



F. Duncan, PE, G. Hasbrouck, PE and A. Dour, PE

Replacing the Aging US 52 Mississippi River Bridge

February 26, 2019

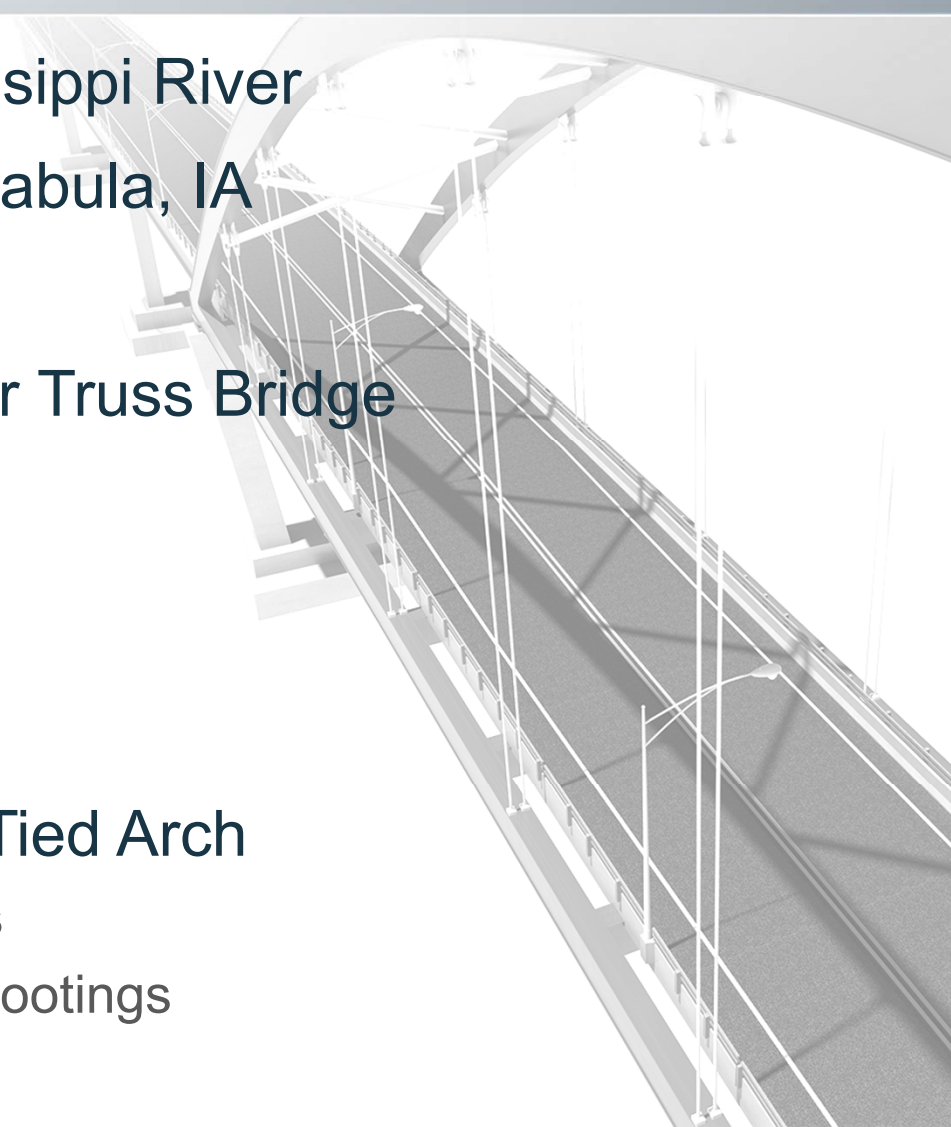


PARSONS

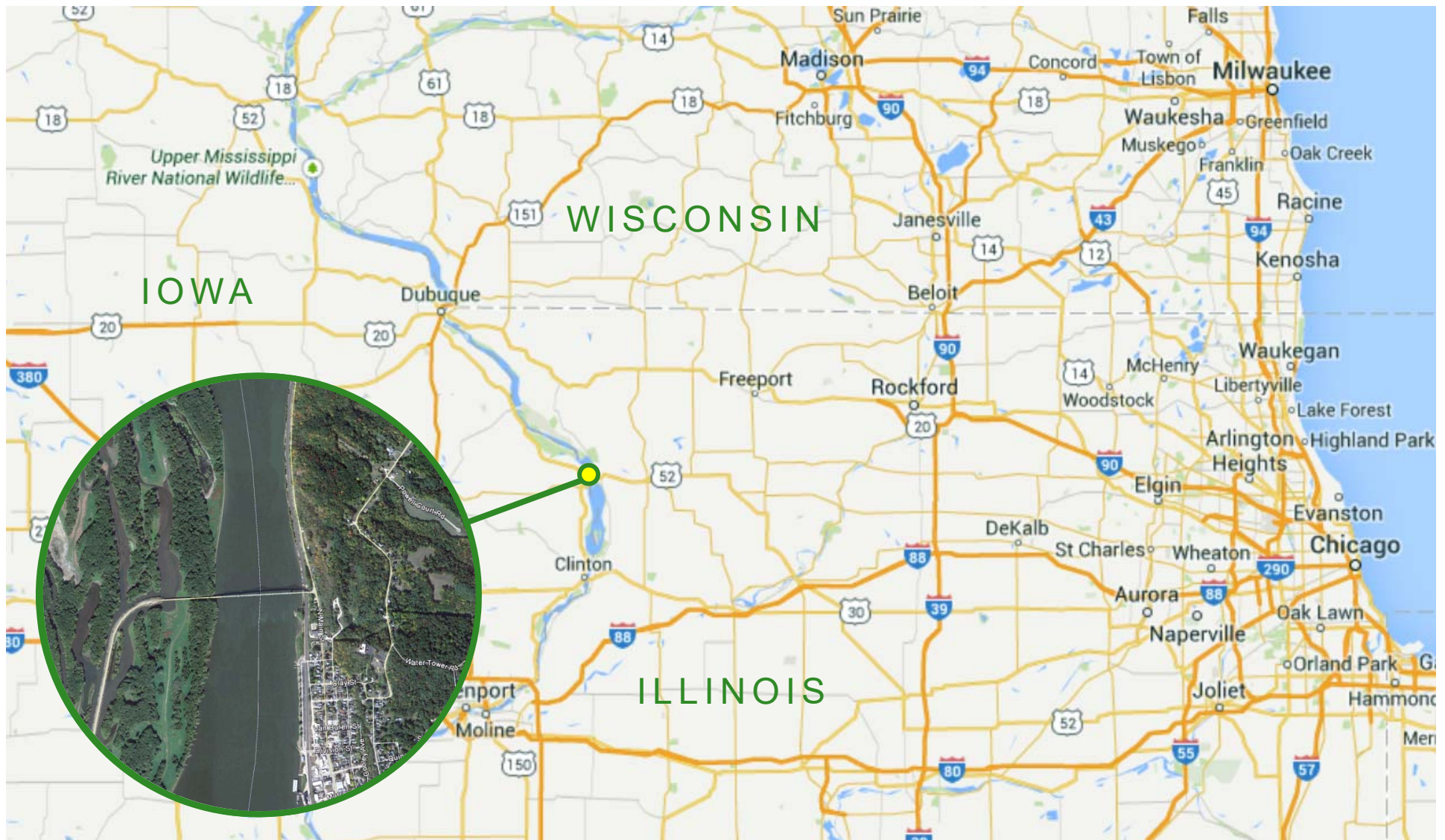


Project Overview

- US 52 / IL 64 over the Mississippi River
- Connecting Savanna, IL to Sabula, IA
- Illinois DOT Led Project
- Replacing Existing Cantilever Truss Bridge
 - 520 ft main span
- Extensive Coordination
 - Environmental and Permitting
 - Railroads and Utilities
- Proposed 546 ft Main Span Tied Arch
 - Steel Plate Girder Approaches
 - Drilled Shafts with Coffercell Footings



Project Location



US 52 / IL 64 OVER THE MISSISSIPPI RIVER

Aerial View

- Sabula, IA
 - “Iowa’s only island city”
 - Pop. 576
- Savanna, IL
 - “Sportman’s Paradise”
 - Pop. 2,945



Iowa Causeway



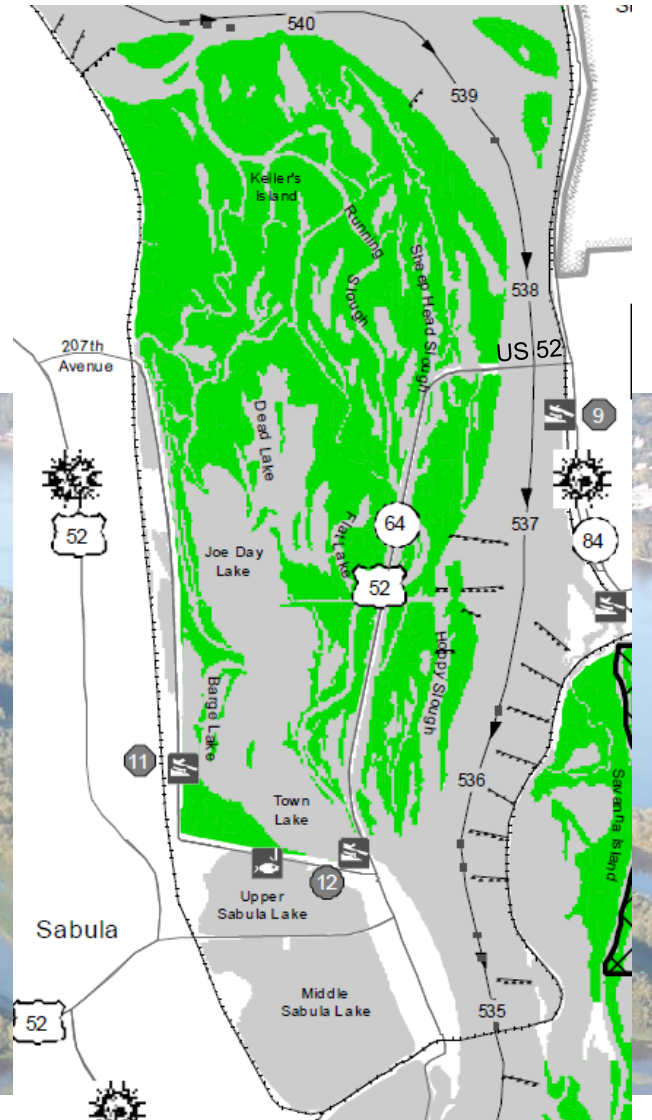
National Fish & Wildlife Refuge



U.S. Fish & Wildlife Service

Upper Mississippi River

National Wildlife and Fish Refuge | Illinois, Iowa, Minnesota and Wisconsin

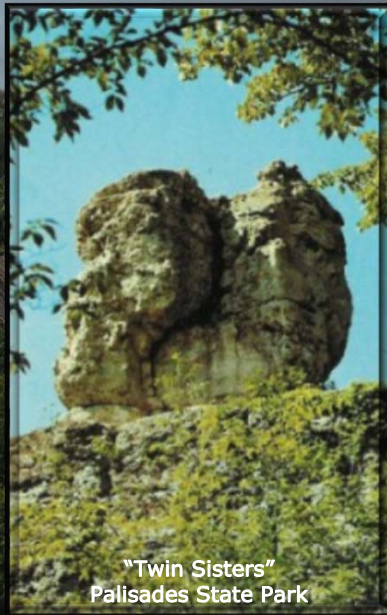


BNSF Railway



US 52 / IL 64 OVER THE MISSISSIPPI RIVER

Mississippi Palisades State Park & Bluffs



"Twin Sisters"
Palisades State Park



INDIAN HEAD PALISADES STATE PARK
SAVANNA, ILLINOIS



Bluffs along IL 84

Mississippi River & Barges



The Upper Mississippi River System is the only waterbody in the nation that has been recognized by Congress as a “nationally significant ecosystem and a nationally significant commercial navigation system.” (Section 1103 of the Water Resources Development Act of 1986, PL 99-662)



History

- Constructed in 1932
- Savanna-Sabula Bridge Company
- Private Toll Bridge before being turned over to Iowa
- Illinois took over jurisdiction in 1987
- Listed as a Historic Structure in 1999



Existing Bridge



- 947 ft Iowa Approach
- 282 ft Simple Span Truss
- 1,160 ft Cantilever Truss
- 520 ft main span
- 78 ft Illinois Approach
- 2,468 ft in total length

Open Deck Grate



Repairs

- Major repairs in 1985
- Minor repairs in 1999
- Partial replacement of steel grid deck in 2008
 - 28 day road closure and \$2.9M
 - Major out cry from public
- Identified more repairs in 2009
 - \$8M repairs + \$8M user cost
 - 9 month closure, 37 mile detour
- Future repairs?



