



# Steel Bridges: Beyond the Textbook

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**Webinar 1: Short Span Steel Bridge Design and  
Construction with a Fabricators Perspective  
June 9, 2026**

**Michael G. Barker, PhD, PE**  
University of Wyoming  
SSSBA, Director of Education

**Tanner Genenbacher, PE**  
DeLong's, Inc.



# Agenda

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- Economical Plate Girders for Mid-Span Bridges
  - Michael Barker
- Bridges of Franklin County: The Missouri Version
  - Tanner Genenbacher
- Q&A



**eSPAN140™**

The logo features a grey curved line above the text. The 'e' is green, and 'SPAN140' is in black with a trademark symbol.

**eBEAM140**

The logo features a grey curved line above the text. The 'e' is green, and 'BEAM140' is in black.

**ePLATE140**

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# Economical Plate Girders for Mid-Span Bridges

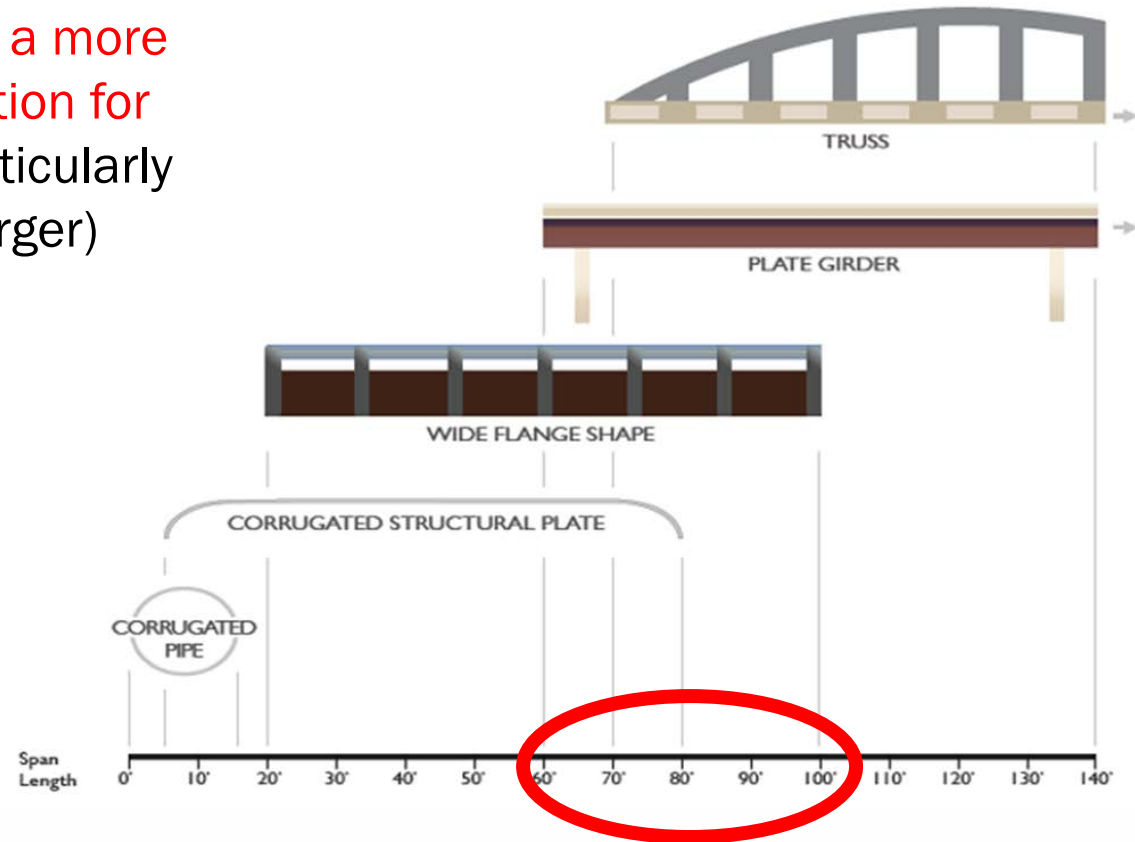
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Michael Barker, PE




# Economical Plate Girders for Mid-Span Bridges (60-100')

- **Objective:** To evaluate and demonstrate how optimized **steel plate girders can serve as a more economical and structurally efficient solution for bridge spans in the 60' to 100' range**, particularly in cases where rolled beams (W40 and larger) become less competitive with concrete!



# Economical Plate Girders for Mid-Span Bridges (60-100')

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- Hypothetical Example – Small Difference in Price Matters!
- Need to replace this bridge 
- Goes out for bid
  - \$590,000 for rolled beam W40×183
  - \$570,000 for a prestressed concrete I-beams
  - Concrete Bridge for \$570,000
  
  - But....what if plate girder was considered?
  - \$550,000 for a welded plate girder option
  - **Steel Bridge for \$550,000 - \$20,000 Saved!**



# Initial Study

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- Two Cross Sections from Actual Bridges
- Three Lengths: 70, 80 & 90 ft
- Optimized Solutions from eBEAM140 and ePLATE140
- Fabricated Costs from DeLong's

