Short Span Steel Bridges for Rail Bridges and Rail Overpasses

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Today’s Presentation

- 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

Short Span Steel Bridge Alliance

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

Producers

Fasteners

Coaters

Service Centers

Fabricators

SHORT SPAN STEEL
BRIDGE ALLIANCE™

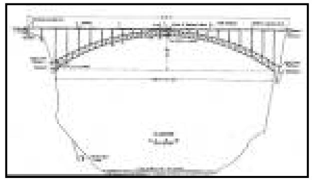
American Galvanizers Association

NCSPA

American Iron and Steel Institute

National Steel Bridge Alliance

Trade Organizations



Design Firms

Contractors

National Association of County Engineers (NACE)

Bridge Owners

Universities

Short Span Steel Bridge Solutions

Buried Bridges

Rolled Beam & Plate Girders

Press-Brake-Formed Tub Girders

Truss Bridges

What Do We Provide?

- 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

Preconception that Concrete is Less Expensive than Steel for Typical Bridges

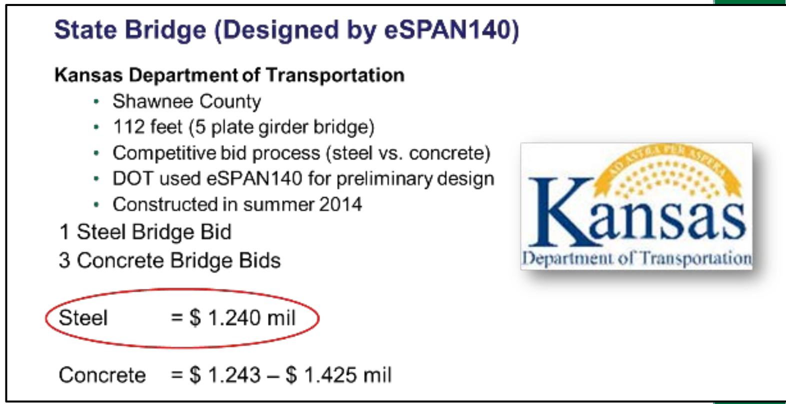
- Many Times Steel is Not Even Considered
- Owners Paying More Than They Could for Bridges
- Unwarranted Lack of Competition Not Good

Summary on Initial Costs

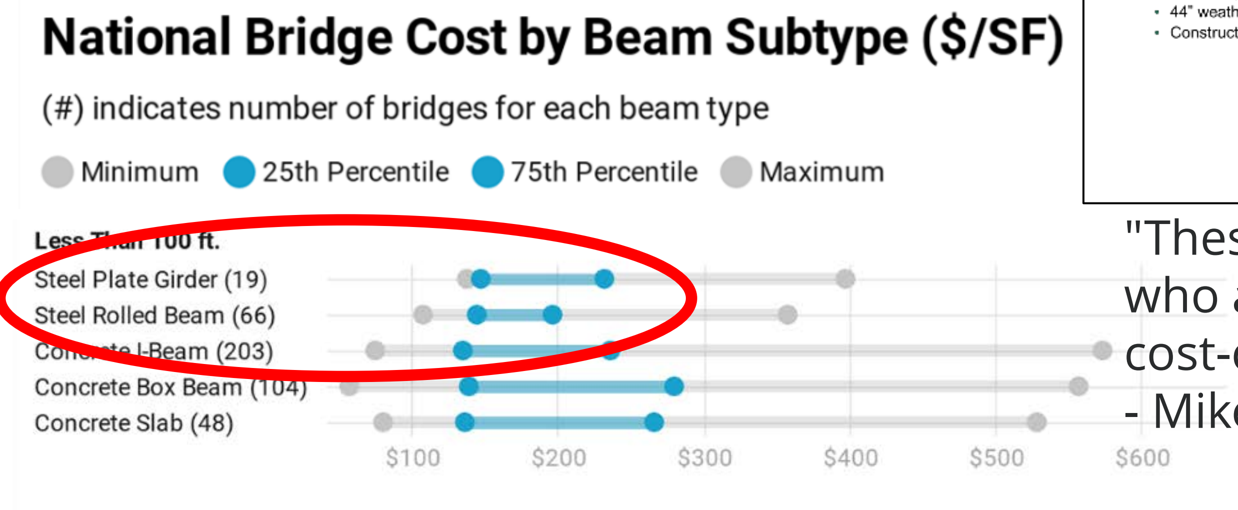
SSSBA Conducted Case Studies:

