Bridge Design Details 11.1 January 2024

Girder Elevation

1. Dimension locations of field splices.
2. Show distances from the centerlines of bearings to the ends of girders.
3. Show sizes of web plates and flange plates.
4. Dimension locations of stiffeners.
5. Show spacing of stud connectors.
6. Denote member designation
    a) Show notes about Charpy V-Notch (CVN) and Fracture Critical Member (FCM) requirements as applicable.
    b) Identify and define limits for:
        i. Fracture Critical Members
        ii. Main Members - Tension (T) or Compression (C)
        iii. Primary Components of Main Members - Tension or Compression
        iv. Secondary Members

Camber Diagram

1. Draw diagrams for both the WEB CAMBER and the SCREED CAMBER, but do not scale.
2. Show Camber components table.

Field Splices

1. Show sizes of all splice plates, fill plates, and bolt diameters.
2. Show weld symbols (weld type and size).
3. Show bolt layout including spacing and edge distance.
4. Show gap distance between spliced girder segments.

Cross frames, Diaphragms and Lateral Bracings

1. Show all member designations and dimensions.
2. Show weld symbols (weld type and size).
3. Show bolt layout including spacing and edge distance.
4. Show dimensions from working points to flanges.
5. Provide notes on loading conditions during erection, as applicable. Specify whether details apply to “NO LOAD”, “STEEL COMPONENTS DEAD LOAD” or “FINAL DEAD LOAD” conditions.

Bearings

1. Show all components and fasteners, including sole plate details.
2. Show weld symbols (weld type and size).
3. Show bolt layout including spacing and edge distance

