


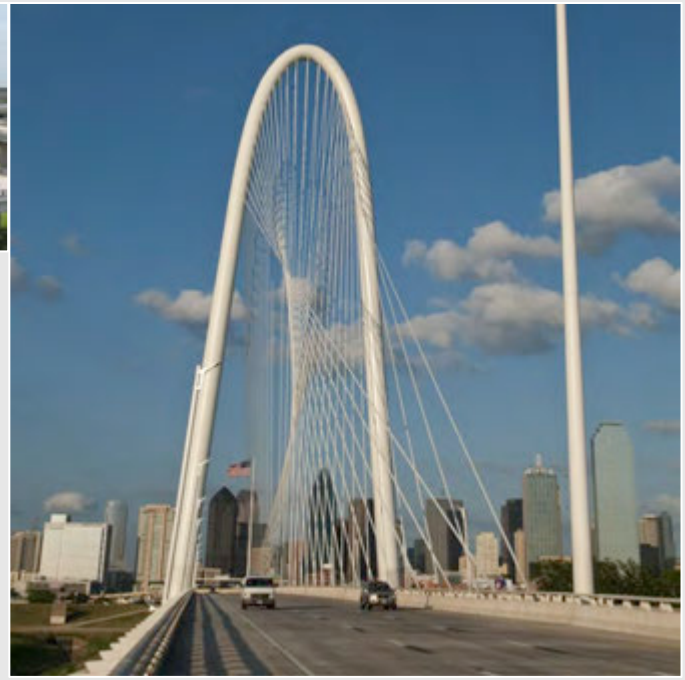

DESIGN CONSIDERATIONS FOR STEEL PLATE GIRDER BRIDGES

Gregory Turco, P.E.
Bridge Division

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Presentation Purpose

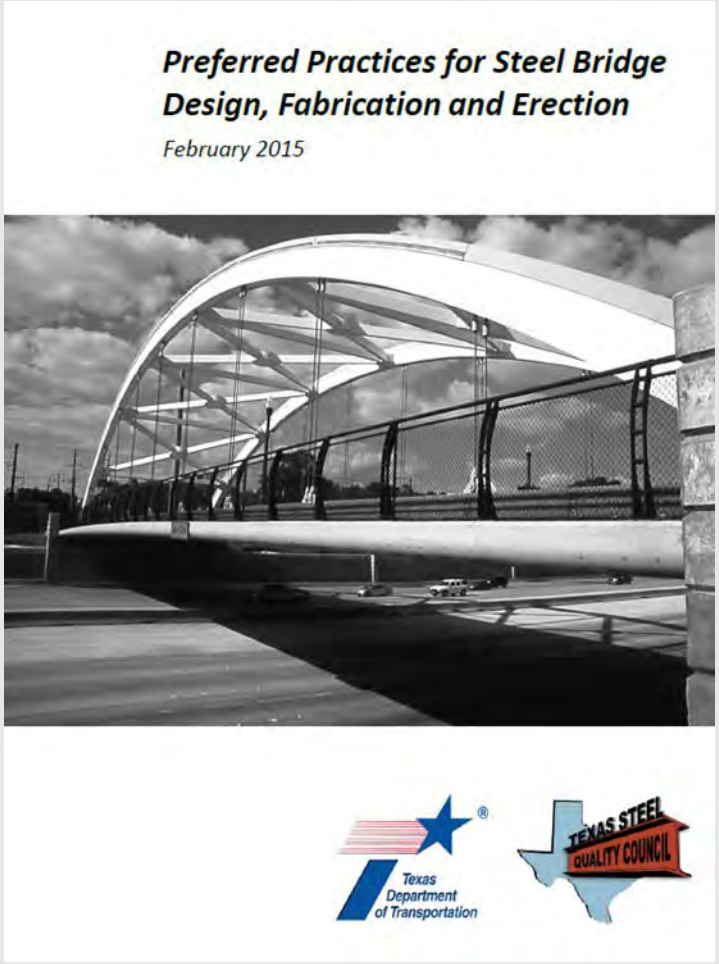
- Recently many steel plate girder bridges have had design and construction issues.
- Some of these issues relate to not following the TxDOT Preferred Practices for Steel bridges.
- This presentation is intended to be highlights as to what is in the Preferred Practices document and to make sure all designers are on the “same page” when designing steel plate girders for TxDOT.
- Some of the discussion points are not necessarily addressed in the Preferred Practices document.