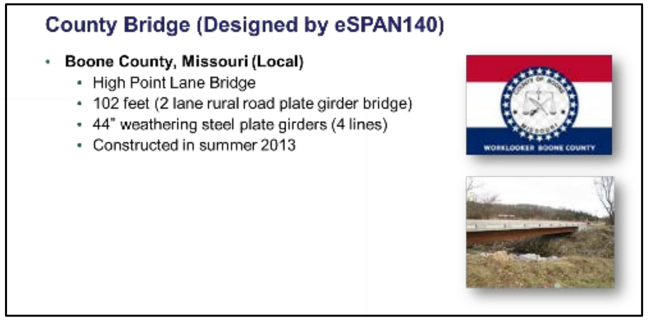
- County & State Bridges
- Bids & Actual Costs
- Case Studies of County Bridges
- **Others Not Shown Here**

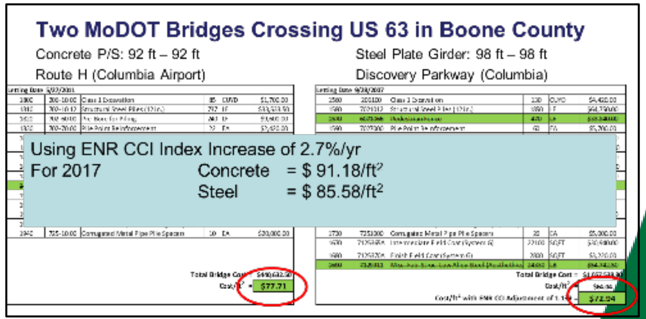
Superstructure	Steel						Concrete				
Bridge Number	061	140	149	152	710	AVG	028	057	069	520	AVG
Year Built	2008	2008	2008	2009	2010	AVG	2009	2010	2011	2006	AVG
Span Length	50	50	40	62	64	53.2	36	36	38	40	37.5
Skew	0	0	0	30	35	13	0	15	20	30	16.25
Cost Summary											
- Labor	$14,568	$21,705	$15,853	$24,765	$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	$5,966	$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 FT²	$74.68	$83.91	$80.01	$102.42	$84.68	$86.09	$91.54	$107.63	$95.48	$91.23	$96.32



NSBA Cost Study







"These conclusions come as a surprise to the authors, who assumed that concrete bridges would be more cost-competitive than steel bridges."
- Mike Digregorio, HDR

https://www.aisc.org/nsba/hdr-pricing-study/

Steel Bridges Compete and Win!

Studies at:
ShortSpanSteelBridges.org

What About Life Cycle Costs?