Figure 11A.A.1 Steel Girder Bridge Detailing Example 1

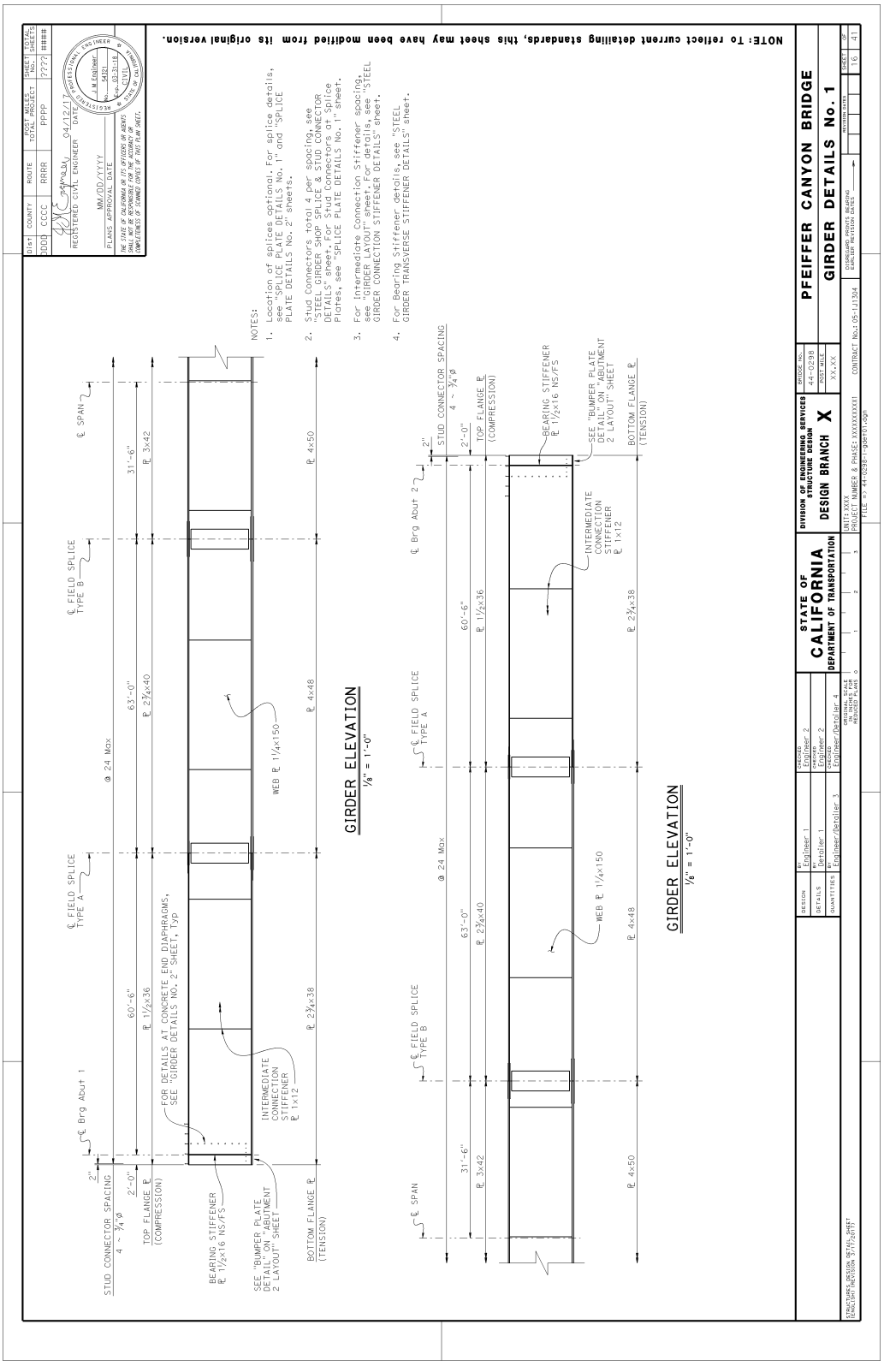


Figure 11A.A.2 Steel Girder Bridge Detailing Example 2

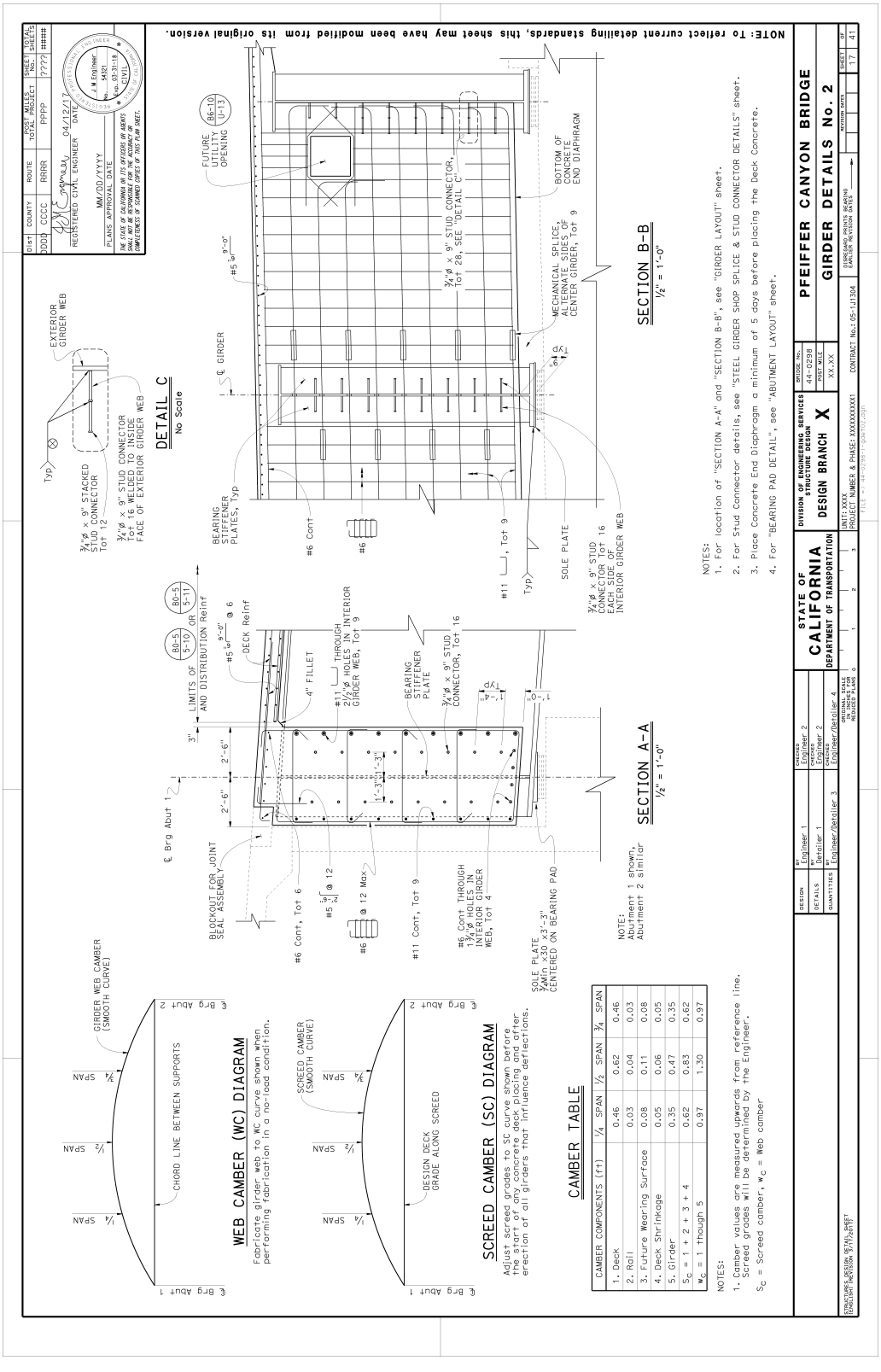


Figure 11A.A.3 Steel Girder Bridge Detailing Example 3

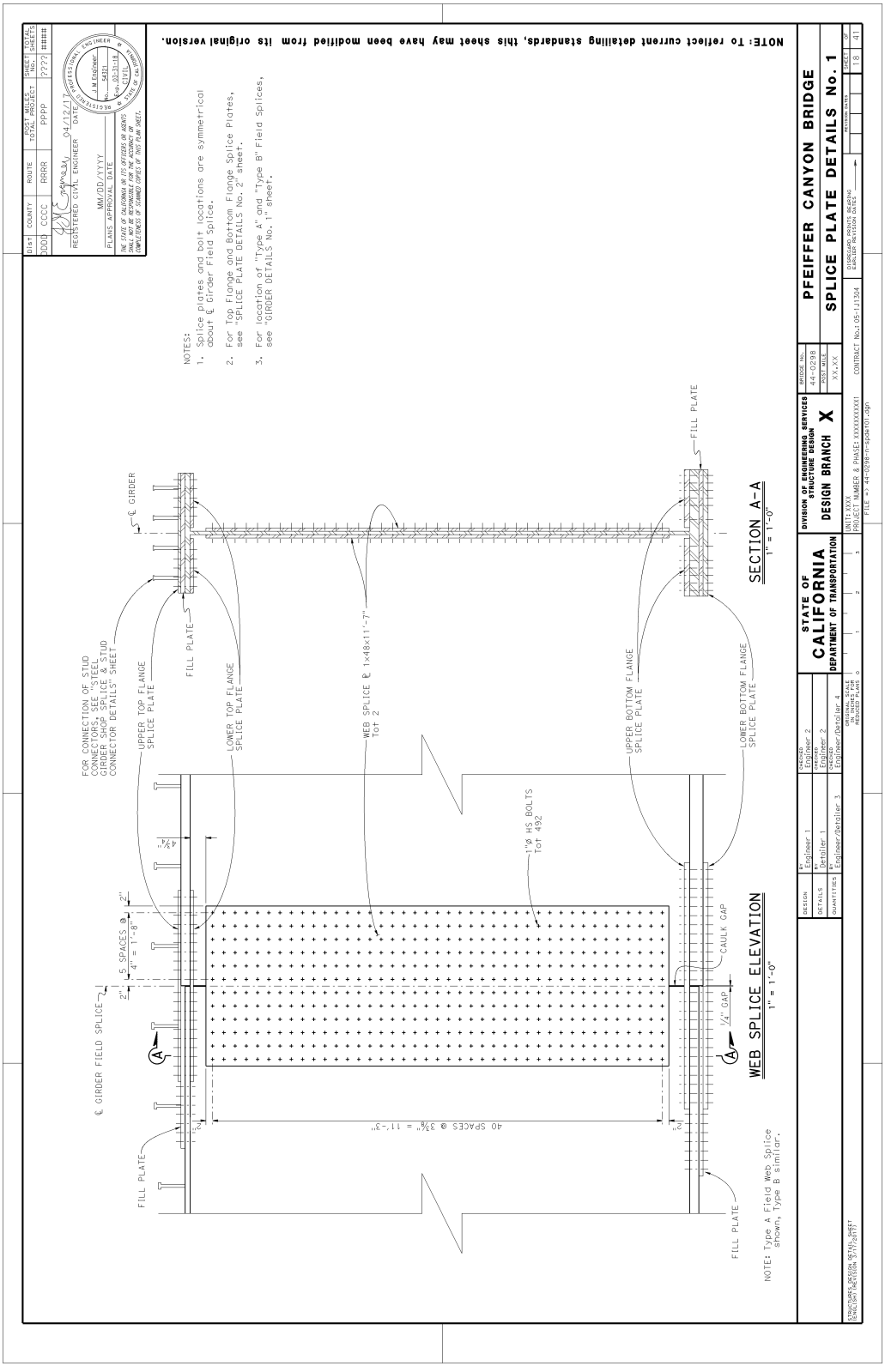


Figure 11A.A.4 Steel Girder Bridge Detailing Example 4

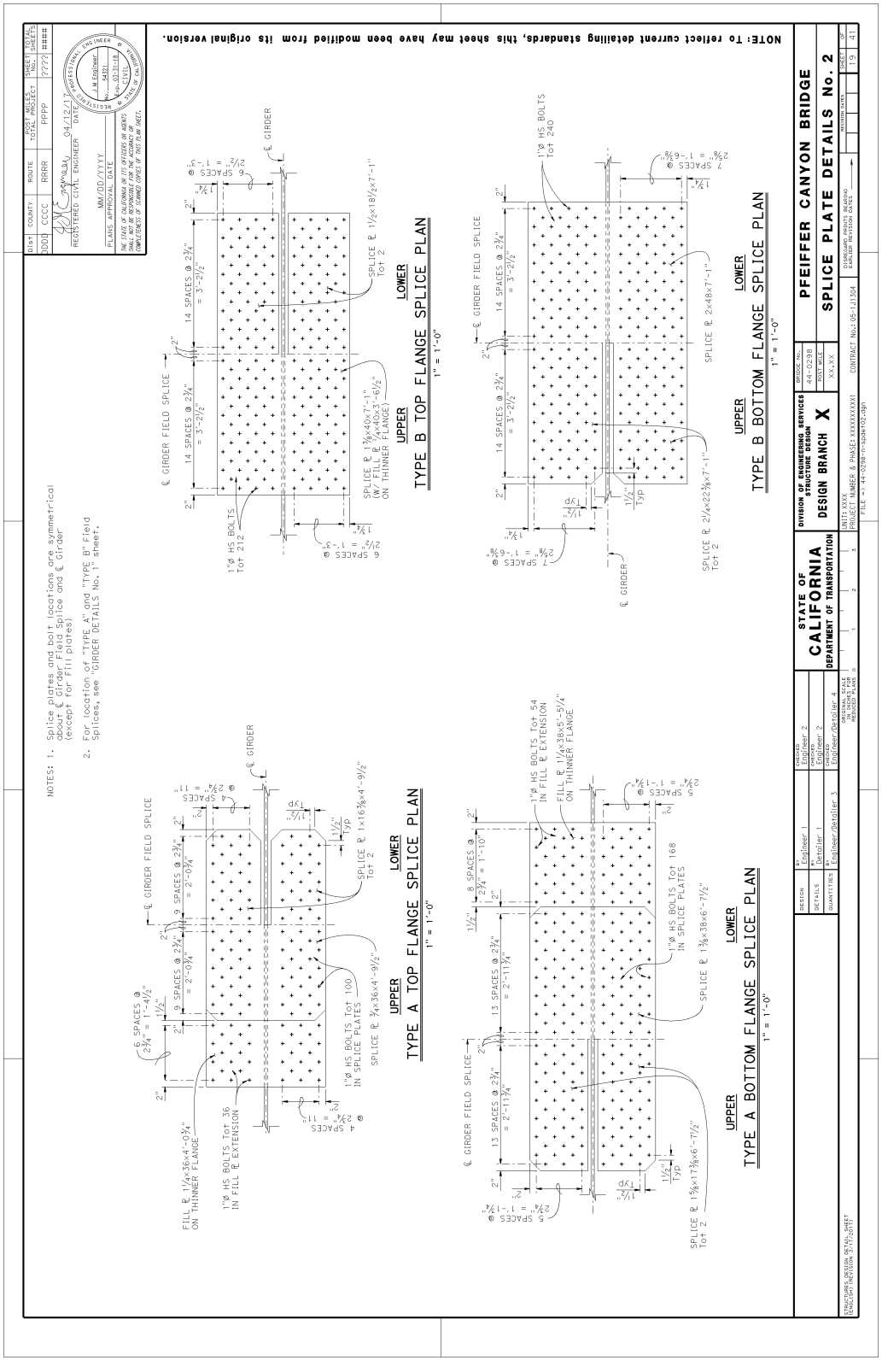


Figure 11A.A.5 Steel Girder Bridge Detailing Example 5

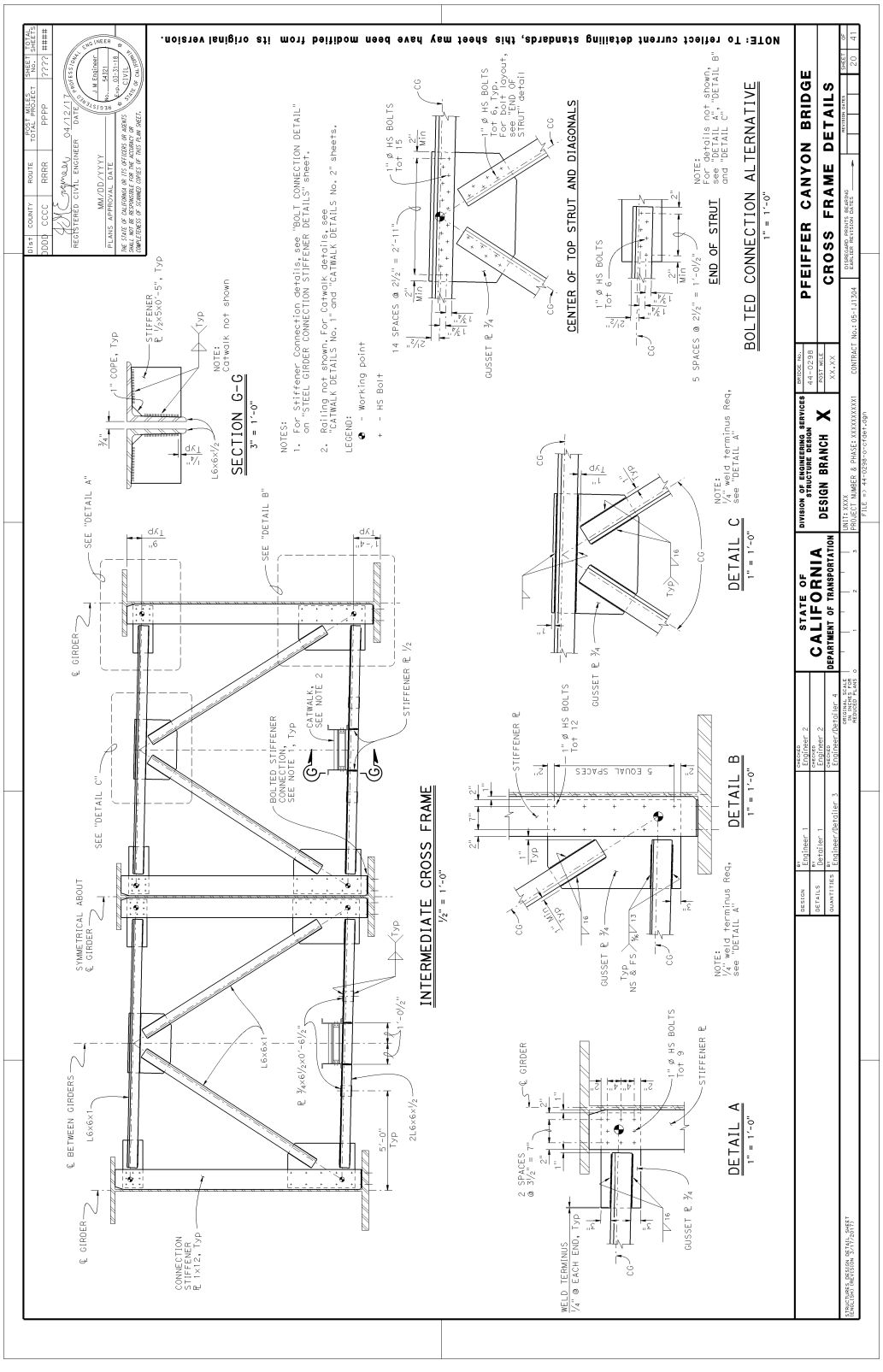
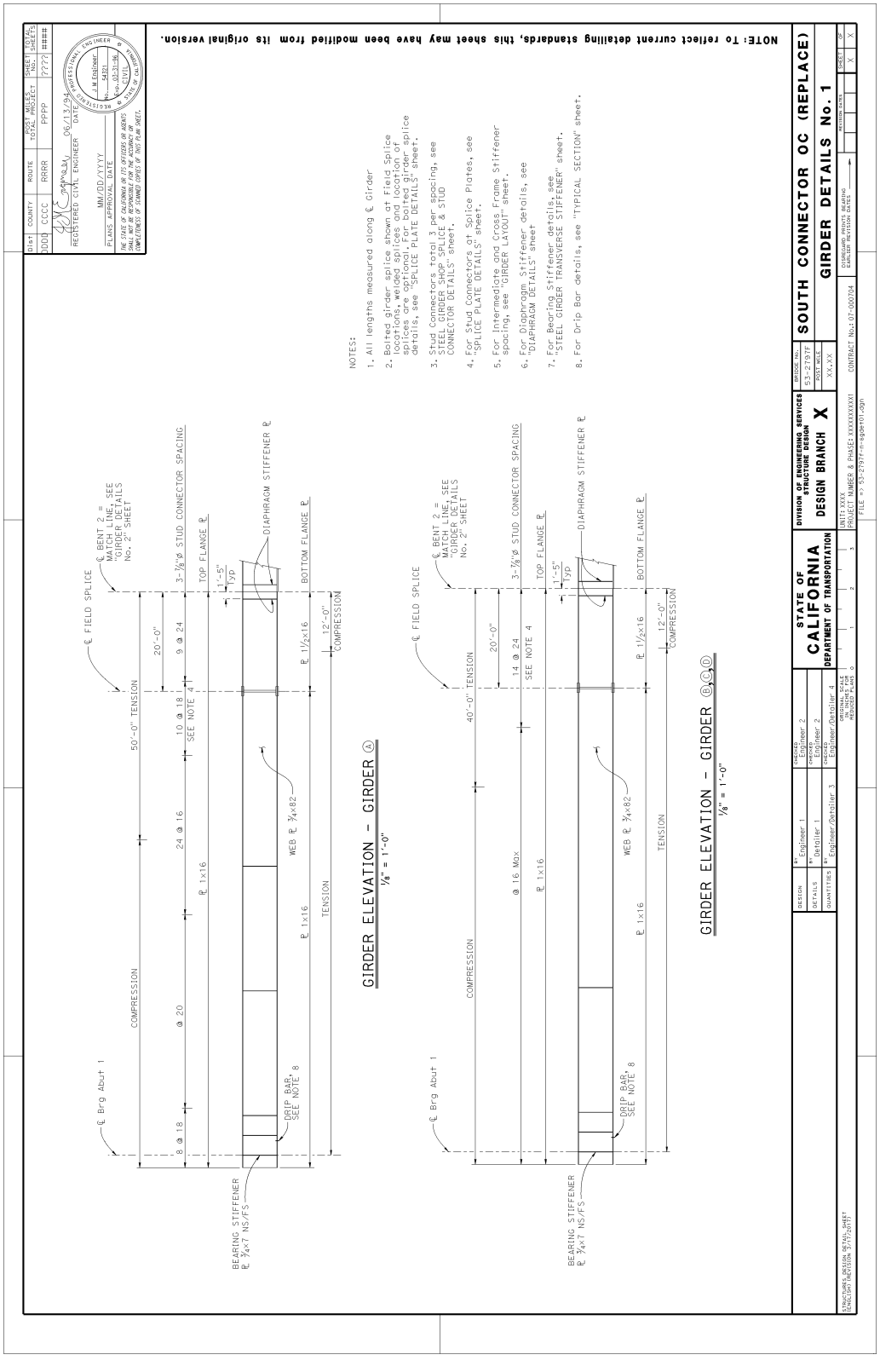


Figure 11A.A.6 Steel Girder Bridge Detailing Example 6



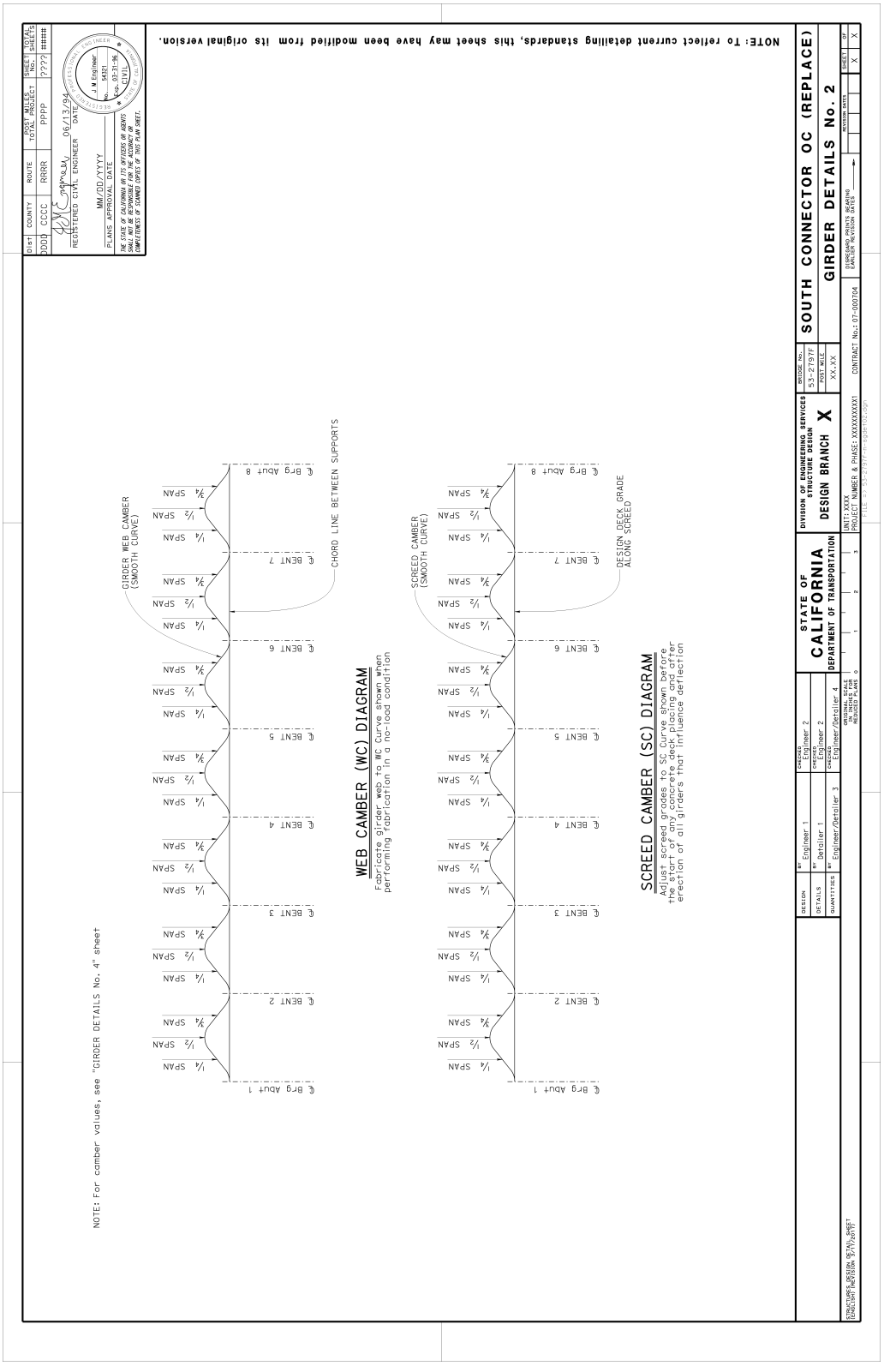


Figure 11A.A.7 Steel Girder Bridge Detailing Example 7

Figure 11A.A.8 Steel Girder Bridge Detailing Example 8

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
DDDD	CCCC	RRRR	PPPP	????	#####

