STANDARDIZED SHORT SPAN STEEL BRIDGES

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Outline

- Objectives
- Survey state DOTs
- Short Span Modular Steel Bridge Concepts
- Grading of Modular Bridge Systems
- Standard Short Span Steel Bridge Designs
- Continued Development Efforts

about

- The Short Span Steel Bridge Alliance is a group of bridge and culvert industry leaders, including manufacturers, fabricators and representatives of related associations and government organizations who have joined together to increase awareness of the unique benefits, cost-competitiveness and safety facts related to the use of short span steel bridges in installations up to 140 feet in length.

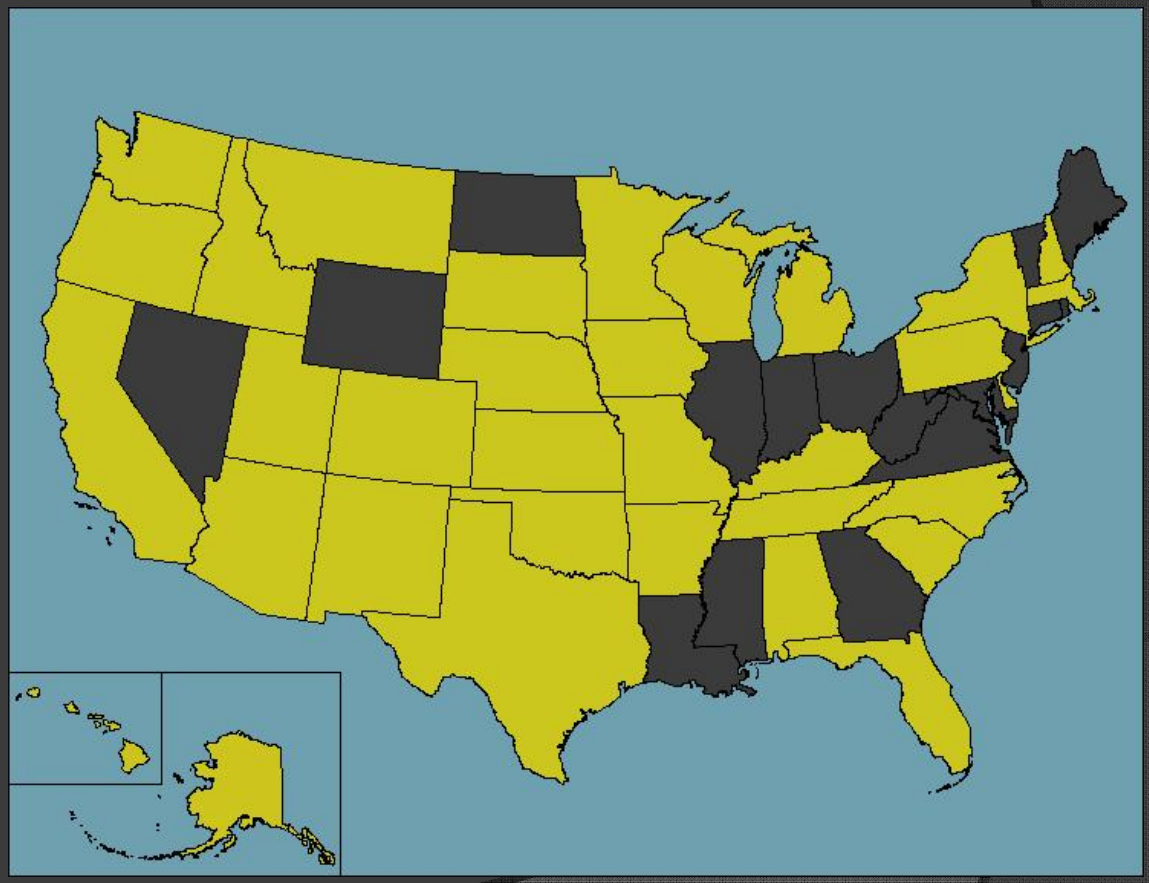
Objective

- Technical working group activities
  - Research innovative modular applications that can be used for short span steel bridges,
  - Determine which modular bridge systems should be further developed into a set of bridge standards,
  - And develop a set of standard short span steel bridge superstructure designs with current design practices to quicken both the fabrication of steel sections and the design of short span steel bridges

Survey of state DOTs

Participation:

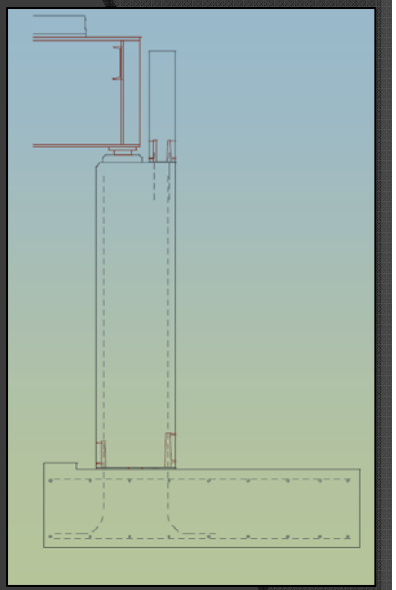
- Received responses from 33 State DOT's.



Short Span Modular Steel Bridge Concepts Manual

Short Span Steel Bridge Substructures

- Precast Concrete Cap Beams
- Precast Concrete Integral Abutments
- Modular Precast Wall Systems
- GRS Soil Wall Abutments



Short Span Steel Bridge Substructures

- T-Wall Systems
- Precast Concrete Footings
- Precast Concrete Piles
- Driven Steel Piles

Short Span Steel Bridge Systems

- Inverset™
- Folded Plate Bridge System
- Simple for Dead, Continuous for Live
- Con-Struct™ Bridge System

Short Span Steel Bridge Systems

- Pretopped Girder Sections
- Modular Steel Girder/Cast-in-Place Deck
- ACROW Panel Bridge System
- Railroad Flatcar System

Grading of Modular Bridge Systems

Bridge Grading Survey Objectives

- Survey specific bridge owners which have “influence” in design within the bridge community.
  - AASHTO T-14 (DOT)
  - NACE Structures Committee (County)
  - Selected other DOTs

- Identify the bridge systems which have the most promise for mainstream use -- “in order to provide a cost-effective short span steel bridge, with modular components, which meets the needs of today’s bridge owners.”

Systems Evaluated

- **Beam/Precast Deck**
  - Conventional single steel girders that employs precast panels installed after beams erected.

Systems Evaluated

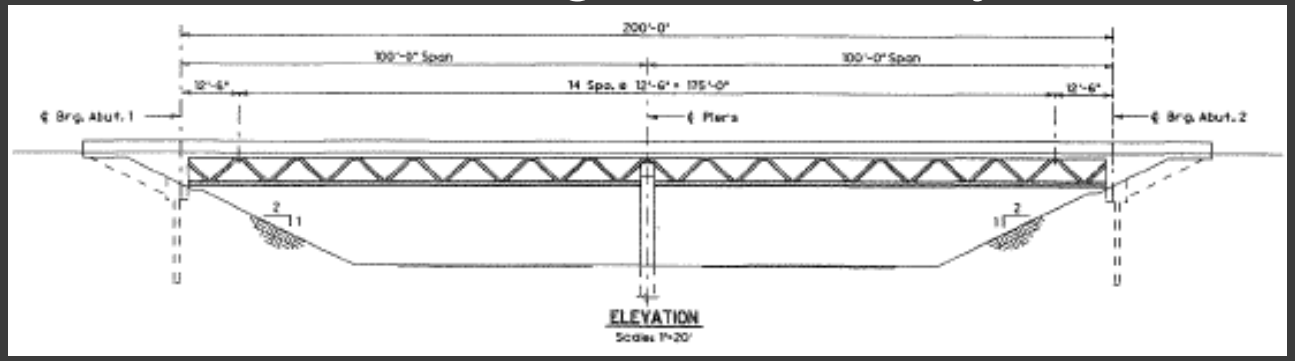
- **Modular Beams**
  - Modular in nature and may use a variety of deck options (deck installed off-site, prior to erection – could use precast or other type of deck systems)

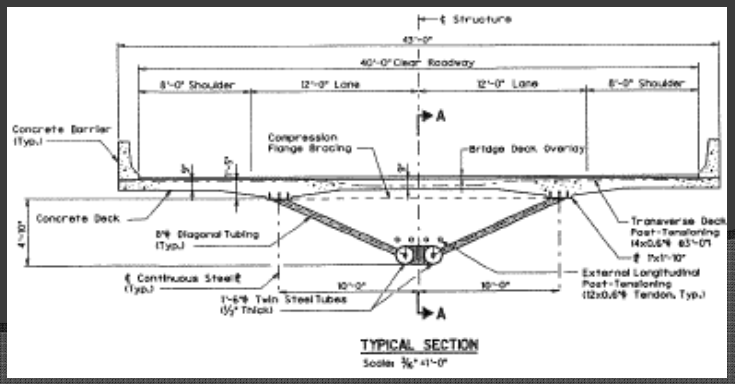
Systems Evaluated

- **Truss-Type**
  - Light bridge composed of large orthotropic deck units and tall truss systems (Acrow Panel Bridge)

Systems Evaluated

- **Modular Space-Truss**
  - Two trusses acting continuously between the





Systems Evaluated

- **Metal Deck Systems**
  - Orthotropic Decks

Systems Evaluated

- **Railroad Flatcar Systems**
  - Decommissioned railroad flatcars as the superstructure of the bridge.

Standard Short Span Steel Bridge Designs

Primary Goal

- The focus of this work was to develop a limited suite of economical single span bridge sections that will:
  - be competitive with other alternatives,
  - expedite and economize the design process,
  - and make use of simple repetitive details and member sizes.

Scope

- The scope of this work was to develop optimized steel girder designs for bridges with spans between 40 ft and 140 ft. Based on these designs, a limited suite of sections were selected to provide higher efficiency to the bridge design process.

Bridges Designed

- The following bridge parameters varied in the designs
  - Span lengths ranging from 40 ft to 140 ft in 5 ft increments
  - Girder spacing arrangements of 6 ft, 7 ft – 6 in, 9 ft and 10 ft – 6 in
  - Homogeneous and hybrid plate girder sections with limited plate sizes
  - Limited depth and lightest weight rolled sections

Design Values and Assumptions

- Design Values
  - f'_c = 4,000 psi
  - Haunch = 2 in
- Design Assumptions
  - Concrete unit wt. = 150 pcf
  - Steel unit wt. = 490 pcf
  - Future Wearing Surface unit wt. = 25 psf
  - Steel Stay-in-Place Formwork unit wt. = 15psf
  - 5% steel increase to account for miscellaneous details
  - Concrete barrier unit wt. = 305 plf each
  - Bridge consists of 5 girders and 3 lanes of traffic loading

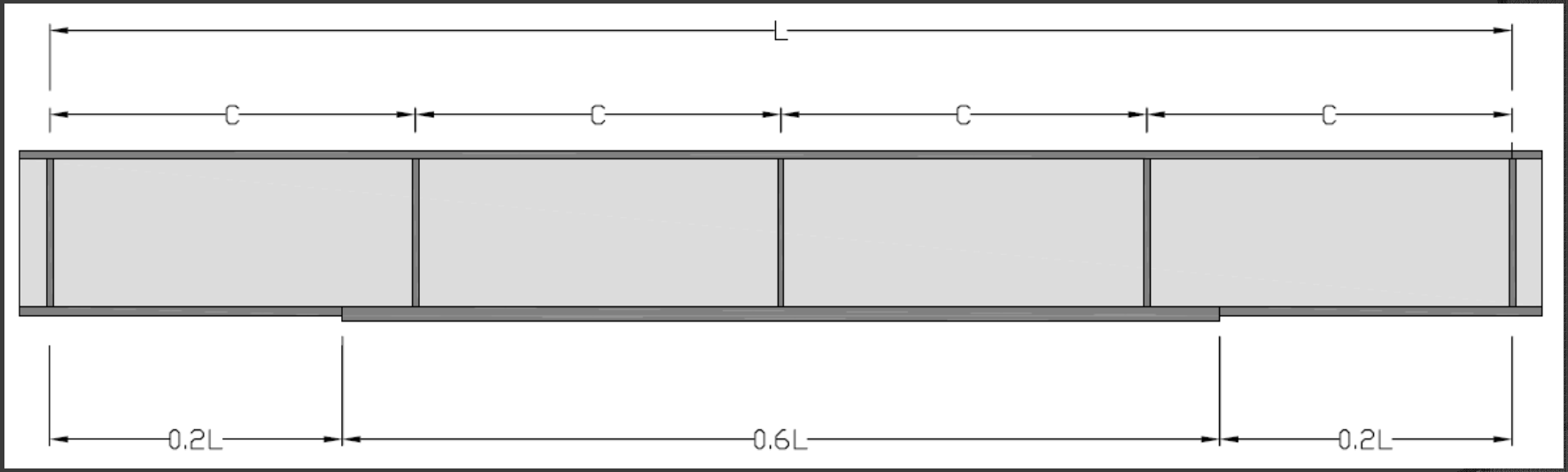
Design Constraints

- Plate Girder Sections
  - Target L/D of 25
  - Material Configurations
    - Homogeneous: 50 ksi steel
    - Hybrid: 50 ksi steel for top flange and web and 70 ksi steel for bottom flange
  - Cross-bracings
    - 1 Intermediate bracing – 40 ft to 55 ft
    - 2 Intermediate bracings – 60 ft to 75 ft
    - 3 Intermediate bracings – 80 ft to 140 ft

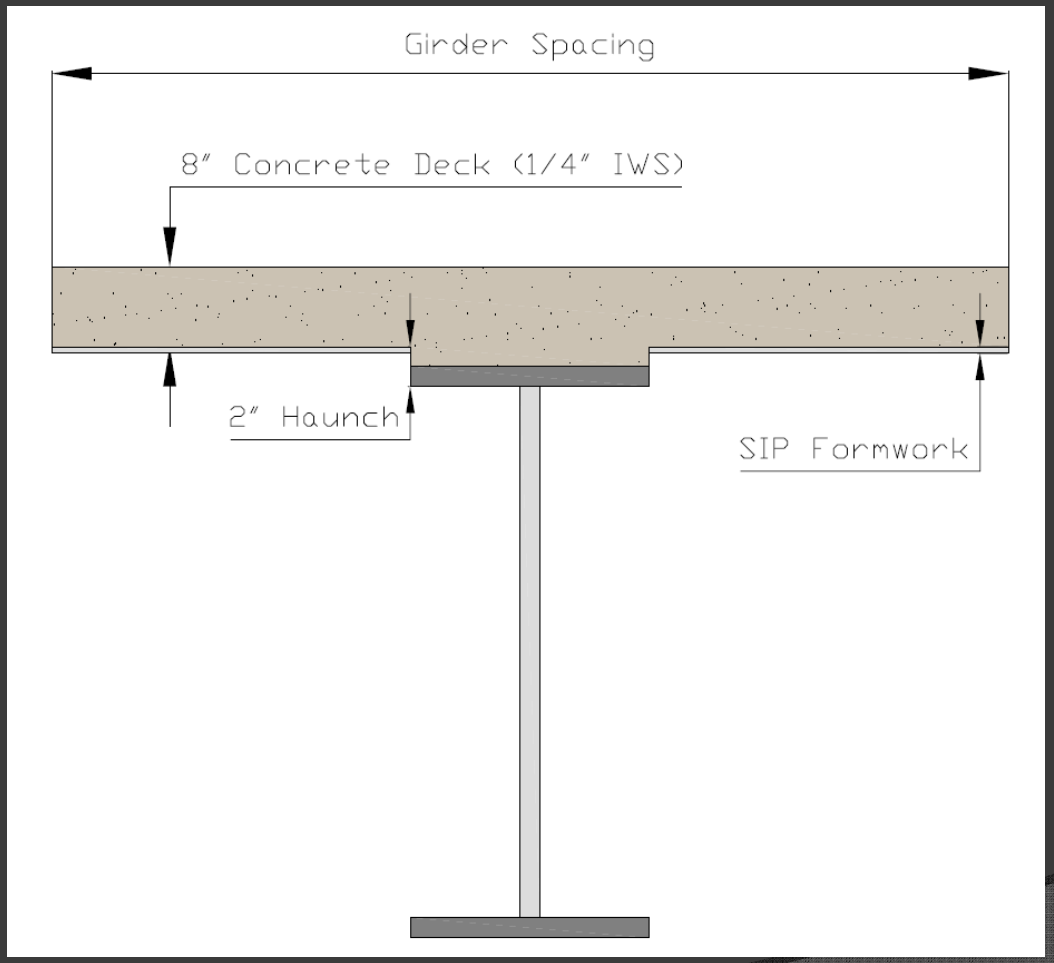
Design Constraints (cont'd)