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

OMB Circular A-94 2011 30 yr Discount Rate = 2.3%

Present Value Cost for 1 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

Large Database of Steel & Concrete Bridges

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

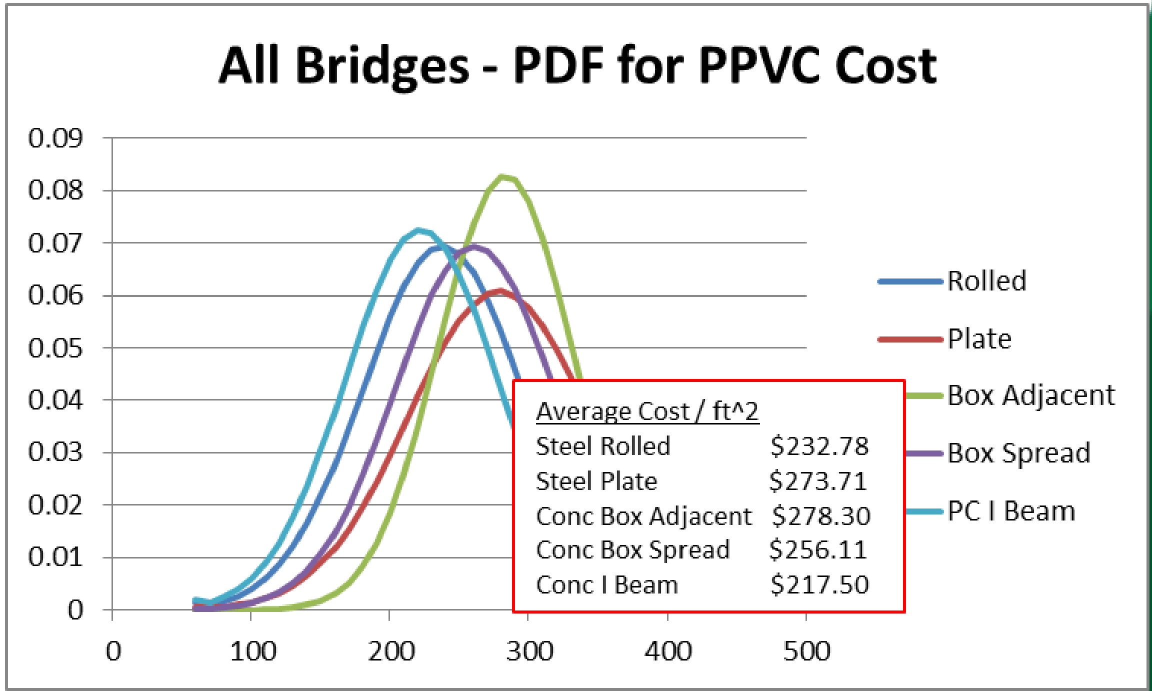
Conclusions

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
Additional Report on LCC Galvanizing



Railroad Bridges

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

AREMA
AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION

NSBA Smarter. Stronger. Steel.

