



# **Short Span Steel Bridges for Rail Bridges and Rail Overpasses**

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AREMA Committee 15  
May 14, 2025

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# Today's Presentation

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- **Short Span Steel Bridge Alliance**
- **Initial and Life Cycle Costs of Steel & Concrete Highway Bridges**
- **Rail Bridges**
  - NSBA Standard Short Span Designs
  - Replacing Many Multi-Span with Longer Spans
  - 80 Ft Plate Girder Bridge Case Study
- **Rail Overpasses**
  - Simple Span Traditional Bridges
  - Buried Steel Bridges
  - Simple Span Prefabricated Bridges
  - Press-Brake Tub Girder Bridges

Short Span Steel Bridge Alliance: [www.ShortSpanSteelBridges.org](http://www.ShortSpanSteelBridges.org)

# Short Span Steel Bridge Alliance

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A group of **bridge** and **buried soil structure** industry leaders who have joined together to provide **educational information** on the design and construction of short span steel bridges in installations up to **140 feet in length**.

# Membership





# Short Span Steel Bridge Solutions

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Buried Bridges



Rolled Beam & Plate Girders



Press-Brake-Formed Tub Girders



Truss Bridges



# What Do We Provide?

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- Education
  - Workshops, Webinars, Newsletter
- Technical Resources
  - Standards, best practices, case studies
- Simple Design Tools (eSPAN140)
- Project Assistance
- Find a Supplier
- Networking / SSSBA Semiannual Meeting



# Initial Costs: Steel & Concrete

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## Preconception that Concrete is Less Expensive than Steel for Typical Bridges

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



# Summary on Initial Costs

SSSBA Conducted Case Studies:

County & State Bridges

Bids & Actual Costs

Case Studies of County Bridges

Others Not Shown Here

Superstructure	Steel						Concrete				
Bridge Number	061	140	149	152	710	AVG	028	057	069	520	AVG
Year Built	2008	2008	2008	2009	2010	AVG	2009	2010	2011	2006	AVG
Span Length	50	50	40	62	64	53.2	36	36	38	40	37.5
Skew	0	0	0	30	35	13	0	15	20	30	16.25
Cost Summary											
- Labor	\$14,568	\$21,705	\$15,853	\$24,785	\$31,949	\$21,768	\$12,065	\$15,379	\$14,674	\$19,044	\$15,291
- Material	\$56,676	\$53,593	\$46,282	\$92,821	\$69,357	\$63,746	\$51,589	\$54,450	\$50,576	\$46,850	\$50,866
- Rock	\$6,170	\$6,216	\$3,694	\$8,235	\$6,501	\$6,163	\$5,135	\$7,549	\$5,378	\$3,621	\$5,421
- Equipment	\$7,487	\$12,026	\$7,017	\$19,579	\$15,266	\$12,275	\$5,568	\$10,952	\$11,093	\$14,742	\$10,589
- Guardrail	\$4,715	\$7,146	\$3,961	\$7,003	\$7,003	\$6,966	\$4,737	\$4,663	\$5,356	\$3,323	\$4,520
Construction Cost	\$89,616	\$100,686	\$76,807	\$152,403	\$130,076	\$109,918	\$79,094	\$92,993	\$87,077	\$87,580	\$86,686
CONST. COST PER FT.	\$74.68	\$83.91	\$80.01	\$102.42	\$84.68	\$86.09	\$91.54	\$107.63	\$95.48	\$91.23	\$96.32

## State Bridge (Designed by eSPAN140)

### Kansas Department of Transportation

- Shawnee County
- 112 feet (5 plate girder bridge)
- Competitive bid process (steel vs. concrete)
- DOT used eSPAN140 for preliminary design
- Constructed in summer 2014



1 Steel Bridge Bid

3 Concrete Bridge Bids

Steel = \$ 1.240 mil

Concrete = \$ 1.243 – \$ 1.425 mil

## NSBA Cost Study

## National Bridge Cost by Beam Subtype (\$/SF)

(#) indicates number of bridges for each beam type

● Minimum ● 25th Percentile ● 75th Percentile ● Maximum

Less Than 100 ft.

