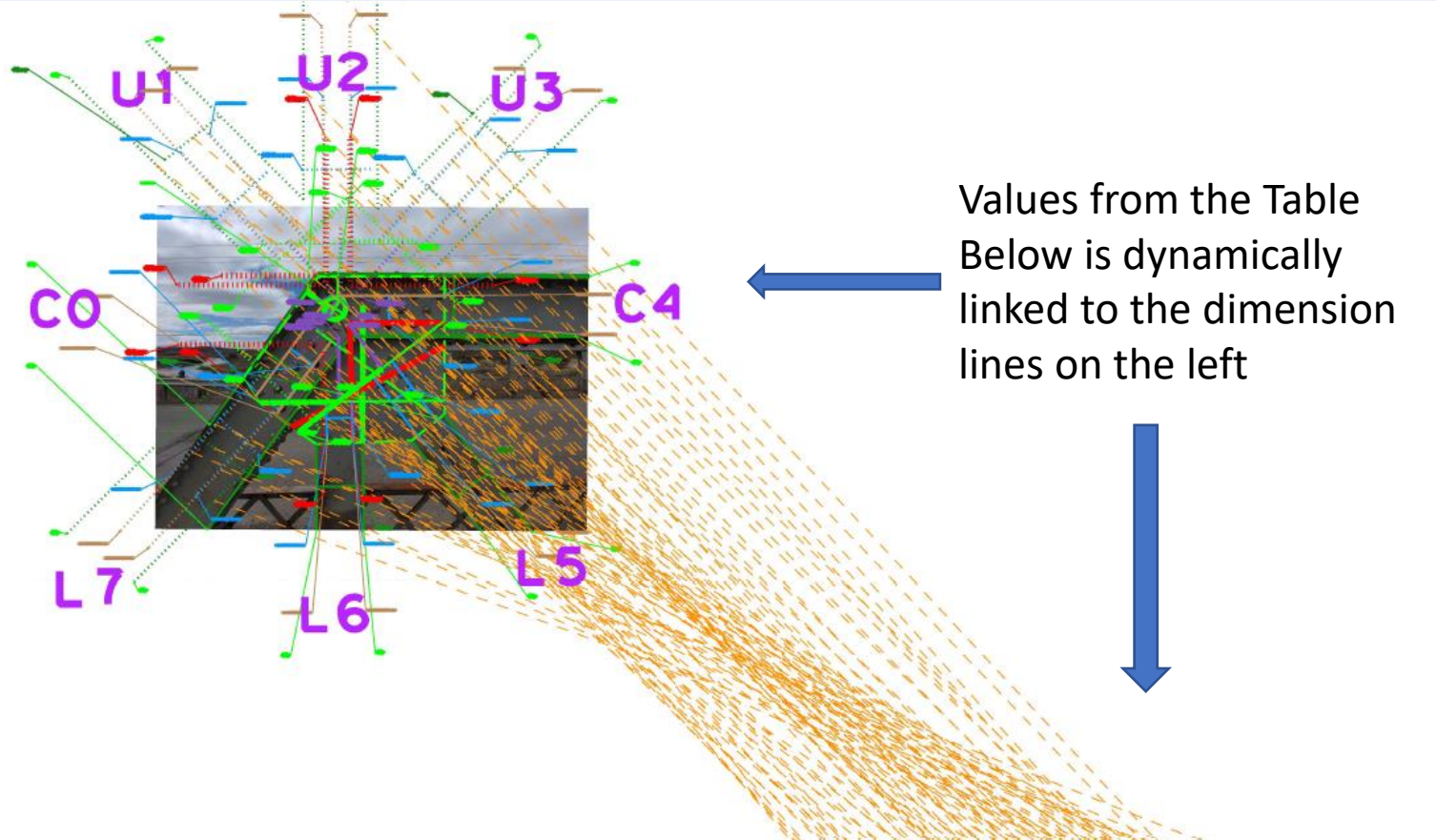
# Dimensions needed for rating gusset plate



# Step 1: Open A Template File and Attach Gusset Plate Details



# Step 2: Adjust Lines to Match Gusset Plate Details



Values from the Table Below is dynamically linked to the dimension lines on the left

Gusset Name:

Macro version 11.14.22

Measurement / Quantity	C0	C4	U1	U2	U3	L5	L6	L7
GEOMETRY								
Depth of Member (reference to CH line)	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
Slope of Member from True Horizontal	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%
FASTENERS AND LENGTHS								
Distance from first to last row (sum of all row spacings)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Distance from edge of gusset to first row (top-left) of bolt hole	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Distance from edge of gusset to first row (top-right) of bolt hole	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Dist. between first and last lower beam	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Distance between extreme fasteners of Steel/Truss row (top)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Distance from edge of gusset to fastener guide hole	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
WHITMORE SECTION								
Distance from Ch. of Mem. to edge of Gusset (in) on left side	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
Distance from Ch. of Mem. to edge of Gusset (in) on right side	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
Unreduced Length (Lmid) (in)	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
FULL SHEAR PLANES DETAIL								
Full shear plane (horizontal)	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
Full shear plane (vertical)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
PARTIAL SHEAR PLANES DETAIL								
Partial Shear Plane (along Chord)	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
Partial Shear Plane (across section)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00



# Step 3: Run Macro to Create Initial Gusset Plate Data File

The screenshot shows the Microsoft Excel interface with the following data in the spreadsheet:

	A	B	C	D	E	F	G	H	I	J	K	L
1	Gusset Name:											
2	10.41"											
3	10.13"											
4	12.00"											
5	12.00"											
6	12.00"											
7	6.78"											
8	7.78"											
9	12.00"											
10	234.459°											
11	359.674°											
12	135.000°											
13	90.000°											
14	45.000°											





# Step 4: Setup Processing File, Import Initial Data and Generate Detailed Gusset Plate Data

AutoSave  03C0091 Gusset Plate DesignRating\_011823 Trial4.xlsm Search (Alt+Q)

File Home Insert Page Layout Formulas Data Review View Help Acrobat

BI247

12 Edge Number 03C0091 T23 Number of Spans 1 Adjust Data Entry CLEAR ALL EXISTING DATA

13 Bridge Name Pix River

14 LRE Name TGZ Do we have corrosion? NO

15 LRC Name XXX Truss Type Pony Truss

16 Date 8/4/2023 SuperStructure Name Span 1 (09/20)

17

18 Longitudinal Section

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21

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23

24

25

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28

29

30 Number of Panels To be Analyzed

Span #	# of NODES	# Nodes need	Adjust NODE Entry Rows
1	24	11	

31

32

33 Enter chord members (Left side first and Right side) first, then enter

34

35

36 Switch to Data Entry Mode

37

Span	Num	Node Name	Number of Members	End Node for Members Connecting to the Joint (Maximum number of members is 8)	Microstation Member Numbers
Generated	1	L0	2	L1 U1	C4 U3
Generated	1	L2	4	L1 L3 U1 U2	C0 C4 U1 U2
Generated	1	L4	4	L3 L5 U3 U4	C0 C4 U1 U2
Generated	1	L6	5	L5 L7 U5 U6 U7	C0 C4 U1 U2 U3
Generated	1	U1	4	L0 U2 L2 L1	C0 C4 L5 L6
Generated	1	U2	4	U1 U3 L3 L2	C0 C4 L5 L6
Generated	1	U4	4	U3 U5 L5 L4	C0 C4 L5 L6
Generated	1	U5	4	U4 U6 L6 L5	C0 C4 L5 L6
Generated	1	L3	4	L2 L4 U2 U3	C0 C4 U1 U2
Generated	1	U3	4	U2 U4 L4 L3	C0 C4 L5 L6
Generated	1	L1	3	L0 L2 U1	C0 C4 U2

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Update Microstation Sheet

Note: Before generating sheets for each NODES, visit the "Original" Sheet and enter common data for ALL connections!!!

After Entering all the Node requiring analysis and End Node for ALL members attached to the Node,