- Rolled Girder Sections
  - All Sections
    - Material: 50 ksi steel
    - Cross-bracings
      - 1 Intermediate Bracing – 40 ft to 55 ft
      - 2 Intermediate Bracings – 60 ft to 75 ft
      - 3 Intermediate Bracings – 80 ft to 140 ft
    - Minimum section depth – W21 shape
  - Limited Depth Sections
    - Target L/D of 25
  - Lightest Weight Sections
    - No Target L/D – focused on lightest section

Typical Girder Elevation



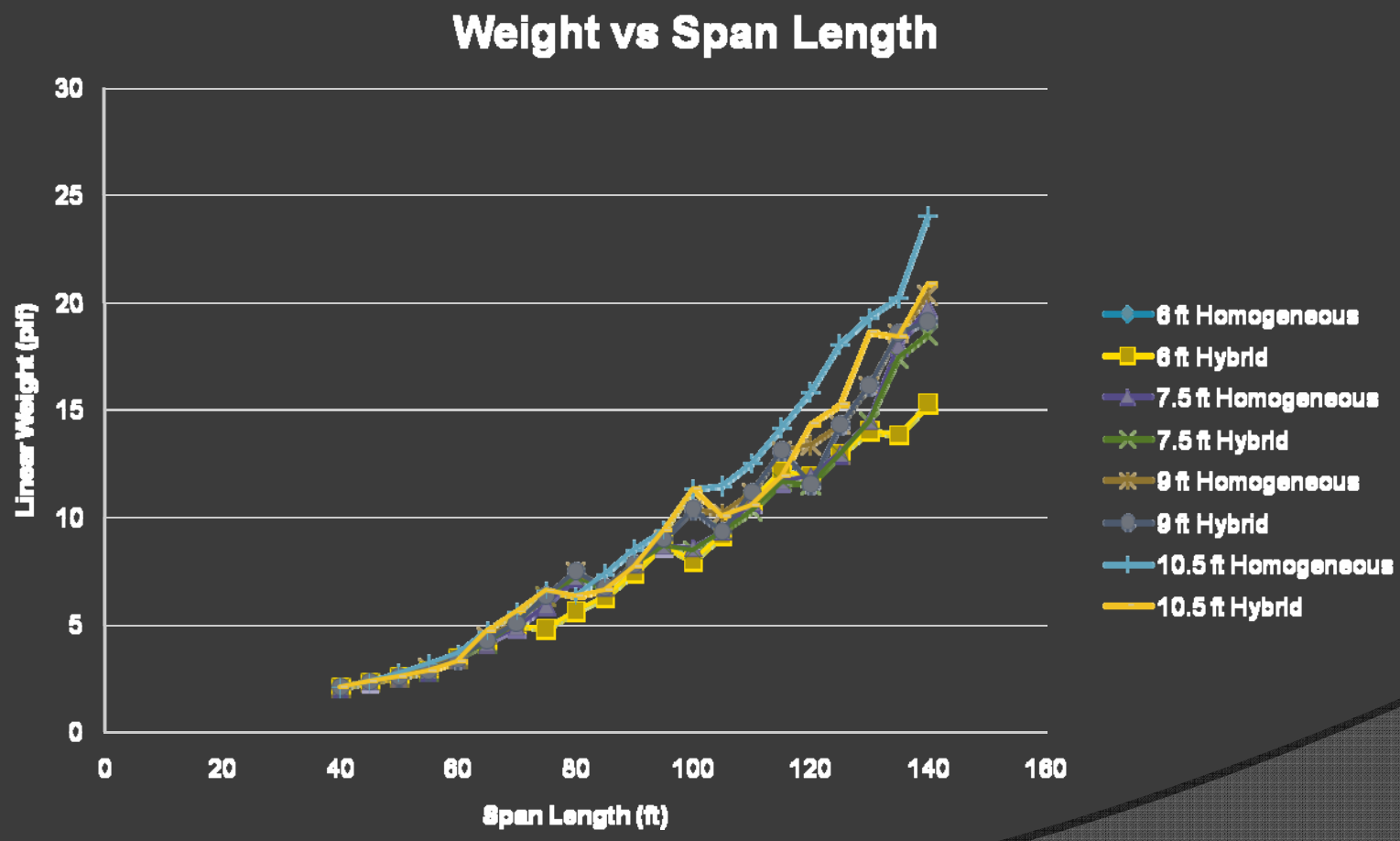
Typical Cross-Section



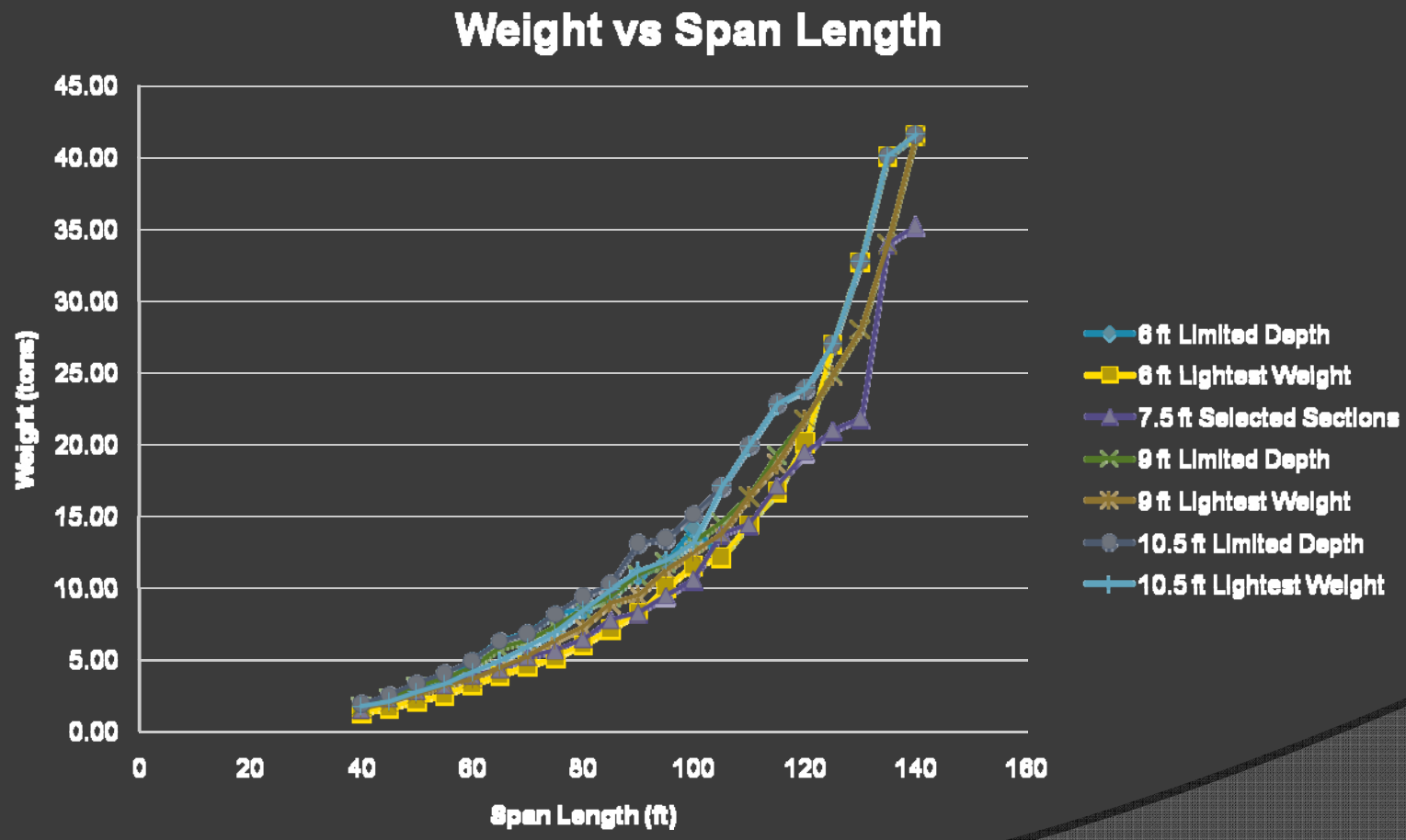
Limited Plate Dimensions

- Web plates
  - Depth: 24 in, 32 in, 40 in, 48 in and 56 in
  - Thickness: ½ in and ¾ in
- Flange plates
  - Width: 12 in, 14 in, 16 in, 18 in and 20 in
  - Thickness: ¾ in, 1 in, 1 ½ in and 2 in