Key Issues

- **Structurally Deficient**
 - Entire Iowa approach substructure
 - Repairs needed for truss spans
 - Weight Limit
- **Functionally Obsolete**
 - 2 narrow 10 ft lanes
 - Trucks encroach into lane
 - Tight turning radius
 - Steel grid deck
- **Remaining Service Life**
 - 8 to 10 years in current state



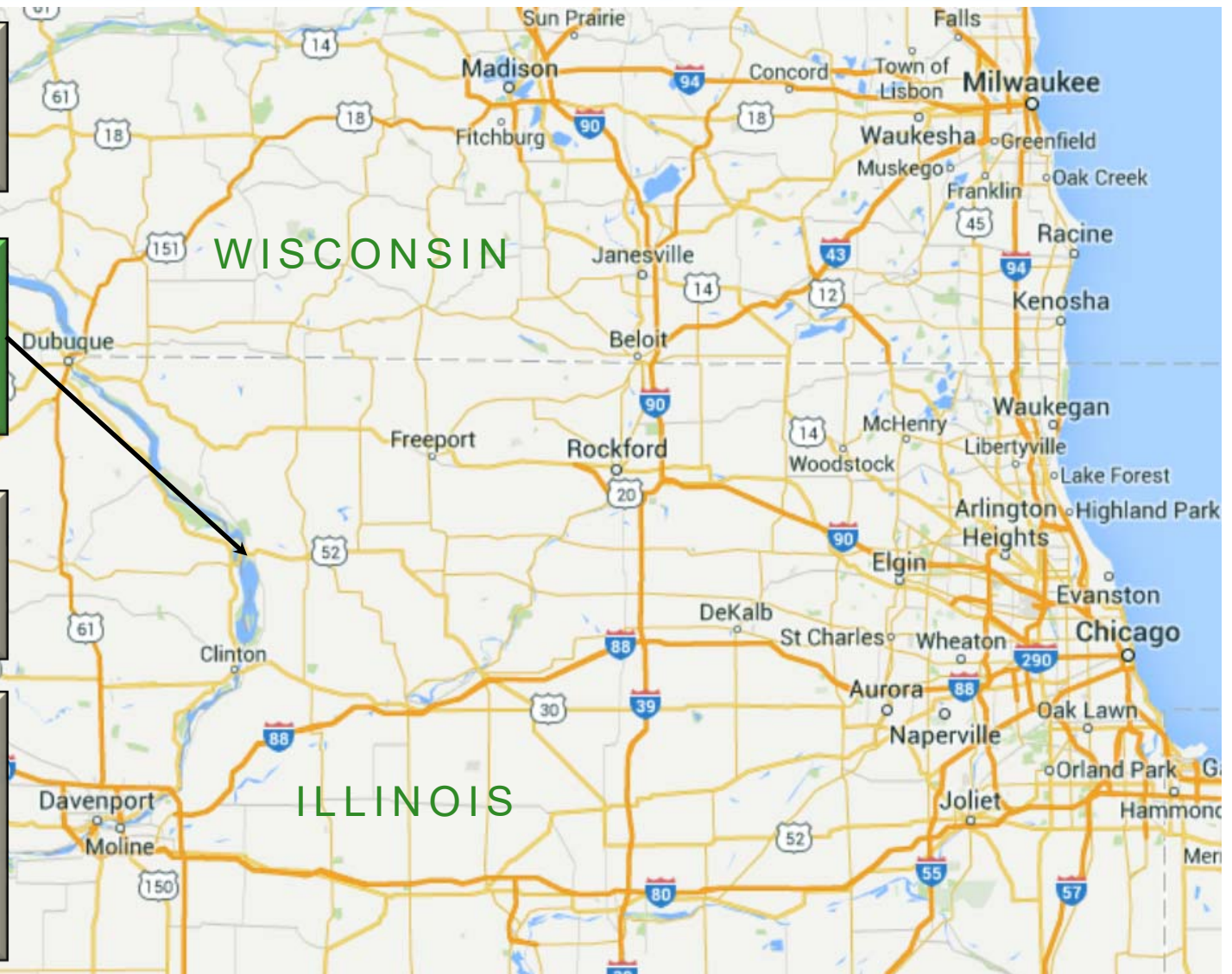
Average Daily Traffic (ADT) over the Mississippi

Dubuque, IA
US 20: 14,600
US 61: 20,700

Savanna, IL
US 52: 2,400

Fulton, IL & Clinton, IA
IL 136: 10,500
US 30: 12,600

Quad Cities
I-80: 37,200
I-74: 76,700
US 67: 30,300
I-280: 19,800



Vital Transportation Link

- Education, Emergency and Jobs
- Nearest alternate crossings
 - Clinton, IA to Fulton, IL – 20 miles south
 - Dubuque, IA to East Dubuque IL – 45 miles north

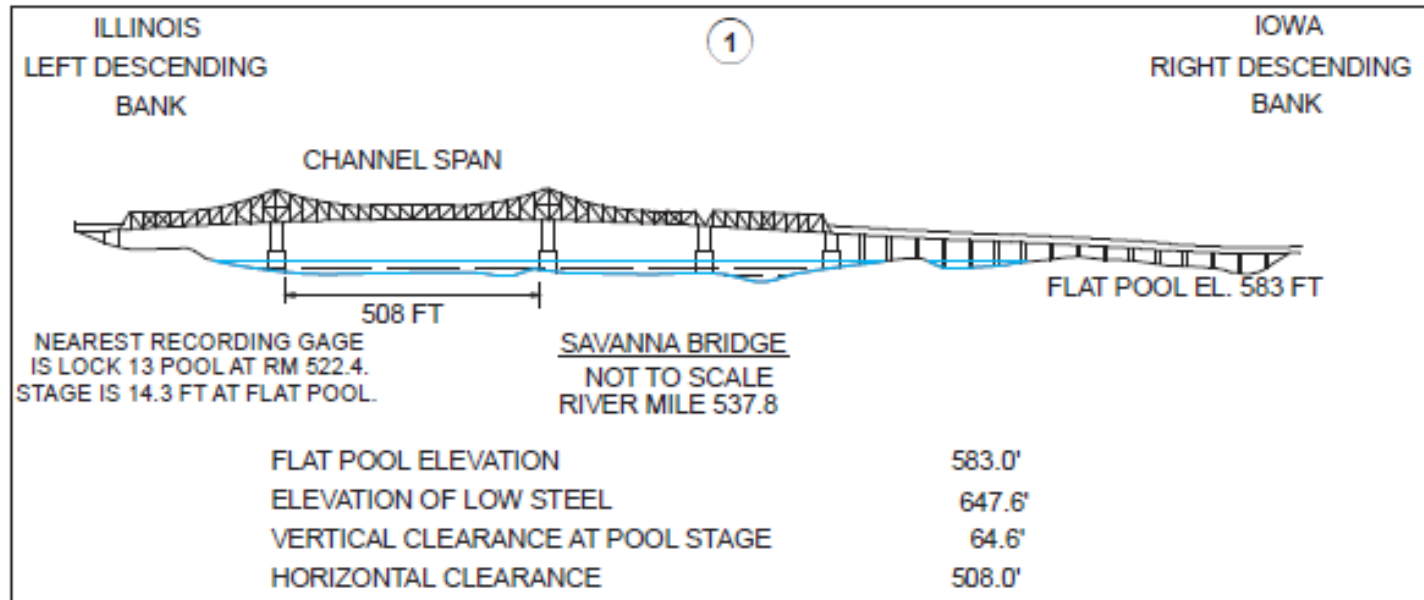


Constraints

- Iowa Causeway
 - Minimize Environmental Impacts
 - Minimize Causeway Construction
- Illinois Intersection
 - Between bluff and railroad
 - Minimal change to existing IL 84
 - Tie-in at highpoint
 - Limit ROW Impact
- Minimize grades to 4% if possible

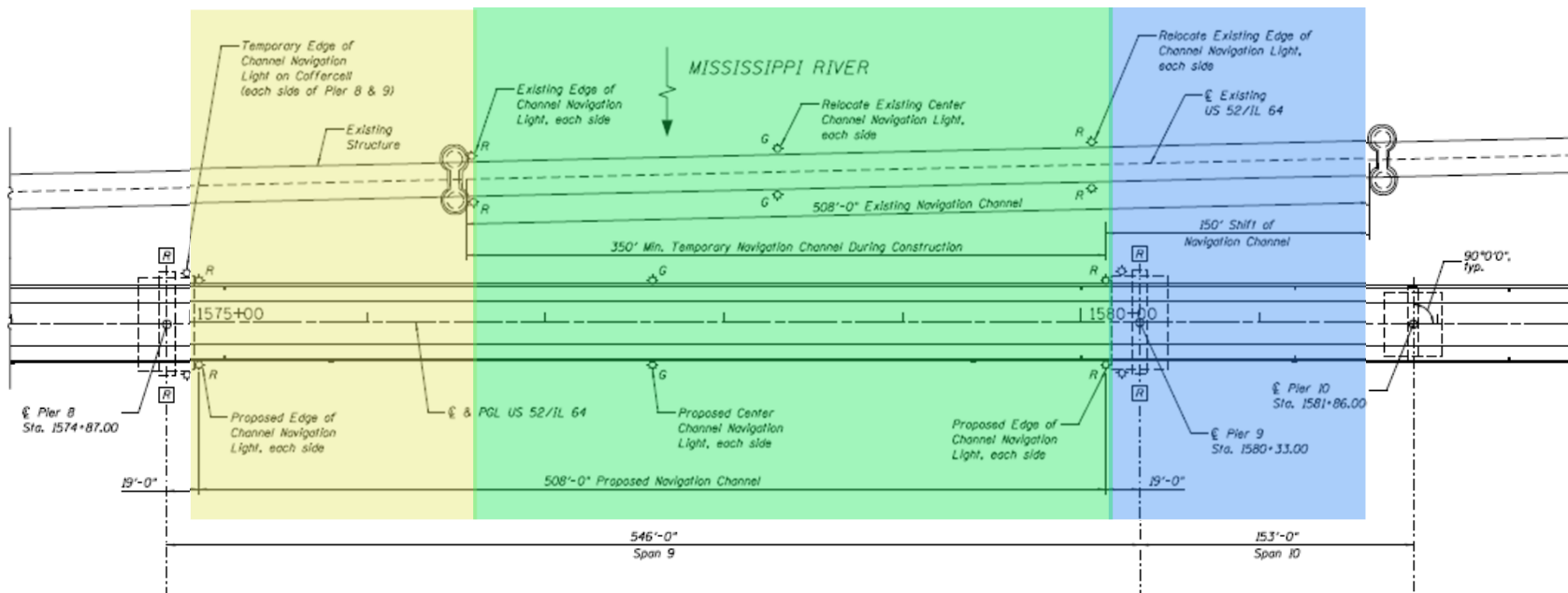


Navigation Clearance



- Maintain Existing Clearances
 - Channel near Illinois bank
 - Steep grade with existing tie-in (> 4%)
 - Minimal Superstructure Depth