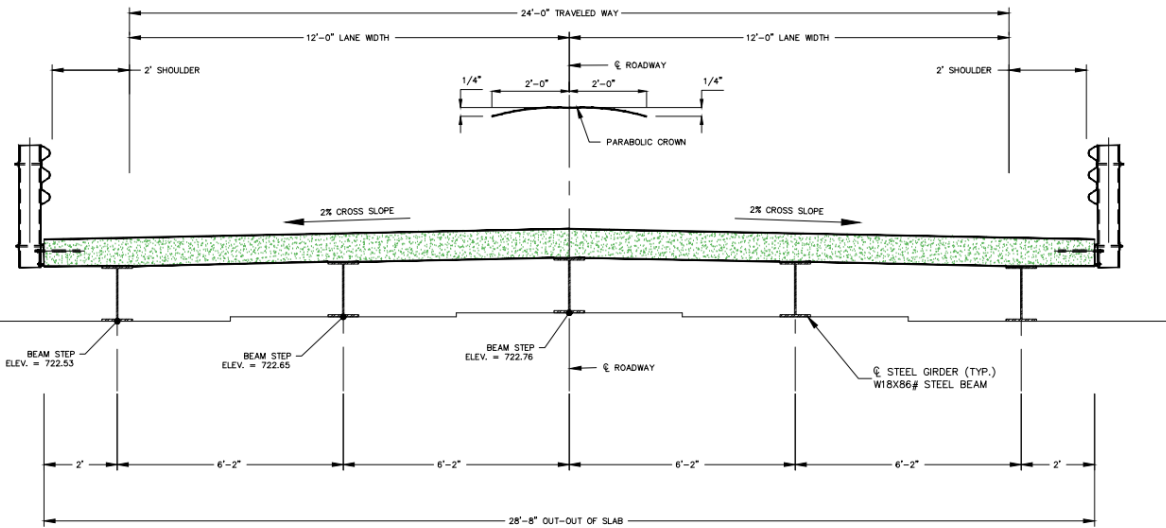


eBEAM140

ePLATE140

June 18 Webinar 4

# 70 ft Simple Span: Lockhart Bridge Section

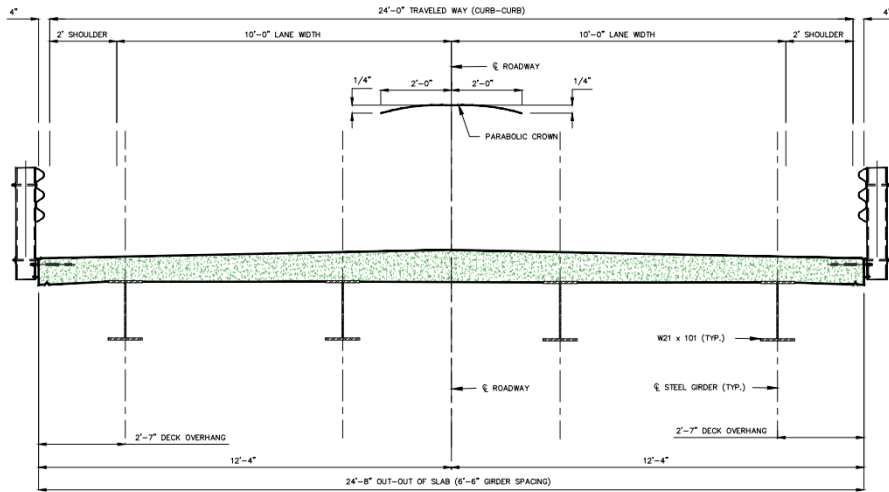


44.8 tons	Yield Strength (ksi)	50	Bridge Width (ft)	28.67	Consider W40 & W44 Beams?	Yes
	Bridge Length (ft)	70	Roadway Width (ft)	28.00	L/D Limited to	30
	Girder Spacing (ft)	6.1667	Shoulders (ft) each side - Double for One Sided	2.00	Minimum Depth Beam (in)	W12
	Number of Girders	5	2 Striped Lanes and 2 Design Lanes		Maximum Depth Beam (in)	W44
Overhang (32.4% of Girder Spacing) (ft)		2	Composite Design	8 in Structural Deck with No SIP Forms		
Barrier Width (ft)		0.3333	AASHTO HL93 Loading and No User Defined Vehicle	Compression Flange Laterally Braced for Final State		
Barrier Load on Girder (lb/ft)		25		Unbraced Length #	Lb	Cb
DC Deck Only Loading (psf)		106.25	Strength Design Uses AASHTO Appendix A6	1	23.33	1.43
Wearing Surface (psf)		25	Fatigue Design Life (yrs)	2	23.33	1.01
Additional DC1 Load on Girder (lb/ft)		0	Fatigue ADTT <sub>SL</sub>	3	23.33	1.43
Additional DC2 Load on Bridge (lb/ft)		0	Limit States Checked			
			Strength I & II			
			Service II			
			Constructability			
			Fatigue			
			Deflection			
			DEFLECTION LIMIT (x for Deflection Limit in L/x)	800		

- W Shape                      28.0 tons                      W36 x 160
- Plate Girder                22.0 tons                      TF16x<sup>3</sup>/<sub>4</sub> ; W26x<sup>1</sup>/<sub>2</sub> ; BF16x<sup>3</sup>/<sub>4</sub>