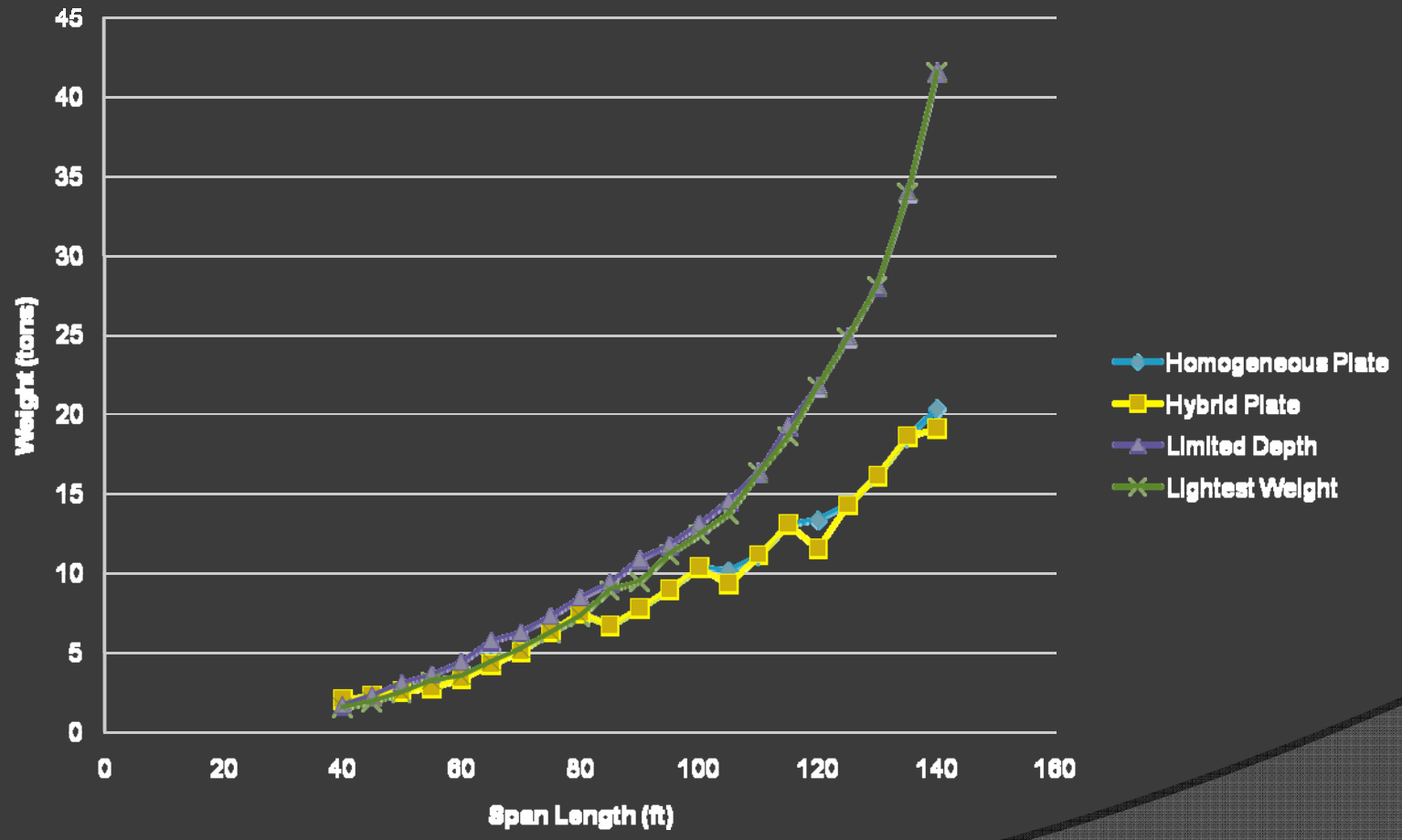
Plate Girder Sections



Rolled Girder Sections Comparison

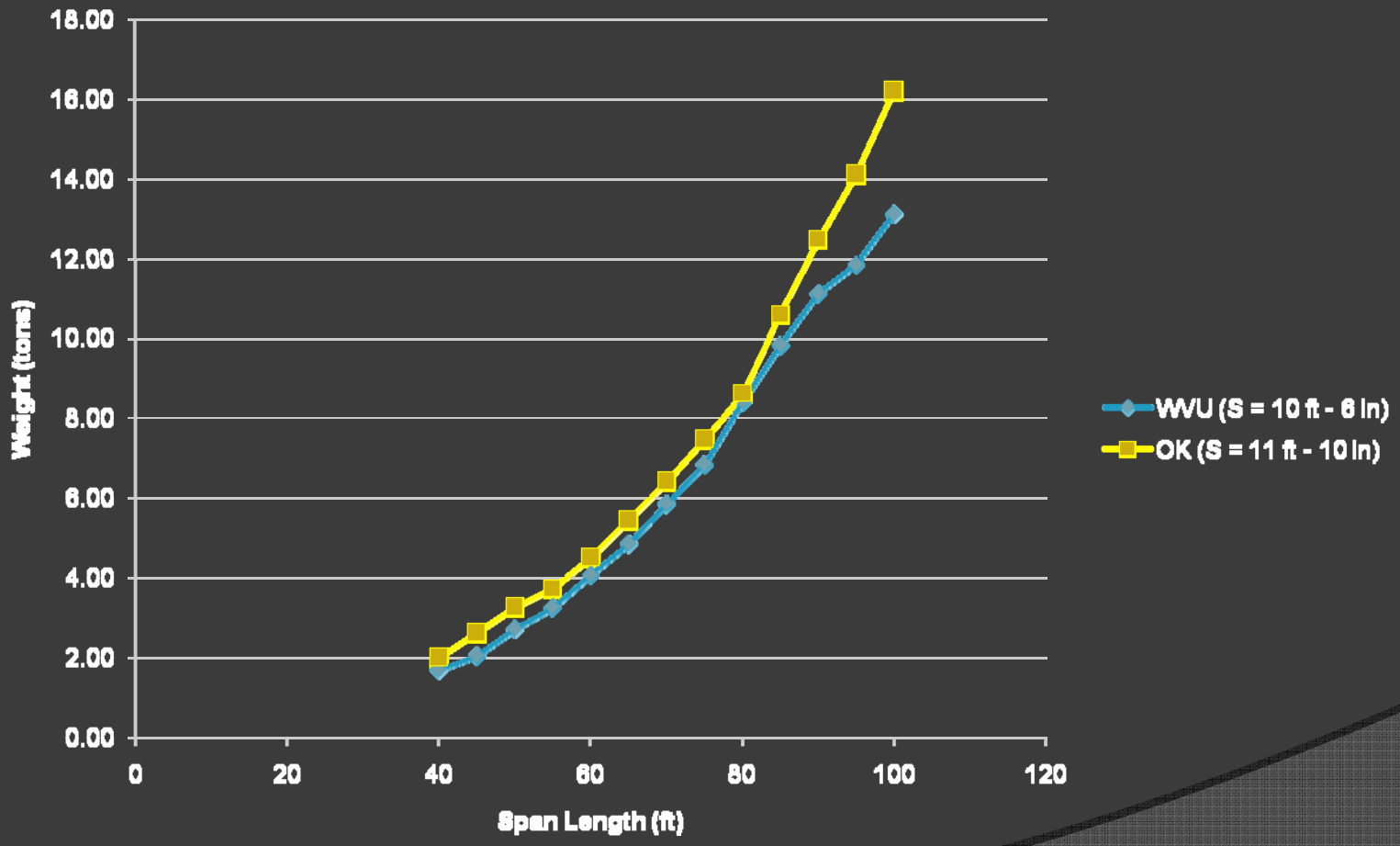


Plate/Rolled Girder 9 ft Spacing Comparison

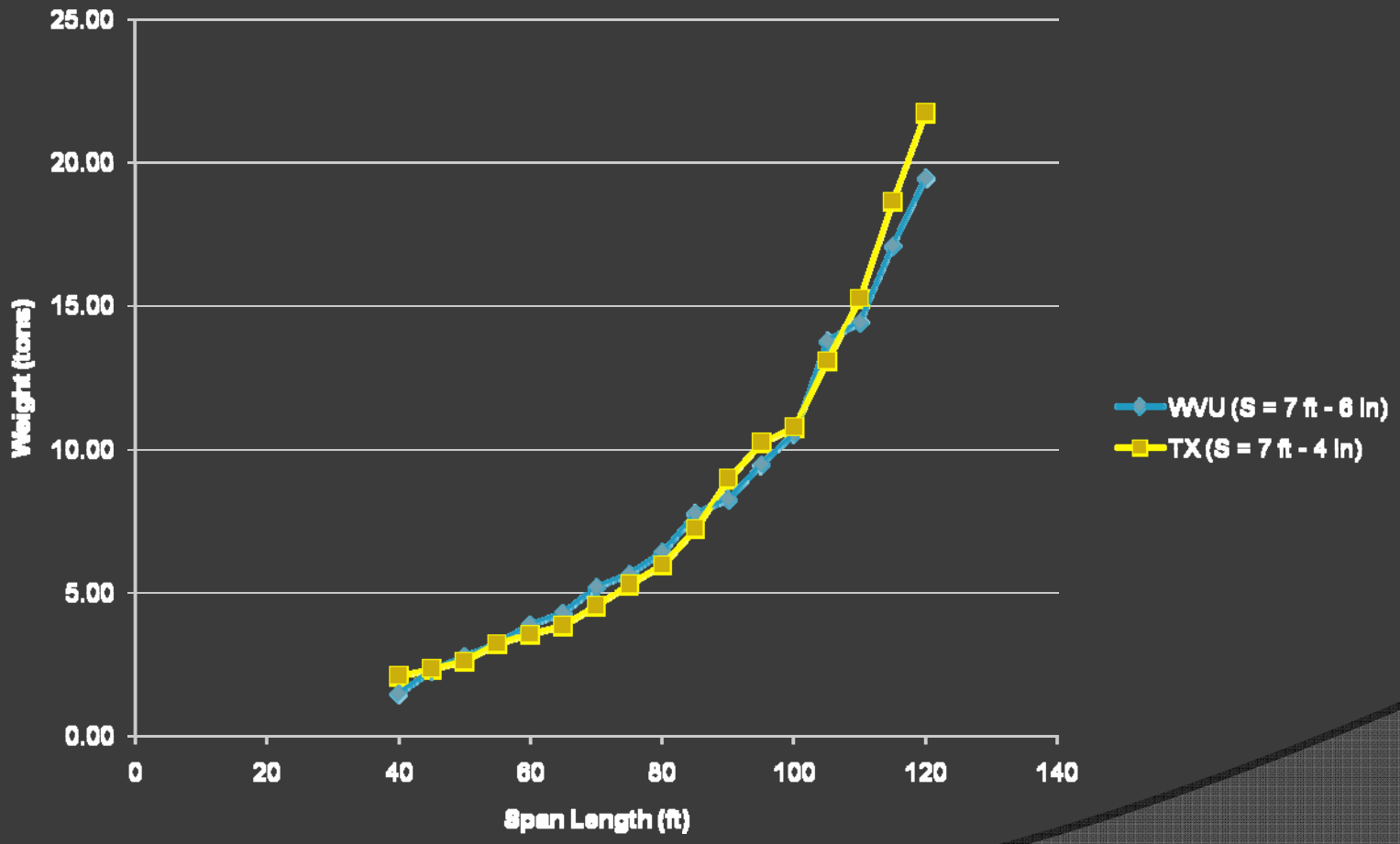


Comparisons with other standard design packages

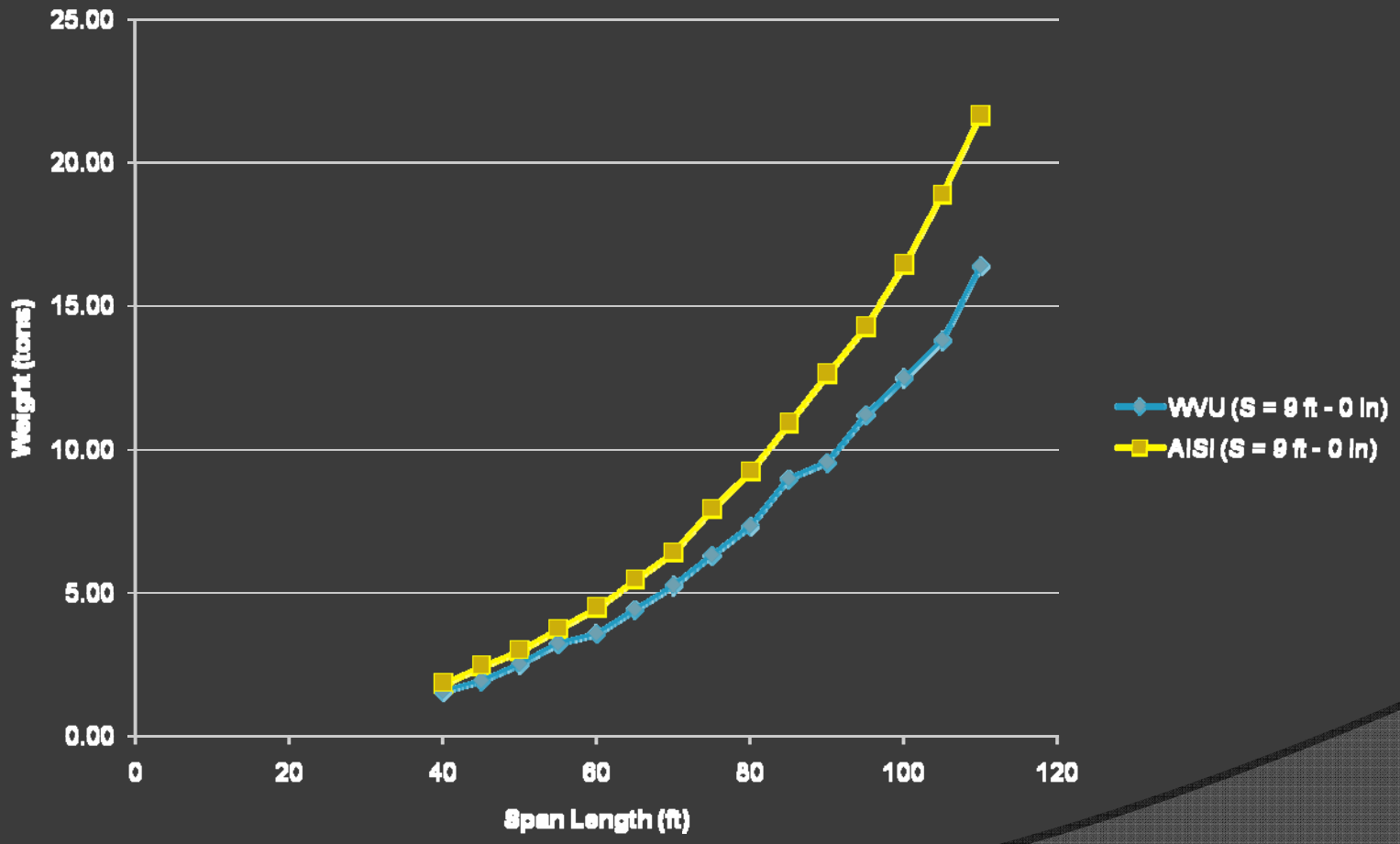
Oklahoma standards



Texas standards



Older AISI standards



Summary results

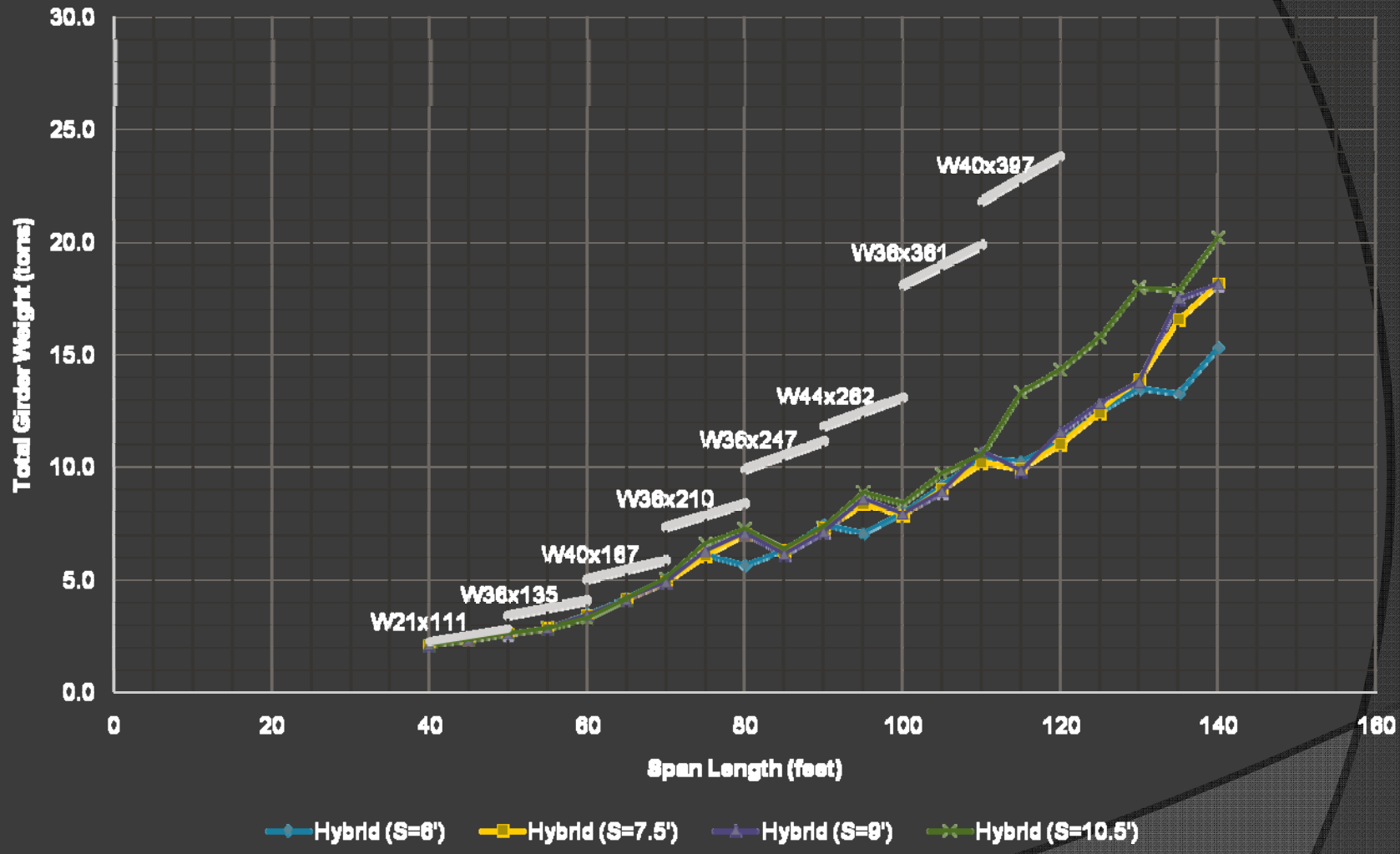
Lightest Weight Rolled Shapes

Span Range	6 ft.	7 ft. - 6 in.	9 ft.	10 ft. - 6 in.	selected section	
40	W21x62	W21x73	W24x76	W24x84	W21x111	
45	W24x68	W21x101	W27x84	W30x90	W21x111	
50	W27x84	W21x111	W30x99	W30x108	W21x111	W21x111
55	W30x90	W24x117	W30x116	W33x118	W36x135	
60	W30x108	W27x129	W33x118	W36x135	W36x135	W36x135
65	W33x118	W30x132	W36x135	W40x149	W40x167	
70	W33x130	W30x148	W40x149	W40x167	W40x167	W40x167
75	W36x135	W36x150	W40x167	W36x182	W36x210	
80	W40x149	W36x160	W36x182	W36x210	W36x210	W36x210
85	W40x167	W36x182	W36x210	W36x231	W36x247	
90	W40x183	W40x183	W40x211	W36x247	W36x247	W36x247
95	W40x211	W40x199	W40x235	W40x249	W44x262	
100	W44x230	W40x211	W40x249	W44x262	W44x262	W44x262
105	W44x230	W44x262	W44x262	W40x324	W36x361	
110	W44x262	W44x262	W40x297	W36x361	W36x361	W36x361
115	W44x290	W40x297	W40x324	W36x395	W40x397	
120	W44x335	W40x324	W40x362	W40x397	W40x397	W40x397
125	W40x431	W44x335	W40x397	W40x431		
130	W40x503	W44x335	W40x431	W40x503		
135	W40x593	W40x503	W40x503	W40x593		
140	W40x593	W40x503	W40x593	W40x593		

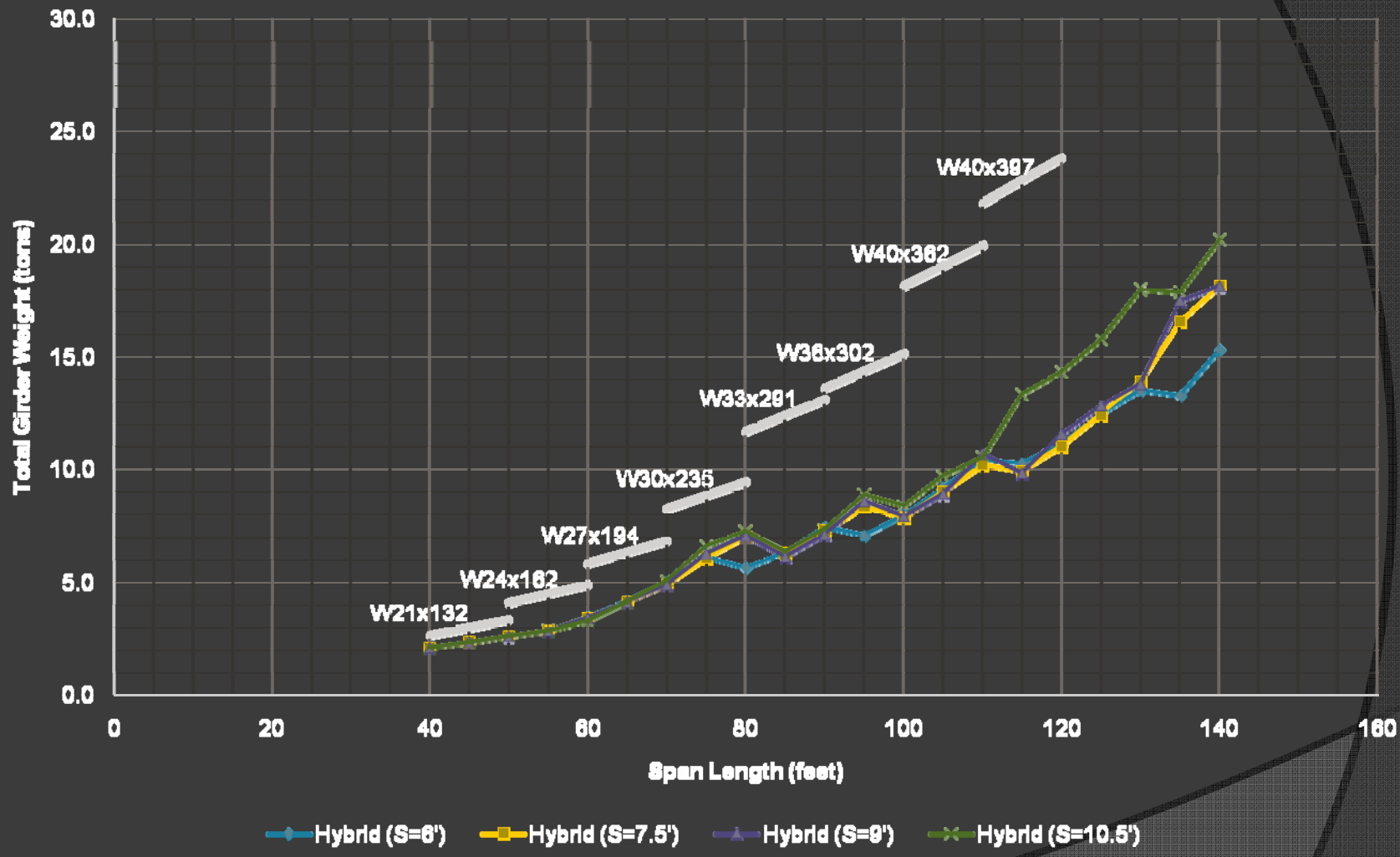
Limited Depth Rolled Shapes

Span Range	6 ft.	7 ft. - 6 in.	9 ft.	10 ft. - 6 in.	selected section	
40	W21x62	W21x73	W21x83	W21x93	W21x132	
45	W21x83	W21x101	W21x101	W21x111	W21x132	
50	W21x111	W21x111	W21x122	W21x132	W21x132	W21x132
55	W24x117	W24x117	W24x131	W24x146	W24x162	
60	W24x162	W27x129	W24x146	W24x162	W24x162	W24x162
65	W24x192	W30x132	W24x176	W24x192	W27x194	
70	W27x194	W30x148	W27x178	W27x194	W27x194	W27x194
75	W27x217	W36x150	W27x194	W27x217	W30x235	
80	W30x211	W36x160	W30x211	W30x235	W30x235	W30x235
85	W33x221	W36x182	W33x221	W33x241	W33x291	
90	W33x241	W40x183	W33x241	W33x291	W33x291	W33x291
95	W36x247	W40x199	W36x247	W36x282	W36x302	
100	W36x282	W40x211	W36x262	W36x302	W36x302	W36x302
105	W44x230	W44x262	W40x277	W40x324	W40x362	
110	W44x262	W44x262	W40x297	W40x362	W40x362	W40x362
115	W44x290	W40x297	W44x335	W40x397	W40x397	
120	W44x335	W40x324	W40x362	W40x397	W40x397	W40x397
125	W40x431	W44x335	W40x397	W40x431		
130	W40x503	W44x335	W40x431	W40x503		
135	W40x593	W40x503	W40x503	W40x593		
140	W40x593	W40x503	W40x593	W40x593		