REGISTERED CIVIL ENGINEER — DATE 06/13/94

J. M. Engineer, No. 54321, Exp. 03-31-96, CIVIL

MM/DD/YYYY
PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

NOTES: Camber values are in feet and are measured upwards from reference line.
Header grades will be determined by Engineer.
S_C = Screed camber, w_C = Web camber

CAMBER TABLE

GIRDER	CAMBER COMPONENTS	SPAN 1			SPAN 2			SPAN 3			SPAN 4			SPAN 5			SPAN 6			SPAN 7		
		¼	½	¾	¼	½	¾	¼	½	¾	¼	½	¾	¼	½	¾	¼	½	¾	¼	½	¾
A	1. Deck	0.07	0.09	0.05	0	-0.02	-0.05	0.31	0.48	0.26	0.06	0.20	0.11	0.14	0.24	0.20	0.20	0.37	0.20	0.08	0.22	0.20
	2. Rail	0.01	0.01	0.01	0	0	0	0.04	0.05	0.03	0.01	0.03	0.02	0.02	0.03	0.02	0.02	0.04	0.02	0.01	0.02	0.02
	3. Deck Shrinkage	0.02	0.02	0.01	-0.01	-0.01	-0.01	0.01	0.01	0.01	-0.01	-0.01	-0.01	0	0.01	0.01	-0.01	-0.02	-0.02	0.02	0.04	0.04
	4. Girder	0.02	0.03	0.02	0	-0.01	-0.02	0.11	0.18	0.10	0.02	0.07	0.04	0.06	0.10	0.04	0.06	0.12	0.06	0.03	0.07	0.07
	5. VERTICAL CURVE	-0.04	-0.05	-0.04	0.04	0.03	0.03	0.48	0.64	0.48	0.46	0.62	0.46	0.36	0.41	0.22	0	0	0	-0.09	-0.18	-0.14
	S_C = 1 + 2 + 3	0.10	0.12	0.07	-0.01	-0.03	-0.06	0.36	0.54	0.30	0.06	0.22	0.12	0.16	0.28	0.23	0.21	0.39	0.20	0.11	0.28	0.26
	w_C = 1 though 5	0.08	0.10	0.05	0.03	-0.01	-0.05	0.95	1.36	0.88	0.54	0.91	0.62	0.58	0.79	0.49	0.27	0.51	0.26	0.05	0.17	0.19
B	1. Deck	0.06	0.08	0.05	0.01	0	-0.03	0.27	0.42	0.23	0.07	0.20	0.11	0.12	0.22	0.10	0.18	0.34	0.18	0.08	0.20	0.18
	2. Rail	0	0.01	0	0	0	0	0.03	0.04	0.02	0.01	0.02	0.01	0.02	0.03	0.01	0.02	0.03	0.02	0.01	0.02	0.02
	3. Deck Shrinkage	0.02	0.02	0.01	-0.01	-0.01	-0.01	0.01	0.01	0.01	-0.01	-0.01	-0.01	0	0.01	0.01	-0.01	-0.02	-0.02	0.02	0.04	0.04
	4. Girder	0.02	0.02	0.01	0	0	-0.01	0.10	0.15	0.08	0.03	0.07	0.04	0.05	0.08	0.04	0.06	0.10	0.06	0.02	0.06	0.06
	5. VERTICAL CURVE	-0.06	-0.07	-0.05	-0.01	-0.02	0.01	0.48	0.64	0.48	0.46	0.62	0.46	0.36	0.41	0.22	0	0	0	-0.09	-0.18	-0.15
	S_C = 1 + 2 + 3	0.08	0.11	0.06	0	-0.01	-0.04	0.31	0.47	0.26	0.07	0.21	0.11	0.14	0.26	0.12	0.19	0.35	0.18	0.11	0.26	0.24
	w_C = 1 though 5	0.04	0.06	0.02	-0.01	-0.03	-0.04	0.89	1.26	0.82	0.56	0.90	0.61	0.55	0.75	0.38	0.25	0.45	0.24	0.04	0.14	0.15
C	1. Deck	0.04	0.08	0.04	0.02	0.01	-0.01	0.23	0.37	0.20	0.08	0.19	0.11	0.11	0.20	0.09	0.17	0.30	0.16	0.07	0.18	0.16
	2. Rail	0	0.01	0	0	0	0	0.02	0.04	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.02	0.03	0.02	0.01	0.02	0.01
	3. Deck Shrinkage	0.02	0.02	0.01	-0.01	-0.01	-0.01	0.01	0.01	0.01	0	0	0	0	0	0	-0.01	-0.01	-0.01	0.02	0.04	0.04
	4. Girder	0.02	0.02	0.01	0	0	-0.01	0.08	0.12	0.06	0.03	0.07	0.04	0.04	0.08	0.04	0.05	0.09	0.05	0.02	0.06	0.05
	5. VERTICAL CURVE	-0.07	-0.10	-0.07	-0.06	-0.09	-0.02	0.48	0.64	0.48	0.46	0.62	0.46	0.36	0.41	0.22	0	0	0	-0.10	-0.19	-0.18
	S_C = 1 + 2 + 3	0.06	0.11	0.05	0.01	0	-0.02	0.26	0.42	0.23	0.09	0.21	0.12	0.12	0.22	0.10	0.18	0.32	0.17	0.10	0.24	0.21
	w_C = 1 though 5	0.01	0.03	-0.01	-0.05	-0.09	-0.05	0.82	1.18	0.77	0.58	0.90	0.62	0.52	0.71	0.36	0.23	0.41	0.22	0.02	0.11	0.08
D	1. Deck	0.05	0.07	0.04	0.03	0.04	0	0.19	0.31	0.17	0.09	0.19	0.10	0.10	0.19	0.09	0.15	0.26	0.15	0.07	0.17	0.15
	2. Rail	0	0.01	0	0	0	0	0.02	0.03	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01
	3. Deck Shrinkage	0.02	0.02	0.01	-0.01	-0.01	-0.01	0.01	0.01	0.01	0	0	0	0	0	0	-0.01	-0.01	-0.01	0.02	0.04	0.04
	4. Girder	0.01	0.02	0.01	0.01	0.01	0	0.06	0.09	0.05	0.03	0.06	0.04	0.03	0.06	0.03	0.04	0.08	0.04	0.02	0.04	0.04
	5. VERTICAL CURVE	-0.09	-0.12	-0.09	-0.12	-0.14	-0.05	0.48	0.64	0.48	0.46	0.62	0.46	0.36	0.41	0.22	0	0	0	-0.11	-0.21	-0.19
	S_C = 1 + 2 + 3	0.07	0.10	0.05	0.02	0.03	-0.01	0.22	0.35	0.20	0.10	0.21	0.11	0.11	0.21	0.10	0.15	0.27	0.15	0.10	0.23	0.20
	w_C = 1 though 5	-0.01	0	-0.03	-0.09	-0.10	-0.06	0.76	1.08	0.73	0.59	0.89	0.61	0.50	0.68	0.35	0.19	0.35	0.19	0.01	0.06	0.05

NOTE: To reflect current detailing standards, this sheet may have been modified from its original version.

DESIGN	BY Engineer 1	CHECKED Engineer 2	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN	BRIDGE No. 53-2797F	SOUTH CONNECTOR OC (REPLACE)
DETAILS	BY Detailer 1	CHECKED Engineer 2		DESIGN BRANCH X	POST MILE XX.XX	GIRDER DETAILS No. 3
QUANTITIES	BY Engineer/Detailer 3	CHECKED Engineer/Detailer 4				

STRUCTURES_DESIGN_DETAIL_SHEET
(ENGLISH) (REVISION 3/17/2017)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: XXXX
PROJECT NUMBER & PHASE: XXXXXXXXXX1 CONTRACT No.: 07-000704