Texas Steel Quality Council (TSQC)

- Joint owner-industry forum
- TxDOT design, fabrication and erection engineers; TxDOT inspectors
- Consultant designers
- FHWA bridge engineers
- Academics
- Steel bridge fabricators, detailers and trade association representatives
- Steel mill representatives
- Meets annually in an open forum to discuss best practices for achieving steel bridges

Preferred Practices document

- Developed by TSQC
- Available for download online
- Provides guidance to help steel bridge designers working on TxDOT projects to achieve optimal quality and value in steel bridges
- Provides design, fabrication and erection guidance
- Provides guidance for plate girders, rolled beams and tub girders
- Review this document when initiating a steel bridge design

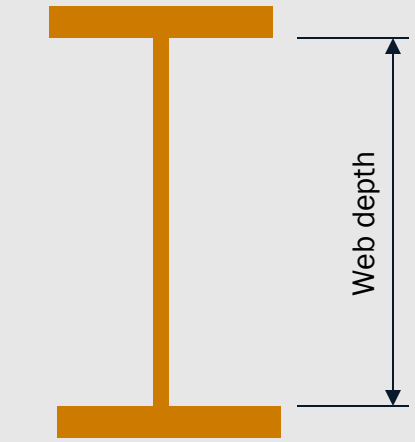


Steel plate girder span configurations

- Section 2.1.4 of Preferred Practices
- Two-span continuous girder units are not efficient because of high negative moments.
- Three–and four–span continuous girder units are preferable.
- For three–and four–span continuous girder units make interior spans about 20 to 30% longer than the end spans

Steel plate girder cross-section proportions: Web depth

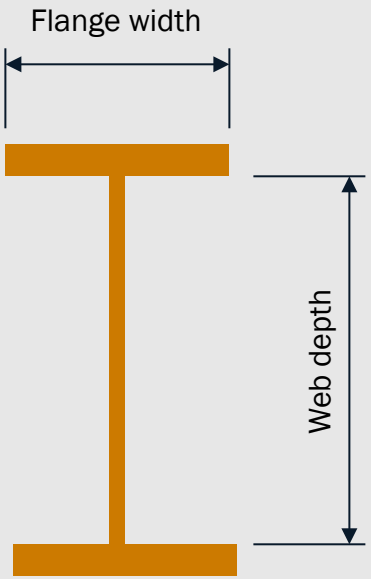
- Section 2.2.4 of Preferred Practices
- Follow AASHTO LRFD Bridge Design Specifications Article 2.5.2.6.3. as a starting point for straight girders.
- For curved girders, use above and increase by 10 to 20 percent, or use LRFD equation 2.5.2.6.3-1
- Rule of thumb is for well proportioned superstructure to have a total section depth (slab plus girder) in the range of 0.033L to 0.04L (L = c-c brg length)



SECTION OF GIRDER

Steel plate girder cross-section proportions: Flange width

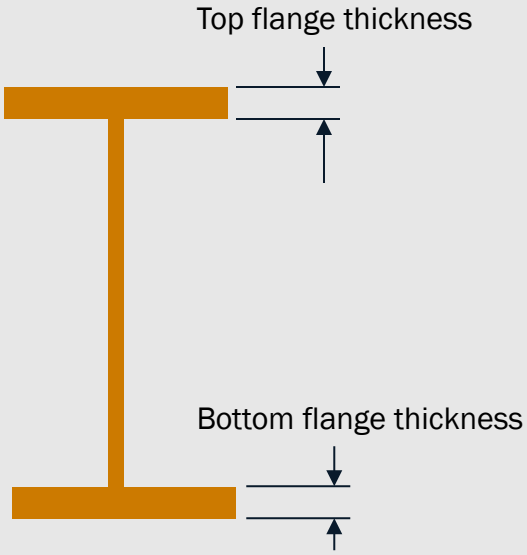
- Section 2.2.1 of Preferred Practices and in TxDOT Bridge Design Manual (Policy).
- For curved girders, flange width no less than 25% of the web depth
- For straight girders, flange width no less than 20% of the web depth