Lightest Weight Rolled Shapes vs. Plate Girders

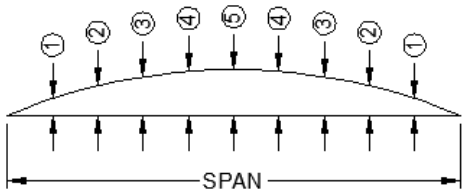


Limited Depth Rolled Shapes vs. Plate Girders



SHORT-SPAN STANDARD DESIGN DETAILS

Hom. PL Girders (S = 6.0’)

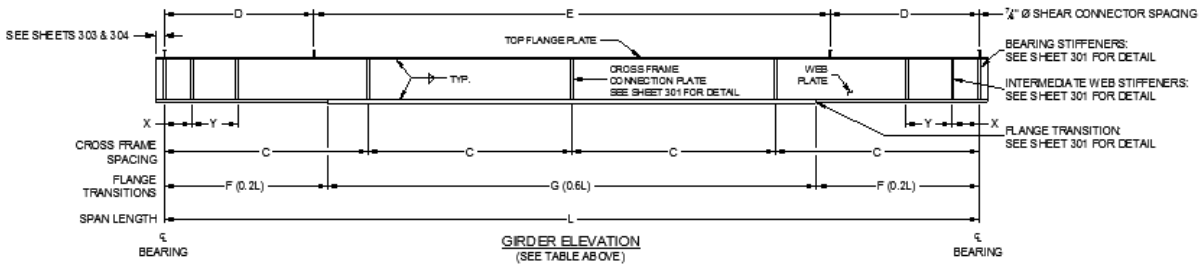


D.L. CAMBER
(SEE TABLE BELOW)

NOTE:
DESIGNS WERE ORIGINATED USING 5 GIRDERS WITH EQUAL SPACING. HOWEVER, PLATE SIZES ARE ADEQUATE FOR ANY INCREMENT OF THE SELECTED SPACING

COMPOSITE PLATE GIRDER WITH PARTIALLY STIFFENED WEB - 6'-0" GIRDER SPACING, HOMOGENOUS

SPAN (L) - Ft.	PLATE GIRDER SIZE						DIAPHRAGM SPACING (C) - Ft.	INTERMEDIATE STIFFENERS - in.		BEARING STIFFENERS - in.		SHEAR STIFFENER SPACING - Ft.		SHEAR CONNECTOR MAX SPACING - in.		D.L. CAMBER				
	TOP FLANGE - in.	BOTTOM FLANGE (F)		BOTTOM FLANGE (G)		WEB PLATE - in.		WIDTH	THICKNESS	WIDTH	THICKNESS	X	Y	D	E	1	2	3	4	5
		PLATE - in.	LENGTH - Ft.	PLATE - in.	LENGTH - Ft.															
60	12 x 3/4	14 x 3/4	12	14 x 1	36	24 x 1/2	20													
65	12 x 3/4	18 x 3/4	13	18 x 1	39	24 x 1/2	21.67													
70	12 x 3/4	16 x 1	14	16 x 1 1/2	42	24 x 1/2	23.33													
75	14 x 3/4	14 x 1 1/2	15	14 x 2	45	24 x 1/2	25													
80	12 x 3/4	18 x 3/4	16	18 x 1	48	32 x 1/2	20													
85	12 x 3/4	14 x 1	17	14 x 1 1/2	51	32 x 1/2	21.25													
90	12 x 3/4	18 x 1	18	18 x 1 1/2	54	32 x 1/2	22.5													
95	12 x 3/4	16 x 3/4	19	16 x 1	57	40 x 1/2	23.75													
100	14 x 3/4	18 x 3/4	20	18 x 1	60	40 x 1/2	25													
105	14 x 3/4	16 x 1	21	16 x 1 1/2	63	40 x 1/2	26.25													
110	16 x 3/4	18 x 1	22	18 x 1 1/2	66	40 x 1/2	27.5													
115	16 x 3/4	18 x 3/4	23	18 x 1	69	48 x 1/2	28.75													
120	16 x 3/4	14 x 1	24	14 x 1 1/2	72	48 x 1/2	30													
125	18 x 3/4	16 x 1	25	16 x 1 1/2	75	48 x 1/2	31.25													
130	18 x 3/4	18 x 1	26	18 x 1 1/2	78	48 x 1/2	32.5													
135	18 x 3/4	18 x 3/4	27	18 x 1	81	56 x 1/2	33.75													
140	18 x 1	14 x 1	28	14 x 1 1/2	84	56 x 1/2	35													



Steel Market Development Institute

COMPOSITE PLATE GIRDER - PART. STIFF. WEB
6'-0" GIRDER SPACING - HOMOGENEOUS

DATE:			
07/19/2011		DO NOT SCALE	
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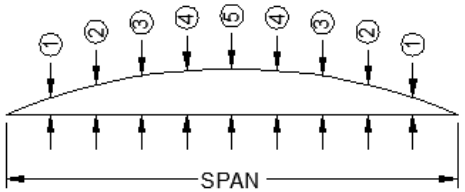
GKM	SAM	KEB	101

Hom. PL Girders (S = 7.5’)

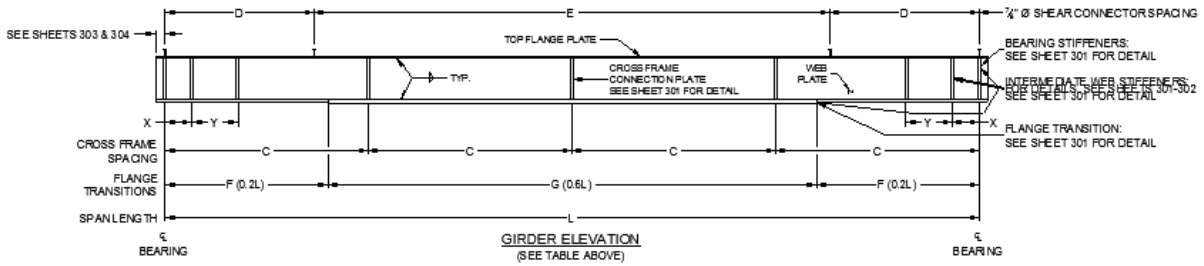


D.L. CAMBER
(SEE TABLE BELOW)

NOTE:
DESIGNS WERE ORIGINATED USING 5 GIRDERS WITH EQUAL SPACING. HOWEVER, PLATE SIZES ARE ADEQUATE FOR ANY INCREMENT OF THE SELECTED SPACING

COMPOSITE PLATE GIRDER WITH PARTIALLY STIFFENED WEB - 7'-6" GIRDER SPACING, HOMOGENEOUS

SPAN (L) - Ft.	PLATE GIRDER SIZE						DIAPHRAGM SPACING (C) - Ft.	INTERMEDIATE STIFFENERS - In.		BEARING STIFFENERS - In.		SHEAR STIFFENER SPACING - Ft.		SHEAR CONNECTOR MAX. SPACING - In.		D.L CAMBER				
	TOP FLANGE - In.	BOTTOM FLANGE (F)		BOTTOM FLANGE (G)		WEB PLATE - In.		WIDTH	THICKNESS	WIDTH	THICKNESS	X	Y	D	E	1	2	3	4	5
		PLATE - In.	LENGTH - Ft.	PLATE - In.	LENGTH - Ft.															
60	12 x 3/4	-	-	16 x 3/4	60	24 x 1/2	20													
65	12 x 3/4	-	-	16 x 1	65	24 x 1/2	21.67													
70	14 x 3/4	14 x 1	14	14 x 1 1/2	42	24 x 1/2	23.33													
75	16 x 3/4	18 x 1	15	18 x 1 1/2	45	24 x 1/2	25													
80	14 x 3/4	16 x 1 1/2	16	16 x 2	48	24 x 1/2	20													
85	12 x 3/4	14 x 1	17	14 x 1 1/2	51	32 x 1/2	21.25													
90	14 x 3/4	16 x 1	18	16 x 1 1/2	54	32 x 1/2	22.5													
95	16 x 3/4	18 x 1	19	18 x 1 1/2	57	32 x 1/2	23.75													
100	14 x 3/4	18 x 3/4	20	18 x 1	60	40 x 1/2	25													
105	16 x 3/4	14 x 1	21	14 x 1 1/2	63	40 x 1/2	26.25													
110	18 x 3/4	16 x 1	22	16 x 1 1/2	66	40 x 1/2	27.5													
115	14 x 3/4	18 x 3/4	23	18 x 1	69	48 x 1/2	28.75													
120	18 x 3/4	14 x 1	24	14 x 1 1/2	72	48 x 1/2	30													
125	16 x 1	16 x 1	25	16 x 1 1/2	75	48 x 1/2	31.25													
130	18 x 1	18 x 1	26	18 x 1 1/2	78	48 x 1/2	32.5													
135	18 x 1	14 x 1	27	14 x 1 1/2	81	56 x 3/4	33.75													
140	20 x 1	14 x 1	28	14 x 1 1/2	84	56 x 3/4	35													



Steel Market Development Institute

COMPOSITE PLATE GIRDER - PART. STIFF. WEB
7'-6" GIRDER SPACING - HOMOGENEOUS

DATE:	
07/19/2011	DO NOT SCALE

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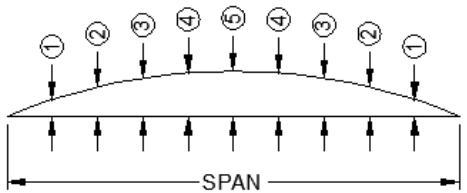
GKM	SAM	KEB	103

Hom. PL Girders (S = 9.0')

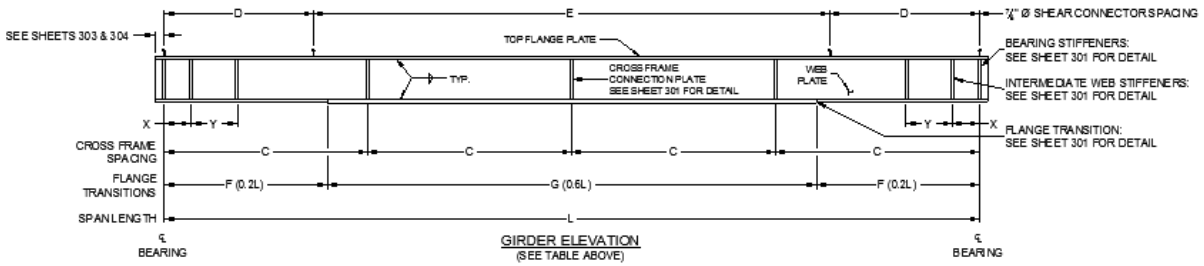


D.L. CAMBER
(SEE TABLE BELOW)

NOTE:
DESIGNS WERE ORIGINATED USING 5 GIRDERS WITH EQUAL SPACING. HOWEVER, PLATE SIZES ARE ADEQUATE FOR ANY INCREMENT OF THE SELECTED SPACING

COMPOSITE PLATE GIRDER WITH PARTIALLY STIFFENED WEB - 9'-0" GIRDER SPACING, HOMOGENOUS

SPAN (L) - Ft.	PLATE GIRDER SIZE						DIAPHRAGM SPACING (C) - Ft.	INTERMEDIATE STIFFENERS - In.		BEARING STIFFENERS - In.		SHEAR STIFFENER SPACING - Ft.		SHEAR CONNECTOR MAX. SPACING - In.		D.L CAMBER				
	TOP FLANGE - In.	BOTTOM FLANGE (F)		BOTTOM FLANGE (G)		WEB PLATE - In.		WIDTH	THICKNESS	WIDTH	THICKNESS	X	Y	D	E	1	2	3	4	5
		PLATE - In.	LENGTH - Ft.	PLATE - In.	LENGTH - Ft.															
60	12 x 3/4	14 x 3/4	12	14 x 1	36	24 x 1/2	20													
65	14 x 3/4	18 x 3/4	13	18 x 1	39	24 x 1/2	21.67													
70	14 x 3/4	14 x 1	14	14 x 1 1/2	42	24 x 1/2	23.33													
75	18 x 3/4	18 x 1	15	18 x 1 1/2	45	24 x 1/2	25													
80	16 x 3/4	18 x 1 1/2	16	18 x 2	48	24 x 1/2	20													
85	14 x 3/4	14 x 1	17	14 x 1 1/2	51	32 x 1/2	21.25													
90	16 x 3/4	16 x 1	18	16 x 1 1/2	54	32 x 1/2	22.5													
95	18 x 3/4	18 x 1	19	18 x 1 1/2	57	32 x 1/2	23.75													
100	16 x 3/4	16 x 1	20	16 x 1 1/2	60	40 x 1/2	25													
105	18 x 3/4	18 x 1	21	18 x 1 1/2	63	40 x 1/2	26.25													
110	16 x 1	14 x 1 1/2	22	14 x 2	66	40 x 1/2	27.5													
115	18 x 3/4	16 x 1	23	16 x 1 1/2	69	48 x 1/2	28.75													
120	18 x 1	18 x 1	24	18 x 1 1/2	72	48 x 1/2	30													
125	18 x 1	14 x 1 1/2	25	14 x 2	75	48 x 1/2	31.25													
130	20 x 1	16 x 1 1/2	26	16 x 2	78	48 x 1/2	32.5													
135	18 x 1	16 x 1	27	16 x 1 1/2	81	56 x 3/4	33.75													
140	20 x 1	18 x 1	28	18 x 1 1/2	84	56 x 3/4	35													



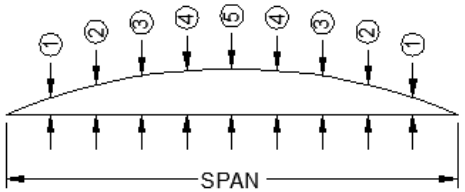
GIRDER ELEVATION
(SEE TABLE ABOVE)

Steel Market Development Institute

COMPOSITE PLATE GIRDER - PART. STIFF. WEB
9'-0" GIRDER SPACING - HOMOGENEOUS

DATE:	DO NOT SCALE		
07/19/2011			
DRAFTED BY:	DESIGNED BY:	CHECKED BY:	SHEET NO:
GKM	SAM	KEB	105

Hom. PL Girders (S = 10.5’)

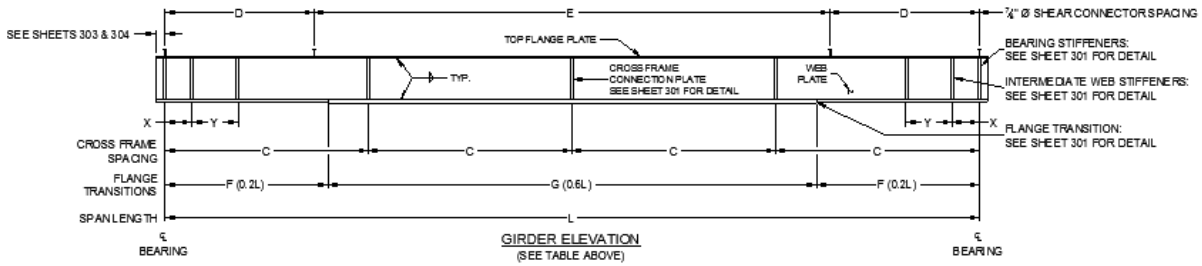


D.L. CAMBER
(SEE TABLE BELOW)