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES				SHEET	OF
				X	X

FILE => 53-2797f-n-sgde103.dgn

Figure 11A.A.9 Steel Girder Bridge Detailing Example 9

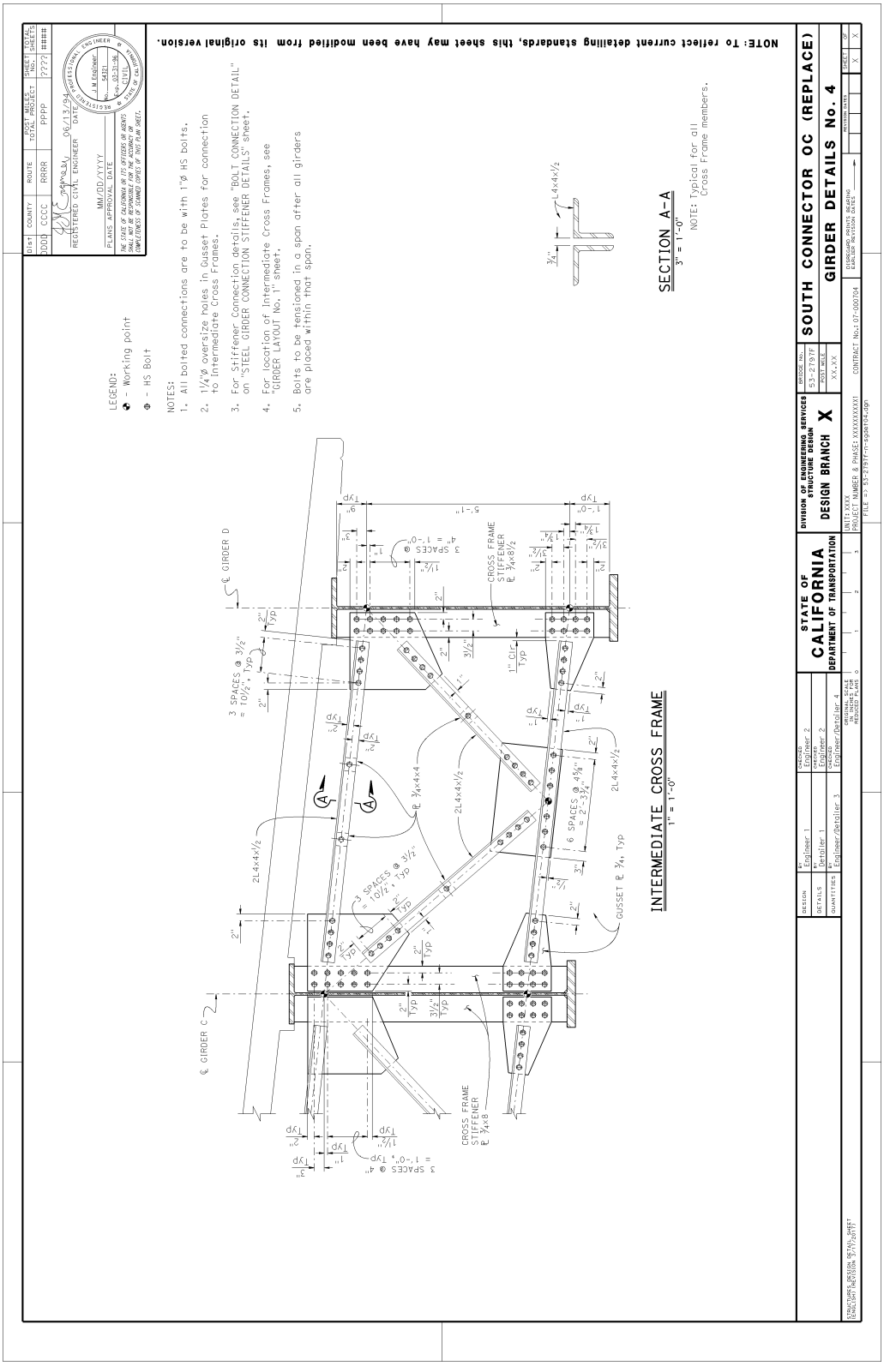


Figure 11A.A.10 Steel Girder Bridge Detailing Example 10

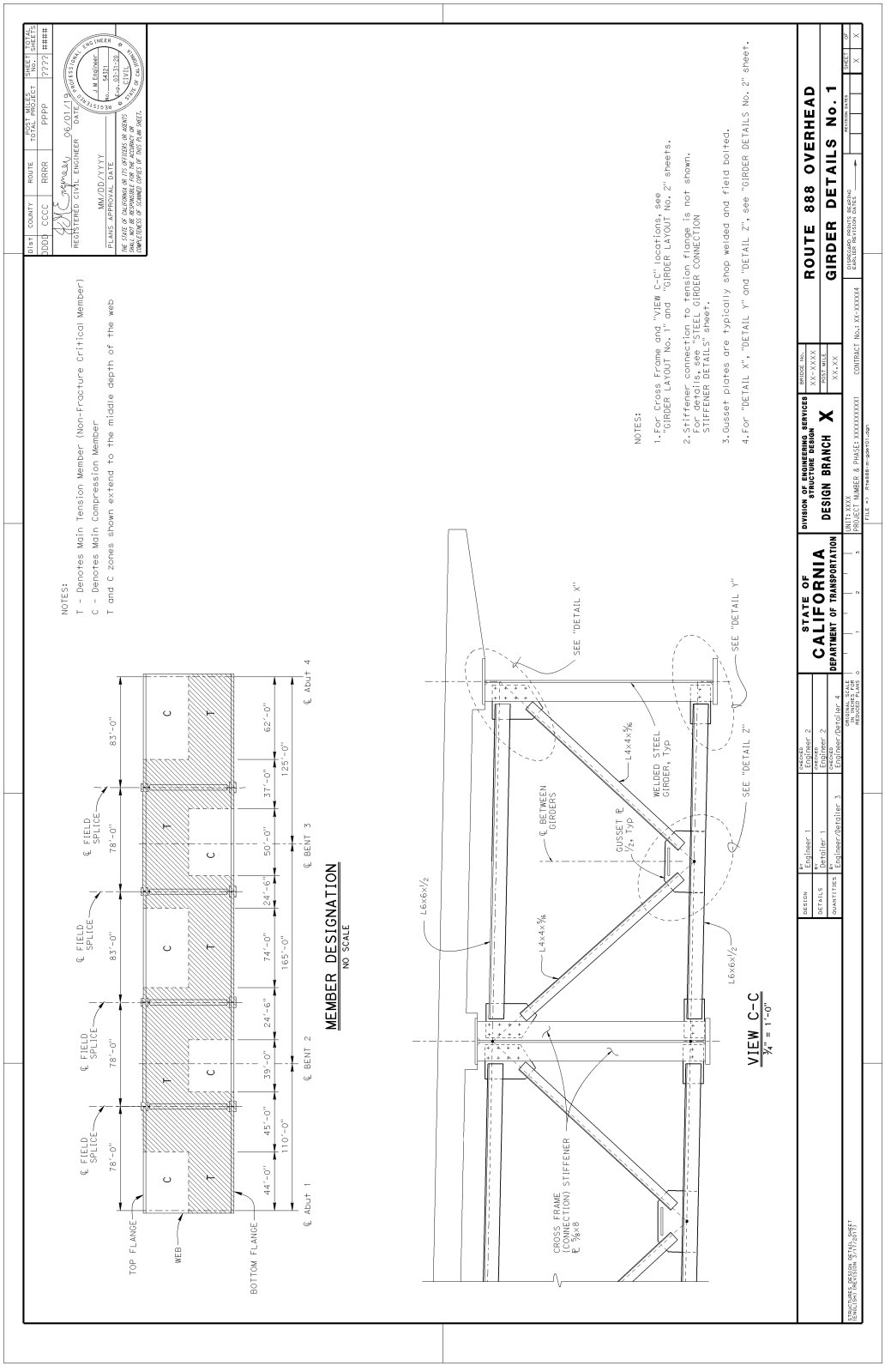


Figure 11A.A.11 Steel Girder Bridge Detailing Example 11

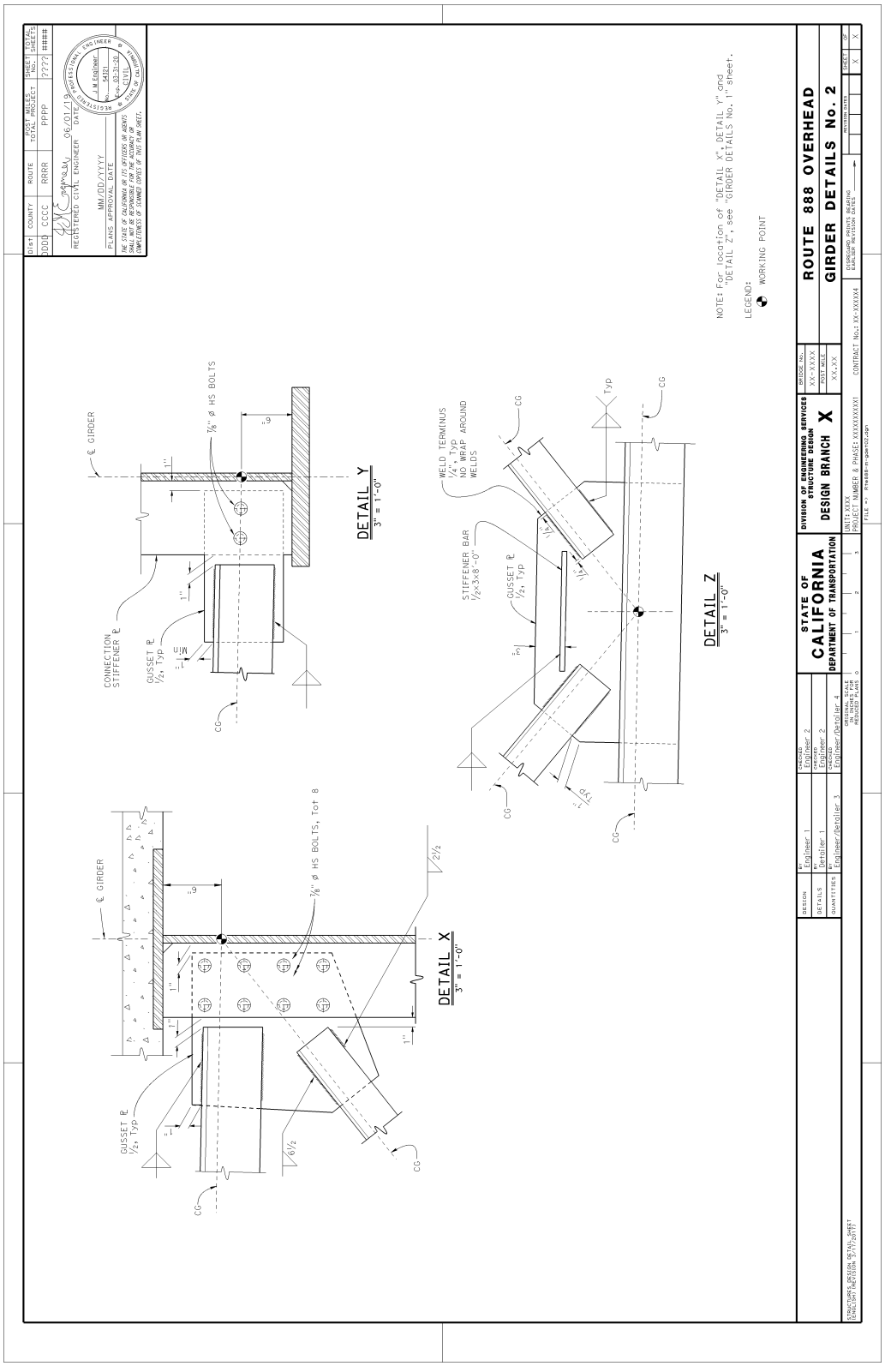


Figure 11A.A.12 Steel Girder Bridge Detailing Example 12

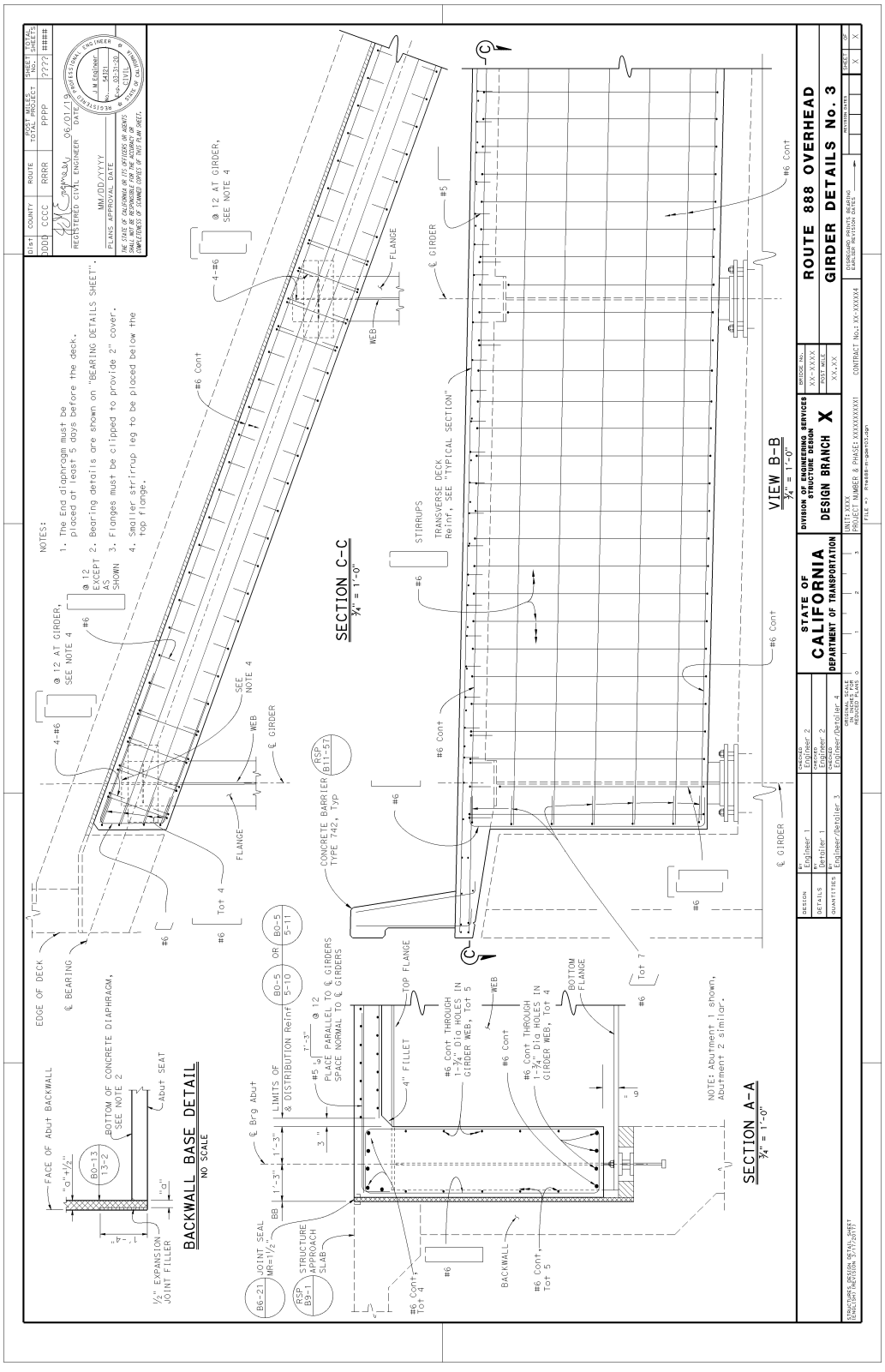


Figure 11A.A.13 Steel Girder Bridge Detailing Example 13

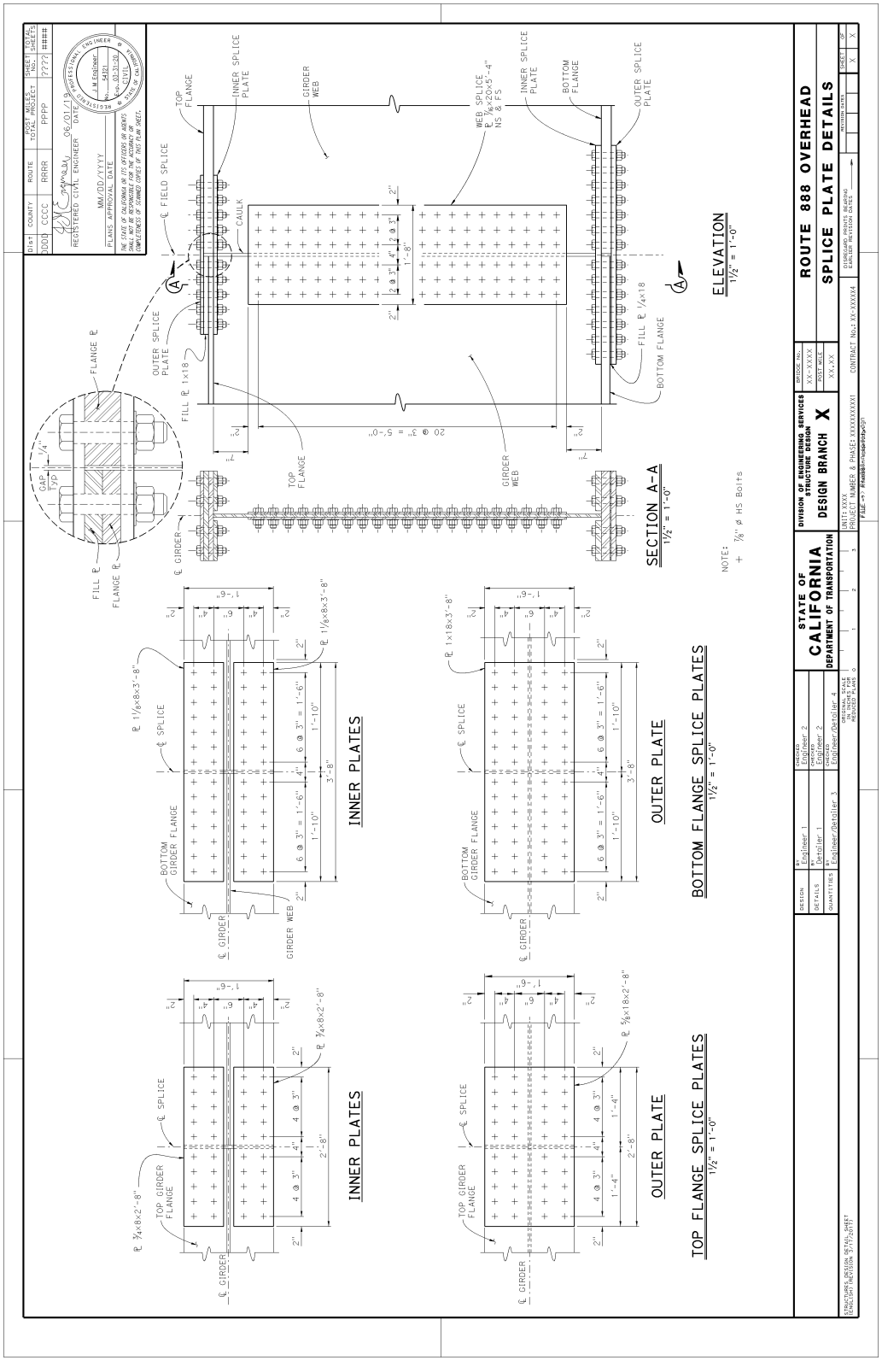


Figure 11A.A.14 Steel Girder Bridge Detailing Example 14

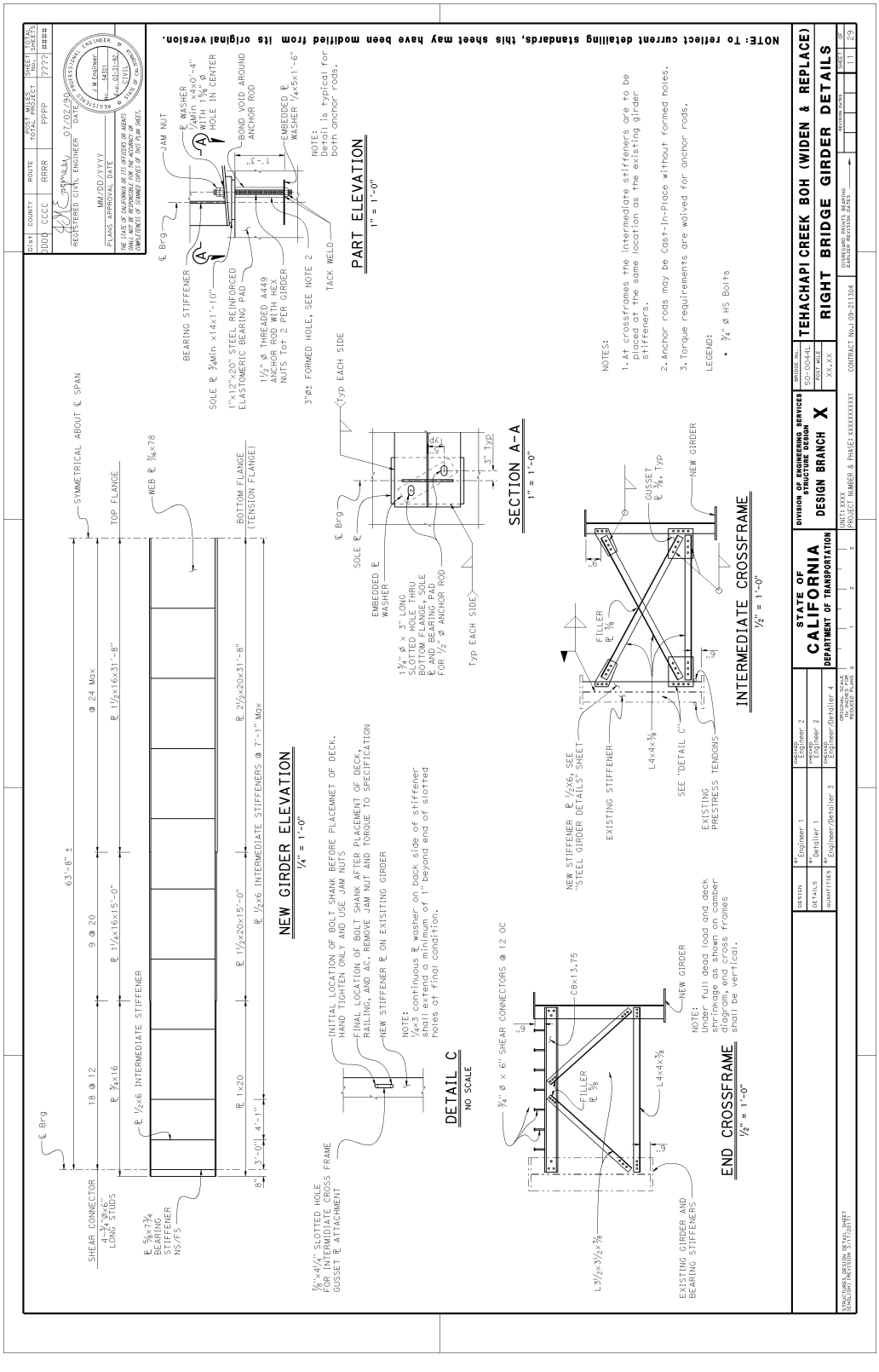


Figure 11A.A.15 Steel Girder Bridge Detailing Example 15

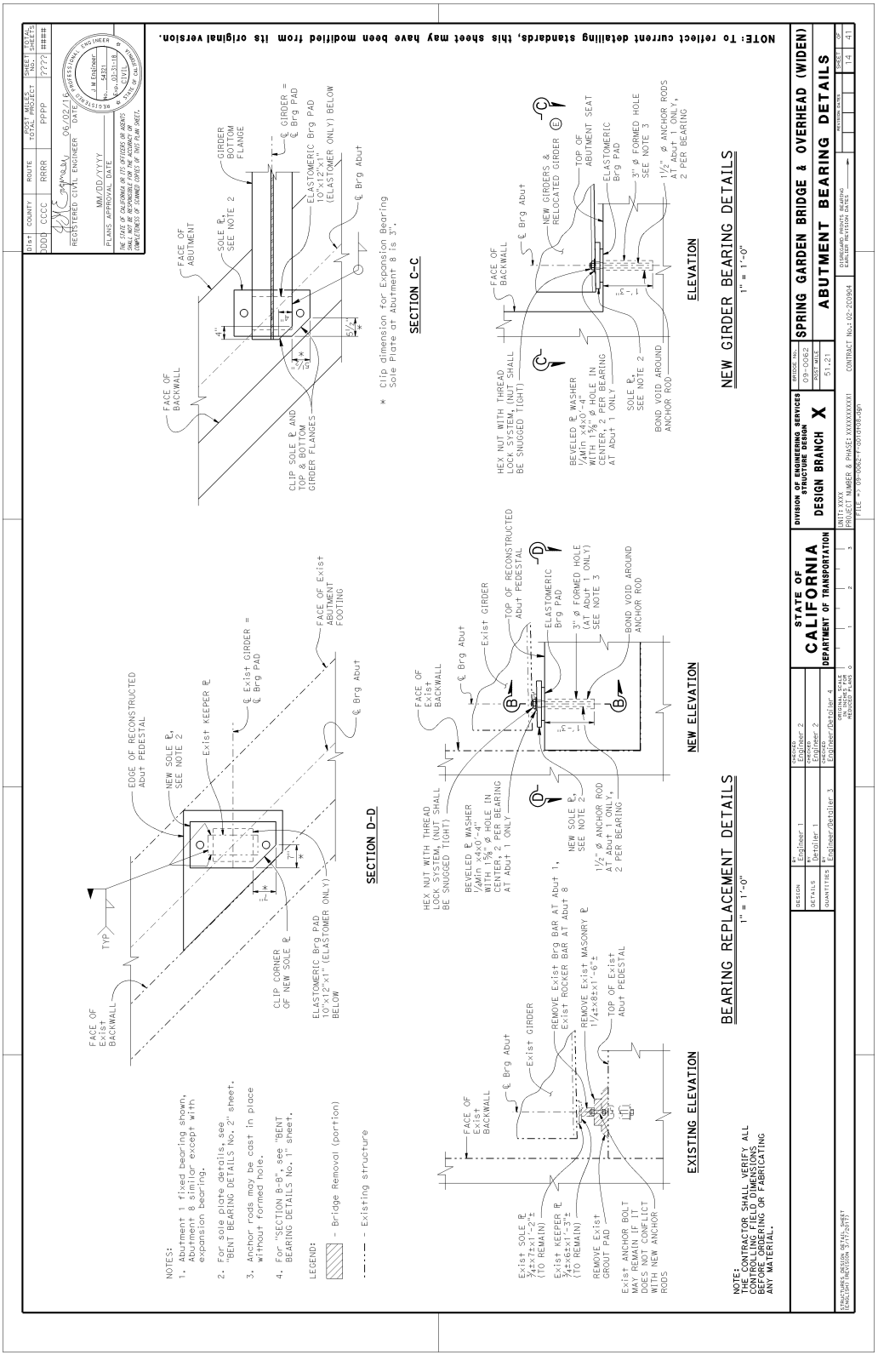


Figure 11A.A.16 Steel Girder Bridge Detailing Example 16

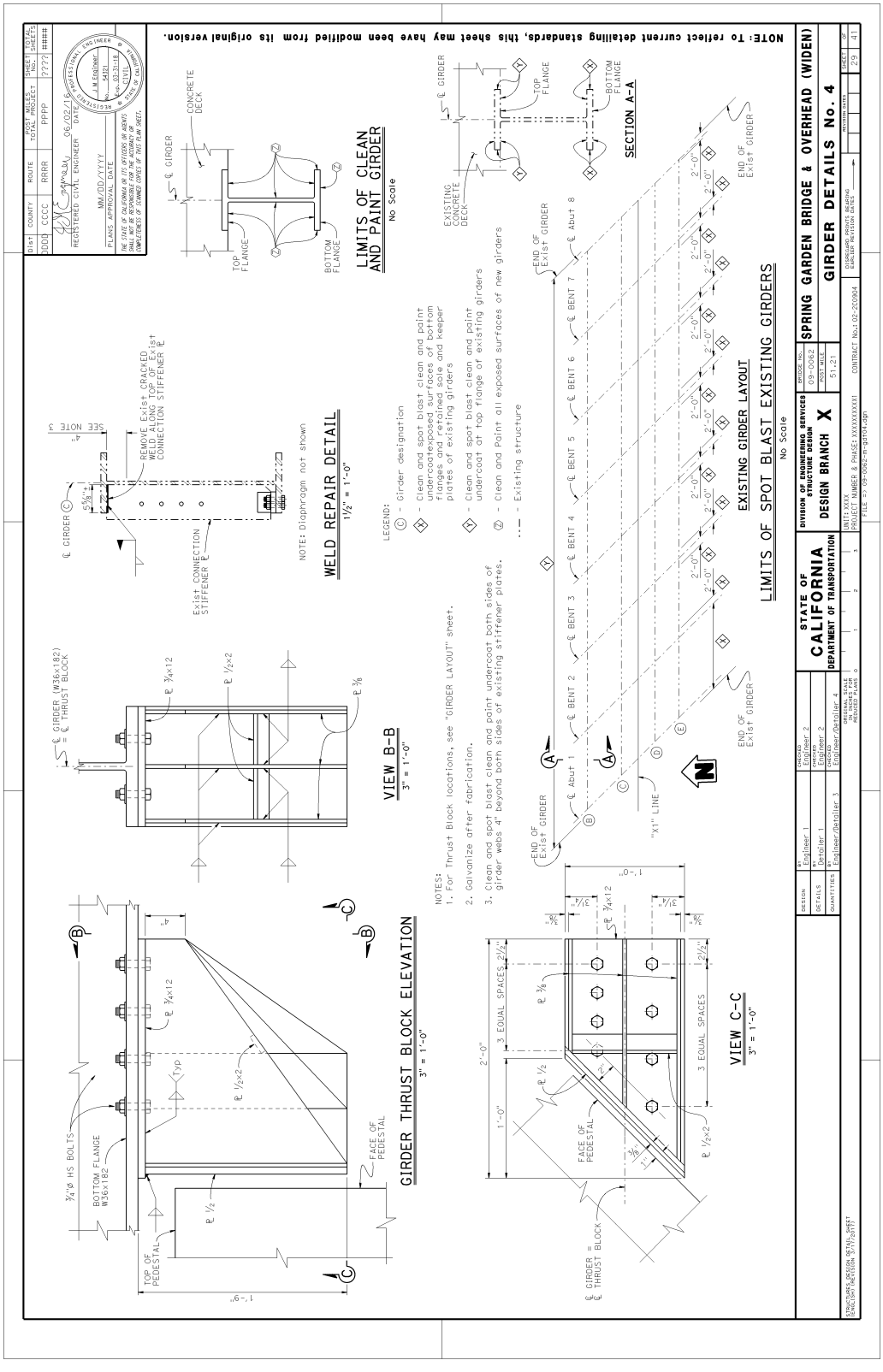


Figure 11A.A.17 Steel Girder Bridge Detailing Example 17

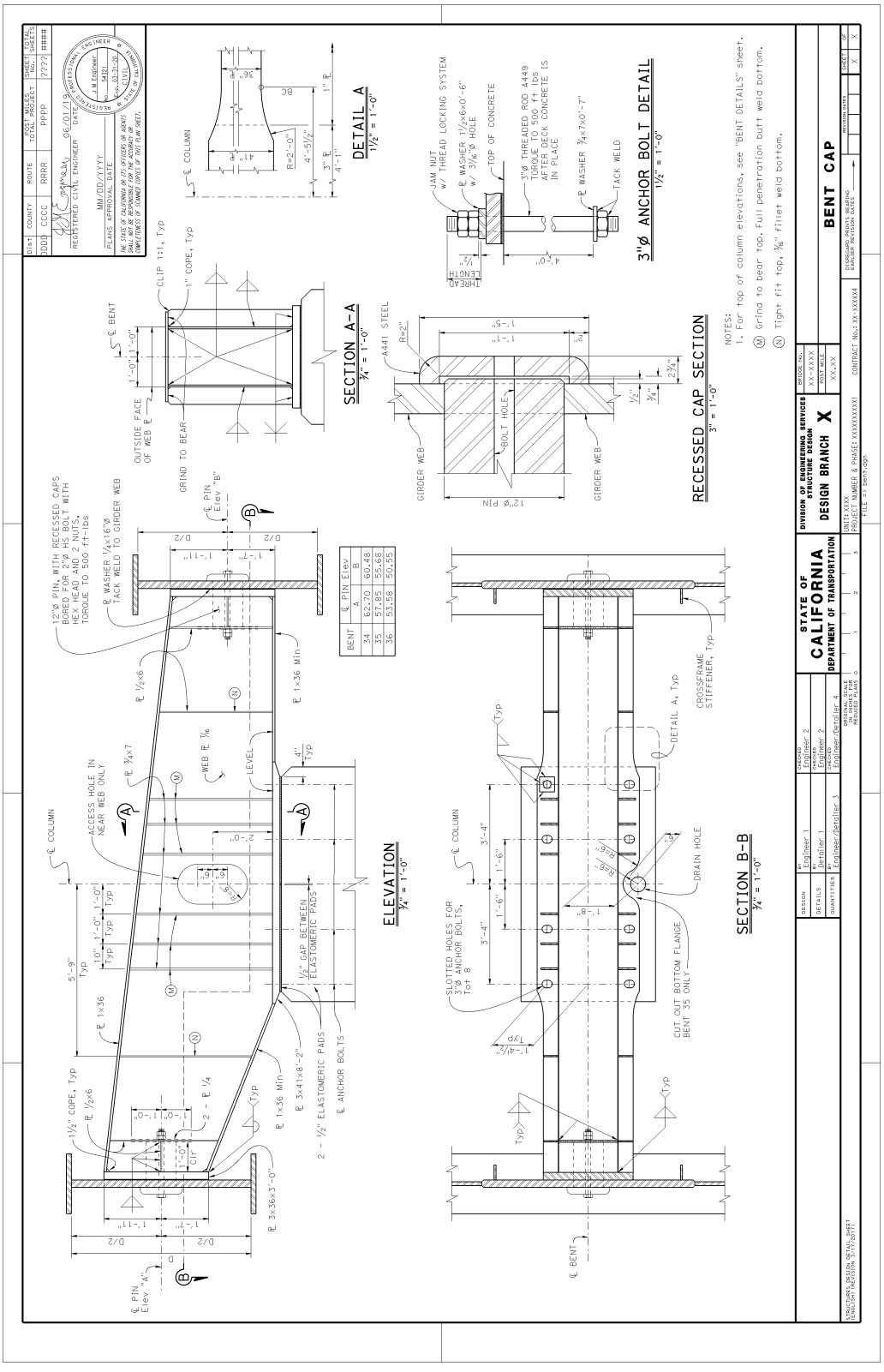
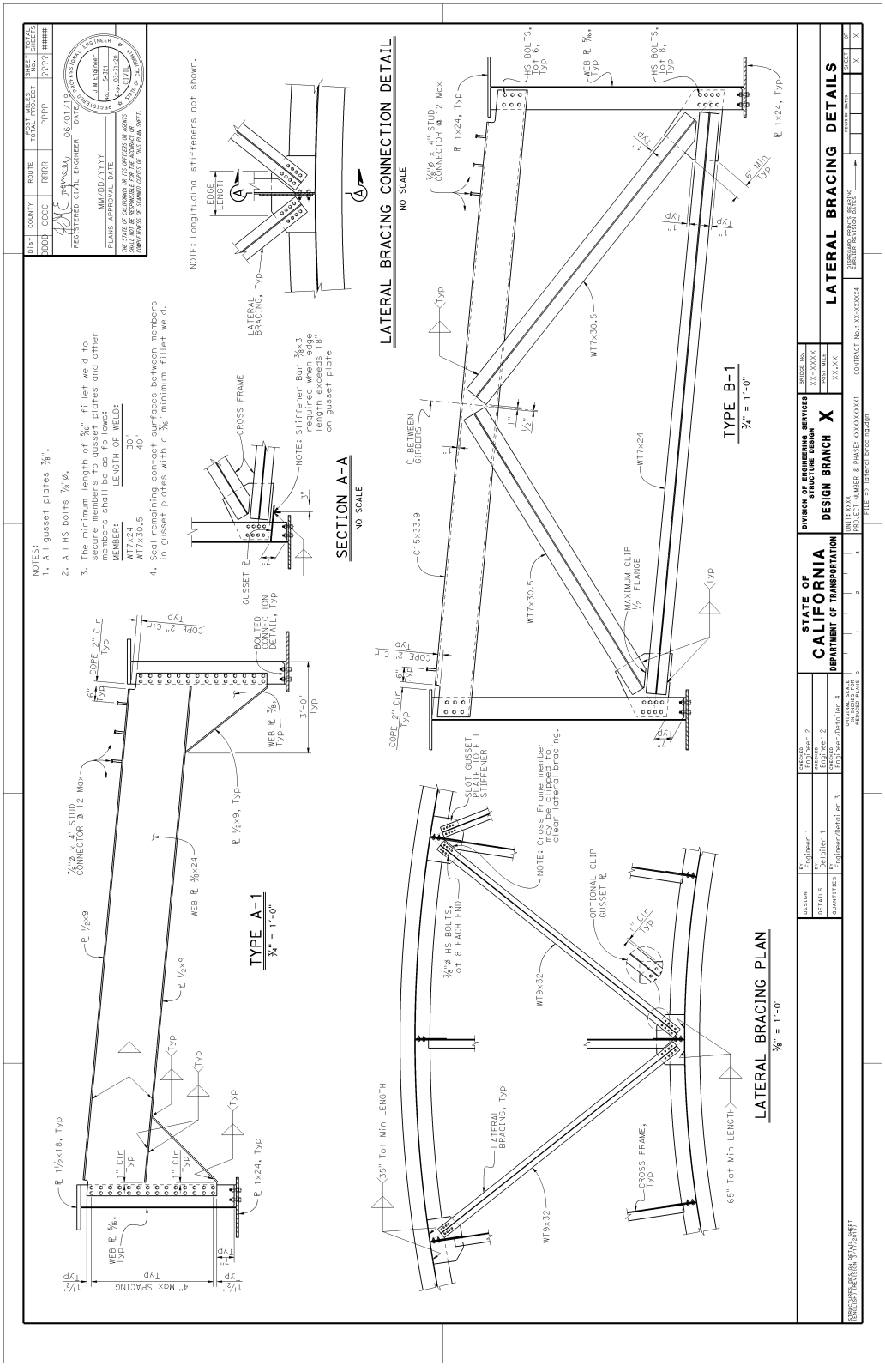


Figure 11A.A.18 Steel Girder Bridge Detailing Example 18



Bridge Design Details 11.2 June 2019

Standard Steel Product Designation

Standard Products	Symbol	Designation Example	Typical ASTM Specification
W-Shapes (Wide Flange Shapes)	W	W36x330	A709 Grade 50
S-Shapes (American Standard Beams)	S	S24x121	A709 Grade 36
M-Shapes (Miscellaneous Shapes)	M	M10x9	A709 Grade 36
HP-Shapes	HP	HP14x89	A709 Grade 50
C-shapes (American Standard Channels)	C	C12x25	A709 Grade 36
MC-shapes (Miscellaneous Channels)	MC	MC12x45	A709 Grade 36
L-Shapes (Angles)	L	L8x4x½	A709 Grade 36
Equal-Leg Double Angles	2L	2L6x6x 3/4	A709 Grade 36
Double Angles (Short Legs Back to Back)	SLBB	2L8x6x1 SLBB	A709 Grade 36
Double Angles (Long Legs Back to Back)	LLBB	2L4x3x½ LLBB	A709 Grade 36
WT-Shapes (Structural Tees made from W-shapes)	WT	WT12x38	A709 Grade 50
ST-Shapes (Structural Tees made from S-shapes)	ST	ST12x50	A709 Grade 36