Navigation Channel Shift



- Approach USCG with Channel Shift
 - Proposed 200 ft shift to west
 - Agreed to 150 ft shift to west
 - Maintain 350 ft channel during construction
 - 7.5 ft superstructure depth and 4% max grade

Bridge Type Study

- Evaluated 3 Types – Tied Arch, Cable-stayed, Plate Girder



Bridge Type Study Evaluation

Criteria

- Initial Cost
- Inspection & Maintenance
- Durability
- Constructability
- Structure Depth
- Aesthetics
- Environmental Impacts
- Geotech
- Hydraulics
- Future Widening

Results

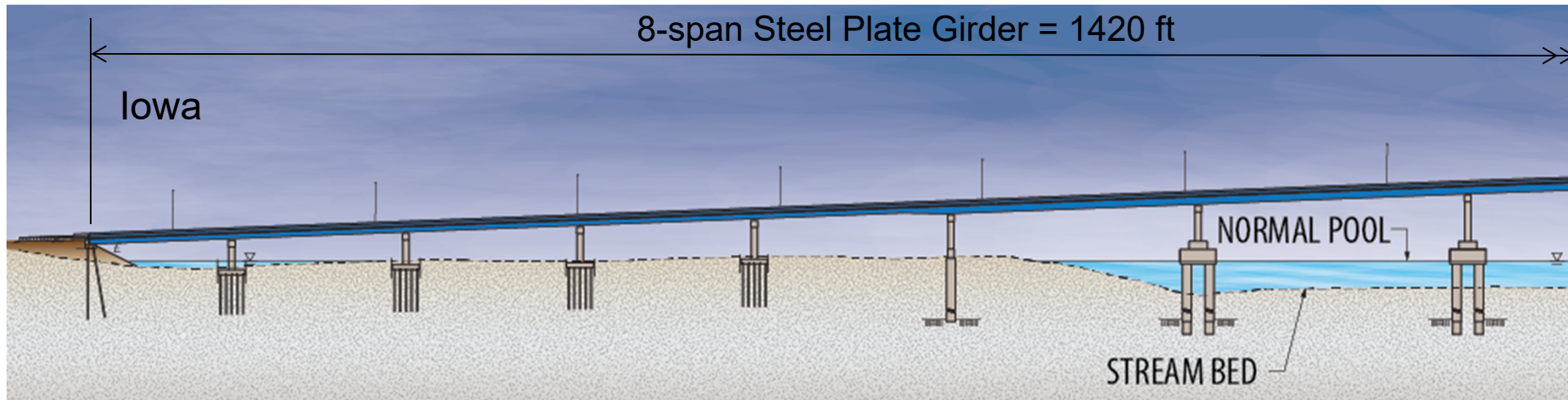
- Tied Arch
 - Float-in Erection
 - Replaceable Deck
- Cable-stayed
 - Not fracture critical
- Similar costs
- Selected Tied Arch
 - Less length of complex structure
 - IDOT familiarity

Preliminary Design Development

- Advance Structural Decisions before Final Design
 - Vessel Collision Study
 - Approved Design Criteria
 - Optimized Span Layout / Pier Locations
 - Foundation Type Study
- Tied Arch Concepts Advanced
 - Sections defined and sized (H, I, Box)
 - Floor beam sized and spacing optimized
 - Hanger arrangement and spacing
 - Floating deck concept advanced
 - Stringer fixities defined
- Final Design completed in 12 months to meet schedule