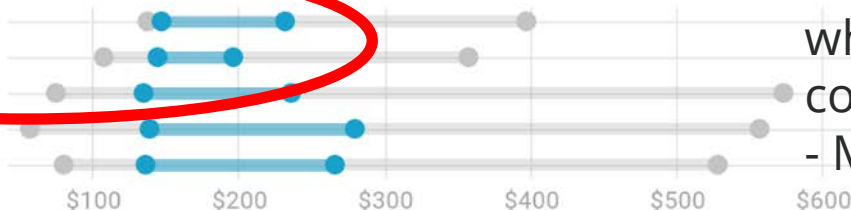
Steel Plate Girder (19)

Steel Rolled Beam (66)

Concrete I-Beam (203)

Concrete Box Beam (104)

Concrete Slab (48)



## County Bridge (Designed by eSPAN140)

- Boone County, Missouri (Local)
  - High Point Lane Bridge
  - 102 feet (2 lane rural road plate girder bridge)
  - 44" weathering steel plate girders (4 lines)
  - Constructed in summer 2013



## Two MoDOT Bridges Crossing US 63 in Boone County

Concrete P/S: 92 ft – 92 ft				Steel Plate Girder: 98 ft – 98 ft			
Route H (Columbia Airport)				Discovery Parkway (Columbia)			
Letter Item: 4022881				Letter Item: 4022887			
100	1	CONCRETE	\$1,700.00	100	1	STEEL	\$4,400.00
101	1	STEEL	\$1,700.00	101	1	CONCRETE	\$4,400.00
102	1	STEEL	\$1,700.00	102	1	CONCRETE	\$4,400.00
103	1	STEEL	\$1,700.00	103	1	CONCRETE	\$4,400.00
104	1	STEEL	\$1,700.00	104	1	CONCRETE	\$4,400.00
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267	1	STEEL	\$1,700.00	267	1	CONCRETE	\$4,400.00



# Steel Bridges Compete and Win!

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Studies at:  
[ShortSpanSteelBridges.org](http://ShortSpanSteelBridges.org)

Preconception is Misconception  
Steel & Concrete Bridges Are Competitive

# What About Life Cycle Costs?

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As owners replace their bridge infrastructure, the question of Life Service and Life Cycle Costs routinely comes up between concrete and steel bridge options

The bridge industry ~~does~~ did not have a good answer:

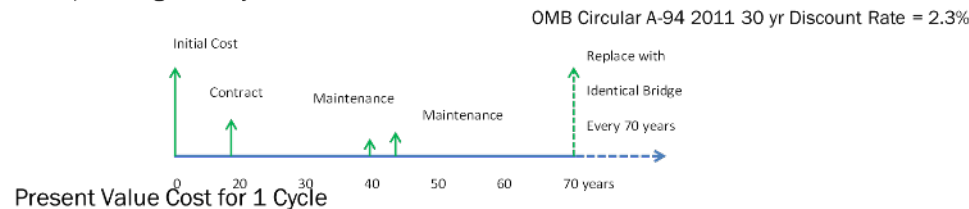
- Both steel and concrete bridge advocates claim an advantage

- Anecdotal information is not convincing

# Historical Life Cycle Costs of Steel & Concrete Girder Bridges

Examine Historical Life Service (Performance and Maintenance) and Agency Life Cycle Costs (True Agency Costs for a Bridge) of Steel and Concrete Bridges in Pennsylvania

Example Bridge Life Cycle



$$PVC = \$143.45 + \$16.63(1.023)^{-19} + \$0.28(1.023)^{-40} + \$0.34(1.023)^{-44} = \$154.49/ft^2$$

Perpetual Present Value Cost = Capitalized Cost

$$PPVC = \$154.49 \left[ \frac{(1 + 0.023)^{70}}{(1 + 0.023)^{70} - 1} \right] = 1.256(\$154.49) = \$193.97/ft^2$$

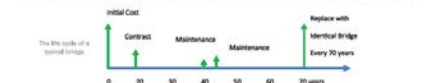
With Capitalized Costs, Can Compare Bridges Directly



**Introduction**  
Historical Life Cycle Costs of Steel and Concrete Girder Bridges research conducted by Michael Barker, Ph.D., P.E., professor at the University of Wyoming, explores the initial costs, life cycle costs, future costs, and bridge life of 1,587 typical steel and concrete spans bridges in Pennsylvania built between 1980 and 2020.