MT-Shapes (Structural Tees made from M-Shapes)	MT	MT4x3.1	A709 Grade 36
Rectangular (and Square) Hollow Structural Sections	HSS	HSS8x6x$^{5}/_{8}$	A1085, A500, A501, A618, A847
Round Hollow Structural Sections	HSS	HSS5.500x0.500	A1085, A500, A501, A618, A847

Table 11.2.1 Standard Steel Product Designation

Standard Products	Symbol	Designation Example	Typical ASTM Specification
Pipe (Standard)	PIPE	PIPE 5 Std	A53 Grade B, A106 Grade B A139 Grade B
Pipe (Extra Strong)	PIPE	PIPE 5 x-Strong	A53 Grade B, A106 Grade B, A139 Grade B
Pipe (Double-Extra Strong)	PIPE	PIPE 5 xx-Strong	A53 Grade B, A106 Grade B A139 Grade B
Pipe	PIPE	PIPE 16.000x0.250	A53 Grade B, A106 Grade B A139 Grade B
Plates	PL	PL ½x18x2'-0"	A709 Grades 36, 50, 50W, HPS 50W, HPS 70W, HPS 100W
Bars	Bar	Bar ½x8x2'-0"	A709 Grades 36, 50, 50W, HPS 50W, HPS 70W, HPS 100W
Sheet	SS	SS 0.135x18x2'-0"	A1008, A1011
Strip	SS	SS 0.135x8x2'-0"	A1008, A1011
Bolts (Head one end - threads other end)	Bolt	3/4"Ø Bolt	A307, F1554 Grade 36
HS Bolts (Head one end - threads other end)	HS Bolt	3/4"Ø HS Bolt	A449 Type 1
Stud (Fastener threaded one or both ends with an unthreaded shank in between)	Stud	3/4"Ø stud with nuts and hardened washer	A307
HS Stud (Fastener threaded at one or both ends with an unthreaded shank in between)	HS Stud	3/4"Ø HS stud with nuts and hardened washer	A449 Type 1
Threaded Rod (Rod with threads full length)	Threaded Rod	3/4"Ø Threaded Rod	A307, F1554 Grade 36
HS Threaded Rod (Rod with threads full length)	HS Threaded Rod	3/4"Ø HS Threaded Rod	A449 Type 1
Anchor Bolts (see Fastener Note 7)	AB	3/4"Ø x 12" AB	F1554
Shear Stud Connectors	Stud Connector	7/8"Ø Stud Connector	A108

Table 11.2.1 Standard Steel Product Designation (continued)

Fastener Notes

1. When a rod with partial length threads at only one or both ends is desired, specify “Stud” and note that a nut and a washer shall also be provided. Detail the required thread length on the plans.