SECTION OF GIRDER

Steel plate girder flange thicknesses

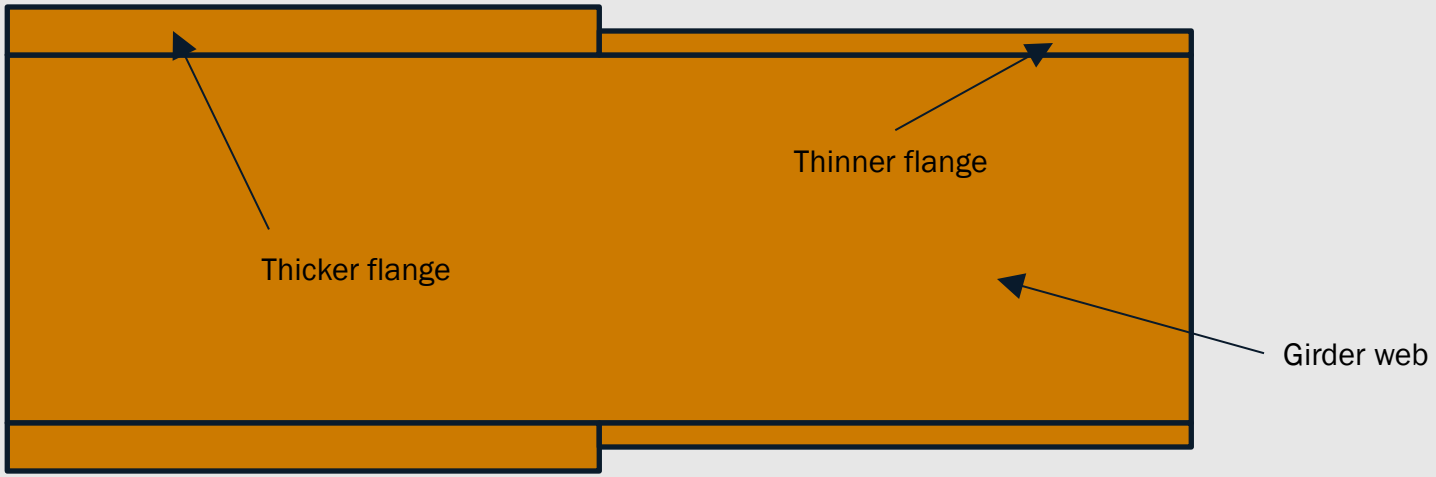
- Section 2.2.2 of Preferred Practices
- 4 to 6 different flange thicknesses on a continuous girder
- 2 or 3 different flange sizes for a simple span
- When designing multiple structures in the same project, designers need to coordinate and establish a preliminary list of no more than eight flange plate thicknesses to use