Plate Girder **12000 lbs** less than W36x160

# 80 ft Simple Span: Hendricks Bridge Section



TYPICAL BRIDGE CROSS SECTION

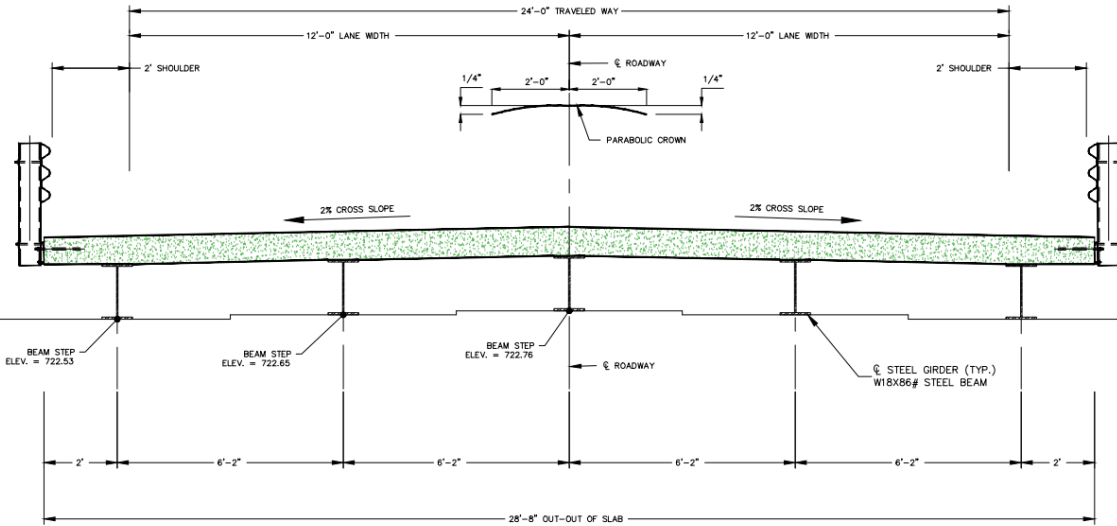
Yield Strength (ksi)	50	Bridge Width (ft)	24.67	Consider W40 & W44 Beams?	Yes
Bridge Length (ft)	80	Roadway Width (ft)	24.00	L/D Limited to	30
Girder Spacing (ft)	6.5	Shoulders (ft) each side - Double for One Sided	0.00	Minimum Depth Beam (in)	W12
Number of Girders	4	2 Striped Lanes and 2 Design Lanes		Maximum Depth Beam (in)	W44
Overhang (39.7% of Girder Spacing) (ft)	2.5833	Composite Design	8 in Structural Deck with No SIP Forms		
Barrier Width (ft)	0.3333	AASHTO HL93 Loading and No User Defined Vehicle		Compression Flange Laterally Braced for Final State	
Barrier Load on Girder (lb/ft)	25			Unbraced Length #	Lb
DC Deck Only Loading (psf)	106.25	Strength Design Uses AASHTO Appendix A6		1	20.00
Wearing Surface (psf)	25	Fatigue Design Life (yrs)	75	2	20.00
Additional DC1 Load on Girder (lb/ft)	0	Fatigue ADTT <sub>SL</sub>	200 Fatigue II Controls	3	20.00
Additional DC2 Load on Bridge (lb/ft)	0			4	20.00
		Limit States Checked			
AT OVERHANG FOR LATERAL FLANGE BENDING		Strength I & II			
Construction w (lb/ft)	275	Service II			
Construction p (lb)	3000	Constructability			
1/2 of Deck Overhang Weight (lb/ft)	137.2378	Fatigue			
ADDITIONAL VERTICAL BENDING ON GIRDERS		Deflection			
Exterior - Construction p (lb)	3000				
Exterior - Construction w (lb/ft)	275				
% Misc Stl for Diaphragms, etc	0%				
DEFLECTION LIMIT (x for Deflection Limit in L/x)	800				7

- W Shape 26.7 tons W40 x 167
- W Shape 27.2 tons W36 x 170
- Plate Girder 21.8 tons TF14x<sup>3</sup>/<sub>4</sub> ; W38x<sup>1</sup>/<sub>2</sub> ; BF14x<sup>3</sup>/<sub>4</sub>

Plate Girder 9800 lbs less than W40x167

Plate Girder 10800 lbs less than W36x170

# 90 ft Simple Span: Lockhart Bridge Section



Yield Strength (ksi)	50	Bridge Width (ft)	28.67	Consider W40 & W44 Beams?	Yes
Bridge Length (ft)	90	Roadway Width (ft)	28.00	L/D Limited to	30
Girder Spacing (ft)	6.1667	Shoulders (ft) eachside - Double for One Sided	2.00	Minimum Depth Beam (in)	W12
Number of Girders	5	2 Striped Lanes and 2 Design Lanes		Maximum Depth Beam (in)	W44
Overhang (32.4% of Girder Spacing) (ft)	2	Composite Design	8 in Structural Deck with No SIP Forms		
Barrier Width (ft)	0.3333	AASHTO HL93 Loading and No User Defined Vehicle		Compression Flange Laterally Braced for Final State	
Barrier Load on Girder (lb/ft)	25			Unbraced Length #	Lb Cb
DC Deck Only Loading (psf)	106.25	Strength Design Uses AASHTO Appendix A6		1	22.50 1.51
Wearing Surface (psf)	25	Fatigue Design Life (yrs)	75	2	22.50 1.05
Additional DC1 Load on Girder (lb/ft)	0	Fatigue ADTT <sub>0</sub>	200 Fatigue II Controls	3	22.50 1.05
Additional DC2 Load on Bridge (lb/ft)	0	Limit States Checked		4	22.50 1.51
AT OVERHANG FOR LATERAL FLANGE BENDING		Strength I & II			
Construction w (lb/ft)	275	Service II			
Construction p (lb)	3000	Constructability			
1/2 of Deck Overhang Weight (lb/ft)	106.25	Fatigue			
ADDITIONAL VERTICAL BENDING ON GIRDERS		Deflection			
Exterior - Construction p (lb)	3000				
Exterior - Construction w (lb/ft)	275				
% Misc Sd for Diaphragms, etc	0%				
DEFLECTION LIMIT (x for Deflection Limit in L/x)	800			7	