2. If the stud or threaded rod is desired to be tensioned, specify the desired rod tension on the plans and include quality control provisions in the special provisions to ensure that the desired tension is achieved. Require hardened washers for studs or threaded rods that are to be tensioned.
3. Specify if threads are to be excluded from the shear plane for bolts and studs. For small grip lengths, thread exclusion may not be possible with bolts. See the Research Council on Structural Connections (RCSC) for non-standard thread lengths.
4. A325 bolts are generally not available with grip lengths greater than 8 inches. Specify A449 when greater than 8 inches are required.
5. Provide thread locking system or consider castellated nuts and cotter pins for bolts that are not tensioned.
6. Provide beveled washers when the outer steel member has a slope steeper than 1:20. The standard slope on the beveled hardened washer is 1:6. If a different slope is desired, the designer must call out the desired bevel angle, and should specify that the unique bevel must be ground or machined.
7. Indicate anchor bolt length, thread length and length of hook (if any) or forged head. Specify nuts and washers as required.

Thickness (inches)	To 3 1/2 inches (Width)	3 1/2 to 6 inches (Width)	6 to 8 inches (Width)	8 to 12 inches (Width)	12 to 48 inches (Width)	Over 48 inches (Width)
0.2300 and thicker	Bar	Bar	Bar	Plate	Plate	Plate
0.2031 to 0.2299	Bar	Bar	Strip	Strip	Sheet	Plate
0.1800 to 0.2303	Strip	Strip	Strip	Strip	Sheet	Plate
0.0449 to 0.1799	Strip	Strip	Strip	Strip	Sheet	Sheet
0.0344 to 0.0448	Strip	Strip	Hot-rolled sheet and strips not generally produced in widths greater than 6 inches for thicknesses between 0.0344 to 0.0448 inches.			
0.0255 to 0.0343	Strip	Hot-rolled sheet and strips not generally produced in widths greater than 3½ inches for thicknesses between 0.0255 to 0.0343 inches.				
0.0254 and thinner	Hot-rolled sheet and strips not generally produced for thicknesses less than 0.0254 inches.					