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

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

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

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

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

Greeley, CO

BIG R BRIDGE

47’11” span x 26’9” rise Arch

Buried Steel Bridge - Corrugated Steel Plate

Buried Steel Bridge - Corrugated Steel Plate

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

Case Studies - Buried Steel Bridge

CONTECH ENGINEERED SOLUTIONS
West Chester, OH

Corrugated Steel Animal Overpass Reduces Wildlife-Vehicle Collisions

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

Case Study Modular Beam

Smith Road Bridge. Clark County, IN

Contractor: CivilCon

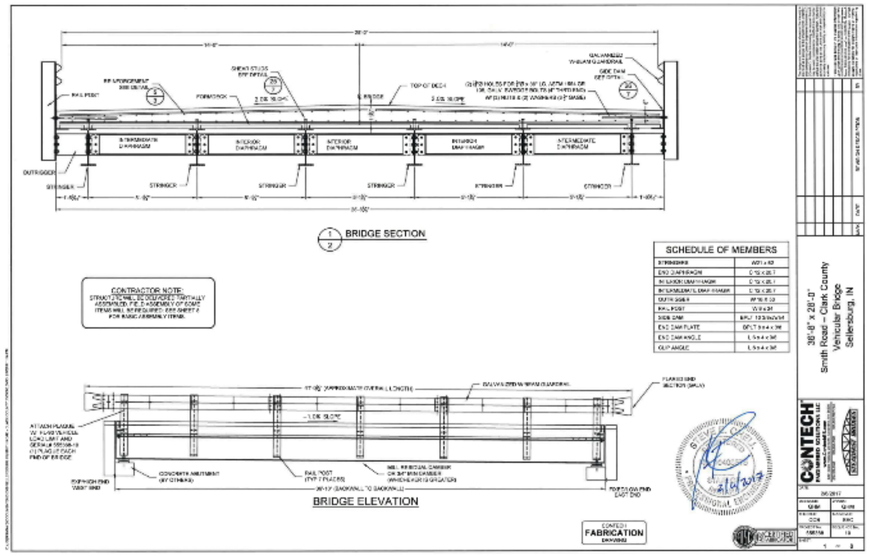
Fabricator: Contech

CONTECH® ENGINEERED SOLUTIONS

West Chester, OH

36 ft 8 in long, 28 ft wide Modular Rolled Beam

Single Span Replaced Two-Span Bridge



Modular Beam

Modular Beam

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

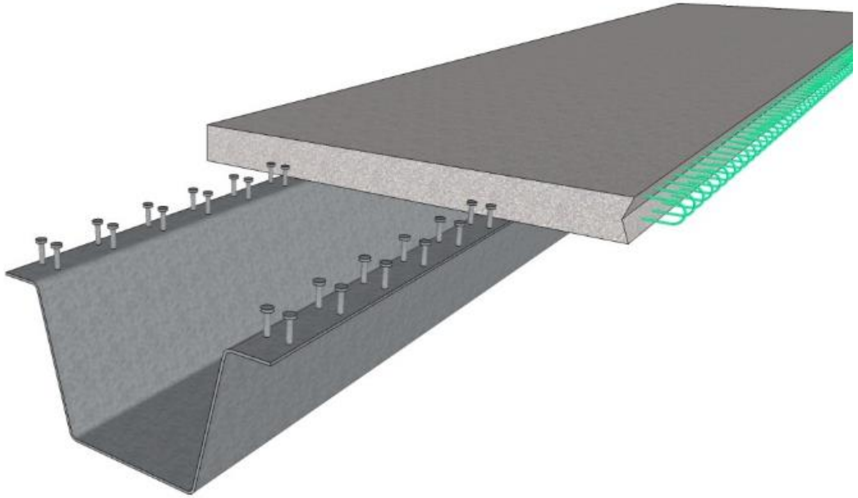
Emergency Replacement During Winter Months

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

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

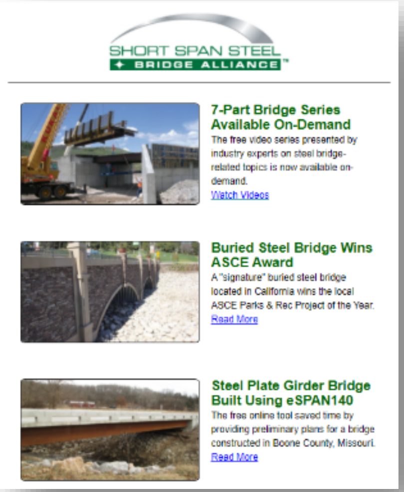
Precast Deck Panels

Grouted Shear Pockets

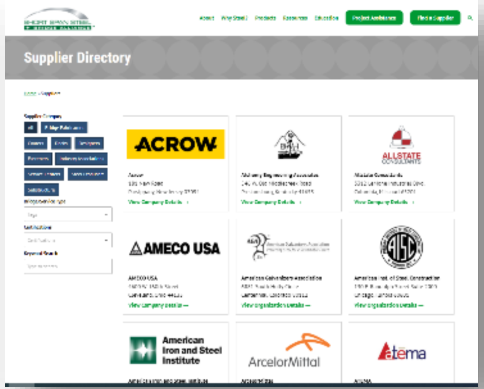
Closure Pours

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

eSPAN140™

4. Receive Free Project Assistance

5. Schedule a Workshop/Webinar

www.ShortSpanSteelBridges.org

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

Website:	ShortSpanSteelBridges.org
Twitter:	@ShortSpanSteel
Facebook:	Short Span Steel Bridge Alliance

Summary: Today's Steel Bridges

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