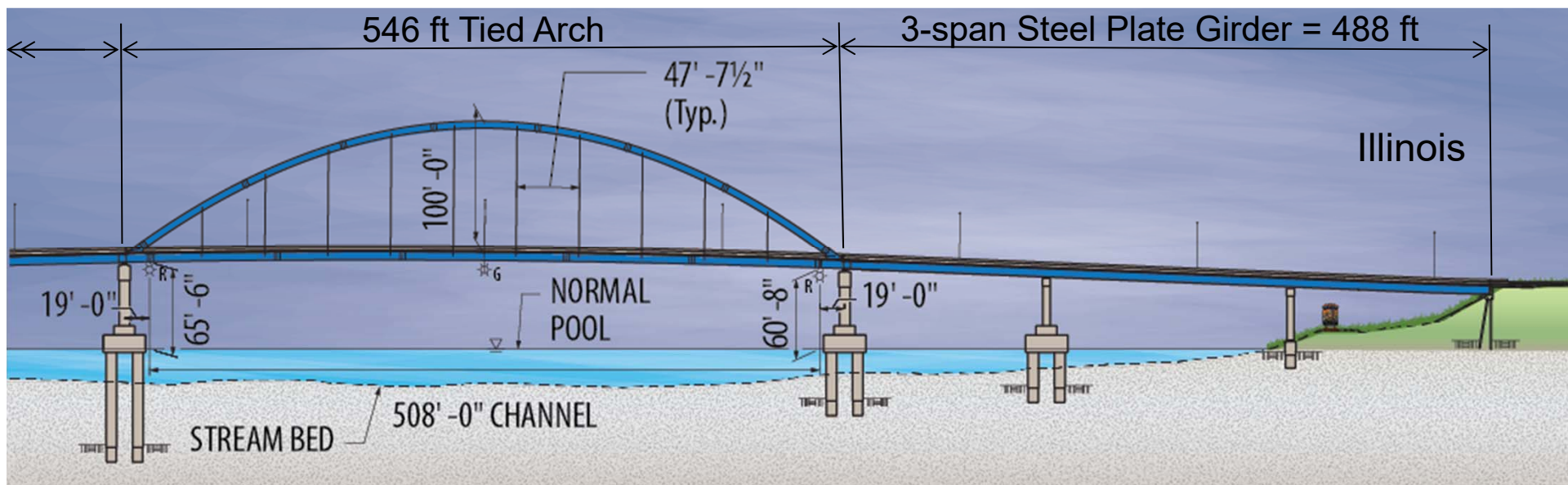
Proposed Structure

8-span Steel Plate Girder = 1420 ft



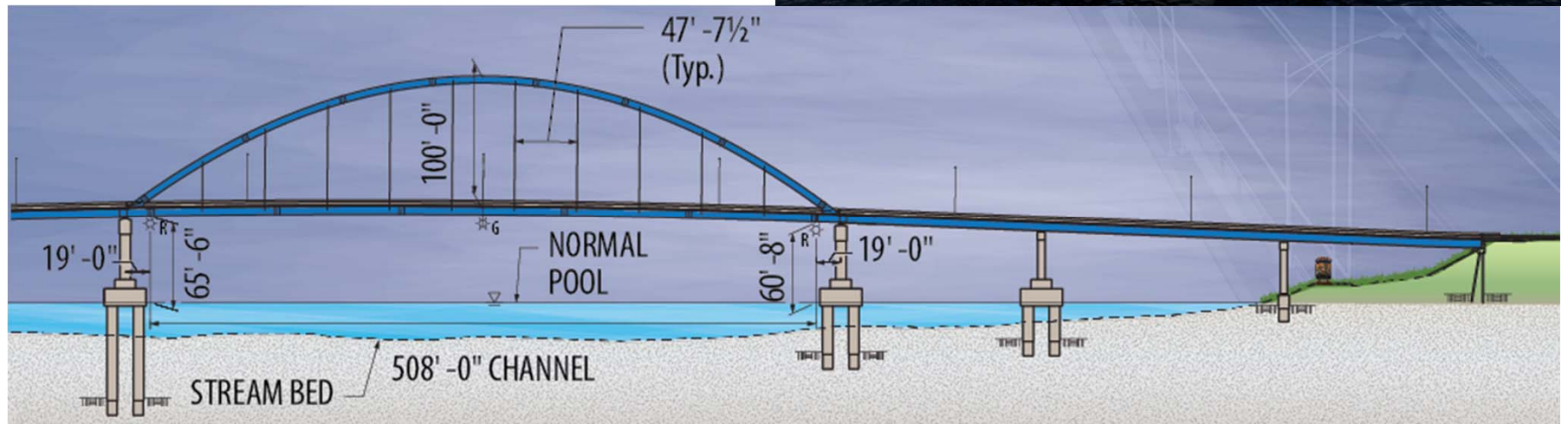
546 ft Tied Arch

3-span Steel Plate Girder = 488 ft

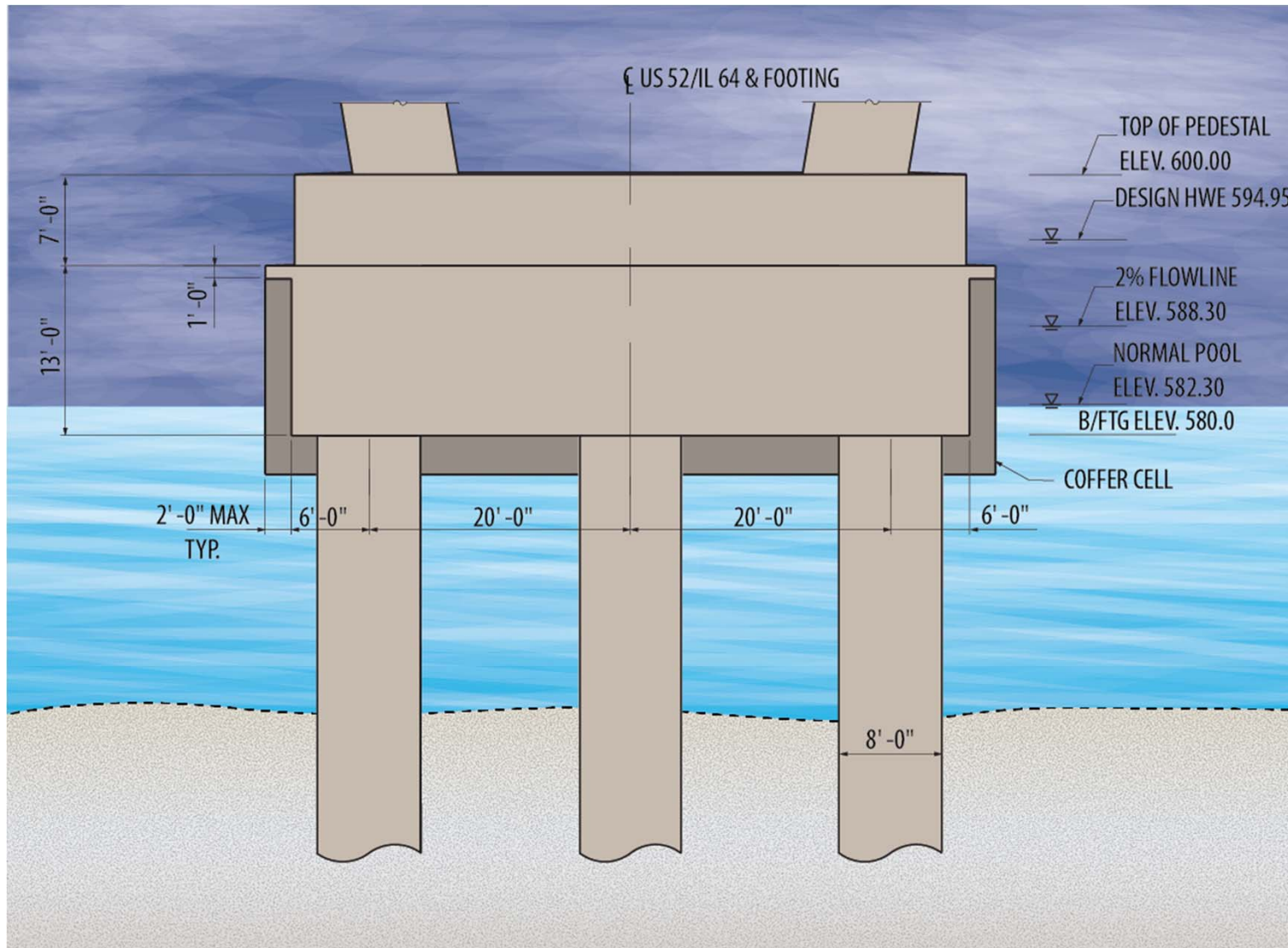


River Pier Foundations

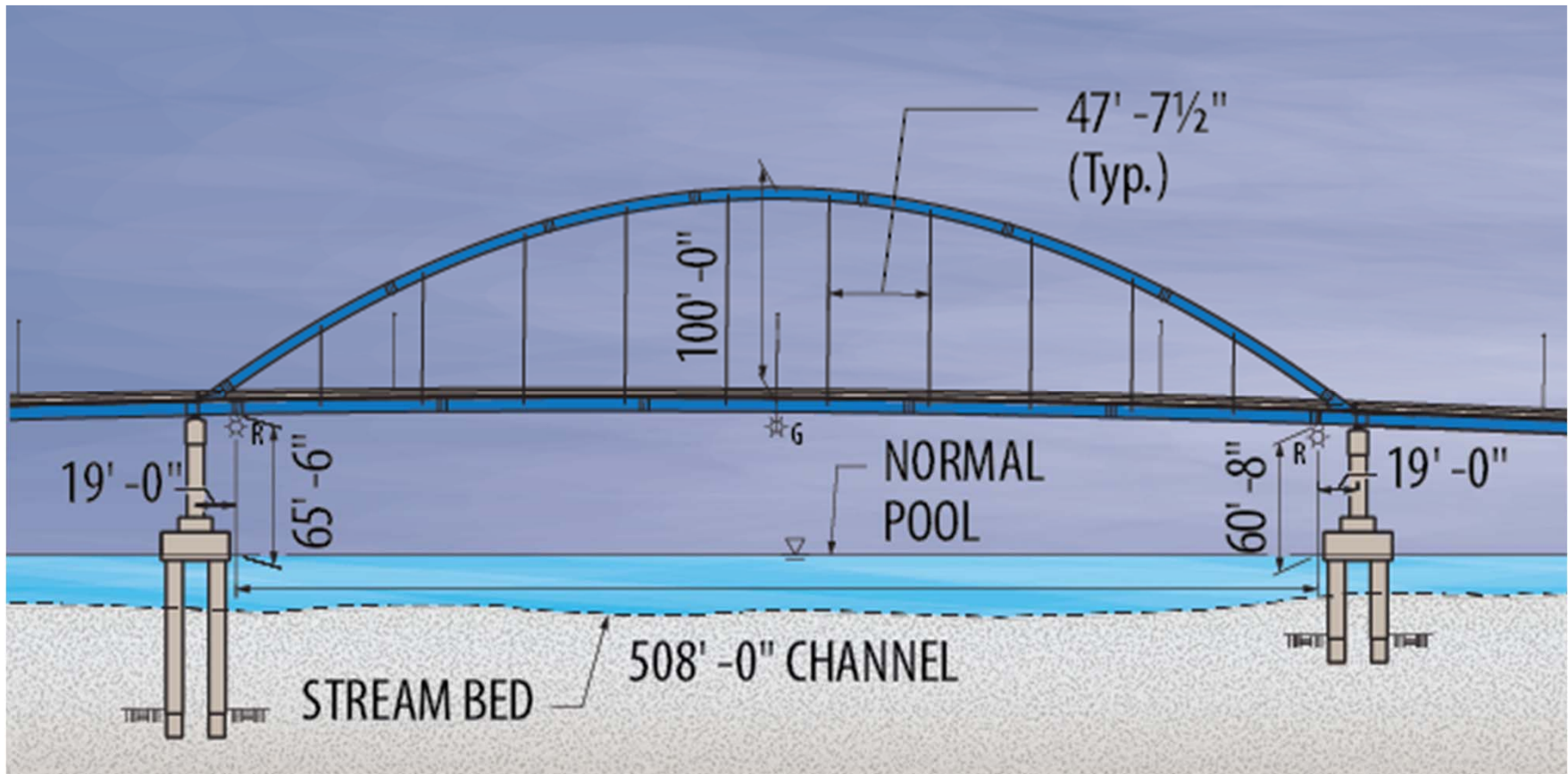
- Minimal cost aesthetic enhancement for arch piers
- Rock close to surface in IL
- 130 ft of sand + on IA side
- Deep river pool
- Waterline footings