Dr. Barker frequently meets with county engineers and other bridge design professionals across the U.S. and poses questions on this topic, but there was no research concerning the true costs, so he undertook the project himself. He compiled a database from PennDOT historical data comparing the types of bridges, including concrete precast beams, box girders, and box girder bridges, and steel rolled beams and welded plate girders. Results showed steel beams have the lowest average deterioration rate, have the longest average expected life (85 years), offer the lowest average initial and life cycle costs for short bridges, and have lower average future costs compared to initial costs.

**Life Cycle Cost Study**  
The Federal Highway Administration promotes consideration of Life Cycle Costs (LCC) in the design and engineering of bridges. LCC determines the "true cost" of bridge alternatives considering the time value of money. To compare the true types of bridges in the study, historical bridge initial and maintenance costs were converted to present-day dollars using historical construction and costs. Future costs were discounted at a rate of 2.3 percent. The life cycle cost analysis involved using the Perpetual Present Value Cost (PPVC) of bridge alternatives for an equivalent comparison between the bridge types. PPVC is the sum of discounted future costs plus the present value cost of constructing the bridge into perpetuity. Results of the PennDOT database show all types of bridges are competitive for initial costs, future costs, life cycle costs and bridge life for any given bridge project, and for the future may result in the lowest life cycle costs. Therefore, owners should consider both steel and concrete alternatives for an individual bridge project.



**Deterioration Rates**  
There are 1,587 bridges in the PennDOT inventory built between 1980 and 2020. They were used to determine the average deterioration rates. Based on condition rating over period for the different types of bridges. To model the deterioration rate, it was assumed the superstructure condition rating increased linearly over time. Table 2 presents the average deterioration rates for each bridge type. Steel beam bridges have the lowest average deterioration rate.

Bridge Type	Number of Bridges	Average Year Built	Average Bridge Life (years)
Steel I Beam	105	1977	85
Steel Box Girder	20	1977	85
P/B Box Girder	10	1977	85
P/B Box Girder	10	1977	85
P/B Box Girder	10	1977	85

Bridge Type	#	PPVC	Initial Cost	PPVC	PPVC
Steel I Beam	105	\$143.45	\$143.45	\$143.45	\$143.45
P/B Box Girder	10	\$143.45	\$143.45	\$143.45	\$143.45
P/B Box Girder	10	\$143.45	\$143.45	\$143.45	\$143.45
P/B Box Girder	10	\$143.45	\$143.45	\$143.45	\$143.45



**Life Cycle Costs of Short-Length Bridges**  
County bridge engineers already require bridges where spans are less than 140 ft. Length. Table 3 shows the average perpetual present value costs and initial costs of bridges with a maximum length of 140 ft. Steel box girder bridges are not common in this bridge length, they are not included. Steel beam bridges have the lowest life cycle costs and the lowest initial costs compared to the other types. A useful method to analyze bridge life cycle costs is to compare the probability a bridge will cost less than a certain amount. Figure 2 is the Cumulative Density Function concerning the PennDOT bridge's probability of 80 percent the cost of the bridge spans of being less than \$100/ft^2.



**Bridge Life**  
To determine the average life for each bridge, it is assumed the bridge will be replaced when the superstructure condition rating reaches 5. Table 4 presents the average age built and the average bridge life for the different types of bridges in the Life Cycle Cost database. A useful method to analyze bridge life is to compare the probability a bridge will cost less than a certain amount. Figure 2 is the Cumulative Density Function concerning the PennDOT bridge's probability of 80 percent the cost of the bridge spans of being less than \$100/ft^2.