- W Shape 44.8 tons W40 x 199
- W Shape 47.3 tons W36 x 210
- Plate Girder 32.3 tons TF15x<sup>3</sup>/<sub>4</sub> ; W38x<sup>1</sup>/<sub>2</sub> ; BF16x<sup>3</sup>/<sub>4</sub>

Plate Girder 25000 lbs less than W40x199

Plate Girder 30000 lbs less than W36x210



# Estimated Costs for Fabricated Girders

Although fabricated plate girders require more shop labor (e.g., welding), they often offer (1) weight savings and better fit-up, (2) easier cambering, and (3) more refined detailing, which can offset some of the added fabrication effort.

Description	PG or W	Tonnage	Budgetary Price	% Diff (From Lowest)
70' Lockhart	PG	22.0		-
70' Lockhart	W36	28.0		9.5%
80' Hendricks	PG	21.8		-
80' Hendricks	W40	26.7		10.6%
80' Hendricks	W36	27.2		4.6%
90' Lockhart	PG	32.3		-
90' Lockhart	W40	44.8		25.9%
90' Lockhart	W36	47.3		22.7%

## Two Initial Observations

**Plate Girder Less Cost than W Shapes (Fabrication costs offset by weight savings)**

**Premium on W40 makes W40 Shapes less Economical (Less weight, but more cost than W36)**

If W36 Costs \$500k & Concrete Cost is \$450k

**Steel Loses with only W Shapes**

If PG Costs  $\$500 * (1 - 0.227) = \$390k$

**Steel Wins with Plate Girder**

# Economical Plate Girders for Mid-Span Bridges (60-100')

## Scope of Work:

1. Design Comparison Variables
2. Optimization Examples
3. Industry Costs



## Three Fabricators:

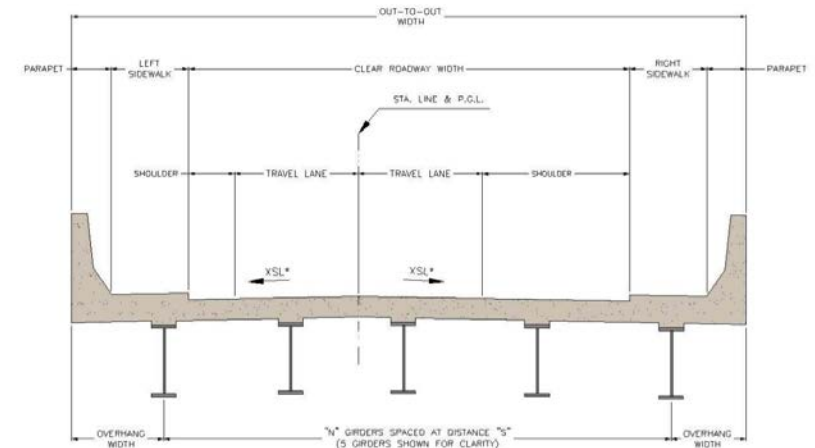
Delong's - Missouri



High Steel Structures - Pennsylvania



Ohio Structures - Ohio



# Economical Plate Girders for Mid-Span Bridges (60-100')

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## Expected Outcomes:

- Demonstrate the cost advantages of optimized plate girder designs
- Offer examples that empower fabricators and engineers to propose plate girder options where rolled beams may fall short
- Increase steel's competitiveness in bridge bids
- Add to SSSBA education and marketing program





# Bridges of Franklin County: The Missouri Version

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Tanner Genenbacher, PE



# Problem Statement

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## Over the Years, Preconception that Concrete is Always Less Expensive Than Steel for Simple Span Bridges

- Many Times Steel is Not Even Considered
- Owners Paying More Than They Could for Bridges
- Unwarranted Lack of Competition Not Good

**COST ESTIMATE GUIDE FOR RURAL PRELIMINARY DESIGN**  
(These cost figures were last updated on 1-1-2017)

<u>Bridge Structures</u>	<u>Sq. foot</u>
Prestressed Concrete	\$95
Steel Girder	\$120

Assumes Concrete is 20% less Expensive  $1 - (95/120)$  or  
Steel is 26% more Expensive  $(120/95) - 1$

# MoDOT Bridge Construction

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Between January 2009 to May 2018:

**10 yrs**

How Many Typical Concrete Bridges Did MoDOT Build?

**378**

- Prestressed NU
- PC I Beam
- PC Box
- PC Bulb T, Dbl T & Slab

How Many Typical Steel Bridges?