Drilled Shaft with Coffercell

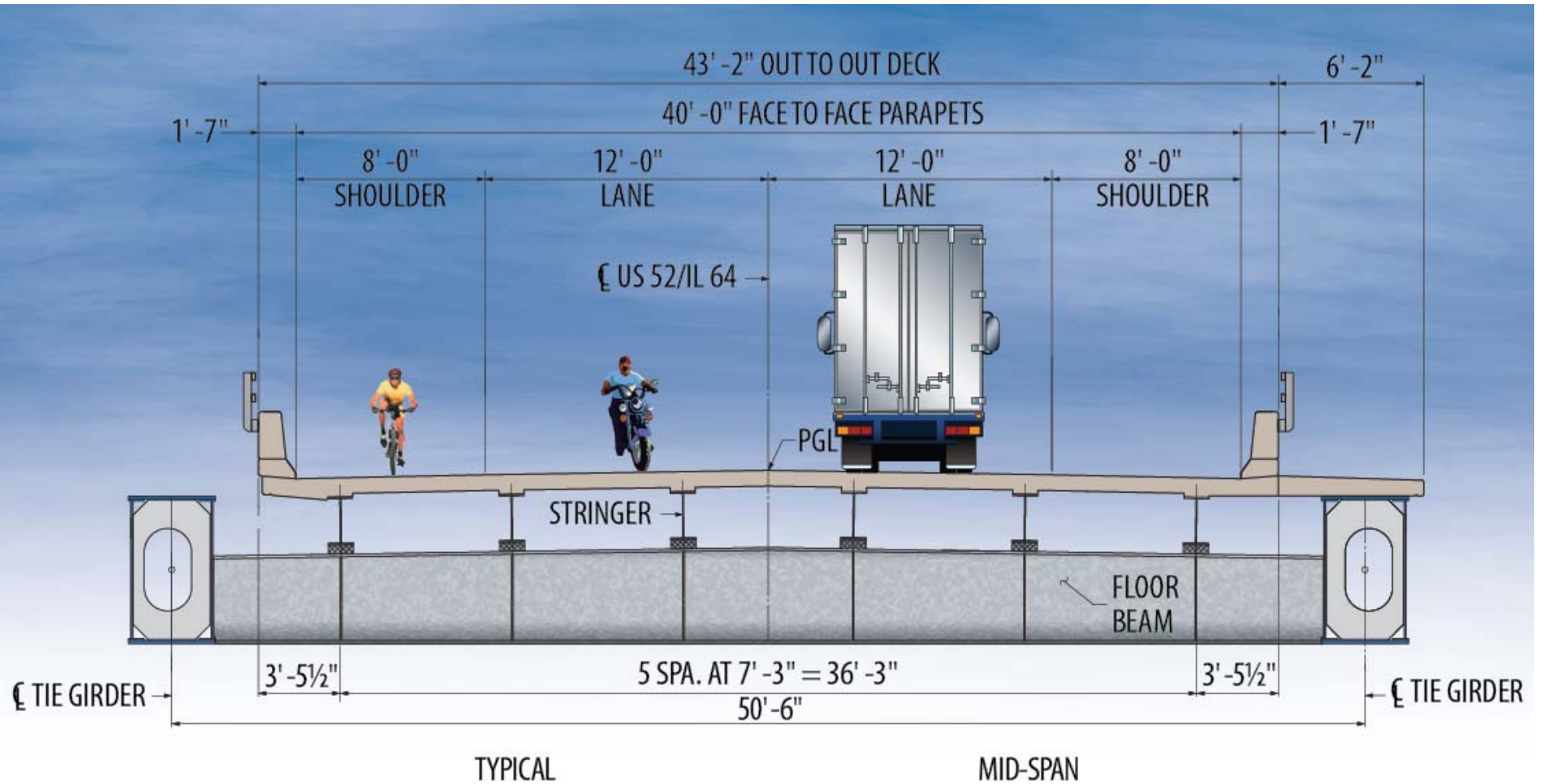


Tied Arch



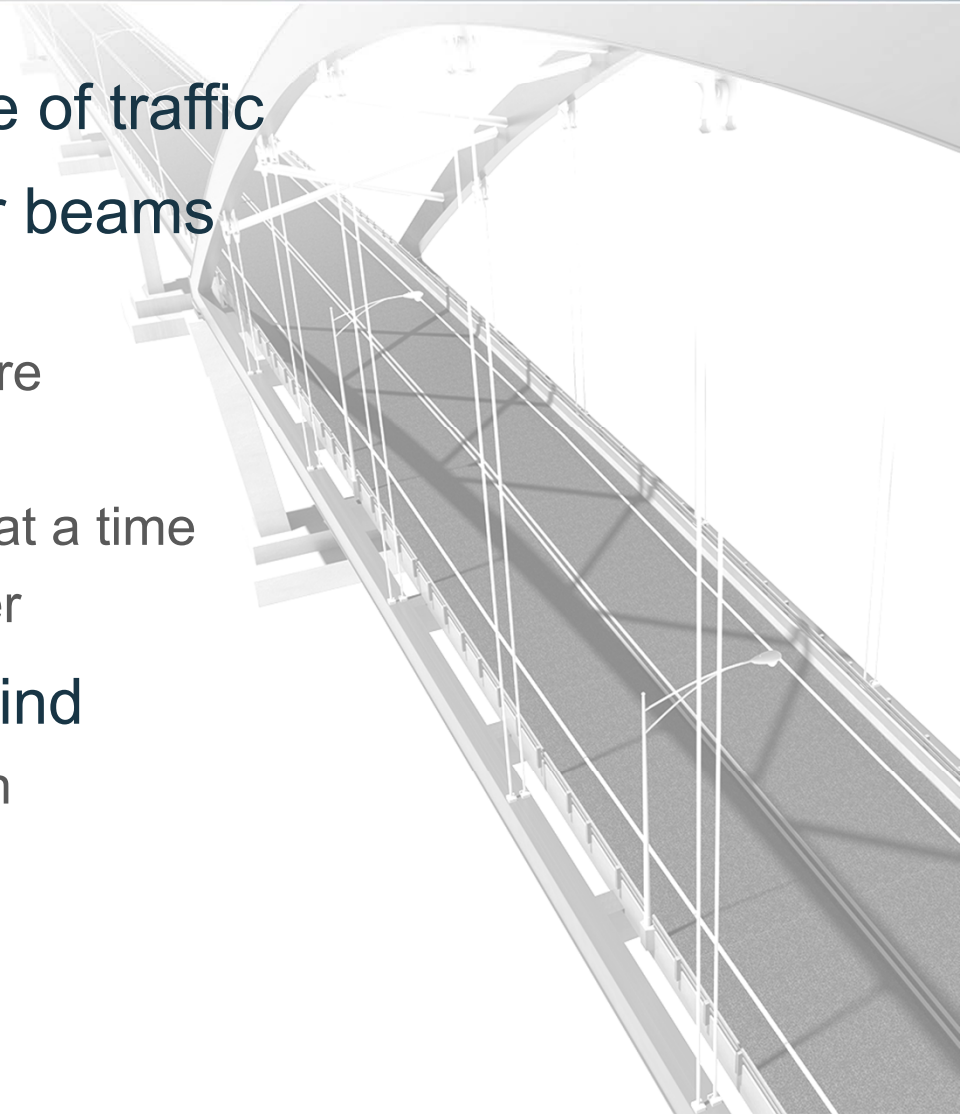
- 546 ft span, 100 ft rise, span to rise ~ 5.5:1
- Floor Beam Spacing – 31'-9"

Cross Section



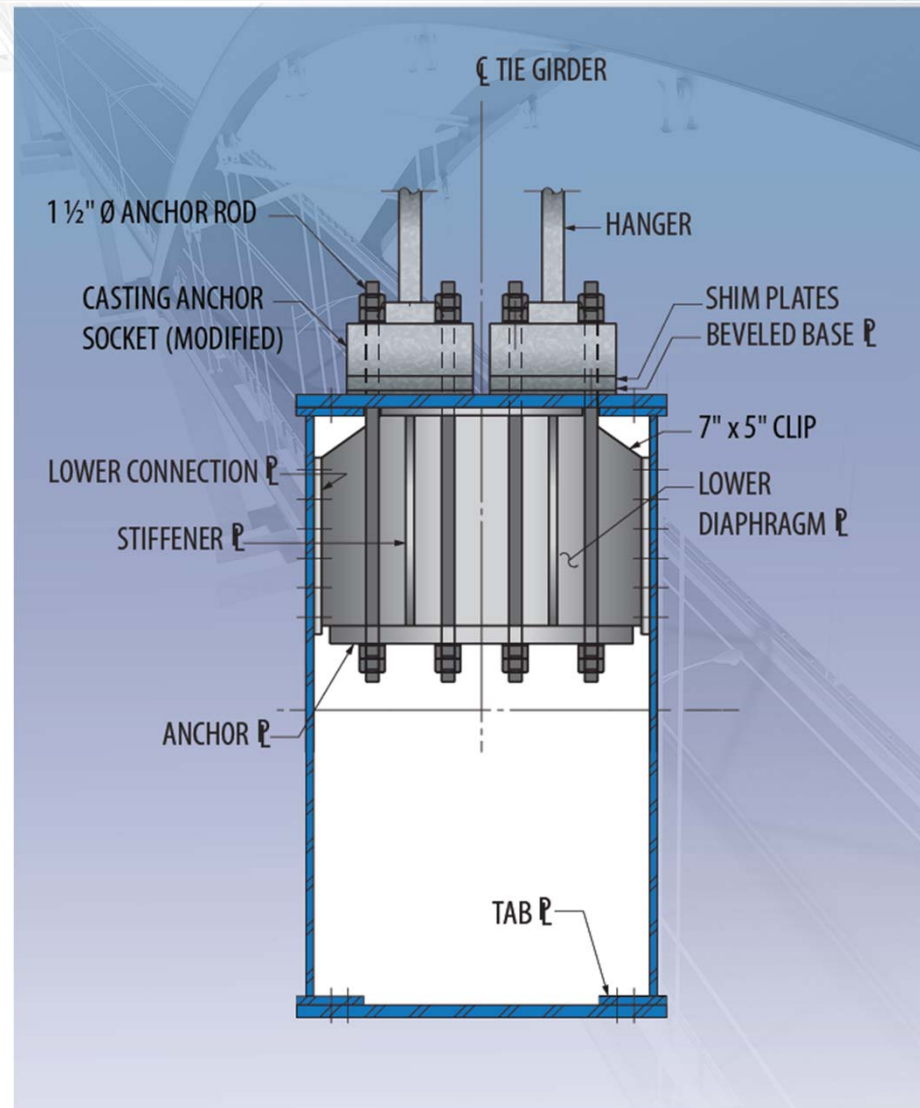
Floating Floor System

- Replaceable deck with 1 lane of traffic
- Stringers spanning over floor beams
 - Bearings at center span fixed
 - Elastomeric bearings elsewhere
 - Deck full length of span
 - Allows deck replacement half at a time
 - Deck connected to tie at center
- Lower lateral K bracing for wind
 - Braces floor beam at mid-span
- Galvanized floor system
 - Lengths under 60 ft
 - Corrosion protection



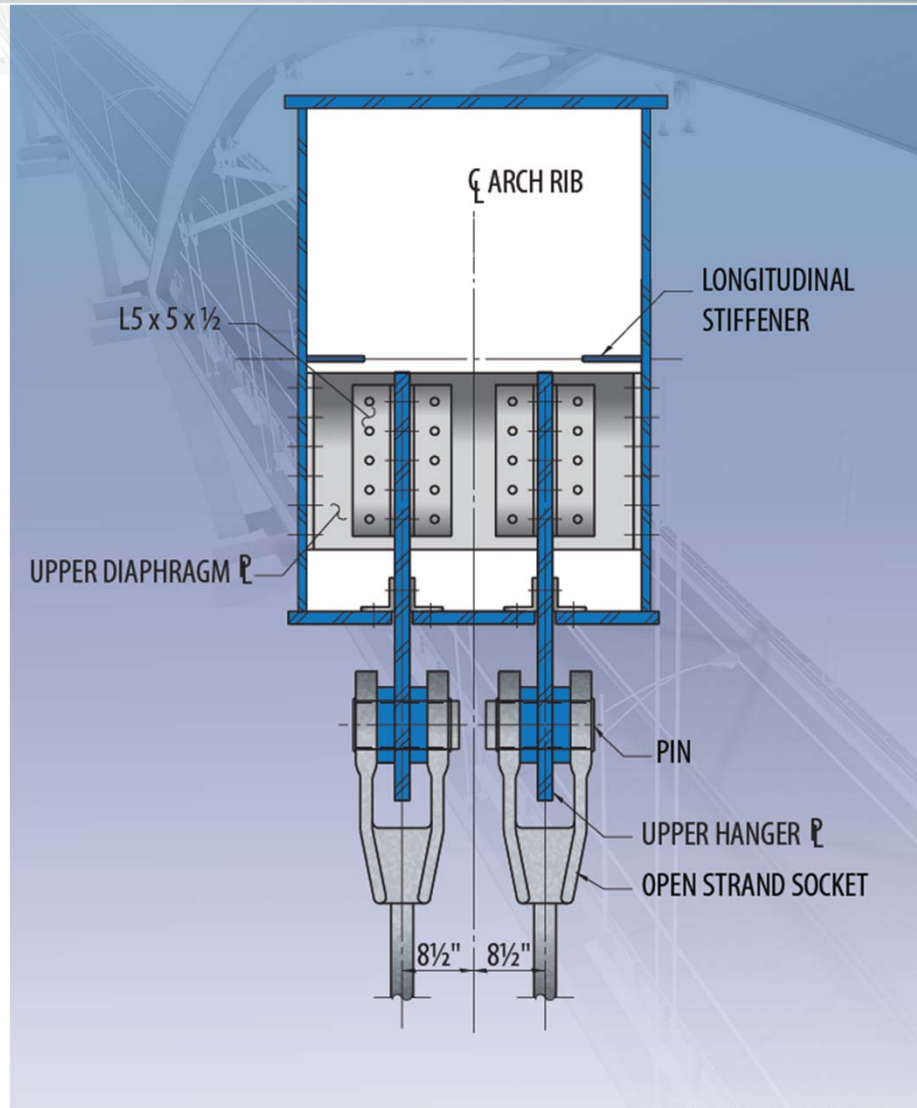
Tie Girder and Lower Hanger

- Bolted Box Tie full length
 - Tab plates
 - 6 ft deep
 - HPS50W
- Hanger connection offset from Floor beam
 - Simplifies detailing
- Connection precompressed
- 4 anchor rods provide redundancy
- Shim plates for length adjustment



Arch Rib and Upper Hanger

- Welded Box Rib
 - Longitudinal stiffener
 - 5 ft deep
- Hanger connection offset from bracing connection
 - Simplifies detailing
- Two hangers
 - minimize strand size
 - easier replacement
- Hanger connections bolted to rib



Upper Bracing

- X-bracing chosen
 - Smaller members than Vierendeel
 - Tension & Compression only
 - More modern look than K-bracing
- HSS 16x16
 - Efficient member section
 - Consistent box section
- Galvanized
 - Corrosion protection on inside of box
 - Distinct contrast with blue rib
 - Low maintenance / impact to traffic



Constructability Review

- **Provided IDOT a constructability review**
 - During preliminary design phase
- **Parsons Construction Group**
 - Experience in Large River Bridge Construction
 - Identified staging and access areas
 - Identified potential construction issues
- **Provided IDOT a contractor style estimate**
 - Preliminary and Final Design