SECTION OF GIRDER

Steel plate girder flange thicknesses: Increments

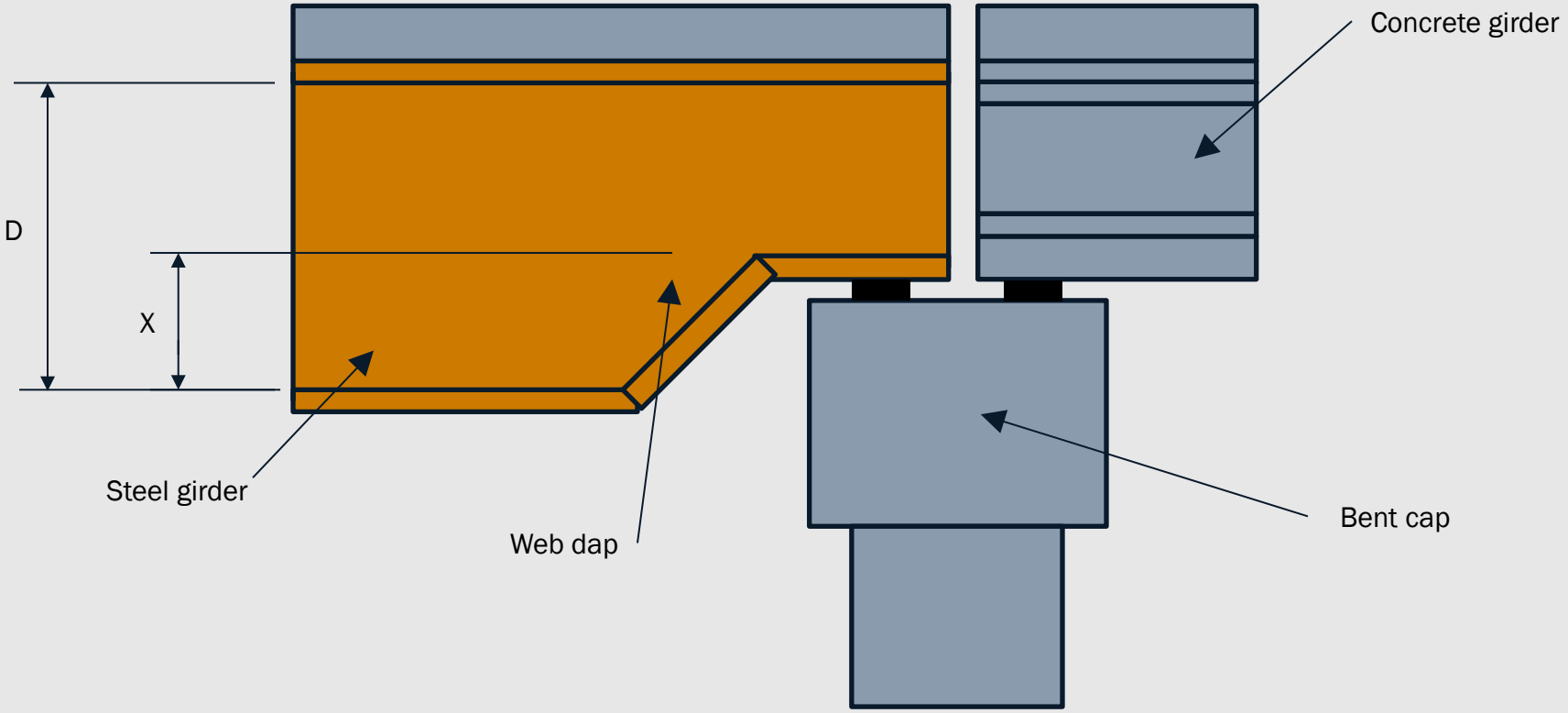
- Section 2.2.2.3 of Preferred Practices
- Increase flange thickness increments by ¼" for flanges between 1 and 3 inches thick, ½" for 3 to 4 inches thick
- Thinner flange should be no less than half the thickness of adjacent thicker flange
- Generally, the thicker flange should have at least 25% more area than the thinner flange