**16**

15 Plate and 1 Wideflange, Excludes:

- Major River Crossings
- Tight Horizontal Curves
- Widening
- And Special Configurations

**4% Typical Steel Bridges**

# Steel & Concrete Bridge Costs in Missouri

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In 2018, Delong's, the SSSBA and MoDOT worked together to study steel and concrete costs for typical bridges. Two workshops delivered in Missouri:

- Learn & Earn Workshop, Kansas City, May 2018
- Learn & Earn Workshop, St. Louis, November 2018
- Presented to MoDOT, Consultants & Contractors



**Results Showed Steel & Concrete Bridges are Competitive for Short Spans**

# Problem Solution

## Over the Years, Preconception that Concrete is Always Less Expensive Than Steel for Simple Span Bridges

- Many Times Steel is Not Even Considered
- Owners Paying More Than They Need To
- Unwarranted

MoDOT Removed Cost Guidance  
 December 2018  
 And Competed Steel Bridges

\$95  
 \$120

But Many States Have Similar Policies  
 - Or At Least Similar Mentalities

**Standard Steel and Concrete Bridges in Missouri**

The belief around the bridge industry in the U.S. was that concrete girder bridges were cheaper than steel girder bridges. This belief was common for spans less than 120 feet. Steel was often used on more complex, expensive bridges, and those complex bridges were more expensive per square foot of steel bridges. MoDOT decided whether to construct a steel or concrete bridge based only on initial cost. Representatives have worked closely with MoDOT to review historical cost data regarding standard steel and concrete bridges. The cost per square foot of standard steel and concrete bridges was comparable.

2017, MoDOT updated the MoDOT Engineering Policy Guide to specify steel and concrete bridges as the same initial cost.

From January 2018 through June 2018, MoDOT has let 22 standard steel bridges totaling \$663,000 and 61 standard concrete bridges totaling \$30,250,000.

**All Bridge Types Used in Missouri and by Adjacent State DOTs**

State	Steel (%)	Concrete (%)
Missouri	11%	89%
Illinois	45%	55%
Arkansas	55%	45%
Kentucky	35%	65%

**Advantages of Steel in Addition to Initial Cost**

- ✓ **Flexibility and Repairability** – Steel bridges can easily be widened, lengthened, strengthened, re-decked, and modified to accommodate future needs, and sections can be repaired quickly and easily.
- ✓ **Recyclability** – Steel is the most recycled material on earth. Recycled content of structural steel is over 90%.
- ✓ **Efficiency** – Steel's strength-to-weight ratio is more efficient than concrete's, reducing fill dirt required at approaches.
- ✓ **Constructability** – Steel girders are lighter than concrete girders for the same span, which enables the use of smaller capacity cranes.
- ✓ **Reusability** – Old beams/girders can be used for new bridges, as falsework support by contractors, or recycled.

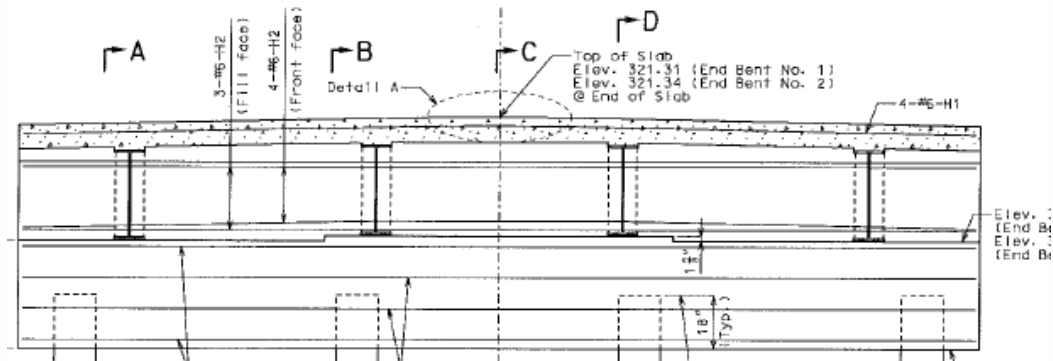
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# What Happened When Competing Short Span Steel Bridges?

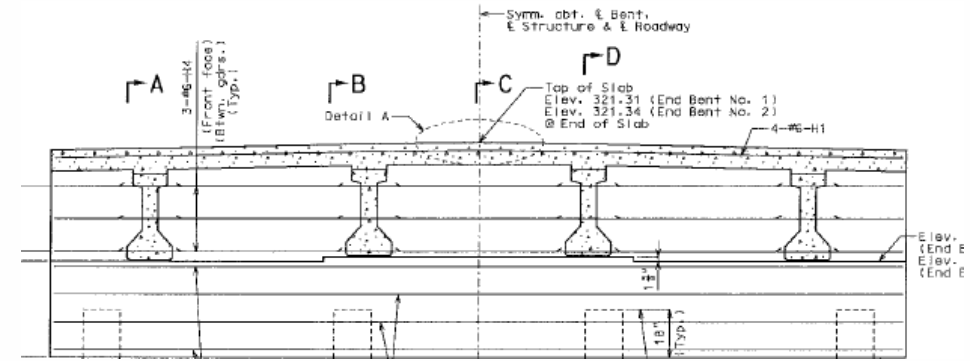
Scott County, MO, 45 ft Simple Span, 26 ft-8 in Width, Built 2019

Increase Length for Hydraulic Opening; Increase Width for Lanes

Composite Rolled W Shapes



Prestressed I Beams



8 Bids from General Contractors

4 for Steel

4 for Concrete

Low Bid Steel – **Galvanized Beams**

Closest Concrete Bid 19% Higher

**Difference of \$290,000**



# Another Example – Large Design-Build Bridge Bundling Project

Fixing Access to Rural Missouri (FARM) Bridge Program: 31 Bridges, \$26 mil



## Bids & Award

- Best Value for
- a Fixed Budget

Category	Available Points	Team 1	Team 2	Team 3
		Primarily Concrete	Primarily Concrete	Primarily Steel
Bridge Bundling Part 1	40	39.7	38.3	40
Bridge Bundling Part 2 (Bonus)	15	1.5	0	1.5
Quality & Longevity	30	18.7	20	21.7
Completion & Maintenance of Traffic	15	5.8	11.8	8.9
<b>TOTAL SCORE</b>	<b>100</b>	<b>65.7</b>	<b>70.1</b>	<b>72.1</b>