NOTE:
DESIGNS WERE ORIGINATED USING 5 GIRDERS WITH EQUAL SPACING. HOWEVER, PLATE SIZES ARE ADEQUATE FOR ANY INCREMENT OF THE SELECTED SPACING

COMPOSITE PLATE GIRDER WITH PARTIALLY STIFFENED WEB - 10'-6" GIRDER SPACING, HOMOGENOUS

SPAN (L) - Ft.	PLATE GIRDER SIZE						DIAPHRAGM SPACING (C) - Ft.	INTERMEDIATE STIFFENERS - In.		BEARING STIFFENERS - In.		SHEAR STIFFENER SPACING - Ft.		SHEAR CONNECTOR MAX. SPACING - In.		D.L CAMBER				
	TOP FLANGE - In.	BOTTOM FLANGE (F)		BOTTOM FLANGE (G)		WEB PLATE - In.		WIDTH	THICKNESS	WIDTH	THICKNESS	X	Y	D	E	1	2	3	4	5
		PLATE - In.	LENGTH - Ft.	PLATE - In.	LENGTH - Ft.															
60	12 x 3/4	16 x 3/4	12	16 x 1	36	24 x 1/2	20													
65	14 x 3/4	14 x 1	13	14 x 1 1/2	39	24 x 1/2	21.67													
70	16 x 3/4	16 x 1	14	16 x 1 1/2	42	24 x 1/2	23.33													
75	16 x 1	18 x 1	15	18 x 1 1/2	45	24 x 1/2	25													
80	16 x 1	20 x 1	16	20 x 1 1/2	48	24 x 1/2	20													
85	16 x 3/4	16 x 1	17	16 x 1 1/2	51	32 x 1/2	21.25													
90	18 x 3/4	18 x 1	18	18 x 1 1/2	54	32 x 1/2	22.5													
95	16 x 1	20 x 1	19	20 x 1 1/2	57	32 x 1/2	23.75													
100	18 x 3/4	18 x 1	20	18 x 1 1/2	60	40 x 1/2	25													
105	18 x 1	20 x 1	21	20 x 1 1/2	63	40 x 1/2	26.25													
110	18 x 1	16 x 1 1/2	22	16 x 2	66	40 x 1/2	27.5													
115	18 x 1	16 x 1	23	16 x 1 1/2	69	48 x 3/4	28.75													
120	18 x 1	18 x 1	24	18 x 1 1/2	72	48 x 3/4	30													
125	20 x 1	16 x 1 1/2	25	16 x 2	75	48 x 3/4	31.25													
130	18 x 1 1/2	18 x 1 1/2	26	18 x 2	78	48 x 3/4	32.5													
135	20 x 1	20 x 1	27	20 x 1 1/2	81	56 x 3/4	33.75													
140	20 x 1 1/2	16 x 1 1/2	28	16 x 2	84	56 x 3/4	35													



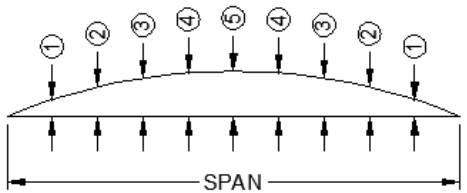
Steel Market Development Institute

COMPOSITE PLATE GIRDER - PART. STIFF. WEB
10'-6" GIRDER SPACING - HOMOGENEOUS

DATE:	
07/19/2011	DO NOT SCALE

DRAFTED BY:	DESIGNED BY:	CHECKED BY:	SHEET NO:
GKM	SAM	KEB	107

Hyb. PL Girders (S = 6.0’)

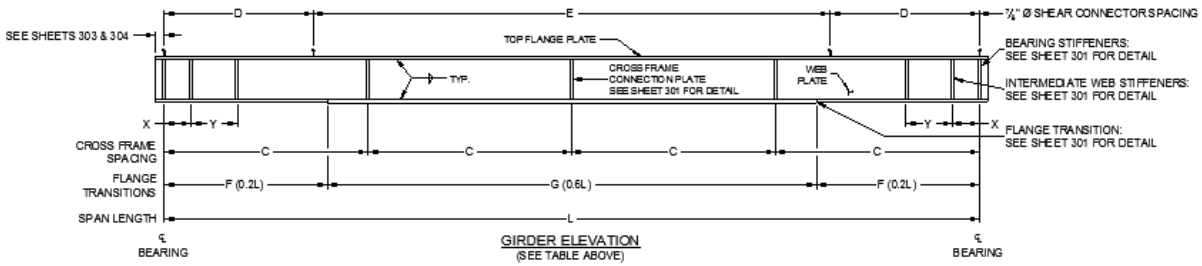


D.L. CAMBER
(SEE TABLE BELOW)

NOTE:
DESIGNS WERE ORIGINATED USING 5 GIRDERS WITH EQUAL SPACING. HOWEVER, PLATE SIZES ARE ADEQUATE FOR ANY INCREMENT OF THE SELECTED SPACING

COMPOSITE PLATE GIRDER WITH PARTIALLY STIFFENED WEB - 6'-0" GIRDER SPACING, HYBRID

SPAN (L) - Ft.	PLATE GIRDER SIZE						DIAPHRAGM SPACING (C) - Ft.	INTERMEDIATE STIFFENERS - in.		BEARING STIFFENERS - in.		SHEAR STIFFENER SPACING - Ft.		SHEAR CONNECTOR MAX. SPACING - in.		D.L CAMBER				
	TOP FLANGE - in.	BOTTOM FLANGE (F)		BOTTOM FLANGE (G)		WEB PLATE - in.		WIDTH	THICKNESS	WIDTH	THICKNESS	X	Y	D	E	1	2	3	4	5
		PLATE - in.	LENGTH - Ft.	PLATE - in.	LENGTH - Ft.															
80	12 x 3/4	18 x 3/4	16	18 x 1	48	32 x 1/2	20													
85	12 x 3/4	14 x 1	17	14 x 1 1/2	51	32 x 1/2	21.25													
90	12 x 3/4	18 x 1	18	18 x 1 1/2	54	32 x 1/2	22.5													
95	12 x 3/4	16 x 3/4	19	16 x 1	57	40 x 1/2	23.75													
100	14 x 3/4	18 x 3/4	20	18 x 1	60	40 x 1/2	25													
105	14 x 3/4	16 x 1	21	16 x 1 1/2	63	40 x 1/2	26.25													
110	16 x 3/4	18 x 1	22	18 x 1 1/2	66	40 x 1/2	27.5													
115	16 x 3/4	18 x 3/4	23	18 x 1	69	48 x 1/2	28.75													
120	16 x 3/4	14 x 1	24	14 x 1 1/2	72	48 x 1/2	30													
125	18 x 3/4	16 x 1	25	16 x 1 1/2	75	48 x 1/2	31.25													
130	18 x 3/4	18 x 1	26	18 x 1 1/2	78	48 x 1/2	32.5													
135	18 x 3/4	18 x 3/4	27	18 x 1	81	56 x 1/2	33.75													
140	18 x 1	14 x 1	28	14 x 1 1/2	84	56 x 1/2	35													

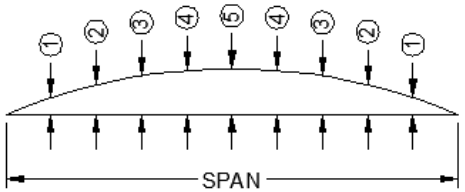


Steel Market Development Institute

COMPOSITE PLATE GIRDER - PART. STIFF. WEB
6'-0" GIRDER SPACING - HYBRID

DATE:			
07/19/2011	DO NOT SCALE		
DRAFTED BY:	DESIGNED BY:	CHECKED BY:	SHEET NO:
GKM	SAM	KEB	102

Hyb. PL Girders (S = 7.5’)

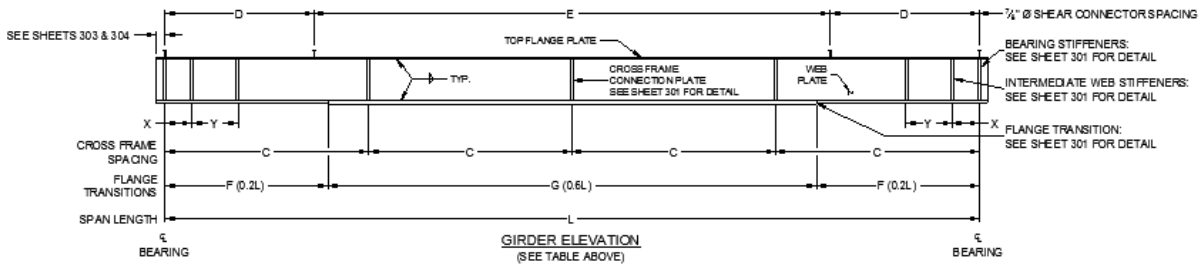


D.L. CAMBER
(SEE TABLE BELOW)

NOTE:
DESIGNS WERE ORIGINATED USING 5 GIRDERS WITH EQUAL SPACING. HOWEVER, PLATE SIZES ARE ADEQUATE FOR ANY INCREMENT OF THE SELECTED SPACING

COMPOSITE PLATE GIRDER WITH PARTIALLY STIFFENED WEB - 7'-6" GIRDER SPACING, HYBRID

SPAN (L) - Ft.	PLATE GIRDER SIZE							DIAPHRAGM SPACING (C) - Ft.	INTERMEDIATE STIFFENERS - in.		BEARING STIFFENERS - in.		SHEAR STIFFENER SPACING - Ft.		SHEAR CONNECTOR MAX. SPACING - in.		D.L CAMBER				
	TOP FLANGE - in.	BOTTOM FLANGE (F)		BOTTOM FLANGE (G)		WEB PLATE - in.			WIDTH	THICKNESS	WIDTH	THICKNESS	X	Y	D	E	1	2	3	4	5
		PLATE - in.	LENGTH - Ft.	PLATE - in.	LENGTH - Ft.																
80	14 x 3/4	16 x 1 1/2	16	16 x 2	48	24 x 1/2		20													
85	12 x 3/4	14 x 1	17	14 x 1 1/2	51	32 x 1/2		21.25													
90	14 x 3/4	16 x 1	18	16 x 1 1/2	54	32 x 1/2		22.5													
95	16 x 3/4	18 x 1	19	18 x 1 1/2	57	32 x 1/2		23.75													
100	14 x 3/4	12 x 1	20	12 x 1 1/2	60	40 x 1/2		25													
105	16 x 3/4	14 x 1	21	14 x 1 1/2	63	40 x 1/2		26.25													
110	18 x 3/4	16 x 1	22	16 x 1 1/2	66	40 x 1/2		27.5													
115	16 x 3/4	16 x 3/4	23	16 x 1	69	48 x 1/2		28.75													
120	18 x 3/4	18 x 3/4	24	18 x 1	72	48 x 1/2		30													
125	16 x 1	14 x 1	25	14 x 1 1/2	75	48 x 1/2		31.25													
130	18 x 1	16 x 1	26	16 x 1 1/2	78	48 x 1/2		32.5													
135	18 x 1	-	-	12 x 1	135	56 x 3/4		33.75													
140	20 x 1	-	-	14 x 1	140	56 x 3/4		35													

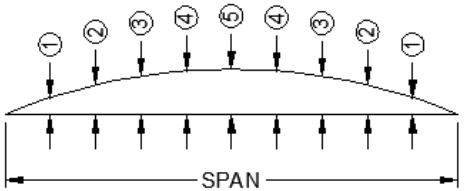


Steel Market Development Institute

COMPOSITE PLATE GIRDER - PART. STIFF. WEB
7'-6" GIRDER SPACING - HYBRID

DATE:			
07/19/2011			DO NOT SCALE
DRAFTED BY:	DESIGNED BY:	CHECKED BY:	SHEET NO:
GKM	SAM	KEB	104

Hyb. PL Girders (S = 9.0’)

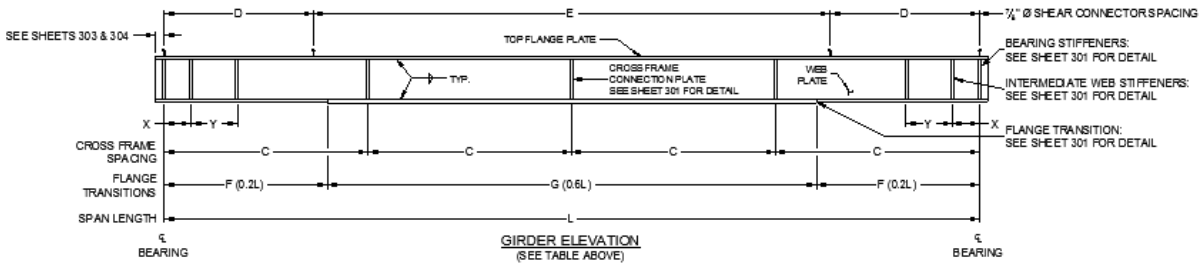


D.L. CAMBER
(SEE TABLE BELOW)

NOTE:
DESIGNS WERE ORIGINATED USING 5 GIRDERS WITH EQUAL SPACING. HOWEVER, PLATE SIZES ARE ADEQUATE FOR ANY INCREMENT OF THE SELECTED SPACING

COMPOSITE PLATE GIRDER WITH PARTIALLY STIFFENED WEB - 9'-0" GIRDER SPACING, HYBRID

SPAN (L) - Ft.	PLATE GIRDER SIZE						DIAPHRAGM SPACING (C) - Ft.	INTERMEDIATE STIFFENERS - in.		BEARING STIFFENERS - in.		SHEAR STIFFENER SPACING - Ft.		SHEAR CONNECTOR MAX. SPACING - in.		D.L CAMBER				
	TOP FLANGE - in.	BOTTOM FLANGE (F)		BOTTOM FLANGE (G)		WEB PLATE - in.		WIDTH	THICKNESS	WIDTH	THICKNESS	X	Y	D	E	1	2	3	4	5
		PLATE - in.	LENGTH - Ft.	PLATE - in.	LENGTH - Ft.															
80	18 x 3/4	20 x 1	16	20 x 1 1/2	48	24 x 1/2	20													
85	14 x 3/4	12 x 1	17	12 x 1 1/2	51	32 x 1/2	21.25													
90	16 x 3/4	14 x 1	18	14 x 1 1/2	54	32 x 1/2	22.5													
95	18 x 3/4	18 x 1	19	18 x 1 1/2	57	32 x 1/2	23.75													
100	16 x 3/4	16 x 3/4	20	16 x 1	60	40 x 1/2	25													
105	18 x 3/4	18 x 3/4	21	18 x 1	63	40 x 1/2	26.25													
110	16 x 1	16 x 1	22	16 x 1 1/2	66	40 x 1/2	27.5													
115	18 x 3/4	14 x 3/4	23	14 x 1	69	48 x 1/2	28.75													
120	18 x 1	16 x 3/4	24	16 x 1	72	48 x 1/2	30													
125	18 x 1	14 x 1	25	14 x 1 1/2	75	48 x 1/2	31.25													
130	20 x 1	14 x 1	26	14 x 1 1/2	78	48 x 1/2	32.5													
135	20 x 1	-	-	14 x 1	135	56 x 3/4	33.75													
140	20 x 1	-	-	14 x 1	140	56 x 3/4	35													

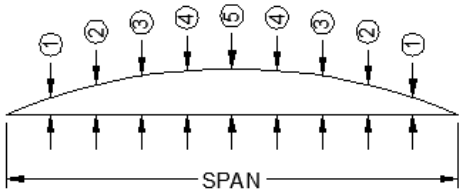


Steel Market Development Institute

COMPOSITE PLATE GIRDER - PART. STIFF. WEB
9'-0" GIRDER SPACING - HYBRID

DATE:			
07/19/2011			DO NOT SCALE
DRAFTED BY:	DESIGNED BY:	CHECKED BY:	SHEET NO:
GKM	SAM	KEB	106

Hyb. PL Girders (S = 10.5’)