PARTIAL ELEVATION OF GIRDER

Steel plate girder web dapping

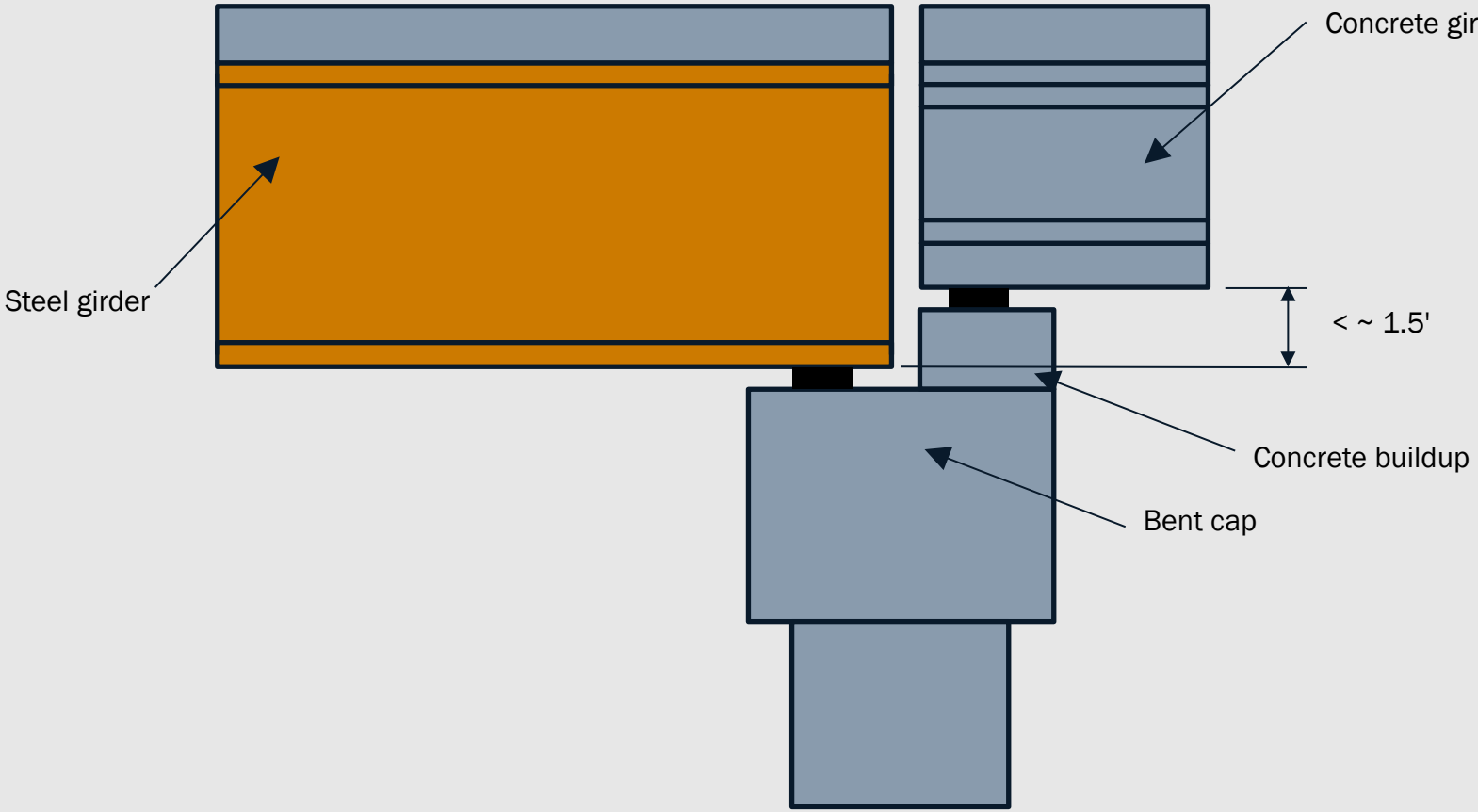
- Section 2.2.4.1 of Preferred Practices
- Value of “X” cannot exceed 40% of D



PARTIAL ELEVATION AT BENT WITH GIRDER WEB DAP

Steel plate girder web dapping (cont.)

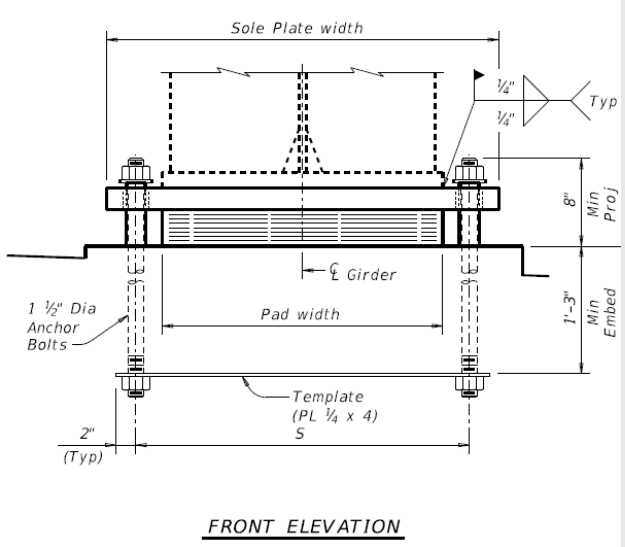
If superstructure depth difference is less than ~ 1.5', construct a concrete build up on the bent cap instead of dapping such a small amount.