## Design-Build Team



How did Steel win the bid? – for the 25 multi-span bridges

- Bridge Bundling (40 pts + 1.5 pts bonus) highest score
  - 31 Bridges replaced
  - Innovative Simple for Dead, Continuous for Live (SDCL) designs
- Quality & Longevity (21.7 pts) highest score
  - Galvanized beams – 100 yr expectation in rural setting
  - Full-depth CIP deck
- Completion & Maintenance of Traffic (8.9 pts) 2nd highest
  - Ease and pace of construction
  - Weight of bridge and lighter equipment



Economy of Steel Bridges



Performance of Steel Bridges





Equipment & Ease of Construction



# Now for the Bridges of Franklin County

5 Bridges in Franklin County to be Replaced (2023 – 2025)

Bridge	Hendrix Road	Little Indian Creek	Huff Road	Little Boone Creek	Lockhart Road
Type of Bridge	Steel	Steel	Steel	Concrete	Steel
Low Bid	\$549,202	\$494,630	\$638,787	\$651,130	\$564,806
Lowest Other Material	\$748,163	\$518,490	\$685,604	\$722,735	\$577,939
% Higher Other Material	36.2%	<b>Saved \$23,860</b>	<b>Saved \$46,817</b>	11.0%	2.3%
Number of Bids	3	6	7	6	4
Order of Bids	Steel	Steel	Steel	Concrete	Steel
	Concrete	Concrete	Steel	Concrete	Steel
	Steel	Concrete	Concrete	Steel	Concrete
		Steel	Steel	<b>Saved \$13,133</b>	Steel
		Concrete	Concrete	Steel	
		Concrete	Concrete	Steel	

**Saved \$198,961**

Delongs Fabricated

**Steel Saved \$282,771**

Delongs Fabricated

# Hendrix Road Bridge

45 ft Span; 24 ft Roadway Width

Four W21x101 Girders @ 6 ft - 6 in

Weathering Steel

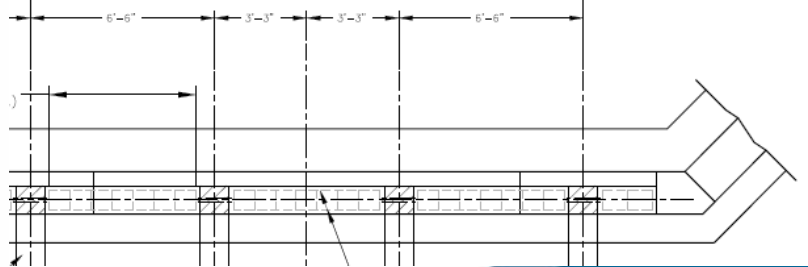
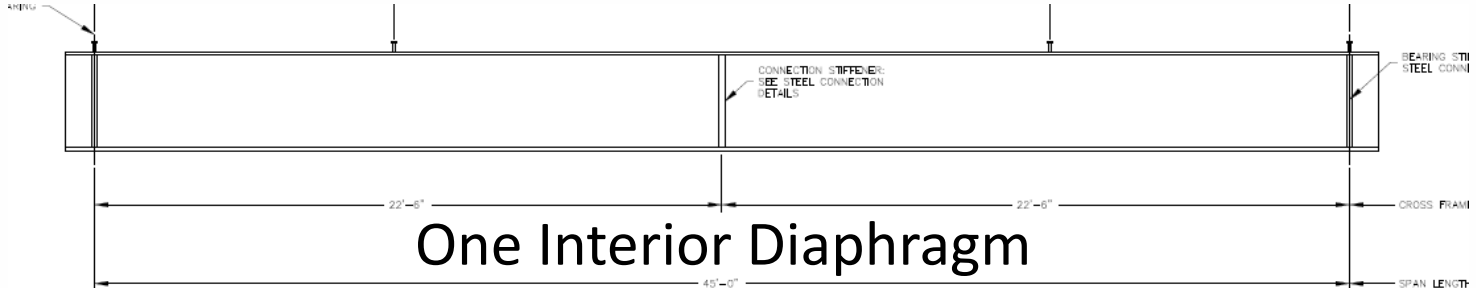
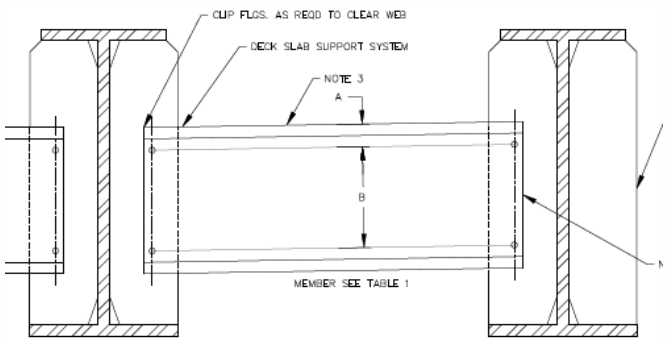
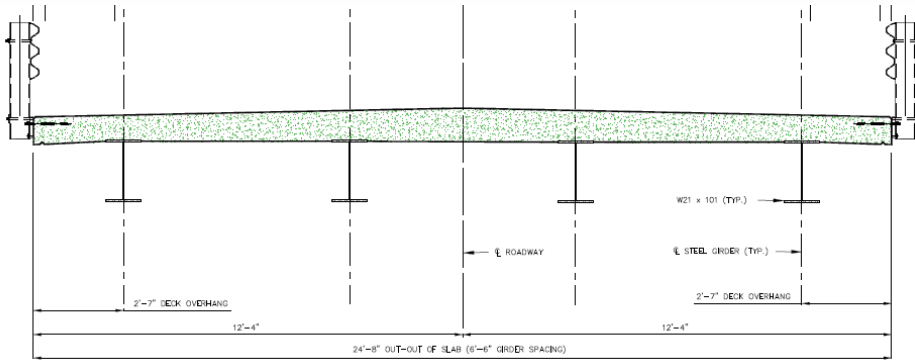
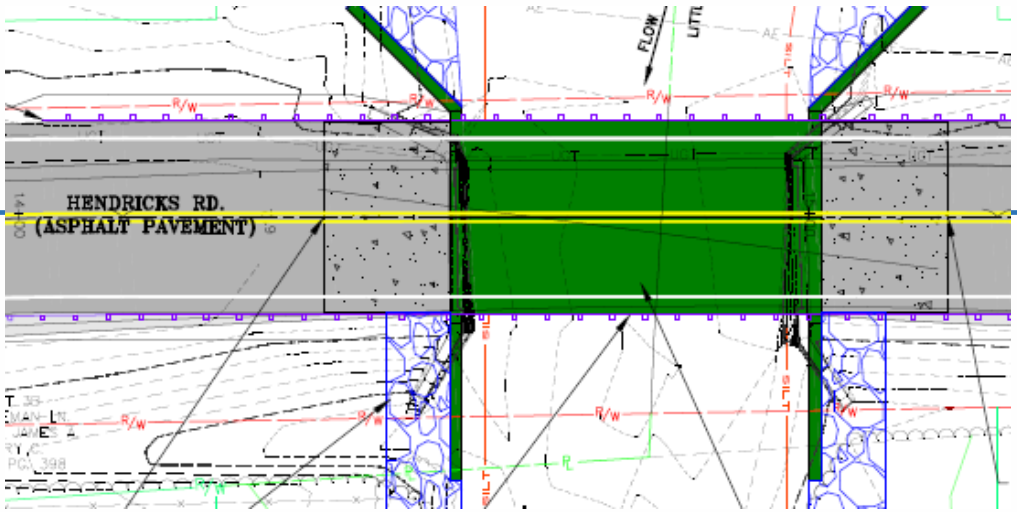
No Skew