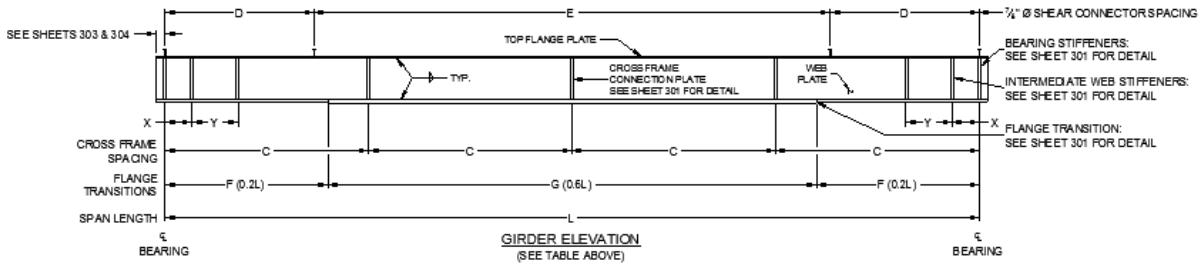


D.L. CAMBER
(SEE TABLE BELOW)

NOTE:
DESIGNS WERE ORIGINATED USING 5 GIRDERS WITH EQUAL SPACING. HOWEVER, PLATE SIZES ARE ADEQUATE FOR ANY INCREMENT OF THE SELECTED SPACING

COMPOSITE PLATE GIRDER WITH PARTIALLY STIFFENED WEB - 10'-6" GIRDER SPACING, HYBRID

SPAN (L) - Ft.	PLATE GIRDER SIZE							INTERMEDIATE STIFFENERS - in.		BEARING STIFFENERS - in.		SHEAR STIFFENER SPACING - Ft.		SHEAR CONNECTOR MAX. SPACING - in.		D.L CAMBER				
	TOP FLANGE - in.	BOTTOM FLANGE (F)		BOTTOM FLANGE (G)		WEB PLATE - in.	DIAPHRAGM SPACING (C) - Ft.													
		PLATE - in.	LENGTH - Ft.	PLATE - in.	LENGTH - Ft.			WIDTH	THICKNESS	WIDTH	THICKNESS	X	Y	D	E	1	2	3	4	5
80	16 x 1	14 x 1 1/2	16	14 x 2	48	24 x 1/2	20													
85	16 x 3/4	12 x 1	17	12 x 1 1/2	51	32 x 1/2	21.25													
90	18 x 3/4	14 x 1	18	14 x 1 1/2	54	32 x 1/2	22.5													
95	18 x 1	16 x 1	19	16 x 1 1/2	57	32 x 1/2	23.75													
100	18 x 3/4	12 x 1	20	12 x 1 1/2	60	40 x 1/2	25													
105	18 x 1	18 x 3/4	21	18 x 1	63	40 x 1/2	26.25													
110	18 x 1	14 x 1	22	14 x 1 1/2	66	40 x 1/2	27.5													
115	18 x 1	-	-	14 x 1	115	48 x 3/4	28.75													
120	18 x 1	-	-	16 x 1	120	48 x 3/4	30													
125	20 x 1	-	-	18 x 1	125	48 x 3/4	31.25													
130	18 x 1 1/2	14 x 1	26	14 x 1 1/2	78	48 x 3/4	32.5													
135	20 x 1	12 x 1	27	12 x 1 1/2	81	56 x 3/4	33.75													
140	18 x 1 1/2	12 x 1	28	12 x 1 1/2	84	56 x 3/4	35													



GIRDER ELEVATION
(SEE TABLE ABOVE)

Steel Market Development Institute

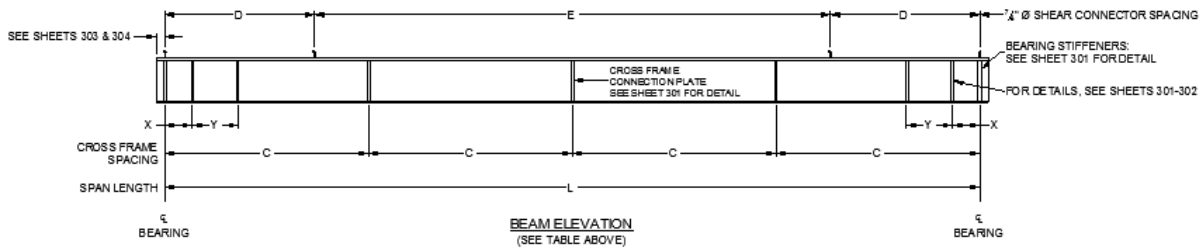
COMPOSITE PLATE GIRDER - PART. STIFF. WEB
10'-6" GIRDER SPACING - HYBRID

DATE:			
07/19/2011			DO NOT SCALE
DRAFTED BY:	DESIGNED BY:	CHECKED BY:	SHEET NO:
GKM	SAM	KEB	108

Rolled Beams (Lightest Weight)

NOTE:
DESIGNS WERE ORIGINATED USING 5 GIRDERS WITH EQUAL SPACING. HOWEVER, BEAM CHOICES ARE ADEQUATE FOR ANY INCREMENT OF THE SELECTED SPACING

ROLLED BEAM WITH PARTIALLY STIFFENED WEB - LIGHTEST WEIGHT					
SPAN (L) - Ft.	GIRDER SPACING				SELECTED SECTIONS
	6'-0"	7'-6"	9'-0"	10'-6"	
40	W21x62	W21x73	W24x76	W24x84	W21x111
45	W24x68	W21x101	W27x84	W30x90	
50	W27x84	W21x111	W30x99	W30x108	
55	W30x90	W24x117	W30x116	W33x118	W36x135
60	W30x108	W27x129	W33x118	W36x135	
65	W33x118	W30x132	W36x135	W40x149	W40x167
70	W33x130	W30x148	W40x149	W40x167	
75	W36x135	W36x150	W40x167	W36x182	W36x210
80	W40x149	W36x160	W36x182	W36x210	
85	W40x167	W36x182	W36x210	W36x231	W36x247
90	W40x183	W40x183	W40x211	W36x247	
95	W40x211	W40x199	W40x235	W40x249	W44x262
100	W44x230	W40x211	W40x249	W44x262	



BEAM ELEVATION
(SEE TABLE ABOVE)

Steel Market Development Institute

ROLLED BEAM - PART. STIFF. WEB
LIGHTEST WEIGHT DESIGNS

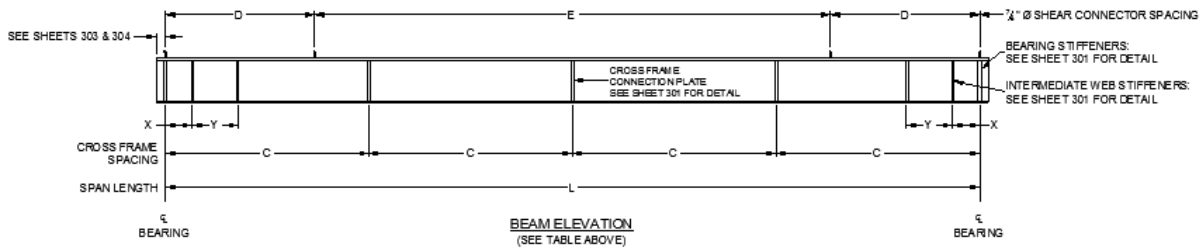
DATE:	
07/19/2011	DO NOT SCALE

DRAFTED BY:	DESIGNED BY:	CHECKED BY:	SHEET NO:
GKM	SAM	KEB	201

Rolled Beams (Limited Depth)

NOTE:
DESIGNS WERE ORIGINATED USING 5 GIRDERS WITH EQUAL SPACING. HOWEVER, BEAM CHOICES ARE ADEQUATE FOR ANY INCREMENT OF THE SELECTED SPACING

ROLLED BEAM WITH PARTIALLY STIFFENED WEB - LIMITED DEPTH					
SPAN (L) - Ft.	GIRDER SPACING				SELECTED SECTIONS
	6'-0"	7'-6"	9'-0"	10'-6"	
40	W21x62	W21x73	W21x83	W21x93	W21x132
45	W21x83	W21x101	W21x101	W21x111	
50	W21x111	W21x111	W21x122	W21x132	
55	W24x117	W24x117	W24x131	W24x146	W24x162
60	W24x162	W27x129	W24x146	W24x162	
65	W24x192	W30x132	W24x176	W24x192	W27x194
70	W27x194	W30x148	W27x178	W27x194	
75	W27x217	W36x150	W27x194	W27x217	W30x235
80	W30x211	W36x160	W30x211	W30x235	
85	W33x221	W36x182	W33x221	W33x241	W33x291
90	W33x241	W40x183	W33x241	W33x291	
95	W36x247	W40x199	W36x247	W36x282	W36x302
100	W36x282	W40x211	W36x262	W36x302	



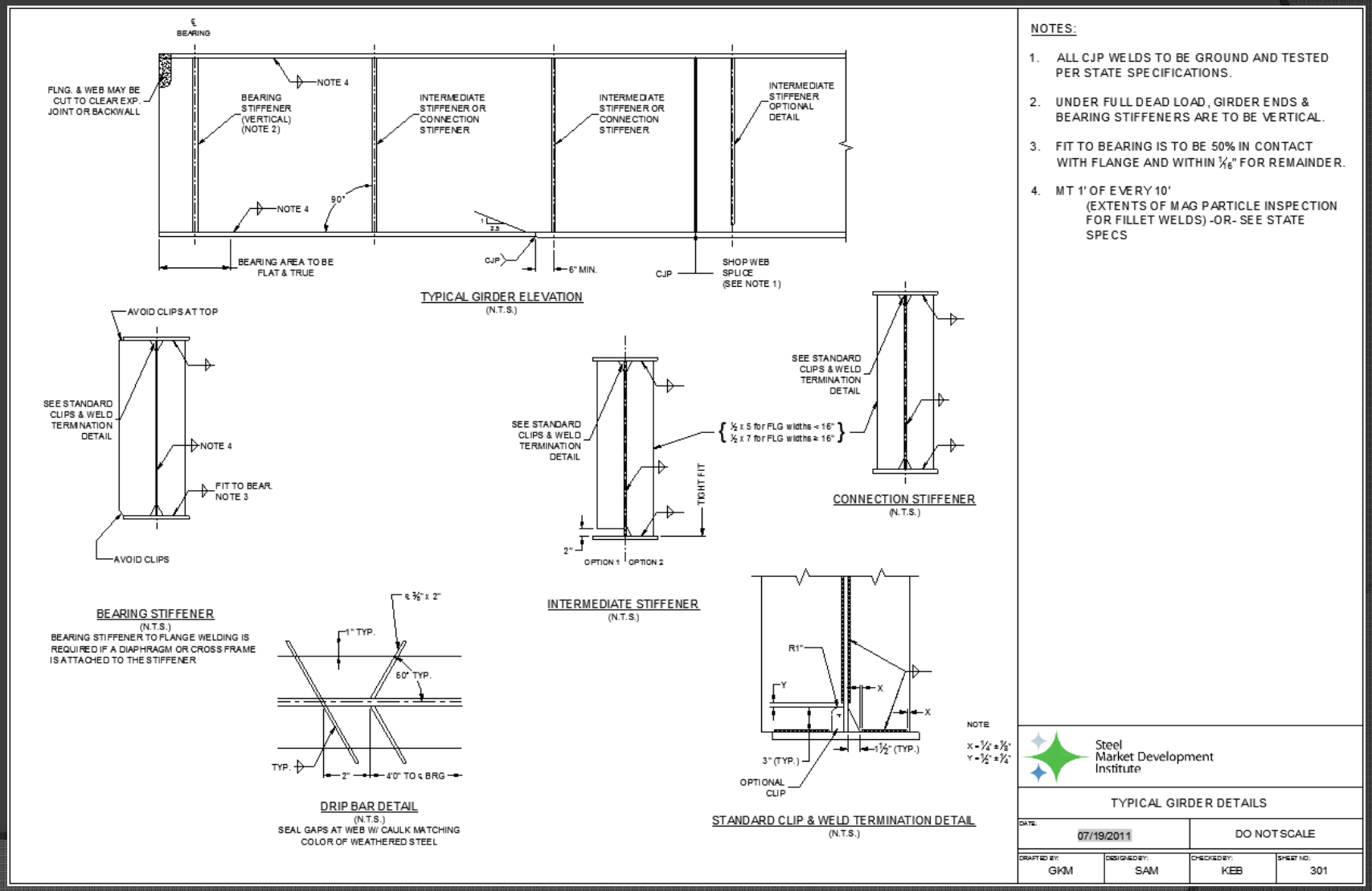
BEAM ELEVATION
(SEE TABLE ABOVE)

Steel Market Development Institute

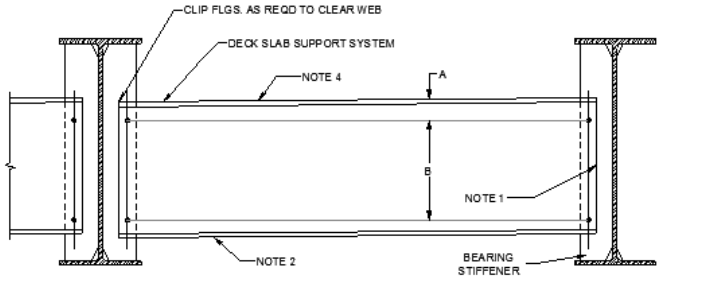
ROLLED BEAM - PART. STIFF. WEB
LIMITED DEPTH DESIGNS

DATE:			
07/19/2011		DO NOT SCALE	
DRAFTED BY:	DESIGNED BY:	CHECKED BY:	SHEET NO:
GKM	SAM	KEB	202

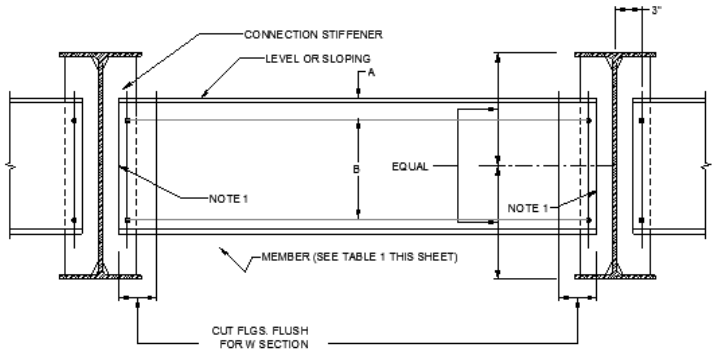
Typ. Girder Details



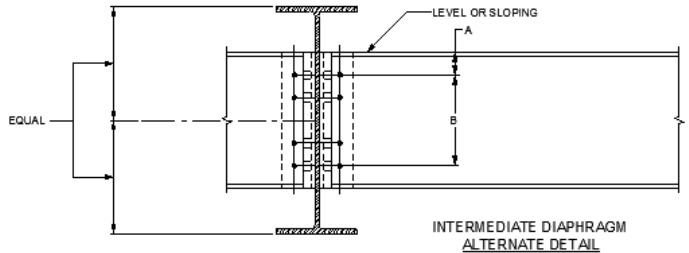
Diaphragm Details



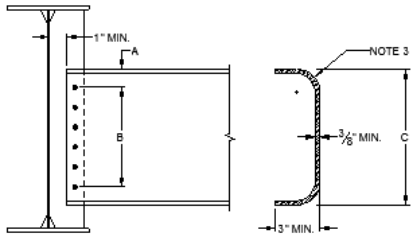
END DIAPHRAGM
(N.T.S.)



INTERMEDIATE DIAPHRAGM
(N.T.S.)



INTERMEDIATE DIAPHRAGM
ALTERNATE DETAIL
(N.T.S.)



BENT PLATE DIAPHRAGM
(N.T.S.)