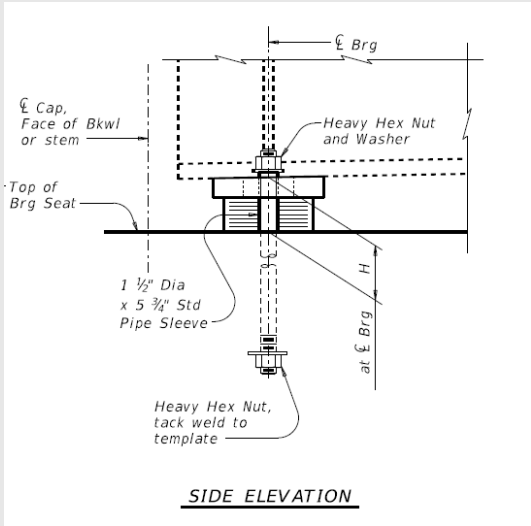


PARTIAL ELEVATION AT BENT WITH CONCRETE BUILDUP

Bearing selection

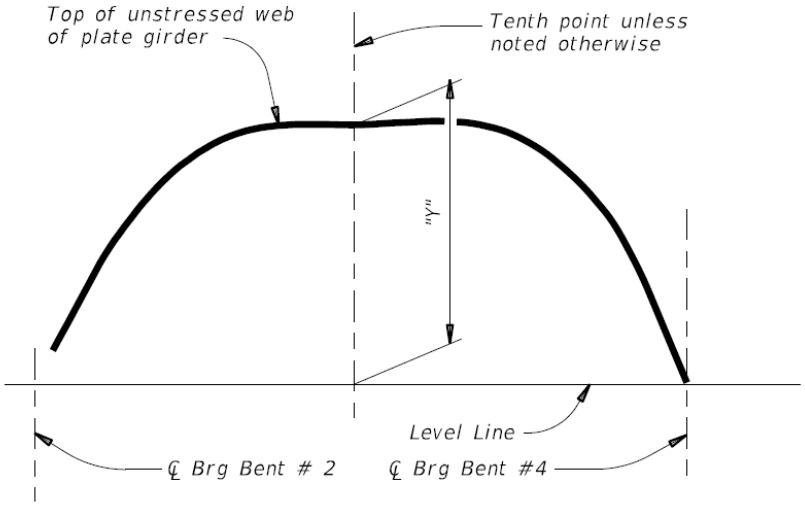
- Section 2.2.9 of Preferred Practices
- Use standard bearings found on TxDOT SGEB Standard
- For expansion bearings, use Type EE whenever possible (Max. expansion length of 250')
- For expansion bearings with a length of expansion greater than 250' and up to 500', use Type ES
- Type ES includes a PTFE/stainless steel Sliding surface, which increases the cost of the bearing significantly compared to Type EE
- Only use the bearing size required at each bearing location. It is not necessary to use the same size of bearing at every possible bearing location.
- Try to avoid the use of HLMR bearings (disc, pot and spherical bearings)





Camber diagrams

- Recommend giving ordinates at 10th points and field splices only
- Not necessary in most cases to use 20th or 30th points



CAMBER DIAGRAM

Webs may be cut on straight lines between ordinates shown or to a smooth curve at the Fabricator's option. Ordinates shown include total dead load deflection and vertical curve corrections.

CAMBER DIAGRAM TABLE (4)

"Y" values in feet

	LOCATION	GIRDER 1	2	3	4	5
SPAN 2	0	0.103	0.103	0.103	0.103	0.103
	1	0.555	0.571	0.586	0.601	0.617
	2	0.952	0.982	1.009	1.036	1.065
	3	1.280	1.317	1.351	1.385	1.422
	4	1.532	1.570	1.605	1.640	1.677
	5	1.704	1.739	1.771	1.799	1.830
	6	1.803	1.830	1.852	1.872	1.891
	FS	1.840	1.857	1.871	1.878	1.881
	7	1.838	1.856	1.869	1.878	1.881
	8	1.827	1.835	1.841	1.844	1.841
	9	1.799	1.800	1.802	1.803	1.799
	10	1.779	1.779	1.779	1.779	1.779
SPAN 3	11	1.786	1.788	1.791	1.791	1.789
	12	1.805	1.813	1.820	1.822	1.819
	13	1.805	1.823	1.837	1.844	1.848
	FS	1.805	1.822	1.835	1.843	1.846
	14	1.761	1.788	1.810	1.829	1.847
	15	1.652	1.687	1.718	1.746	1.778
	16	1.469	1.508	1.543	1.578	1.616
	17	1.208	1.244	1.280	1.314	1.351
	18	0.869	0.899	0.926	0.954	0.983
	19	0.463	0.479	0.493	0.509	0.526
	20	0.000	0.000	0.000	0.000	0.000