Aerial View



Aerial View



May 2016– Retaining Wall along IL 84



June 2016 – Retaining Wall along IL 84



Retaining Wall along IL 84



Retaining Wall along IL 84



Substructure Construction



Substructure Construction



Drilled Shaft Construction



Wirth Drill on Pier 9



The Perils of River Work



The Perils of River Work



Pump Trucks on Barge

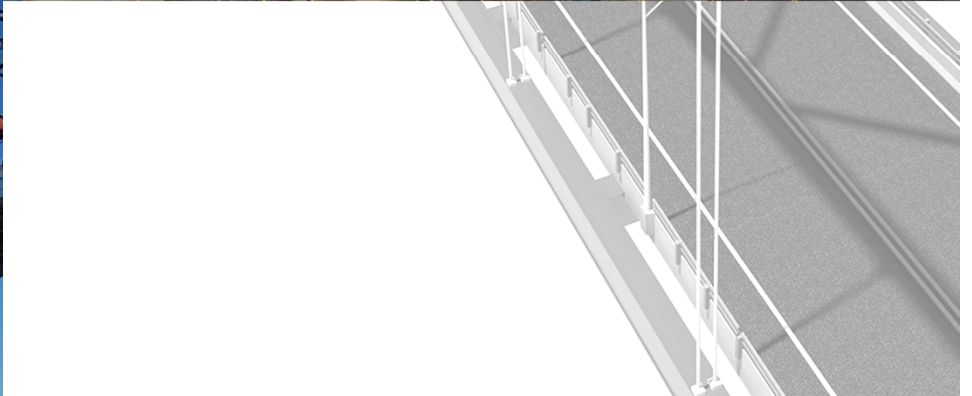
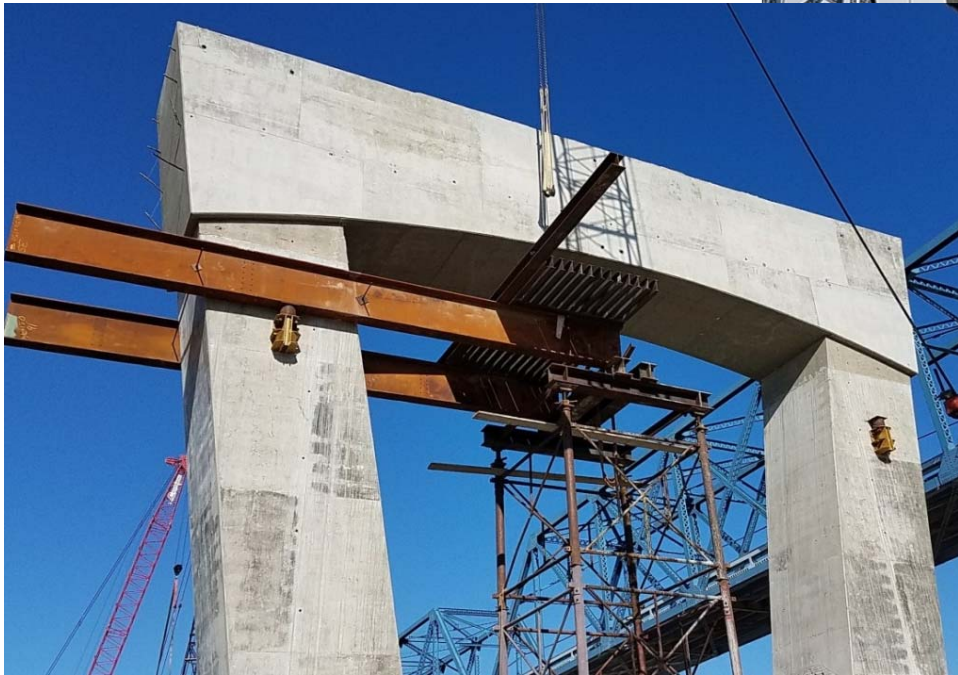


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Pier Coffercell Construction



River Pier Construction



Pier 5 – Pier 8 8,000 Cubic Yards of Concrete



Structural Steel Erection



Steel Plate Girder Erection



© Roger Husband

Steel Plate Girder Erection



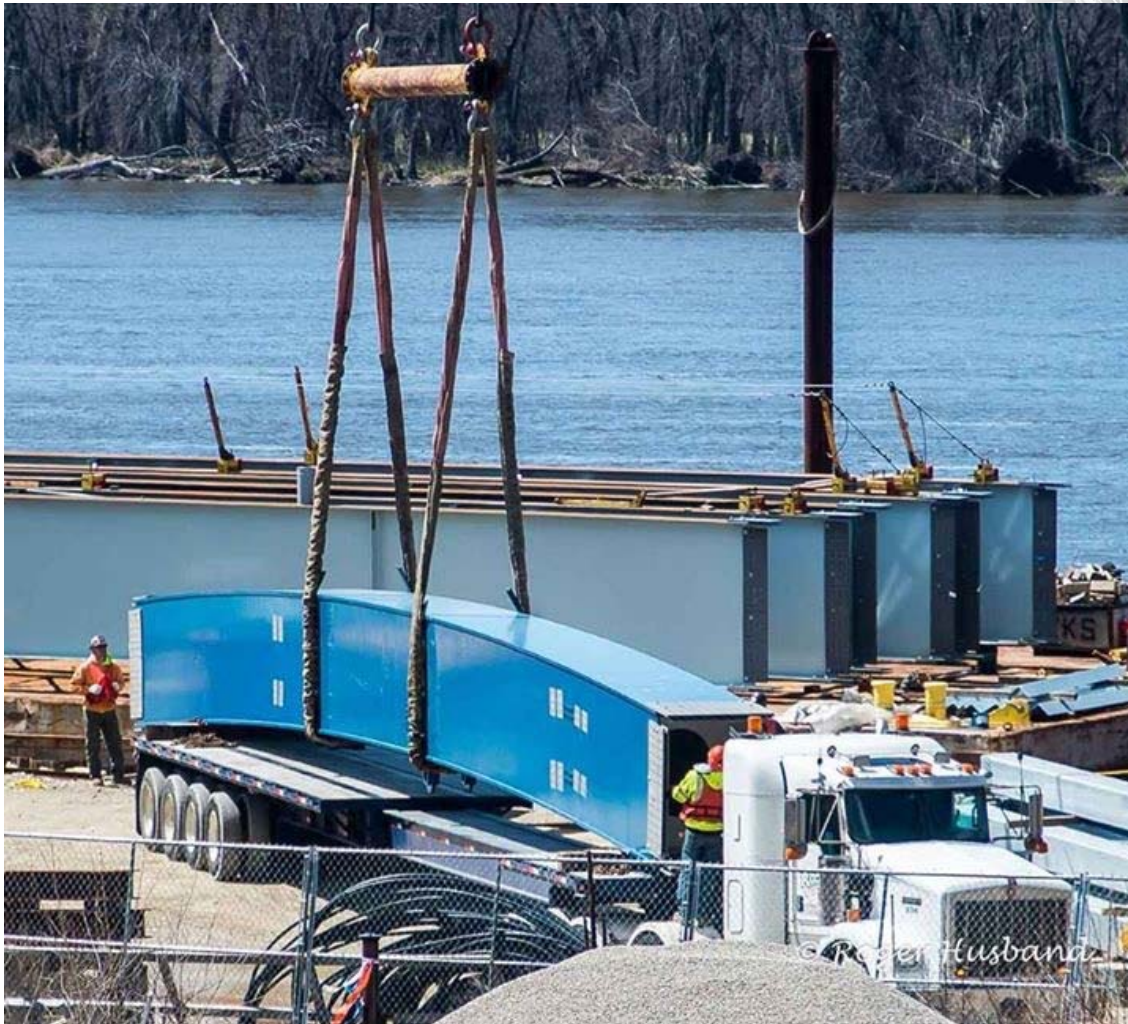
Steel Plate Girder Erection



Steel Plate Girder Erection



Steel Tied Arch Erection



ujmag

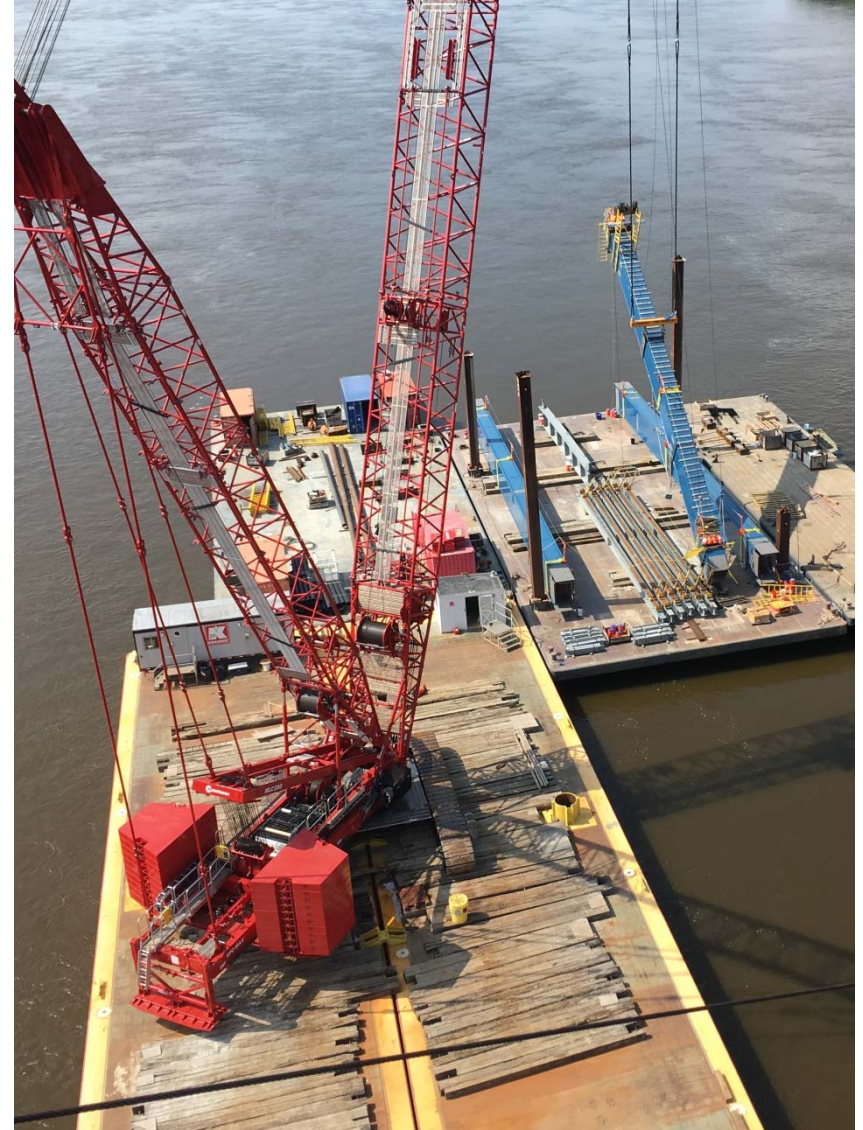
Manitowoc MLC 300



Boom Length = 295 feet
Counter Weight = 160 tons
Variable Position Counterweight
26 Truck Loads to Assemble
Tilting Cab
8 Onboard Cameras
Two Monitors