Number of Node Worksheet to generate

Generate NODE Worksheets

Generate Specific NODE Worksheet

Delete Specific NODE Worksheet

Delete ALL NODE Worksheets

TRANSFER DATA TO BrDR SOFTWARE

Transfer Data from Another workbook



# Step 5: Add Additional Data to the Generated Sheet

L2	Span Number	1			
	Number of members connected	4			
	Joints	L1	L3	U1	U2
	BrDR Member Number	7	3	8	1
	Member Name	L2-L1	L2-L3	L2-U1	L2-U2
	Type of Member	Lower Chord	Lower Chord	Diagonal	Vertical
	Microstation Member Name	C0	C4	U1	U2
	<b>Overall Gusset Plate Size and Material</b>				
	Thickness of gusset =	0.3125 in		Connector Name: 0.875 inch Rivet	
	Diameter of Rivets =	0.875 in		Material Name: Fy = 30 ksi; Fu = 56 ksi	
	Diameter of Holes =	0.9375 in		Condition of the Gusset Plates: Good or Satisfactory	
	F <sub>y</sub> Gusset =	30.0 ksi		Do we have Corrosion within Gusset? (YES/NO): NO	
	F <sub>u</sub> Gusset =	56.0 ksi		Identical Gusset Plates (either side)? YES	
	Overall Maximum Width (Length)	26.100 in		Chord End Bearing? NO	
	Overall Maximum Height	29.635 in		Chord End Bearing Percentage? NO	
		Lower Chord	Lower Chord	Diagonal	Vertical
	Is Chord a Continuous through the Joint?	NO	NO		
	% Loads Transfer via rivets/bolts (If YES)				
	% Loads transfer to Gusset Plates (if YES)				
	Is there a chord splice within Gusset Plate?	NO	NO		
	Depth of Member [perpendicular to CL] (in)	10.530	10.240	7.820	8.640
	Slope of Members (from True Horizontal)	180.00	0.00	127.00	90.00
	<b>Fasteners and Lengths</b>				
		L1	L3	U1	U2
	Total (N <sub>fast</sub> )	9	5	10	12
	Number of rivets Along Left edge	3	2	5	6
	Number of Rivet holes for shear (N <sub>sh</sub> ) along Left edge	2.5	1.5	4.5	5.5
	Distance from first to last row (L <sub>don_left</sub> ) of Left layer	12.090	5.590	10.670	14.860
	Distance from edge of Gusset to first row (L <sub>vg_left</sub> ) of Left layer	13.500	6.940	12.230	16.320
	Number of rivets Along right edge	3	2	5	6
	Number of Rivet holes for shear (N <sub>sh</sub> ) along right edge	2.50	1.50	4.50	5.50
	Distance from first to last row (L <sub>don_right</sub> ) of Right layer	12.180	5.490	10.600	15.070
	Distance from edge of Gusset to first row (L <sub>vg_right</sub> ) right layer	13.520	6.750	12.140	16.510
	Total shear plane length (L <sub>vg</sub> )	27.020	13.690	24.370	32.830
	Total number of rivet holes (N <sub>vh</sub> )	5.00	3.00	9.00	11.00
	Distance from first to last row (L <sub>don</sub> )	12.180	5.590	10.670	15.070
	Number of End row Fasteners (N <sub>fast_end</sub> )	2	2	2	2
	Dist between first and Last Layer (D <sub>don</sub> )	4.920	4.870	4.630	4.720
	Number of first row Fasteners (N <sub>fast</sub> )	2	2	2	2
	Distance between extreme fasteners at Start/First row (L <sub>vg</sub> )	7.725	7.555	4.630	4.720
	Number of Rivet holes for tension (N <sub>th</sub> )	2	2	2	2
	Distance from edge of gusset to fastener along long. axis (L <sub>str_e</sub> )	1.500	1.500	1.500	1.500
	<b>Length Perpendicular to Member at first row (for Whitmore Section)</b>				
	Distance from CL of Mem to edge of Gusset (in) on Left side	24.610	5.000	16.350	6.400
	Distance from CL of Mem to edge of Gusset (in) on Right side	4.980	24.680	13.210	19.330