Large Database of Steel & Concrete Bridges

Download the research report at [www.ShortSpanSteelBridges.org](http://www.ShortSpanSteelBridges.org)

Thank You to PennDOT professionals for their participation Support from AISI, NSBA and AGA

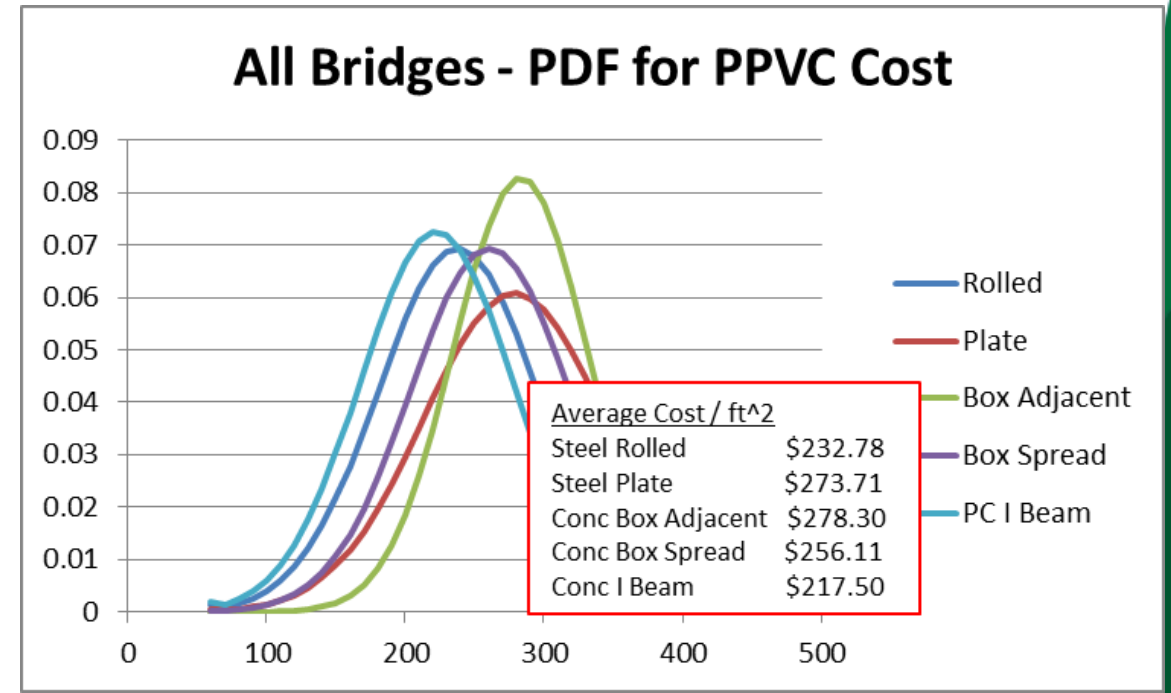
# Conclusions

Typical Concrete and Steel Bridges are Competitive on Initial Cost, Future Costs, Life Cycle Costs and Bridge Life

Owners Should Consider Both Steel and Concrete Alternatives for Individual Bridge Projects

All are “similar” with  
None “Way Out” of Balance

Report on [ShortSpanSteelBridges.org](http://ShortSpanSteelBridges.org)  
Additional Report on LCC Galvanizing





# Railroad Bridges

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## Priorities

Shutdown Time – Revenues

Economy

Substructures

Roadway Closures

Deck Configurations

Open Deck

Ballast Deck



# Steel Railroad Bridges



Guidelines for the  
Design of Steel  
Railroad Bridges  
for Constructability  
and Fabrication



## 2.2. Span Length

Practical span lengths by superstructure type are:

- Rolled beam or welded deck girders for spans up to 70 feet.
- Deck plate girders for spans of 70 to 150 feet.
- Through plate girders for spans between 70 to 200 feet.
- Trusses over 200 feet. The maximum practical length of simply supported truss spans is 400 feet.

The above practical span lengths are applicable to open and ballasted deck bridges.

Rolled beams are usually more economical than welded plate girders for short spans.

Welded built-up plate girders are more economical than bolted construction.