Integral Abutment

Channel Diaphragms

SIP Form Deck

Simple Bridge Railing



# Hendrix Road Bridge



# Hendrix Road Bridge



# Lockhart Road Bridge

41ft – 6 in Span; 28 ft Roadway Width

Five W18x86 Girders @ 6 ft – 2 in

Weathering Steel

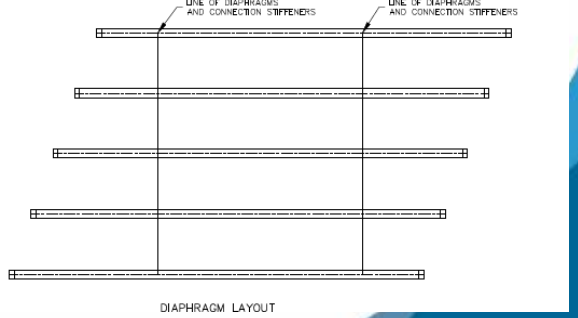
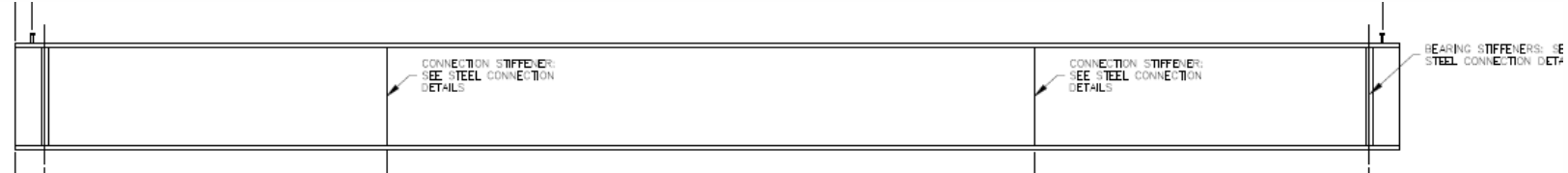
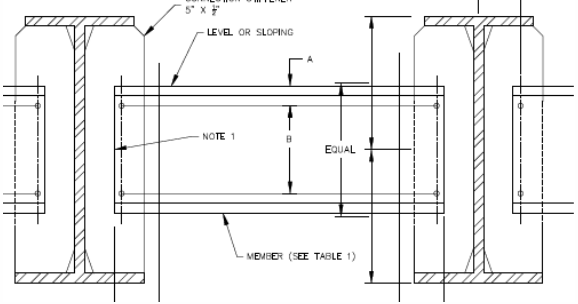
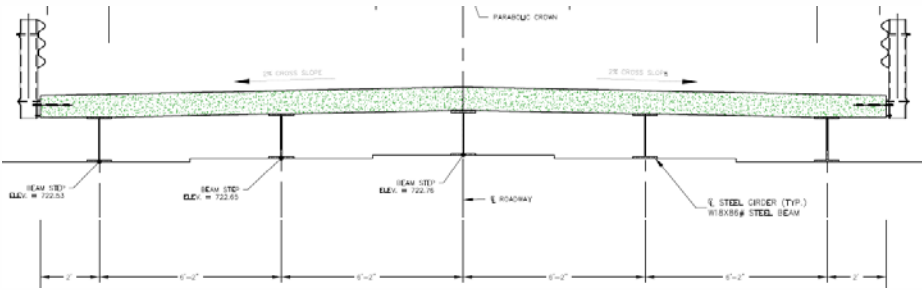
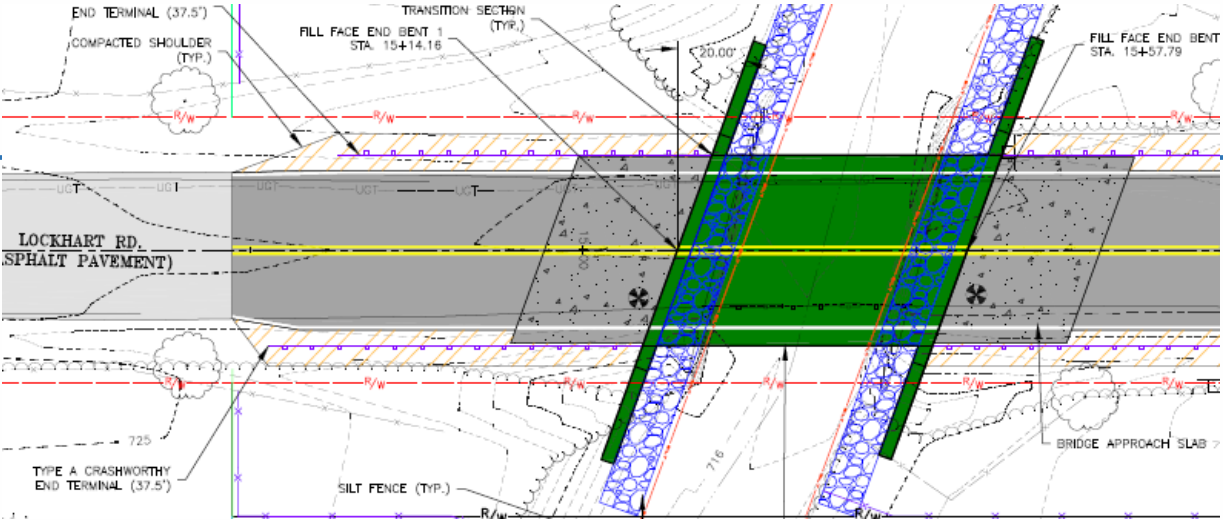
20° Skew

Integral Abutment

Normal Diaphragms

Solid Deck

Simple Bridge Railing

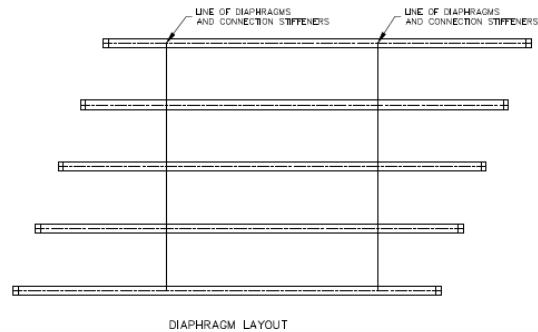


Two Interior Diaphragms - Staggered

# Lockhart Road Bridge



# Lockhart Road Bridge



# Recent MoDOT Bridge Construction

Between January 2009 to May 2018 2021 to 2025

~~10~~ 5 yrs

How Many Typical Concrete Bridges Did MoDOT Build?

~~378~~ 230

- Prestressed NU
- PC I Beam
- PC Box
- PC Bulb T, Dbl T & Slab

How Many Typical Steel Bridges? <sup>- 39%</sup>

~~16~~ 24

- 15 8 Plate and 1 16 Wideflange, Excludes:
- Major River Crossings
  - Tight Horizontal Curves
  - Widening
  - And Special Configurations

<sup>+ 50%</sup>

Does Not Include  
Bridge Bundling Bridges

- 25 Steel: FARM
- 24 Steel: NW MO
- 12 Steel: SW MO
- 4 Steel: Kaysinger Basin
- 7 Steel: Improve I-70  
Rocheport to COMO

~~4~~ 10% Typical Steel Bridges – AND Competition Saving Missouri Money!

# Summary & Conclusions

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- Competition Between Steel & Concrete is Healthy For:
  - Costs
  - Quality of Bridges
  - Industry Responsiveness
  - Industry Capabilities
- Steel and Concrete are Competitive on First Costs & Life Cycle Costs
- Steel or Concrete May Be the Lowest Cost for a Particular Project

**Owners, Designers & Contractors Should Consider Both Concrete & Steel for Bridge Projects**



# Questions?

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## Webinar 1: Short Span Steel Bridge Design and Construction with a Fabricators Perspective June 9, 2026

**Michael G. Barker, PhD, PE**  
University of Wyoming  
SSSBA, Director of Education

**Tanner Genenbacher, PE**  
DeLong's, Inc.