Table 11.2.2 Classification of Plate Product

Gauge Number	Uncoated Minimum Thickness (inches)	Uncoated Nominal Thickness (inches)	Galvanized Nominal Thickness (inches)
7	0.1703	0.1793	0.1833
8	0.1562	0.1644	0.1684
9	0.1420	0.1495	0.1532
10	0.1278	0.1345	0.1382
11	0.1136	0.1196	0.1233
12	0.0994	0.1046	0.1084
13	0.0852	0.0897	0.0934
14	0.0710	0.0747	0.0785
15	0.0639	0.0673	0.0710
16	0.0568	0.0598	0.0635
17	0.0511	0.0538	0.0575
18	0.0454	0.0478	0.0516
19	0.0397	0.0418	0.0456
20	0.0341	0.0359	0.0396
21	0.0313	0.0329	0.0366
22	0.0284	0.0299	0.0336
23	0.0256	0.0269	0.0306
24	0.0227	0.0239	0.0276
25	0.0199	0.0209	0.0247
26	0.0170	0.0179	0.0217
27	0.0156	0.0164	0.0202
28	0.0142	0.0149	0.0187
29	0.0128	0.0135	0.0172
30	0.0114	0.0120	0.0157

Table 11.2.3 Steel Sheet Gage Number and Thickness

Sheet thickness notes:

1. Uncoated minimum thickness is taken as 95% of uncoated nominal thickness and used by design engineers in calculation.
2. Uncoated nominal thickness is used by detailers in dimensioning materials galvanized after fabrication. A sheet galvanized after fabrication is designated as:

   Example: Sheet thickness x width x length, Galv AFTER FABRICATION

3. Galvanized nominal thickness is used by detailers in dimensioning pre-galvanized materials. A pre-galvanized sheet is designated as:

   Example: Galv Sheet thickness x width x length

Bridge Design Details 11.3 January 2024

Complete Joint Penetration and Partial Joint Penetration Groove Welds

The Complete Joint Penetration (CJP) groove weld is a groove weld that extends completely through the thickness of components joined and should have the same strength as the components being joined. The Partial Joint Penetration (PJP) groove weld is a groove weld that does not extend completely through the thickness of components joined.

When a CJP groove weld or a PJP groove weld is used, do not detail specific groove details and do not call out the symbol for a specific weld type (Example: a double-V-groove or square-groove). Instead, point the weld arrow to the joint location and call out CJP or PJP as shown in the following figures.

The welding symbol for CJP weld does not denote weld size:

Figure 11.3.1 CJP Welding Symbol

The welding symbol for PJP weld denotes effective weld size (E1) for other side and (E2) for arrow side:

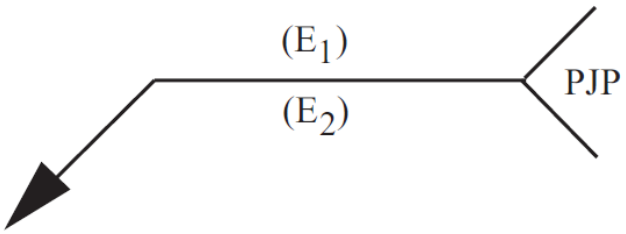


Figure 11.3.2 PJP Welding Symbol

The welding symbol for a PJP weld that uses minimum effective weld size, specified by Section 55-1.02E(7) in the Caltrans Standard Specifications, is denoted without dimensions:

Figure 11.3.3 Minimum Effective Weld Size PJP Welding Symbol

Specific weld types for CJP and PJP will be shown in shop drawings prepared by the Contractor, and reviewed by the Designer, the Structure Representative and a representative from the Materials Engineering and Testing Services (METS).

For other weld information types and symbols, see *Bridge Design Details*: 11 American Welding Society Symbols, Attachment 11A.B.1 through 11A.B.4.