# Removing Interior Piers



## Benefits of Longer Spans

Economy

Less Environmental Impact

Less Piers & Obstructions





# Plate Girder Replacement Railroad Bridge Project

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## Assonet River Bridge, Assonet, MA

Designer:	HNTB
Fabricator:	Greiner Industries
Owner:	Mass Bay Transit Authority
Galvanizer:	V&S Galvanizing

MBTA Commuter Rail System  
Forest Setting over the Assonet River

80 FT Simple Span with 7 ft Steel Plate Girders  
Hot-Dip Galvanized  
Assembled Off Site, Railed In & and Lifted into Place

11 Day Shutdown



# Plate Girder Replacement Railroad Bridge Project

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Assonet River Bridge, Assonet, MA



## Benefits of Steel Bridges

Economy

Longer Spans

Reduce Interior Piers

Minimize Underneath Disruption

Light Weight

Lighter Equipment

Smaller Abutments

Modular

Accelerated Bridge Construction

Resilient

Long Life – 100+ Years

Robustness Against Extreme Events

Ease of Inspection

Ease of Repair



# Steel Bridges Over Railroad Lines

## Manufacturer Solutions & Traditional Fabricated Bridges



## Benefits of Steel Bridges

- Economy
- Light Weight
- Lighter Equipment
- Smaller Abutments
- Modular
- Accelerated Bridge Construction
- Resilient



# **Prefabricated & ABC Steel Bridges**

## **Showcase of 3 Different Steel Bridges**

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### Bridge Case Studies

Buried Steel Bridge – Big R

Modular Beam Bridge - Contech

Press-Brake Tub Girder – Valmont

**Prefabricated Bridges**

**Accelerated Bridge Construction**

# Buried Steel Bridge - Corrugated Steel Plate – Contractor Built

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VT Route 2B Bridge Replacement, St. Johnsbury, VT

Contractor: JP Sicard

Fabricator: Big R Bridge

28 day max. trail closure / 50 day road closure for all work

**47'11" span x 26'9" rise Arch**



Greeley, CO

**BIG R**  
B R I D G E





# Buried Steel Bridge - Corrugated Steel Plate





# Buried Steel Bridge - Corrugated Steel Plate

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VT Route 2B Bridge Replacement, St. Johnsbury, VT

# Case Studies - Buried Steel Bridge

## Corrugated Steel Animal Overpass Reduces Wildlife-Vehicle Collisions



## Buried Steel Bridge Saves \$500,000 and Three Months Versus Concrete Option







# Modular Beam

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# Modular Beam

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# Case Studies Modular Beams

## Seltice-Warner Bridge, White Road, Whitman County, WA

Fabricator: BigR/Contech  
Contractor: Whitman County Crew  
Design Engineer: Mark Storey, County Engineer

35 ft Span x 28 ft Wide – Gravel Riding Surface  
2-Girder Modules / 3 Modules  
No Concrete Curing



**CONTECH**  
ENGINEERED SOLUTIONS

## Schoepps Valley Road, Waumandee, WI

Fabricator: Wheeler  
Contractor: JF Brennan

Three-Simple-Span (3 x 48 ft) with 24 ft Roadway  
Emergency Replacement During Winter Months  
No Concrete Curing