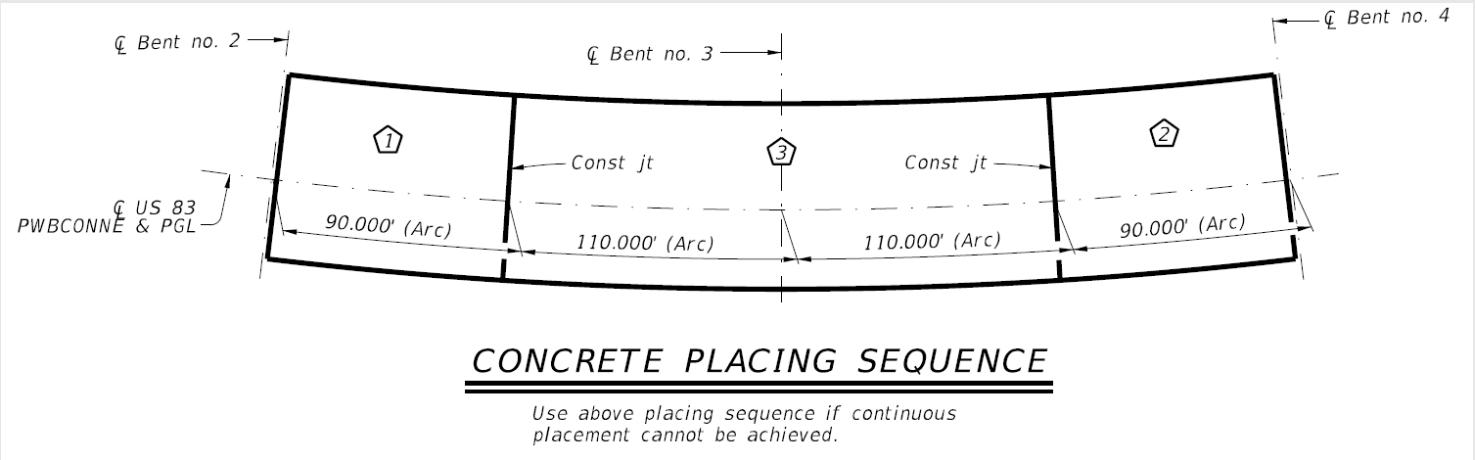
FS = Field Splice

Bottom flange lateral bracing

- Try to avoid using
- Costly fabrication
- Difficult to install
- Fatigue sensitive
- May be necessary for highly curved girders
- Try increasing flange sizes instead

Concrete placing sequence

- Design for and permit continuous placement
- Permit staged placement as an option if possible
- Require staged placement only when completely necessary