(CAN BE USED AS ALTERNATE TO ROLLED SHAPE DIAPHRAGM)

TABLE 1				
DEPTH OF STRINGER OR GIRDER WEB	DIAPH. SIZE	A	B	C
≤30"	C15 x 33.9	3	3@3	15
30" < X ≤ 36"	MC18 x 42.7	3	4@3	18
> 36"	W30 x 90	5	5@4	30

ROLLED SHAPE & BENT PLATE DIAPHRAGM NOTES:

1. SLOPE DIAPHRAGM AND KEEP HOLES VERTICAL IN STIFFENER AT CONSTANT DIMENSIONS (TO KEEP ALL STIFFENERS THE SAME) AND CUT ENDS OF DIAPHRAGM SQUARE
2. AT EXPANSION JOINT, ORIENT CHANNEL FLANGES AWAY FROM JOINT OPENING.
3. MINIMUM RADIUS AS PER AASHTO/NSBA FABRICATION S2.1
4. ALL HOLES TO BE $^{15}/_{16}$" Ø FOR $^{7}/_{8}$" Ø HS BOLTS, ASTM A325 TYPE 3 W/ F436-3 WASHERS (RCT).
5. THREADS EXCLUDED FROM SHEAR PLANE

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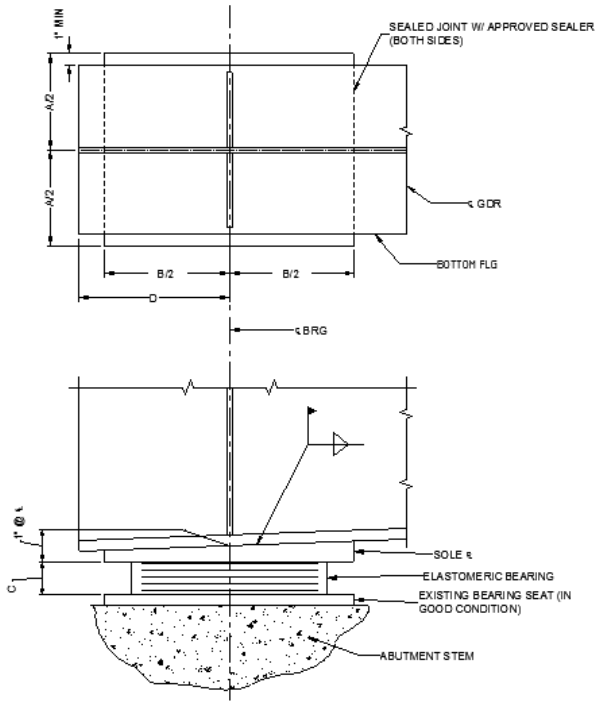
ROLLED SHAPE & BENT PLATE DIAPHRAGM DETAILS

DATE:			
07/19/2011		DO NOT SCALE	
DRAFTED BY:	DESIGNED BY:	CHECKED BY:	SHEET NO:
GKM	SAM	KEB	302

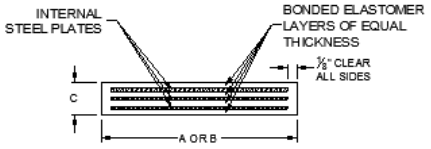
Bearing Details (Welded Sole PL)



BEARING ELEVATION
OPTION "A"
(N.T.S.)

SOLE PLATE AND BEARING SCHEDULE

SPAN - FT	ELASTOMERIC BEARING (N) A	B	C	D	NO. OF INTERNAL STEEL PLATES	NO. OF INTERNAL ELASTOMER LAYERS
40						
45						
50						
55						
60						
65						
70						
75						
80						
85						
90						
95						
100						
105						
110						
115						
120						
125						
130						
135						
140						



SECTION VIEW OF ELASTOMERIC BEARING
(N.T.S.)

NOTES:

1. BEVEL SOLE ℄ IF GRADE EXCEEDS ± 1%.
2. MAX GRADE IS ± 5%.
3. SOLE ℄ TO BE FACTOR VULCANIZED TO ELASTOMERIC BEARING PAD.

COMMENTARY:

1. CARE MUST BE EXERCISED WITH THE FIEDL WELDING. THE TEMPERATURE OF THE STEEL ADJACENT TO THE BEARING MUST BE KEPT BELOW 250°F (120°C). TEMPERATURE CRAYONS SHOULD BE USED TO MONITOR THE STEEL TEMPERATURE DURING WELDING.

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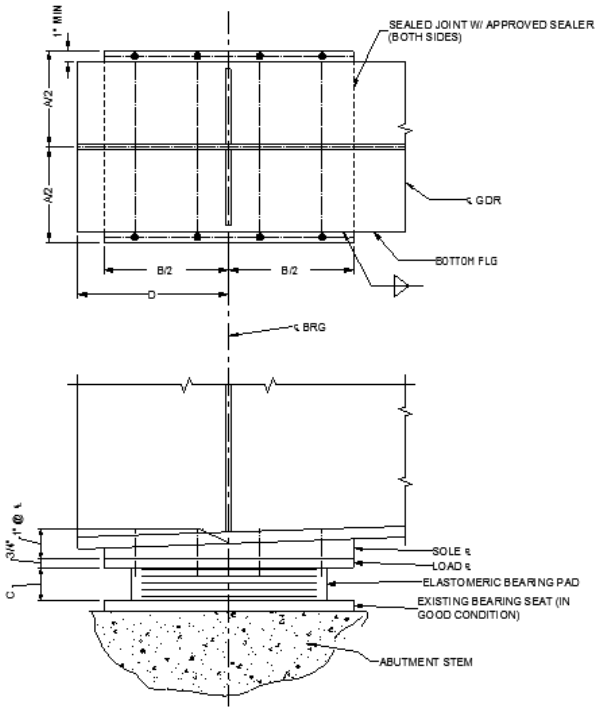
ELASTOMERIC BEARING DETAILS

DATE:	
07/19/2011	DO NOT SCALE

DRAFTED BY:	DESIGNED BY:	CHECKED BY:	SHEET NO:
GKM	SAM	KEB	303

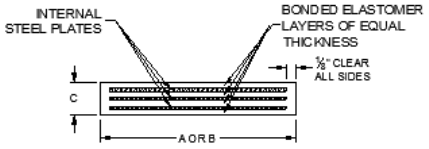
Bearing Details (Bolted Sole PL)



BEARING ELEVATION
OPTION "B"
(N.T.S.)

SOLE PLATE AND BEARING SCHEDULE

SPAN - FT	ELASTOMERIC BEARING (IN) A	B	C	D	NO. OF INTERNAL STEEL PLATES	NO. OF INTERNAL ELASTOMER LAYERS
40						
45						
50						
55						
60						
65						
70						
75						
80						
85						
90						
95						
100						
105						
110						
115						
120						
125						
130						
135						
140						



SECTION VIEW OF ELASTOMERIC BEARING
(N.T.S.)

NOTES:

1. HOLES TO BE 1 1/16" Ø IN SOLE ℄ FOR 7/8" Ø BOLT

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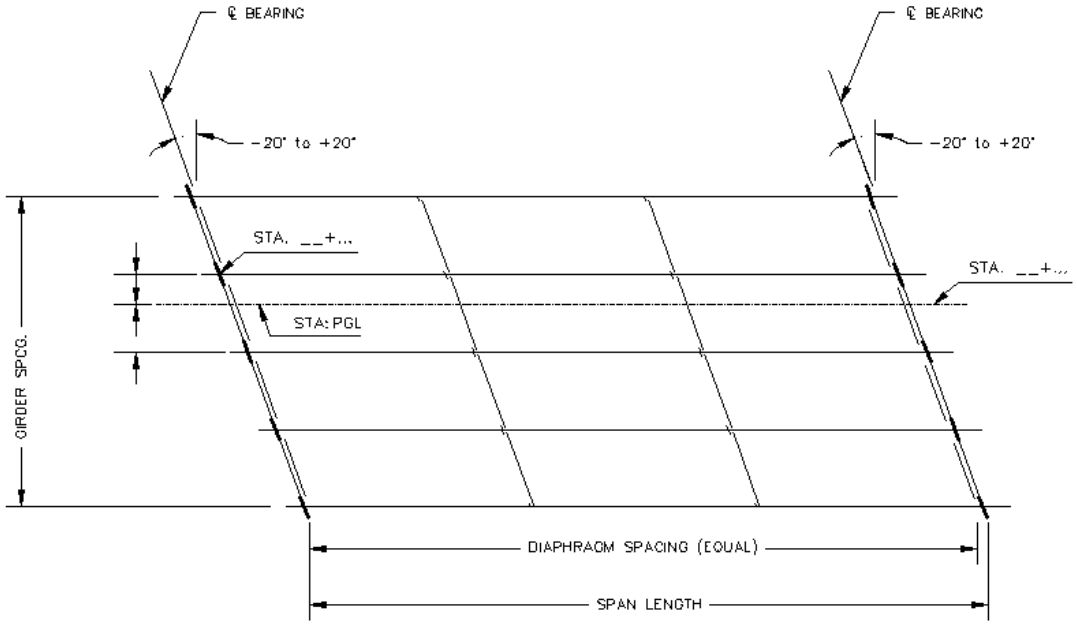
ELASTOMERIC BEARING DETAILS

DATE:			
07/19/2011	DO NOT SCALE		
DRAFTED BY:	DESIGNED BY:	CHECKED BY:	SHEET NO:
GKM	SAM	KEB	304

Framing Plan



NOTES:

1. SUPERSTRUCTURE IS INTENDED TO SIT ON EXISTING BRIDGE SEATS. CONTRACTOR TO VERIFY SPACING IN FIELD.
2. DESIGN WILL ACCOMMODATE SKEWS UP TO 20° SKEWS UP TO 20° FROM ⊥, BUT ARE INTENDED TO BE PARALLEL.
3. STATION LINE IS INTENDED TO BE ON A TANGENT ALIGNMENT.
4. MAX GRADE AT BEARINGS IS ±5%.
5. ORIENT TOES OF CHANNEL DIAPHRAGM DOWN GRADE.

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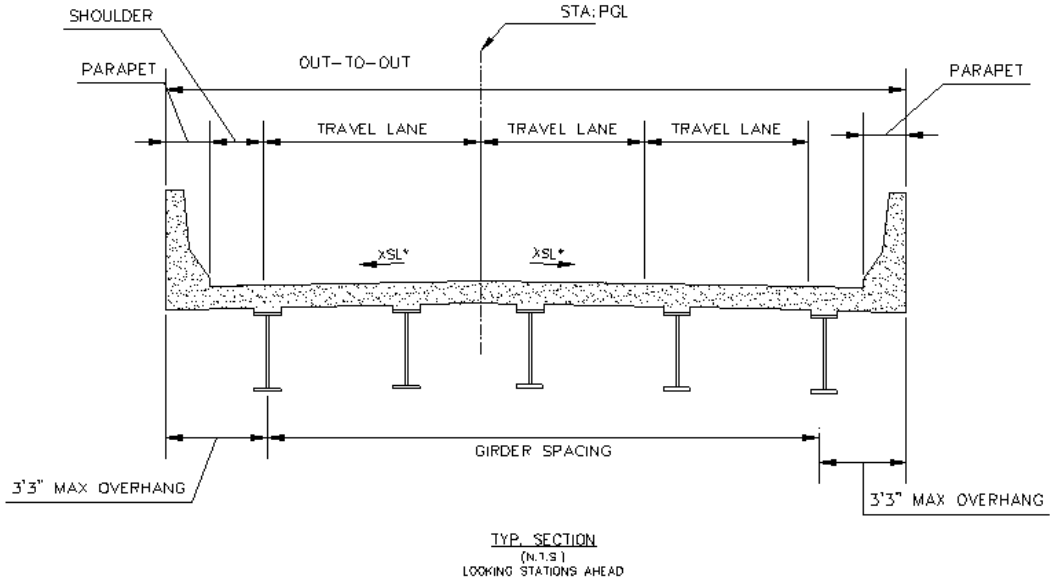
FRAMING PLAN

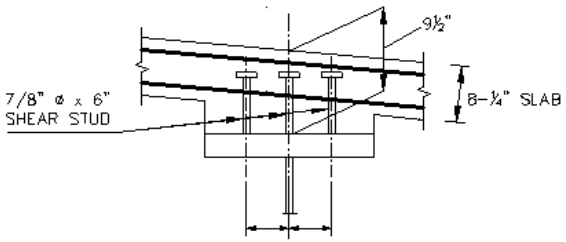
DATE:		DO NOT SCALE	
07/19/2011			
DRAFTED BY: AJY	DESIGNED BY: SAM	CHECKED BY: KEB	SHEET NO: 401

Typ. Section Plan



TYP. SECTION
(N.T.S.)
LOOKING STATIONS AHEAD

*XSL- CROSS SLOPE CAN VARY FROM -.06% TO +.06%



DETAIL A

NOTES:

1. SHEAR STUD SPCG PER DWG.
2. PARAPETS PER STATE DOT REQUIREMENTS. IF CAST IN PLACE, PROVIDE 2'0" LAP WITH TRANSVERSE BARS.

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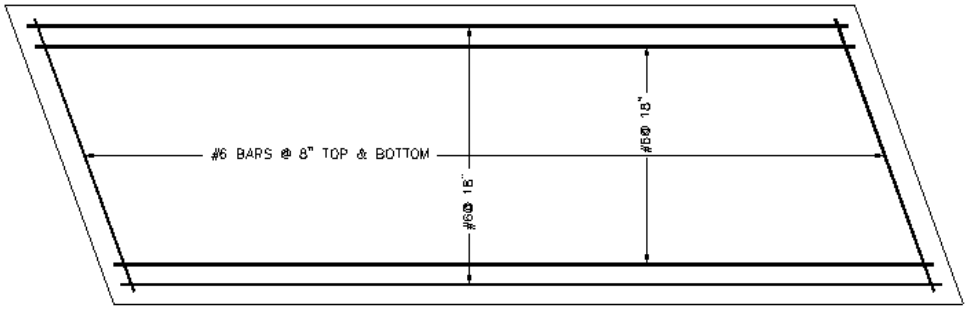
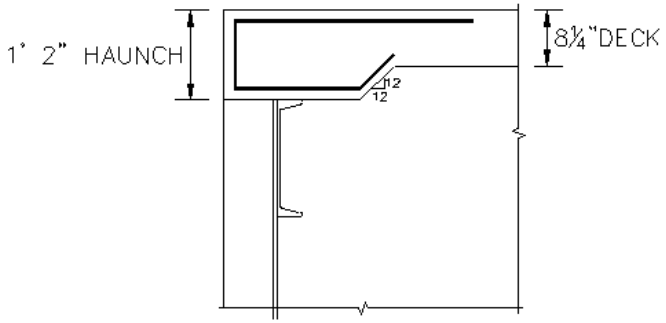
TYPICAL SECTION

DATE:			
07/19/2011	DO NOT SCALE		
DRAFTED BY: AJY	DESIGNED BY: SAM	CHECKED BY: KEB	SHEET NO: 402

Deck Details



REINFORCING PLAN
(N.T.S.)



HAUNCH DETAIL
(N.T.S.)

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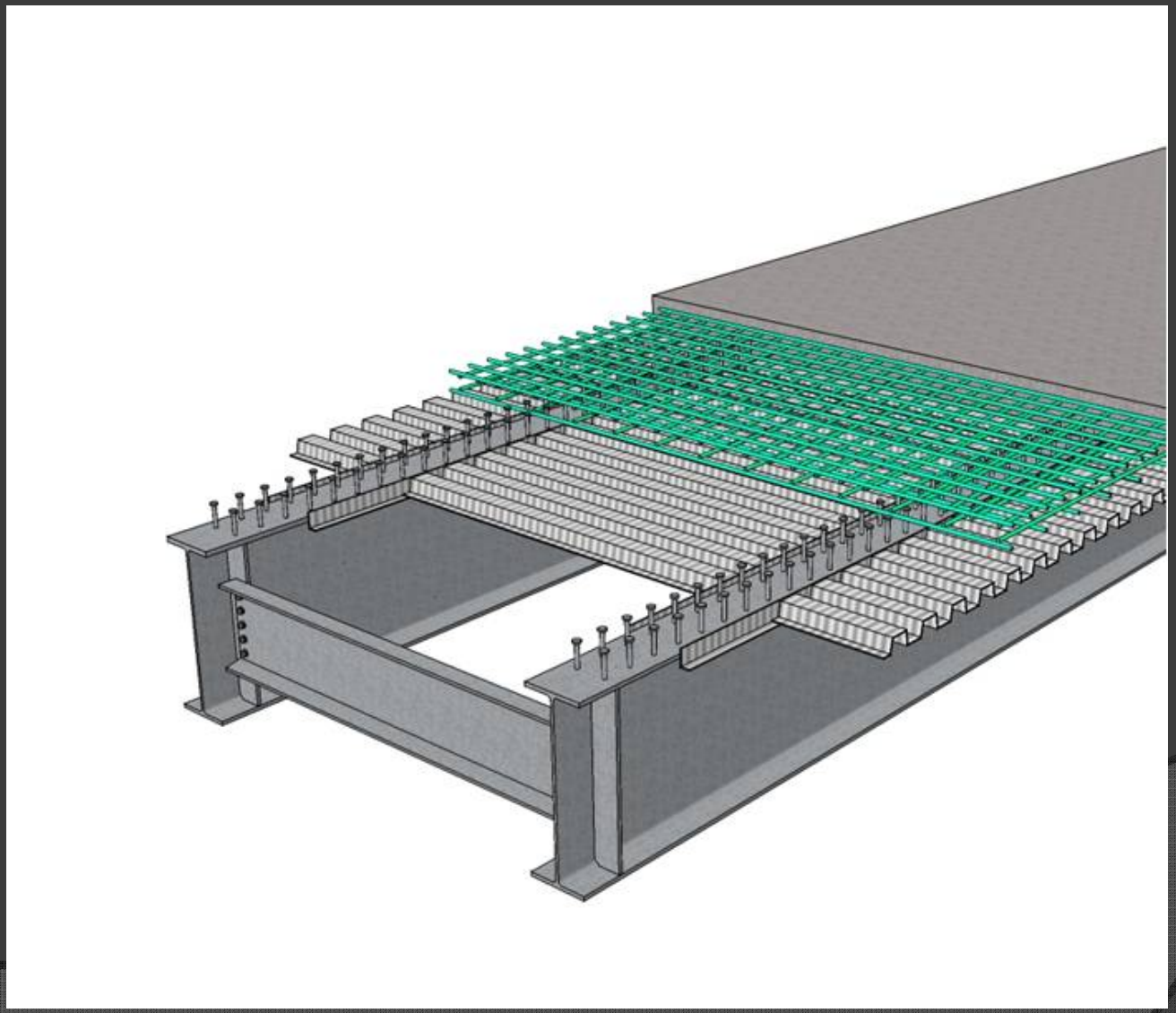
DECK DESIGN