Reset the data entry fields

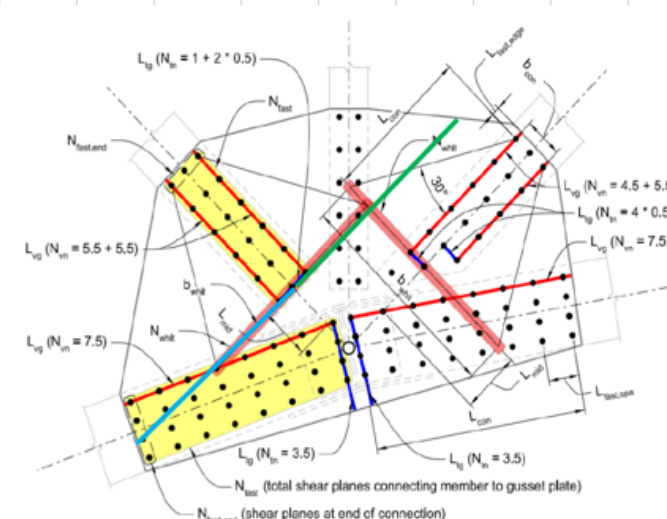
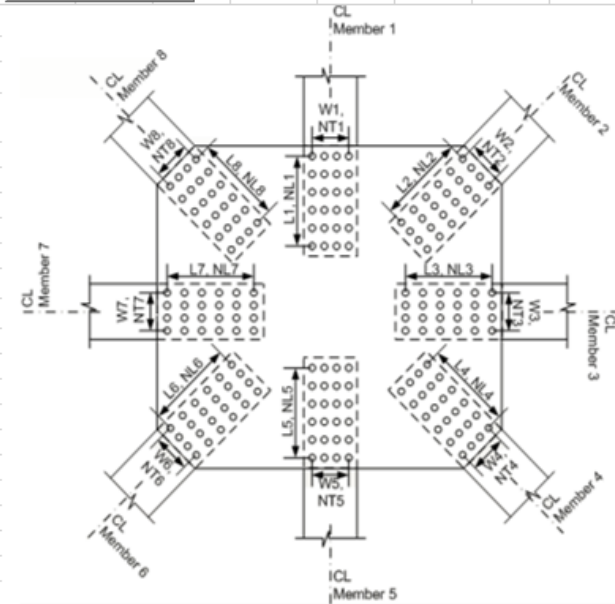


Figure 13 - Member Connection Variables



# Step 6: Transfer Gusset Plate Data into BrDR Model

CLEAR ALL EXISTING DATA

Bridge Number	03C0091 T23	Number of Spans	1	<span style="border: 1px solid gray; padding: 2px;">Adjust Data Entry</span>	Step_1 Enter the Number Spans and Click on <b>Adjust Data Entry Rows</b>
Bridge Name	Pit River	Do we have corrosion?	NO		Step_2 Enter Number of Panels, needs analysis in each Span and then Click on <b>Adjust DataEntry</b>
LRE Name	TGZ	Truss Type	Pony Truss		Step_3 Enter Joint Number and End of all Members joining the Nodes for ALL joints that need to be analyzed.
LRC Name	XXX				Step_4 Once entered all of them Click on <b>Update MicroStationSheet</b> .
Date	8/4/2023	SuperStructure Name	Span 1 (01/20)		Step_5 Go to DataFromMicroStation sheet, and paste the values for corresponding Joint

**Longitudinal Section**

**Number of Panels To be Analyzed**

Span #	# of NODES	# Nodes need	<span style="border: 1px solid gray; padding: 2px;">Adjust NODE Entry Rows</span>
1	24	11	

Enter chord members (Left side first and Right side) first, then enter

1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Switch to Data Entry Mode

Span	Num	Node Name	Number of Members	End Node for Members Connecting to the Joint (Maximum number of members is 8)	Microstation Member Numbers
Generated	1	L0	2	L1 U1	C4 U3
Generated	1	L2	4	L1 L3 U1 U2	C0 C4 U1 U2
Generated	1	L4	4	L3 L5 U3 U4	C0 C4 U1 U2
Generated	1	L6	5	L5 L7 U5 U6 U7	C0 C4 U1 U2 U3
Generated	1	U1	4	L0 U2 L2 L1	C0 C4 L5 L6
Generated	1	U2	4	U1 U3 L3 L2	C0 C4 L5 L6
Generated	1	U4	4	U3 U5 L5 L4	C0 C4 L5 L6
Generated	1	U5	4	U4 U6 L6 L5	C0 C4 L5 L6
Generated	1	L3	4	L2 L4 U2 U3	C0 C4 U1 U2
Generated	1	U3	4	U2 U4 L4 L3	C0 C4 L5 L6
Generated	1	L1	3	L0 L2 U1	C0 C4 U2

After Entering all the Node requiring analysis and End Node for ALL members attached to the Node,

Update MicroStation Sheet

Note: Before generating sheets for each NODES, visit the "Original" Sheet and enter common data for ALL connections!!!