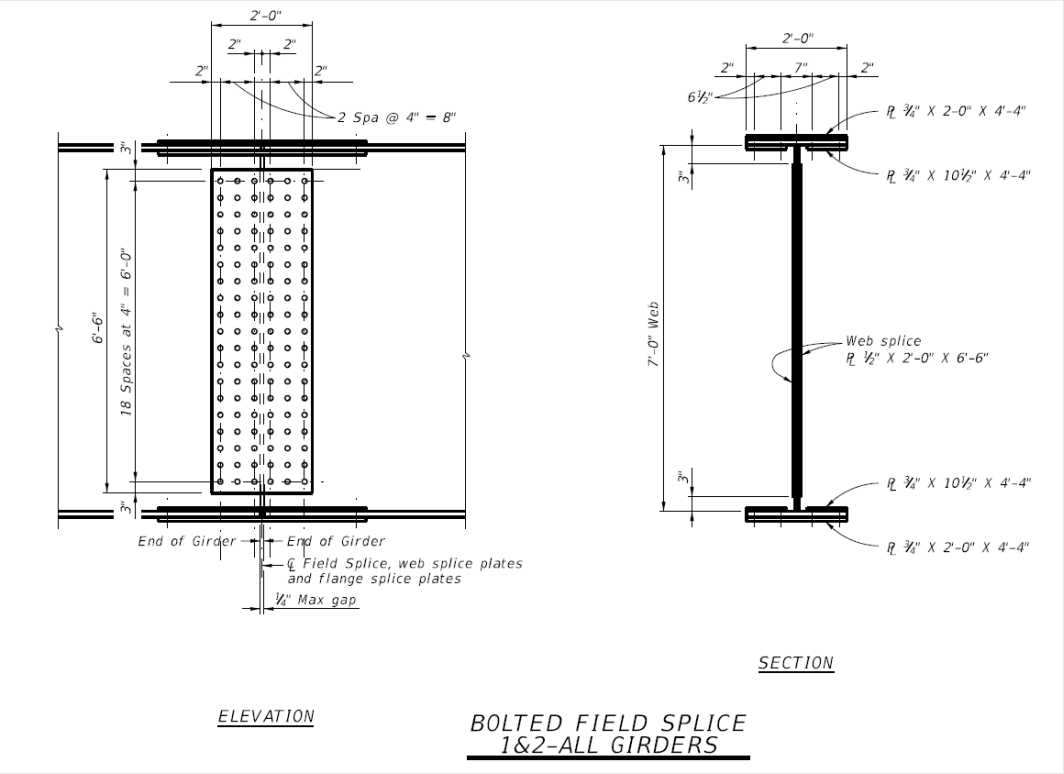


CONCRETE PLACING SEQUENCE

Use above placing sequence if continuous placement cannot be achieved.

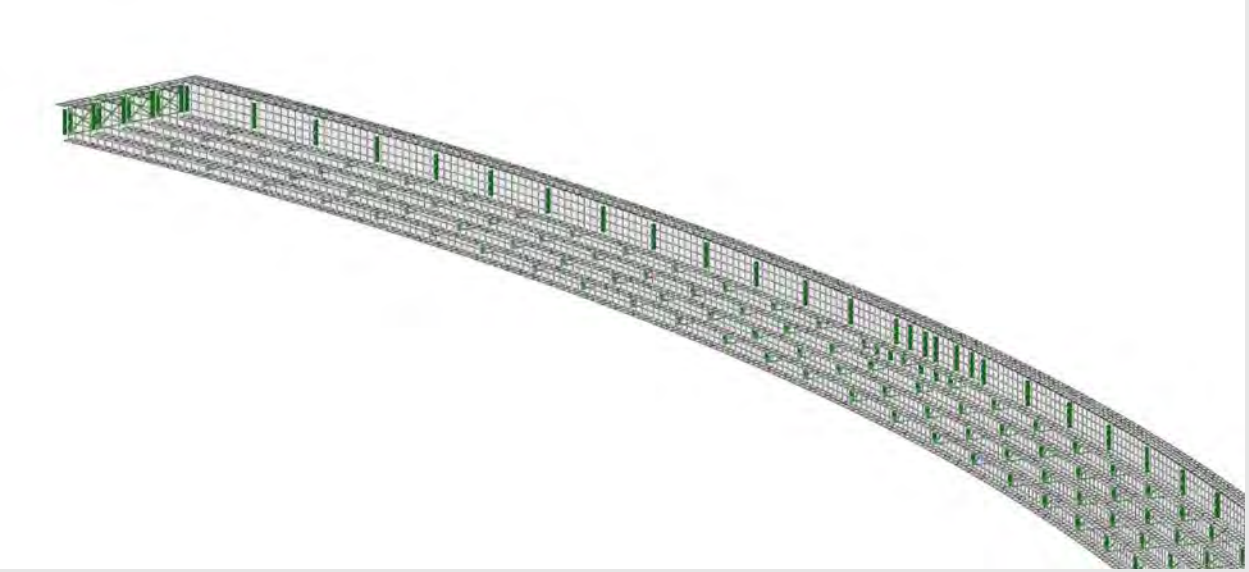
Bolted field splices

- Section 2.2.10 of Preferred Practices: Field splices-**out of date**
- Requires designers to detail welded splices and only show welded splices
- Welded field splices are not commonly used
- **Show bolted field splices as the primary option in the plans** per December 2016 memo from TxDOT Bridge Division Director Gregg Freeby
- Per the memo, include the field splice plates in the structural steel weight for payment
- Preferred Practices will be updated for consistency in the future



Design verifications

- For simple steel plate girder bridges, consider spot checking computer program design and analysis output by rough hand calculations if practical
- For complicated steel plate girder bridges (curved), consider verifying design with a second design/analysis program
- No two programs will match exactly of course



Next Texas Steel Quality Council meeting

- Scheduled for the morning of September 13, 2017
- TxDOT Riverside Campus Building 200 Austin, TX
- Agenda is forthcoming
- To be added to the distribution list, email greg.turco@txdot.gov

Questions?

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