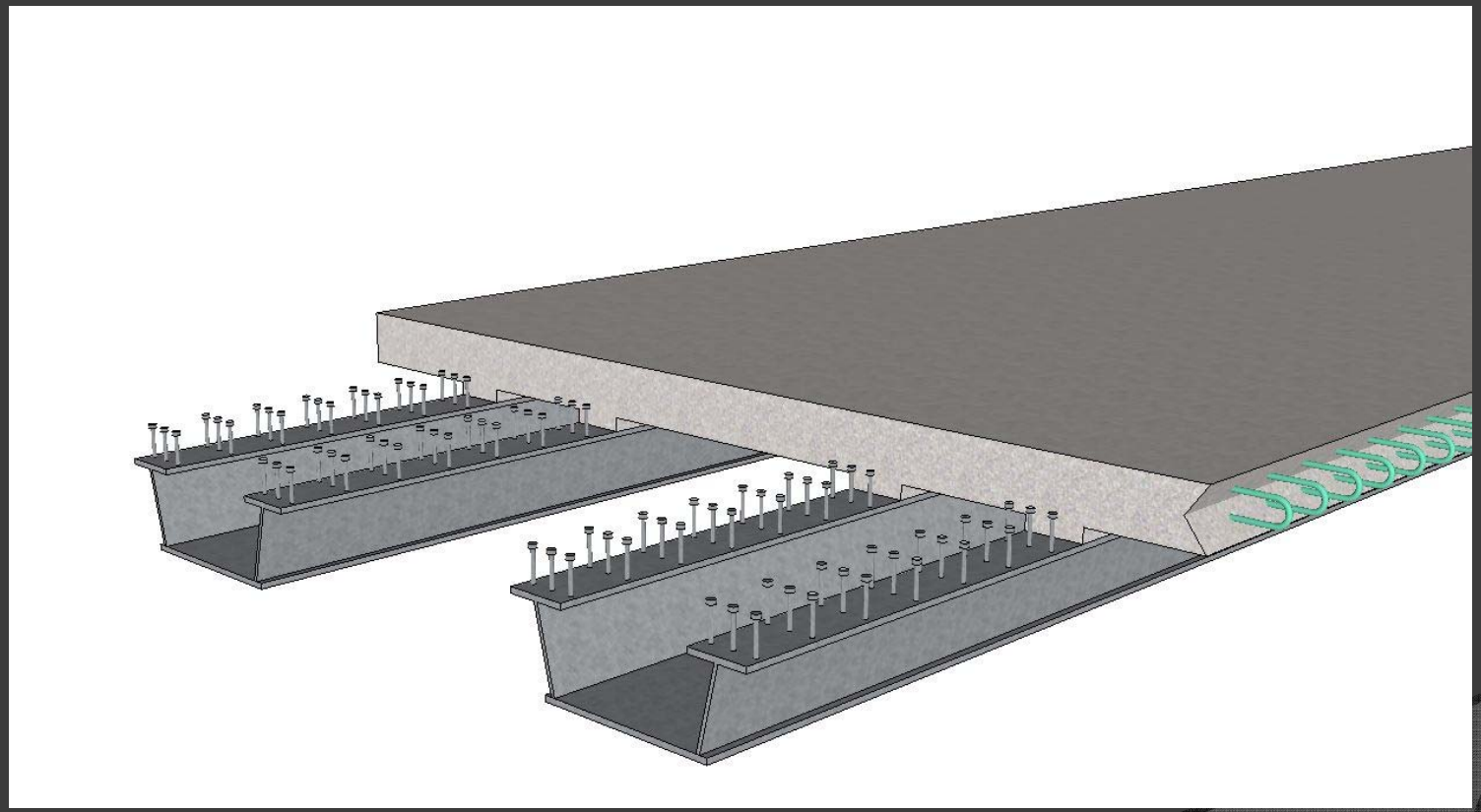
DATE:			
07/19/2011			DO NOT SCALE
DRAFTED BY: AJY	DESIGNED BY: SAM	CHECKED BY: KEB	SHEET NO: 403

MODULAR BRIDGE SYSTEM RENDERINGS

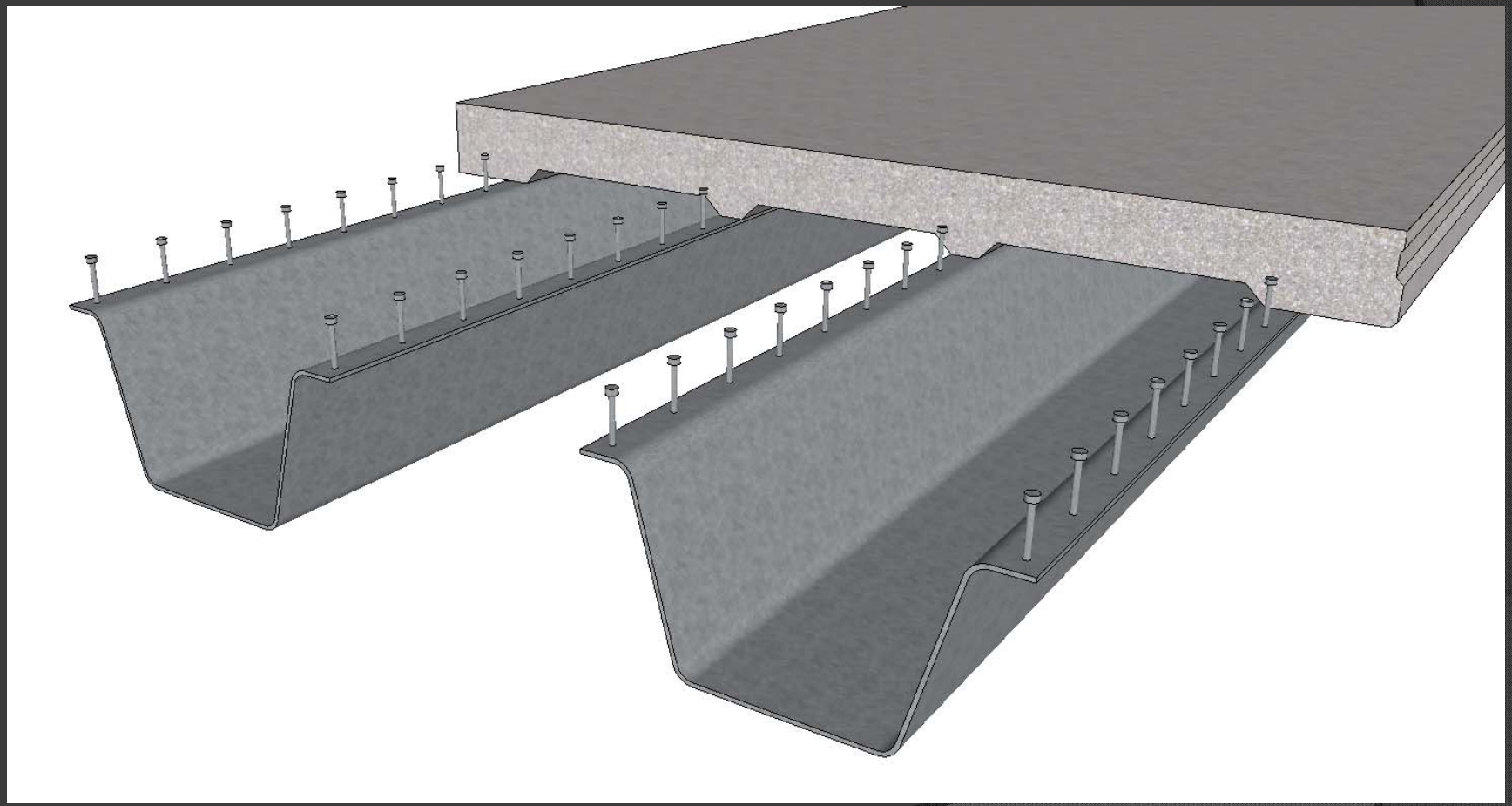
Rolled Beam



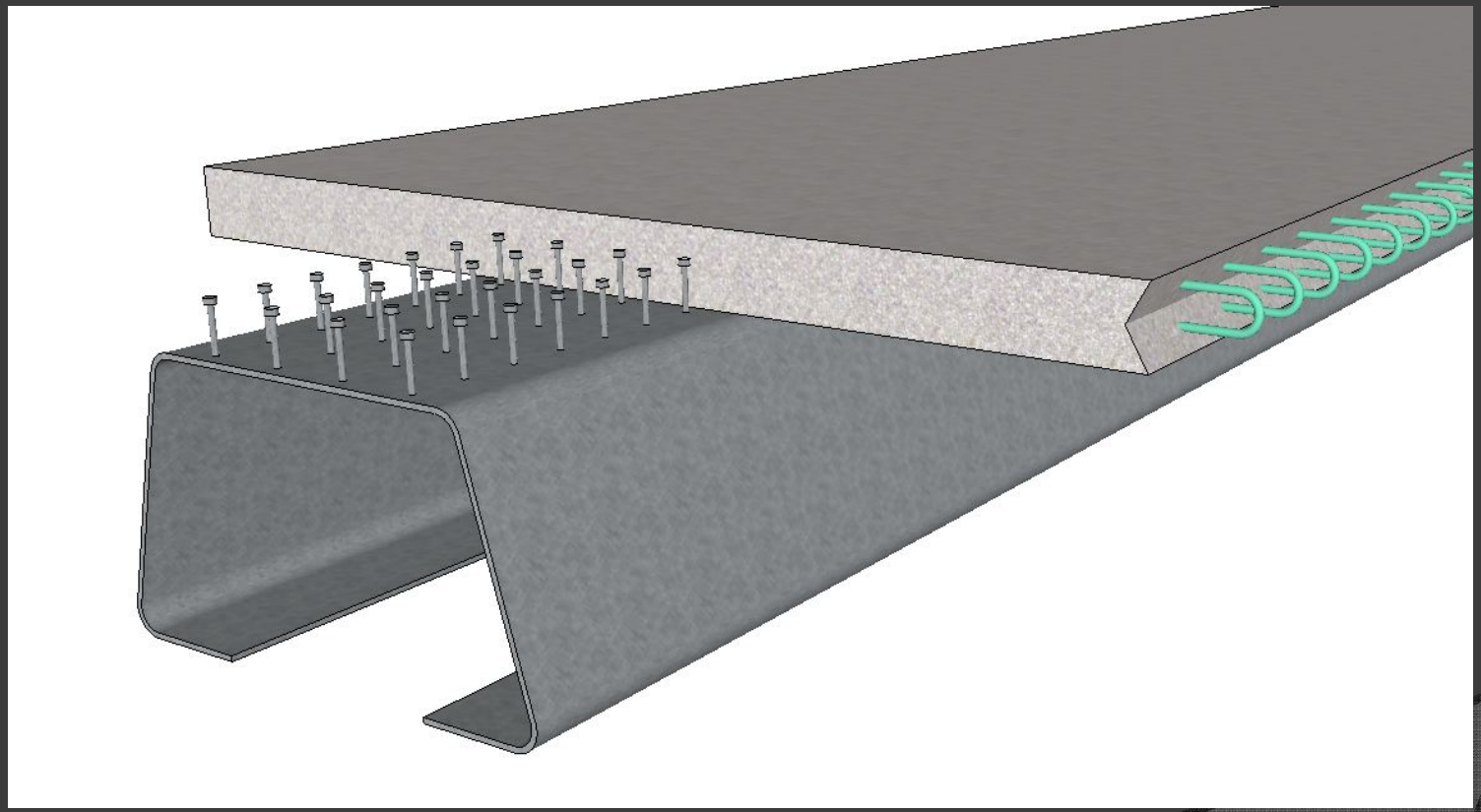
Shallow Box Girder



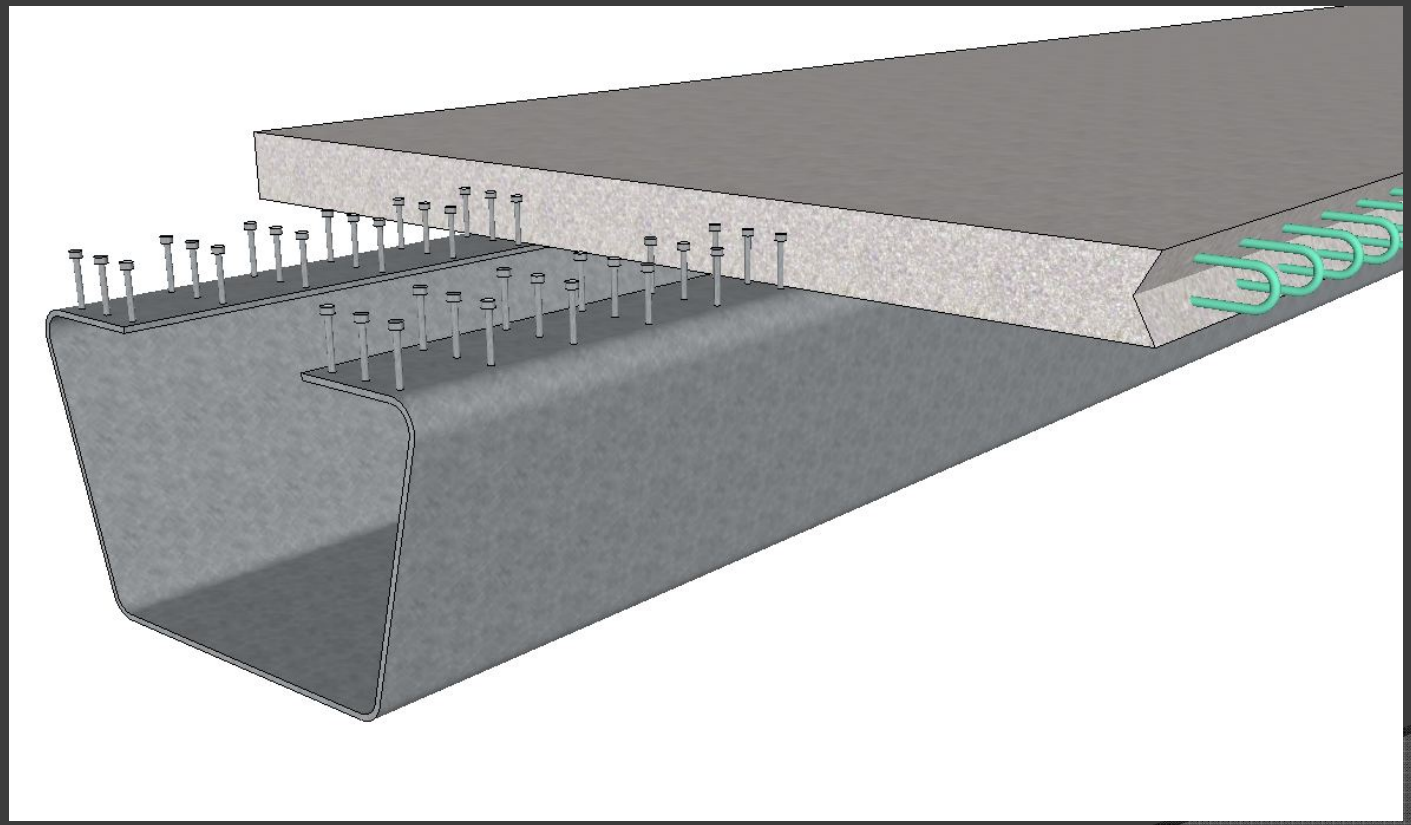
Con-Struct Prefab. System



Folded Plate



Inverted Folded Plate



Concluding remarks

remarks

- Finalizing design selections and availability of rolled beams
- Developing economical detailing items
- Creating online resources for ease of member selection
- Working with FHWA on development of economic modular concepts for ABC