Number of Node Worksheet to generate

Generate NODE Worksheets	Generate Specific NODE Worksheet	Delete Specific NODE Worksheet	Delete ALL NODE Worksheets
--------------------------	----------------------------------	--------------------------------	----------------------------

TRANSFER DATA TO BrDR SOFTWARE
Transfer Data from Another workbook



# Transfer Gusset Plate Data to BrDR Model with VBA Macro

```
\\ct.dot.ca.gov\dfshq\SMI\Corporate\Analysis\Bridge Ratings\Rating Analysis Branch\AASHTOWareBrR\13_Tools\Gusset Plate Automation Tool\Gusset...
----- BrDR 7.4 GUSSET PLATE AUTOMATION TOOL V. 04122023 -----
Database Name: SMI_local74
Enter Bridge Name: 03C0091 TZ3
Session started!

Bridge Description: Date: 01-16-2020
Bridge Name: PIT RIVER
Bridge Number: 03C0091
Reviewer: Jian Hu; Checker: Dol Adhikari
RecursiveLastChangeTimestamp: 5/18/2023 7:01:02 PM

Gusset Plate Automation has started...
D:\BrDR Tools\Gusset Plate Transfer Tool Files\BrDRGussetPlateTransferFile.xlsx has been loaded

The 'Span 1 (01/20)' superstructure definition is found.
The 'Fy = 30 ksi; Fu = 56 ksi' structural steel definition is found.
The '0.875 inch Rivet' rivet definition is found.

Press any key to continue or close the window to cancel...

'L0' Gusset Plate Definition is created
'L2' Gusset Plate Definition is created
'L4' Gusset Plate Definition is created
'L6' Gusset Plate Definition is created
'U1' Gusset Plate Definition is created
'U2' Gusset Plate Definition is created
'U4' Gusset Plate Definition is created
'U5' Gusset Plate Definition is created
'L3' Gusset Plate Definition is created
'U3' Gusset Plate Definition is created
'L1' Gusset Plate Definition is created

11 Gusset Defs are created and saved to the model!
Session ended!

Press any key to exit...
```



# New Gusset Plate Data Added in Existing BrDR Model

The screenshot displays the Bridge Workspace software interface. The top menu bar includes 'BRIDGE WORKSPACE', 'WORKSPACE', 'TOOLS', 'VIEW', and 'ANALYSIS'. The 'ANALYSIS' menu is currently active, showing options like 'DESIGN/RATE', 'Open', 'New', 'Copy', 'Paste', 'Duplicate', 'Delete', and 'Schematic'. The main workspace area is divided into a 'Workspace' pane on the left and a 'Schematic' pane on the right. The 'Workspace' pane shows a tree view of the project structure, with 'Gusset Plate Definitions' expanded to show a list of gusset plates: L0, L2, L4, L6, U1, U2, U4, U5, L3, U3, and L1. The 'U1' entry is highlighted with a red box. The 'Schematic' pane shows the 'Gusset Plate Definition' dialog box for 'U1'. The dialog box has a 'Name' field set to 'U1' and several tabs: 'Description', 'Panel point', 'Fasteners', 'Plate tension', 'Plate compression', 'Plate shear', 'Chord splice', and 'Load transfer'. The 'Description' tab is selected. The 'Description' field is empty. The 'Plates' section has three radio button options: 'Single gusset plates', 'Identical double gusset plates' (which is selected), and 'Different double gusset plates'. The 'Condition factor' is set to 'Good or Satisfact' and 'Contains corrosion' is unchecked. The 'Dimensions' section has a checkbox for 'Field measured section properties' which is unchecked. The 'Left plate' section has a material dropdown set to 'Fy = 30 ksi; Fu = 56 ksi', an 'As-built plate thickness' of 0.31 in, a 'Length' of 28.94 in, and a 'Height' of 30.29 in. The 'Right plate' section has a material dropdown set to '1905 to 1936 Steel', and empty fields for 'As-built plate thickness', 'Length', and 'Height'. At the bottom of the dialog box, there is a 'Member arrangement' button and 'OK', 'Apply', and 'Cancel' buttons.



# Discussion

- Accuracy of Drone Photos
- Corrosion and Deterioration
- LFR vs LRFR for truss bridge rating
- Rivet Size and Material Designation
- Enhancements recommended for Truss/Gusset Plate Rating



# Enhancement for Truss and Gusset Plate

## Gusset Plate:

- BSSD-2794 (HNTB): BrDR Gusset Module: Comments on the treatment of continuous chords (the item same as BSSD-4091)
- BSSD-3849 (Caltrans): Include splice plates when rating gusset plate chord splices, if any
- BSSD-1826(Baker): Check connector's bearing and block shear capacity on all the connected truss members when rating gusset plates.

## Truss:

- BSSD-1810(Billy Metcalf): Spec check for AASHTO BDS Article 6.8.2 does not use the user-defined shear lag factor U

# Thanks!

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Questions?