Figure 11A.B.1 American Welding Society Symbol Chart 1

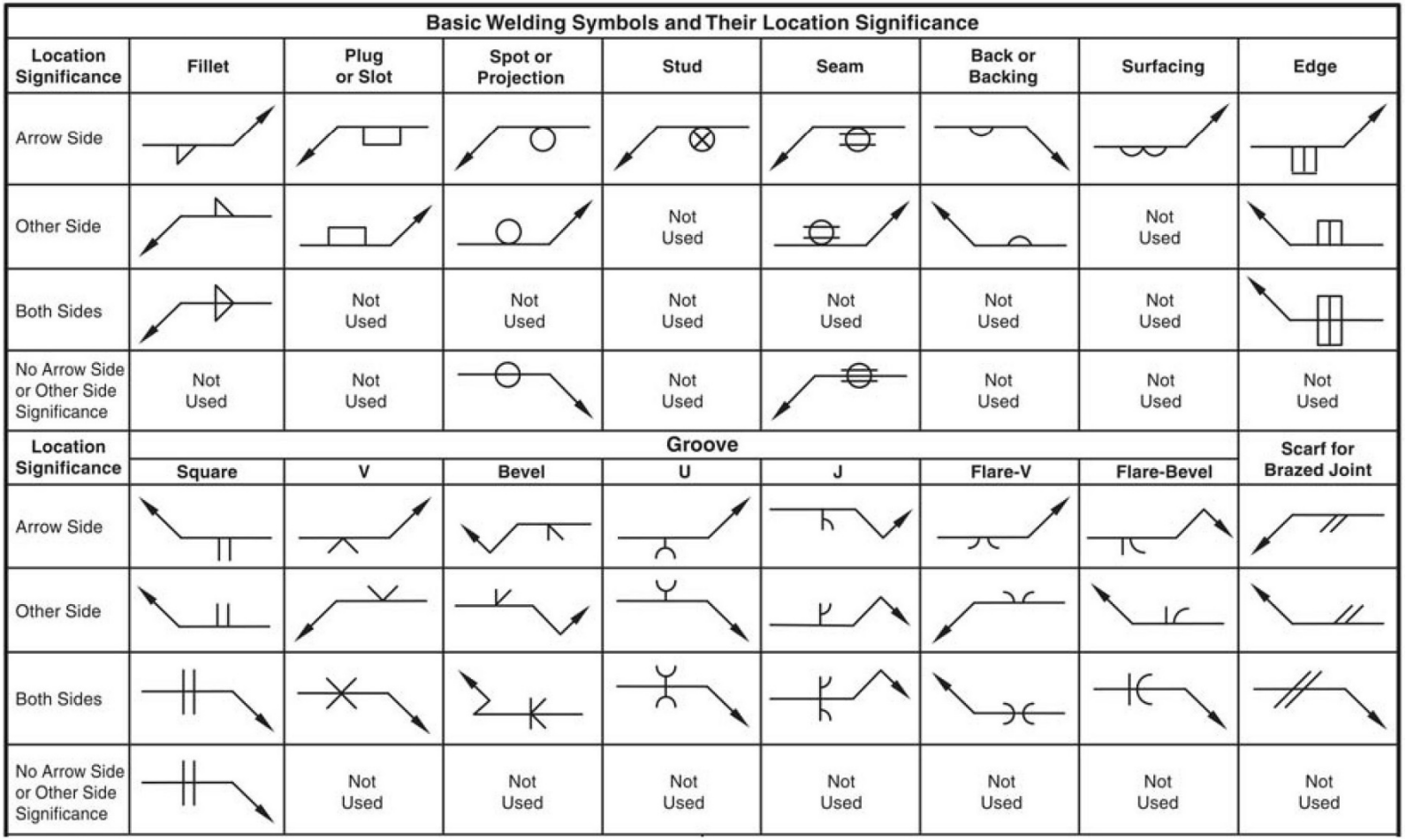


Figure 11A.B.2 American Welding Society Symbol Chart 2

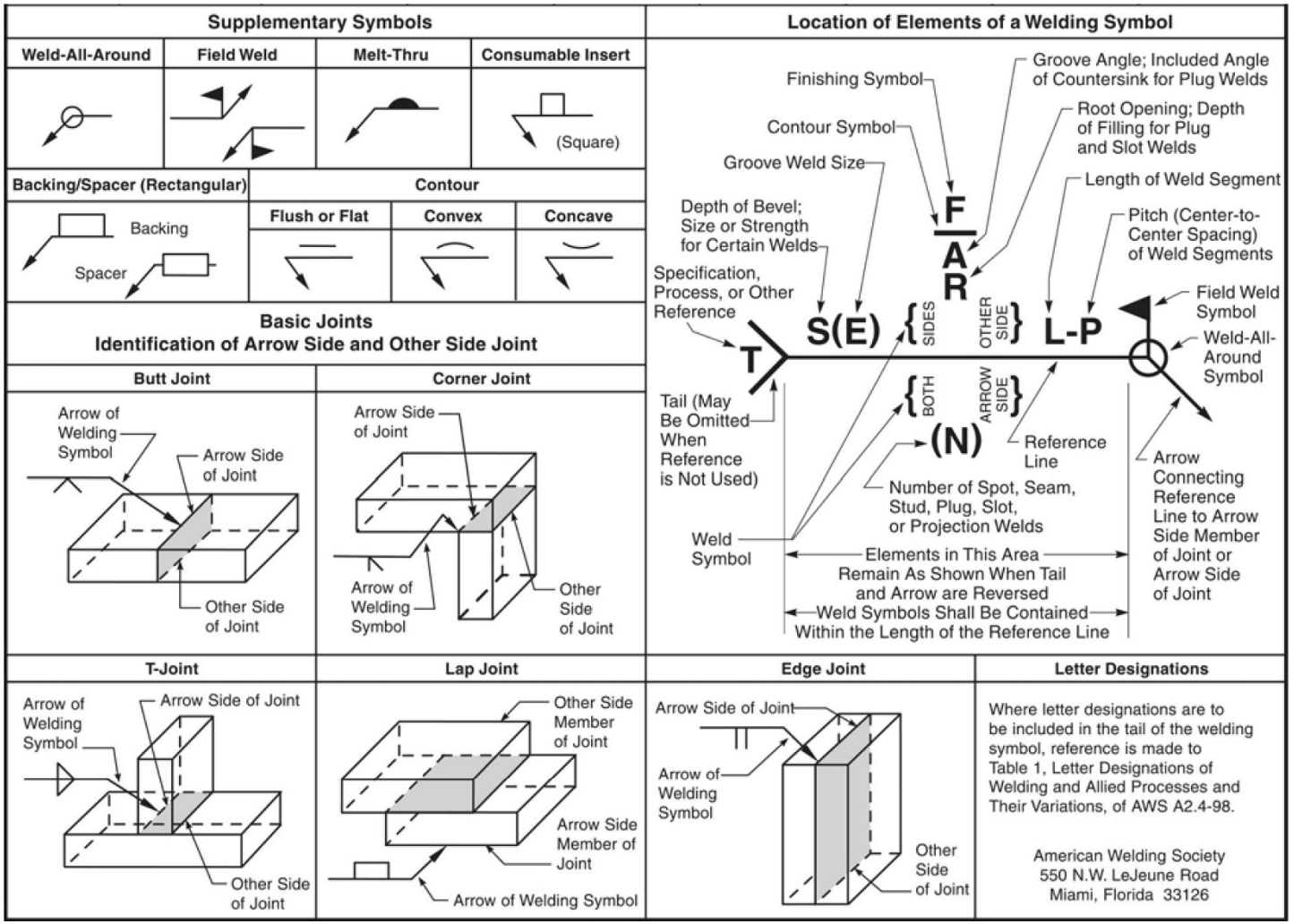


Figure 11A.B.3 American Welding Society Symbol Chart 3

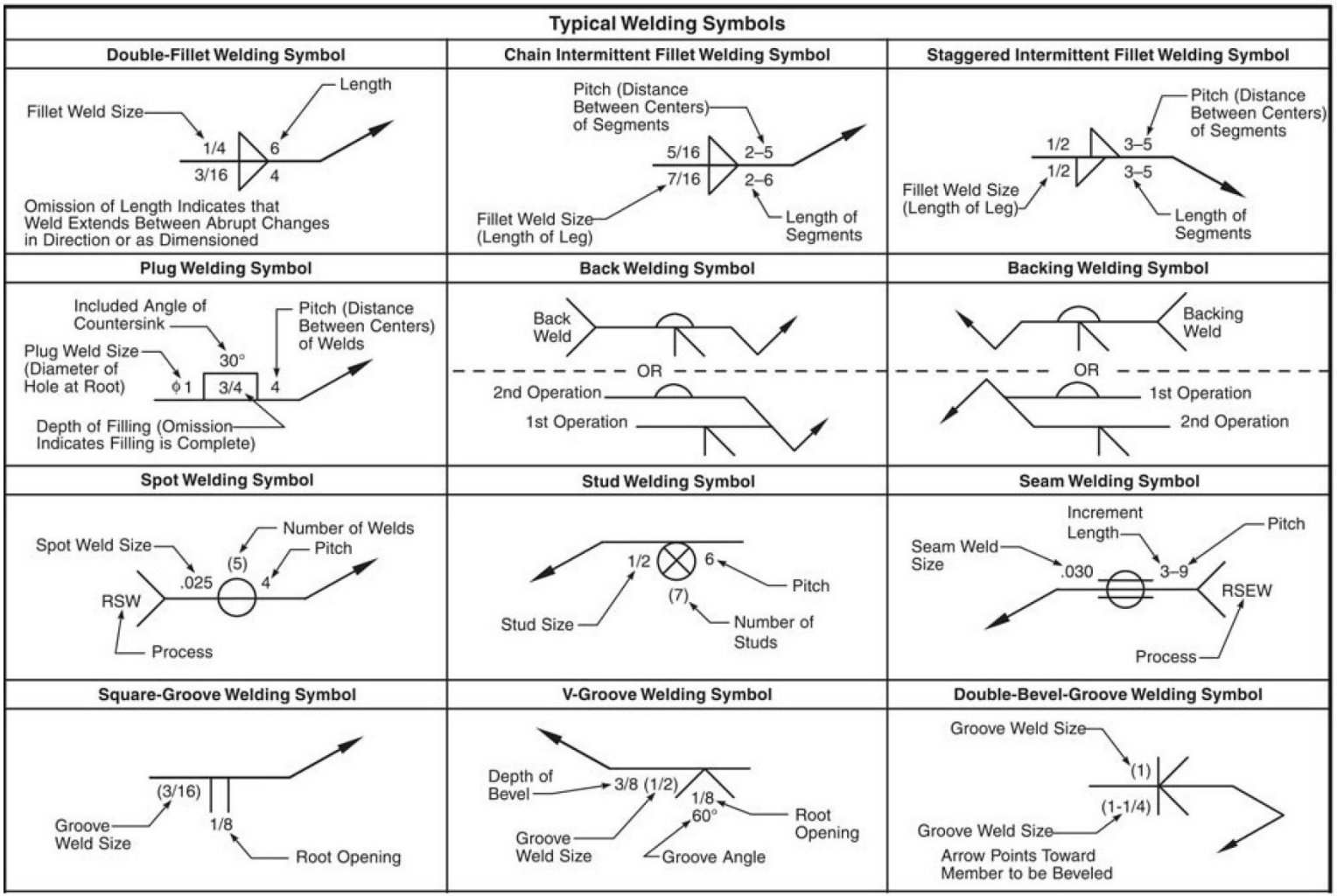
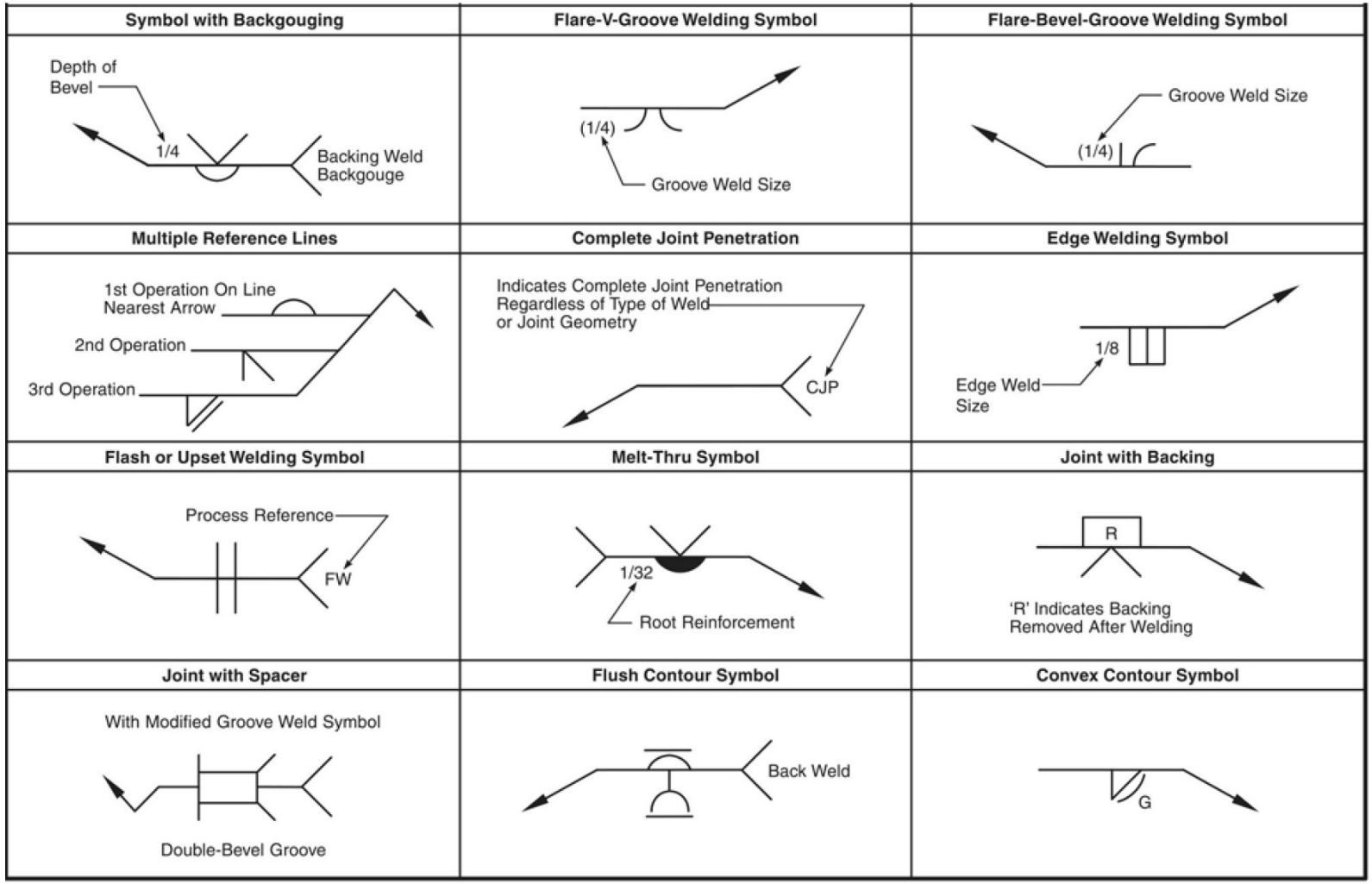


Figure 11A.B.4 American Welding Society Symbol Chart 4



Bridge Design Details 11.4 June 2019

Control Dimension “Y” on Steel Girders

The control dimension “Y” is defined as the distance from the top of deck slab to the top of web plate and must be shown at centerline of bearings on the TYPICAL SECTION sheet and rounded up to the nearest ½ inch. The “Y” dimension is shown on the plans to allow construction and camber tolerances while ensuring adequate clearance is provided between the top flange and the bottom concrete deck slab.

The control dimension “Y” includes the following components:

1. Deck thickness
2. Correction for roadway slope = $\frac{\text{Maximum Flange Width}}{2} \times$ (roadway across slope)
3. Maximum top flange thickness of girders
4. Correction for sagging (for a straight girder on a sharp horizontal curve or at a sag vertical curve, the depth of fillet at the supports shall be increased so that the girder will not encroach into the decks).
5. Thickness of splice plate, if applicable.
6. Excess fillet to allow for fabricating tolerance in girder camber. Allow 1 inch for span lengths less than or equal to 40 ft; allow 1.5 inches for span lengths greater than 40 feet.

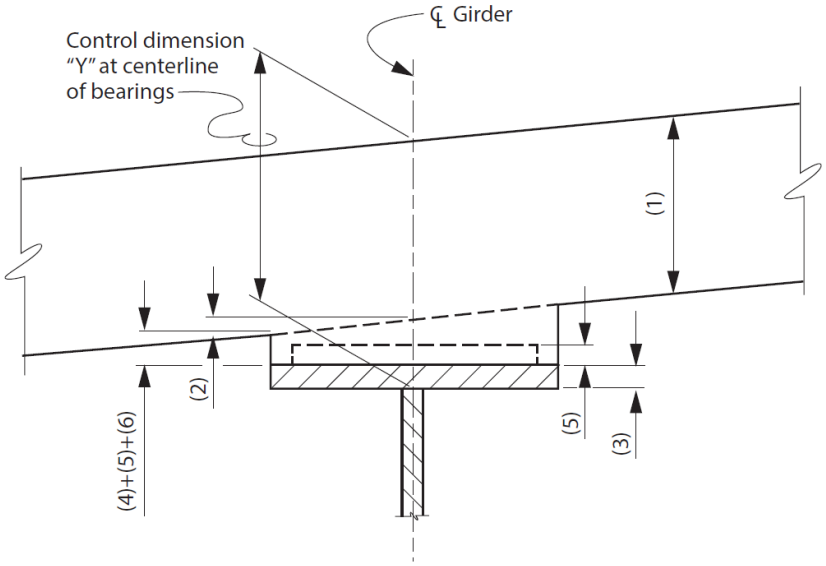


Figure 11.4.1 Control Dimension “Y”

It is preferred that the control dimension “Y” should be the same at all supports throughout a bridge. The minimum concrete cover over the tops of the shear connectors on composite girders (2 inch) and the minimum penetration depth into the concrete deck of the shear connectors (3 inch minimum) must be provided (See Figure 11.4.3). Straight girders on a horizontal curve with a cross slope require special attention.

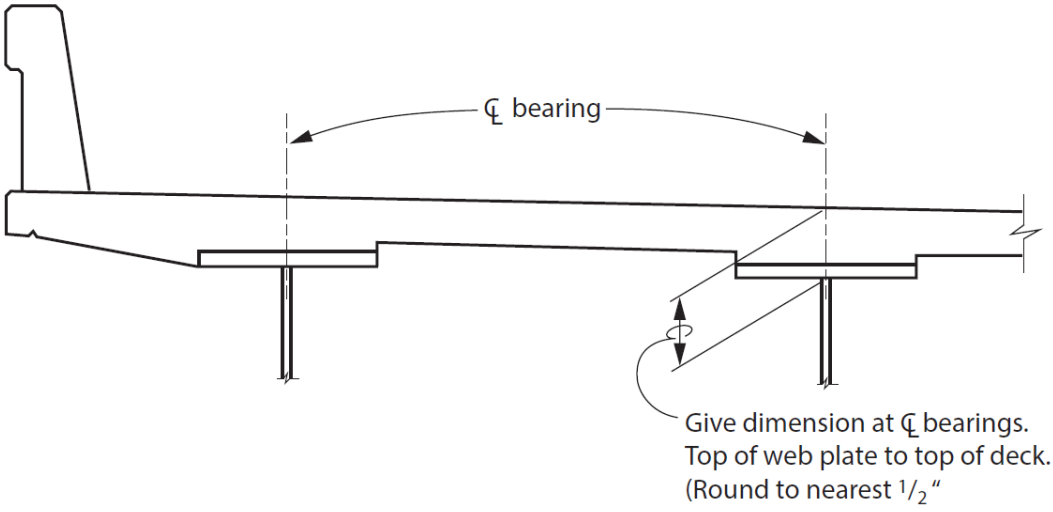


Figure 11.4.2 Centerline Bearings

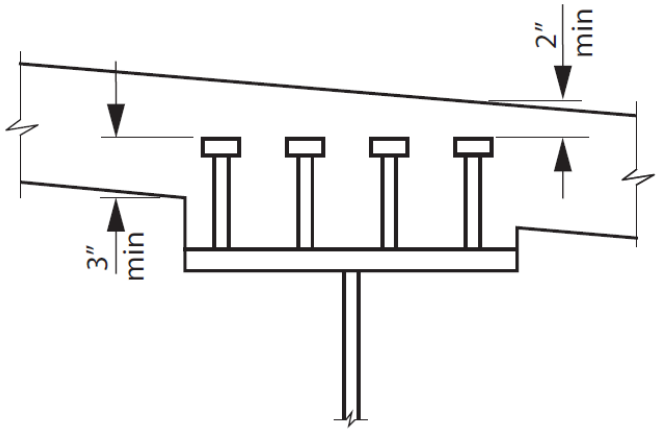


Figure 11.4.3 Minimum Concrete Cover Depth and Minimum Penetration Depth

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Cross Frames with Lateral Bracing

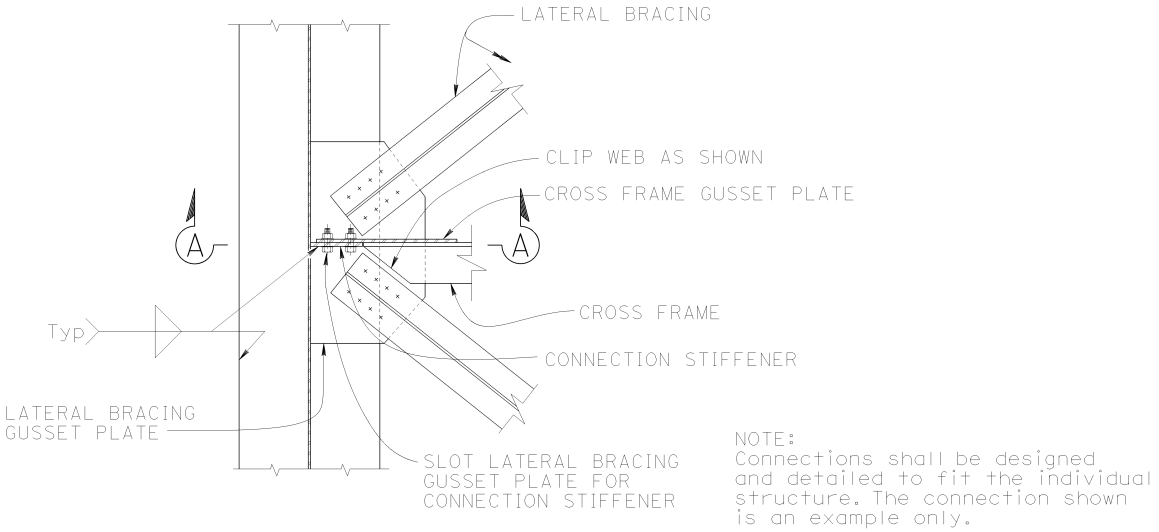

Figure 11.5.1 Cross Frames with Lateral Bracing

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Retrofit Hardware

Layout sheets may show location and application of the finished product; however, all parts must be described clearly with dimensions for fabrication. Avoid showing detailed fasteners unless assembly, tool clearance issues or the scale of the detail supports their use. The use of a “drill-point symbol” or hole labeled for the correct size fastener may be adequate. The “Rectangular” and “Polar” Array tools in MicroStation are ideal for placing drilling patterns based on using a symbol from a cell library.

Steel connections are typically bolted or welded. If the project requires the detailing of older steel structures for retrofit, rivets may need to be detailed in the As-Built configuration.

Older steel structures usually have beam and column shapes that are no longer manufactured. The publication “*Iron and Steel Beams 1873 to 1952*” from the “*American Institute of Steel Construction*” (AISC) is a historical reference handbook that will provide the data needed when detailing older steel shapes.

The “*Bridge Inspection Records Information System*” (BIRIS) is a resource to find As-Built and shop plans that can be used to draw existing structures. Shop drawings are the best source of the information to create dimensionally correct drawings for existing steel structures. Furthermore, shop drawings dimension of every piece of steel that was needed to fabricate the bridge component shown on the As-Builts.