1° List Chart: 160,800 lbs at 115 ft Radius

MLC 300-VPC Max



The Right Crane For the Right Job



Steel Tied Arch Erection

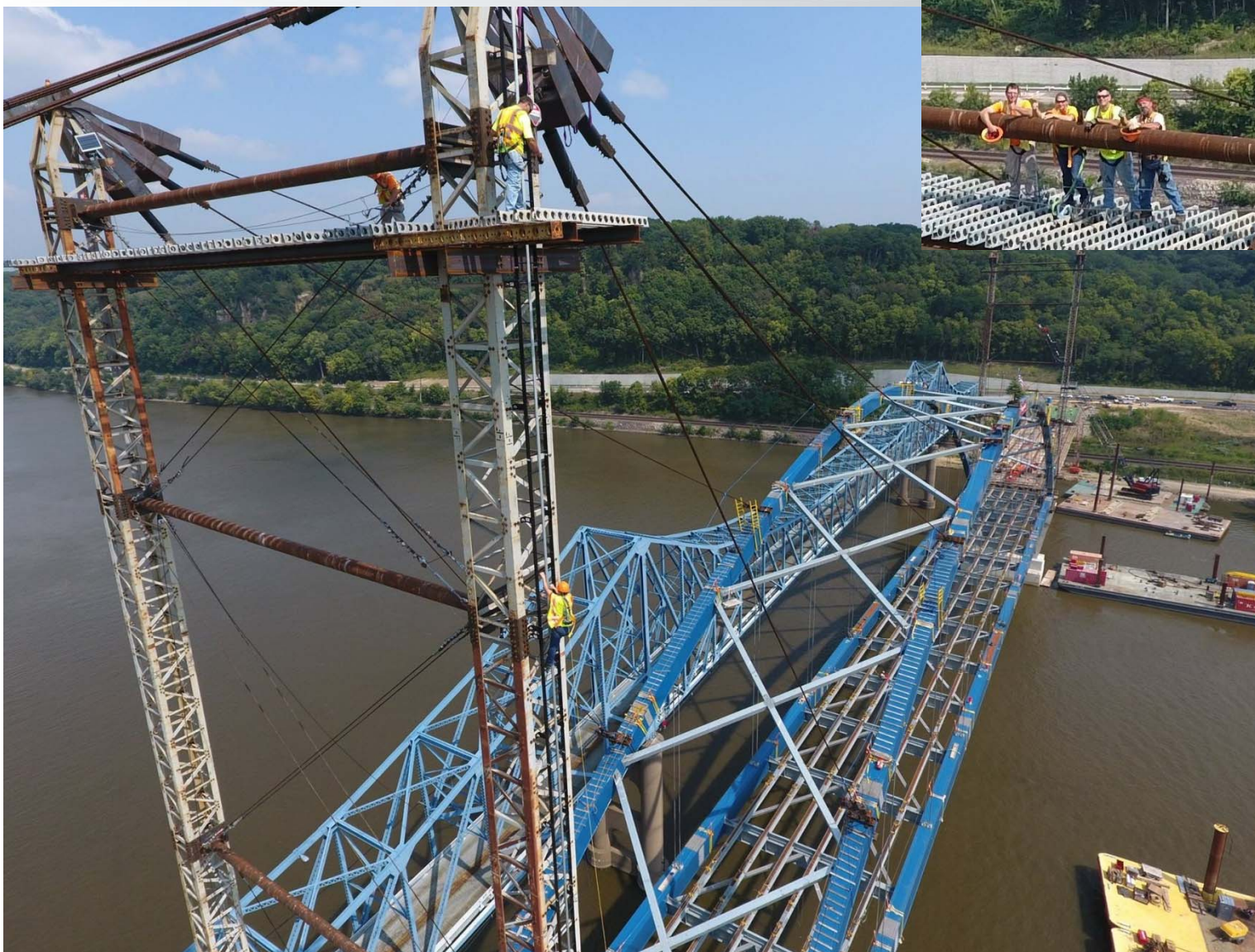


Arch Erection Falsework



US 52 / IL 64 OVER THE MISSISSIPPI RIVER

Arch Erection Falsework



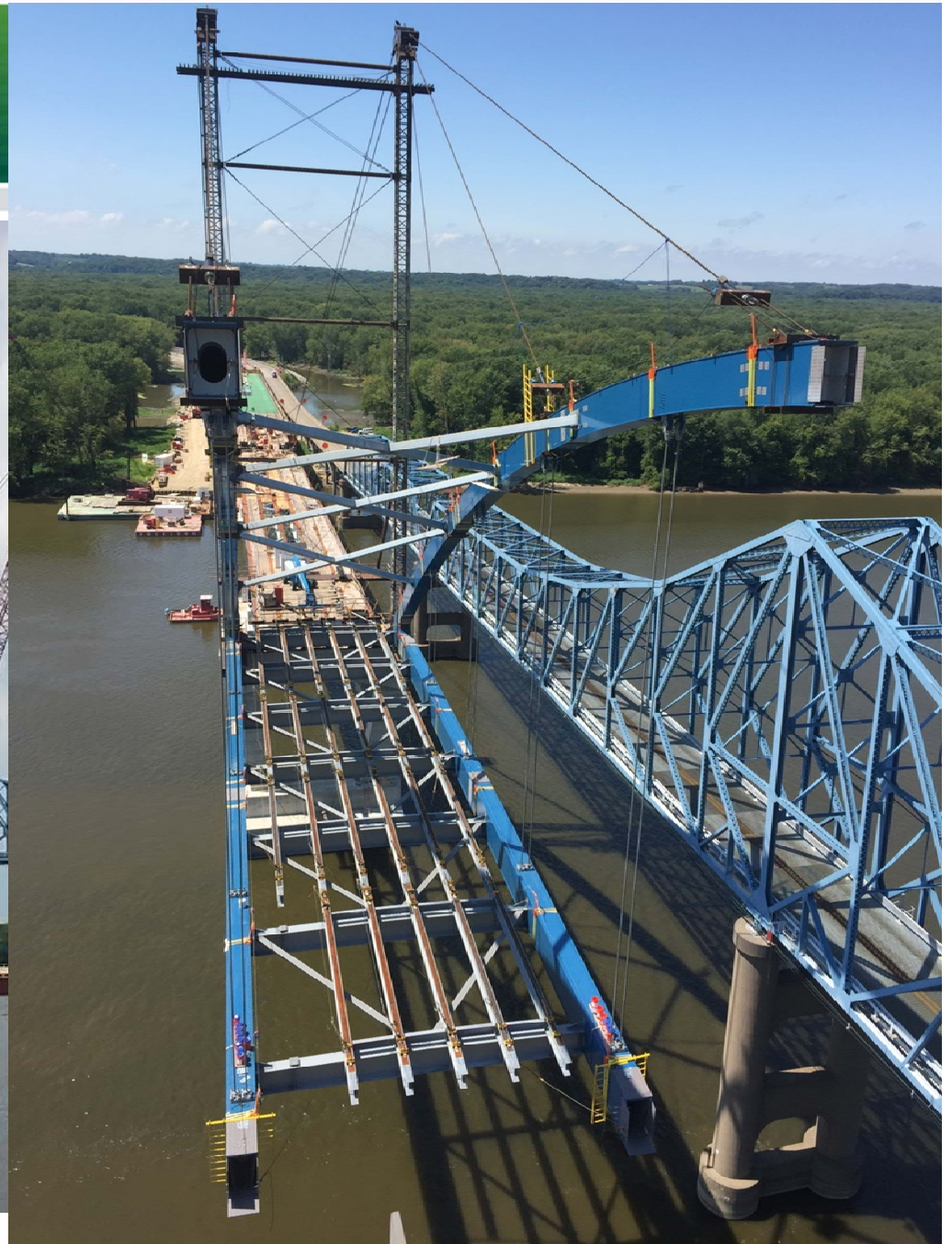
Steel Tied Arch Erection



Steel Tied Arch Erection



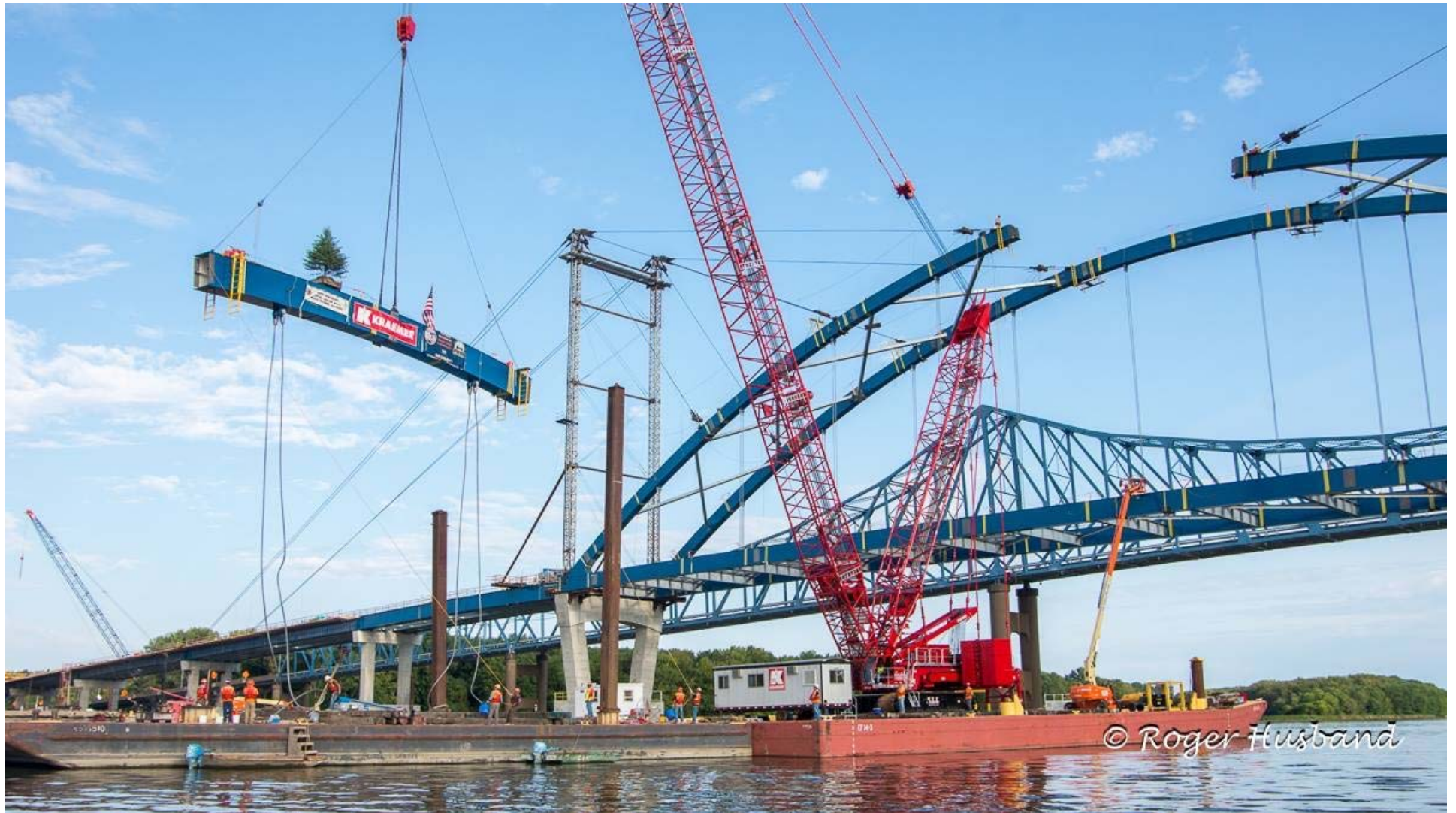
Steel Tied Arch Erection



Topping Out – August 2017



Topping Out



Topping Out



US 52 / IL 64 OVER THE MISSISSIPPI RIVER

Topping Out



Topping Out



Topping Out



Arch Erection Geometry Control

Contract No. 6463P
 State of Illinois Department of Transportation
 IAD Item 17
 (10/22/16.04)