*Wheeler*

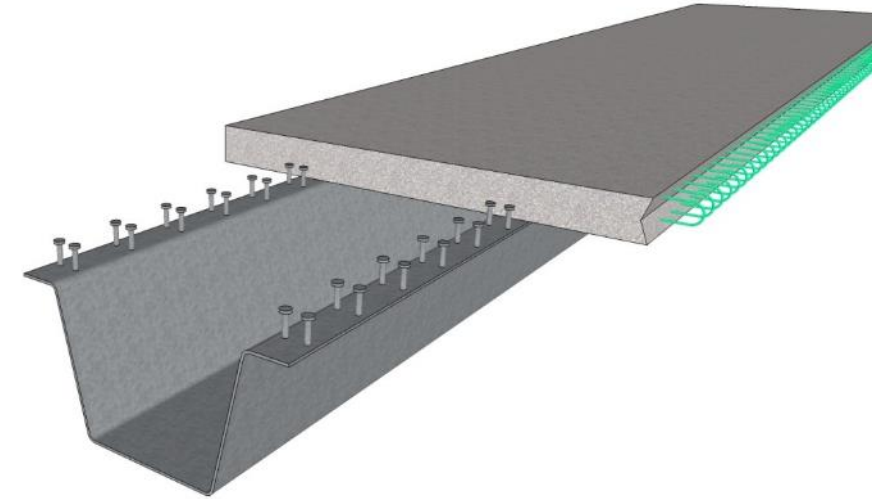




# Press-Brake-Formed Steel Tub Girders

- Modular shallow trapezoidal boxes fabricated from cold-bent structural steel plate
  - Weathering steel or galvanized.
- Reduction in fabrication costs due to cold-bending versus welding of the section and mass production.
- Advantages include:
  - Accelerated with precast deck (install in 1 or 2 days)
  - Modular
  - Simple to fabricate and install

SSSBA Research Started in 2012  
First PBTG Bridge Built in 2015





# Press-Brake Tub Girder – Contractor Built

## Barron County, WS

Fabricator: Valmont  
Contractor: Larson Construction

### Existing Structure

3-Span Timber Slab  
96 ft Length  
Deterioration and Deficient

**valmont** 



### Replacement Structure Requirements

Two Span  
104 ft Length  
Increased Hydraulic Opening and Clearance



# Press-Brake Tub Girder

## Other Finishing Fabrication

### Pre-Decked - Composite

PBTGs Pre-Decked  
Closure Pours



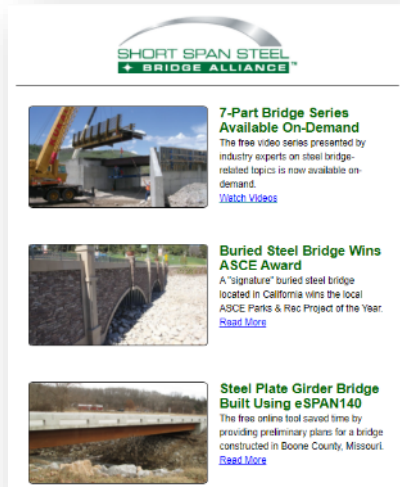
### Field Assembly - Composite

PBTGs no Deck  
Precast Deck Panels  
Grouted Shear Pockets  
Closure Pours

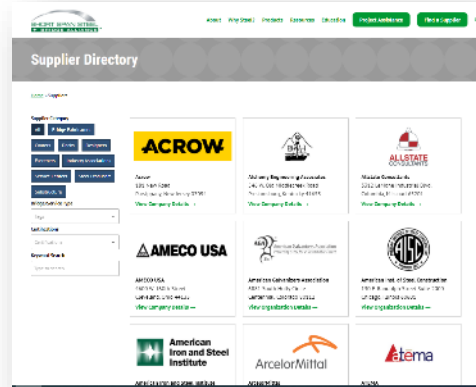


# 5 Ways to Keep Learning About Steel Bridges

## 1. Subscribe to the Weekly Newsletter



## 2. Find a Supplier



## 3. Design a Bridge in 5-Minutes



## 4. Receive Free Project Assistance



## 5. Schedule a Workshop/Webinar



[www.ShortSpanSteelBridges.org](http://www.ShortSpanSteelBridges.org)

Questions? Dan Snyder, Director, SSSBA, [dsnyder@steel.org](mailto:dsnyder@steel.org), (301) 367-6179



Website: [ShortSpanSteelBridges.org](http://ShortSpanSteelBridges.org)

Twitter: [@ShortSpanSteel](https://twitter.com/ShortSpanSteel)

Facebook: [Short Span Steel Bridge Alliance](https://www.facebook.com/ShortSpanSteelBridgeAlliance)



# Summary: Today's Steel Bridges

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State of the Art & Innovative Designs

Durable

Speed of Construction – Accelerated Bridge Construction

Cost Effectiveness

Sustainability

Resiliency

How Can SSSBA and SSSBA Members  
Help and Support  
AREMA and AREMA Members