Arch Erection Geometry Worksheet

DATE	TIME	WEATHER
01/17/2017	6:00:00 AM	Cloudy

ARCH (East/West)	Stage	Check (R/S)
East/West	Stage 9	

Temperature	79 °F
-------------	-------

WORK POINT	Plan		Surveyed		Variance (Surveyed - Plan)		Must Criteria? (within 1")					
	Station	Elevation	Station	Elevation	Station	Offset						
R1	North	1975+46.19	690.36	25.25	1975+46.11	690.31	25.40	-0.06	-0.05	0.10	Yes	Yes
	South	1975+46.19	690.36	-25.25	1975+46.16	690.30	-25.15	-0.03	-0.06	0.10	Yes	Yes
R2	North	1975+04.00	715.21	25.25	1975+03.93	715.20	25.52	-0.07	-0.03	0.27	Yes	Yes
	South	1975+04.00	715.21	-25.25	1975+03.96	715.23	-25.01	-0.04	-0.09	0.24	Yes	Yes
R3	North	1976+41.74	733.94	25.25	1976+41.72	733.86	25.52	-0.05	-0.10	0.20	Yes	Yes
	South	1976+41.74	733.94	-25.25	1976+41.74	733.85	-24.91	-0.04	-0.09	0.34	Yes	Yes
R4	North	1976+89.52	746.23	25.25	1976+89.47	746.13	25.56	-0.05	-0.10	0.31	Yes	Yes
	South	1976+89.52	746.23	-25.25	1976+89.52	746.10	-24.86	0.00	-0.05	0.39	Yes	Yes
R5	North											
	South											
R6	North											
	South											
R7	North	1979+32.45	744.90	25.25	1979+32.74	745.11	25.44	0.28	0.21	0.16		
	South	1979+32.45	744.90	-25.25	1979+32.74	745.13	-24.95	0.32	0.23	0.30		
R8	North	1978+79.98	731.74	25.25	1978+80.28	731.98	25.53	0.32	0.22	0.28		
	South	1978+79.98	731.74	-25.25	1978+80.21	731.99	-24.96	0.25	0.25	0.26		
R9	North	1979+27.40	712.24	25.25	1979+27.48	712.44	25.52	0.28	0.20	0.27		
	South	1979+27.40	712.24	-25.25	1979+27.60	712.41	-25.02	0.20	0.20	0.23		
R10	N											
R11	S											

Geometry Control

- Two (2) Leica GeoMas Total Stations (1")
- Magnetic Prisms
- Continuous survey monitoring
- Geometry Engineer - Yuhei



September 2017



Superstructure



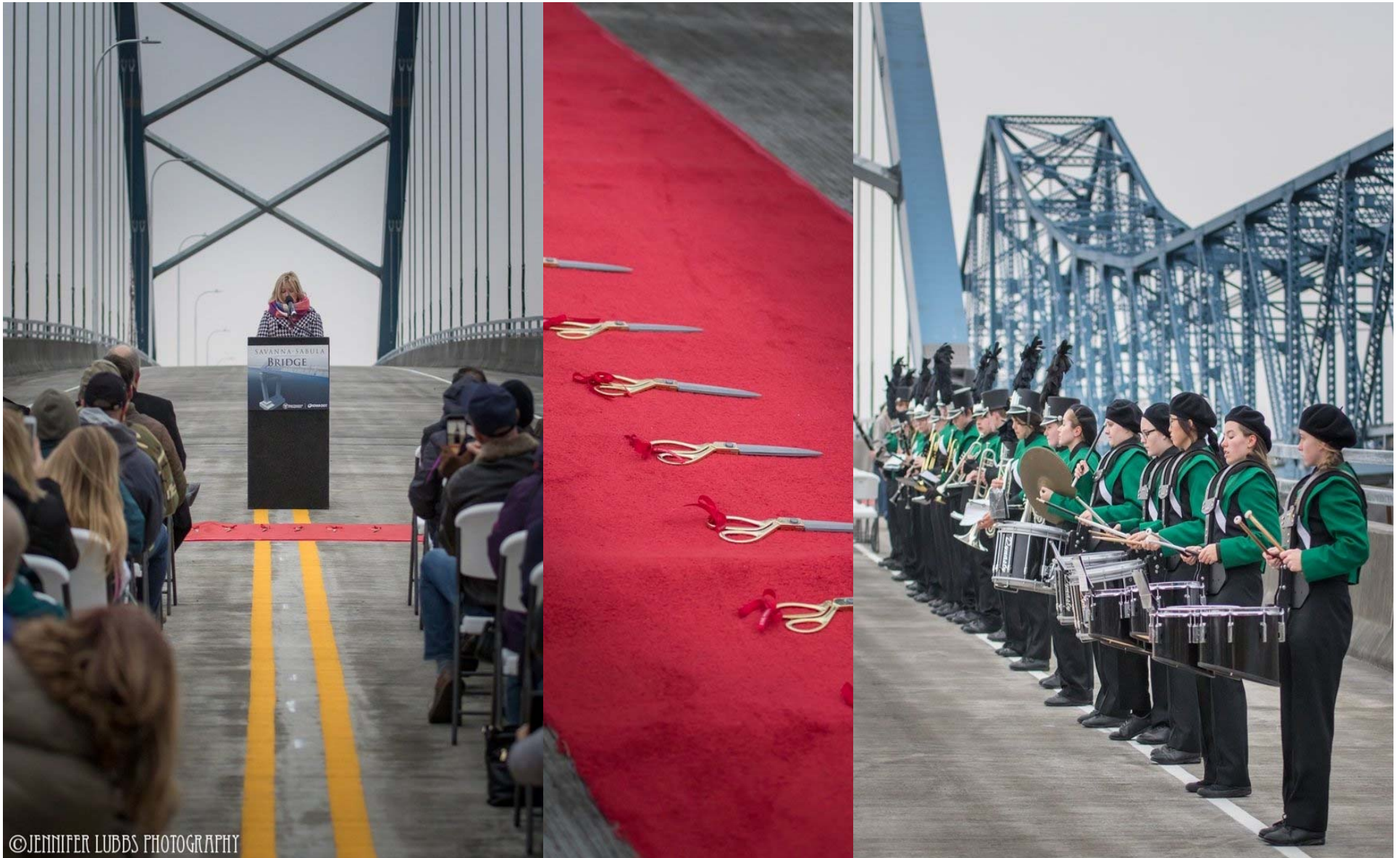
POUR SCHEDULE

6AM Fri 9/22	Unit 1 Phase 1 Parapet S.	85 yd ³
6AM Sat 9/23	Unit 1 Phase 1 Parapet N.	85 yd ³
7AM Mon 9/25	Unit 3 Pour 2	104 yd ³
Wed 9/27	Unit 1 Pour 5	440 yd ³
Fri 9/29	Unit 3 Pour 3	264 yd ³
Mon 10/2	Unit 1 Pour 6	424 yd ³
Wed 10/4	Unit 3 Pour 4+5	232 yd ³
Mid Oct.	Unit 2	

Race to the Finish



Ribbon Cutting – November 17, 2017



Ribbon Cutting

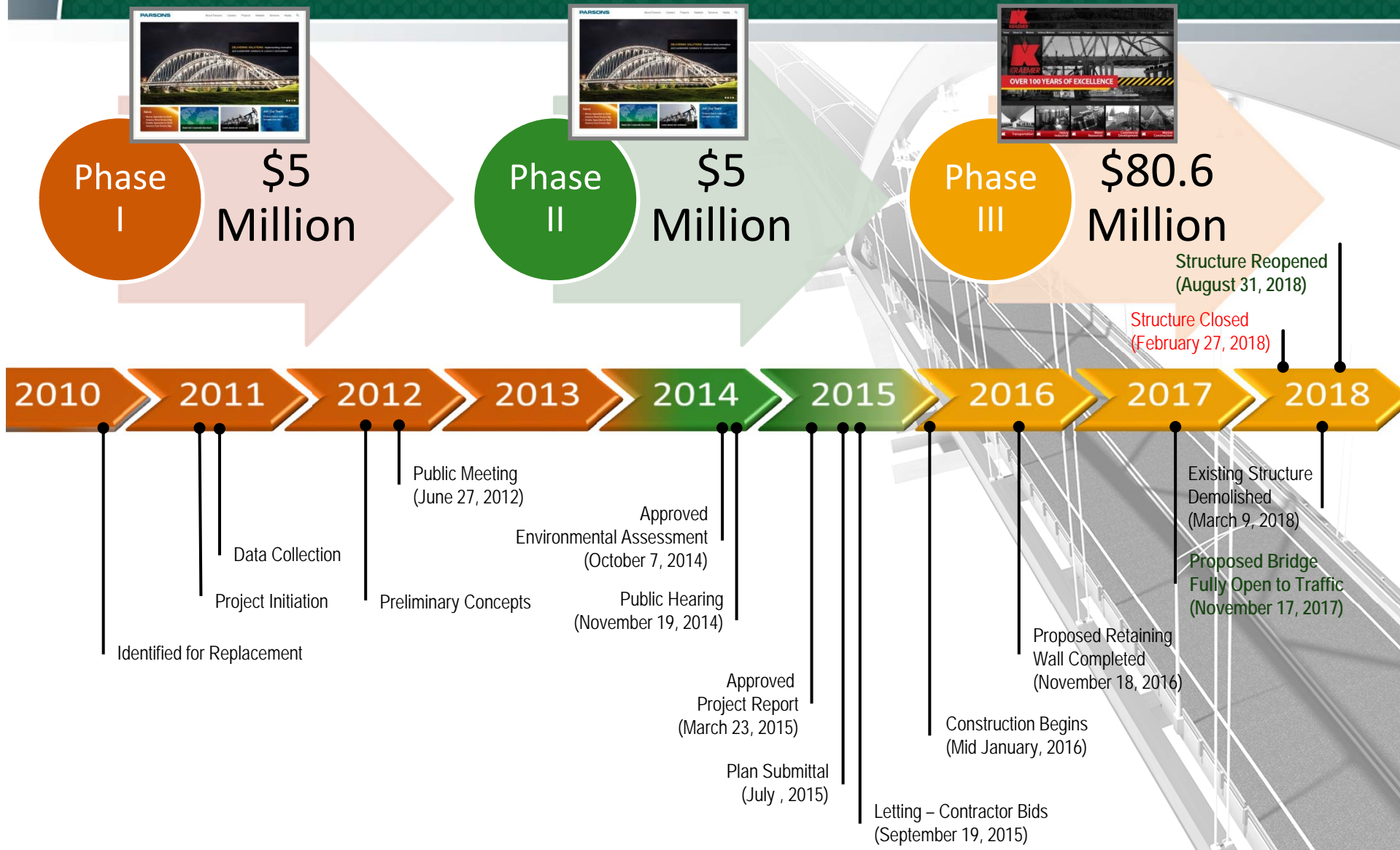


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Demolition – March 9, 2018



Cost & Schedule & Keys to Success



Questions?



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Thank You!



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