



**REHABILITATION
OF THE
BEN SAWYER BRIDGE**

“OUT WITH THE OLD IN WITH THE NEW”

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Existing Swing Span Bridge - Constructed in 1943

Swing Span

- Pratt Truss
- Center bearing type with balance wheels
- End & Center wedge supports
- Span- 247 Feet
- Width-34- c-c Trusses
- 2 Lanes of Traffic - 1'-6" safety walks
- Designed for H-20 Truck Loading as per 1941 AASHO
- Spans over ICWW 94' navigation channel
- Vertical clearance- 35'



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Approach Spans

- 12 spans (6 per side) in 3 span continuous units
- 2 Non-redundant riveted steel plate girders supports:
 - Floor beam/ stringer framing
 - 7" concrete deck
 - Concrete post and steel railing



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Substructure

- Reinforced concrete piers founded on timber piles
- Substructure is in good condition
- Existing concrete compression tests range from 5,300 to 10,060 psi



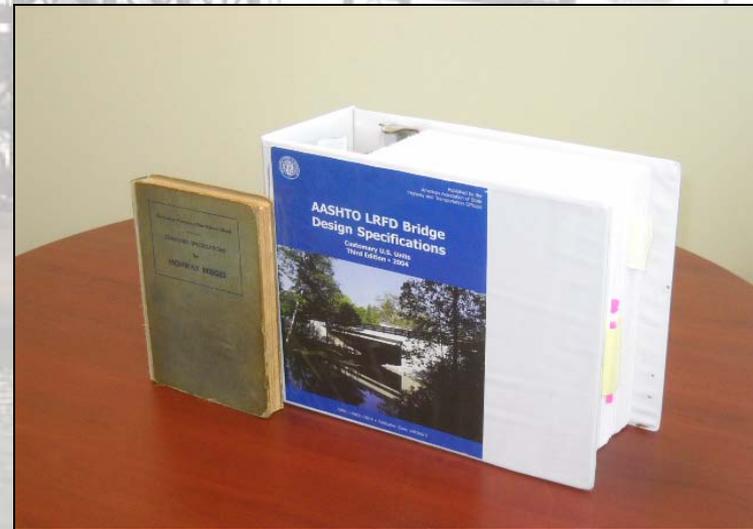
Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Design Criteria

- AASHTO LRFD Code & Including Seismic Criteria
- SCDOT Design Criteria & Memorandums
- RFP Technical Specifications

New Superstructure to Match Existing **EXCEPT:**

- Bridge Roadway Width increased - 26 feet to 28 feet
- Provide 5' 6" sidewalk on west side of Bridge
- Increase vehicular vertical clearance to 16 feet at Truss Portal
- Provide TL-3 capacity for identical bridge rail
- Provide seismic isolation bearings at approach span piers
- Provide Pivot bearing that resists seismic forces
- Maintain octagonal shape control house



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Goals of the Rehabilitation Project

- Maintain Similar Aesthetic Appearance
- New Structure to meet New Design Code including existing substructure
- Maintain Existing Profile
- Communicate with local citizens during construction
- Sensitive to the wetlands during construction
- Adhere to construction schedule
 - 540 Total Days (Including Design)
 - 10 Bridge Closure Days
 - (Required 11 due to adverse weather)
- Design/Build Contract Bid \$33.5 million



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Approach Spans

In kind replacement with following modifications

- Lightweight concrete deck (115 lb /ft³; $f'_c = 5,000$ psi)
- TL-3 design bridge rail vs unrated bridge rail
- 5' 6" sidewalk vs no sidewalk
- 2 – 14 foot lanes vs 2 -13 foot lanes
- A709 Gr 50 steel vs A7
- Welded steel plate girders vs riveted
- LFRD design code vs allowable stress design
- Replace rocker bearings with isolation bearings



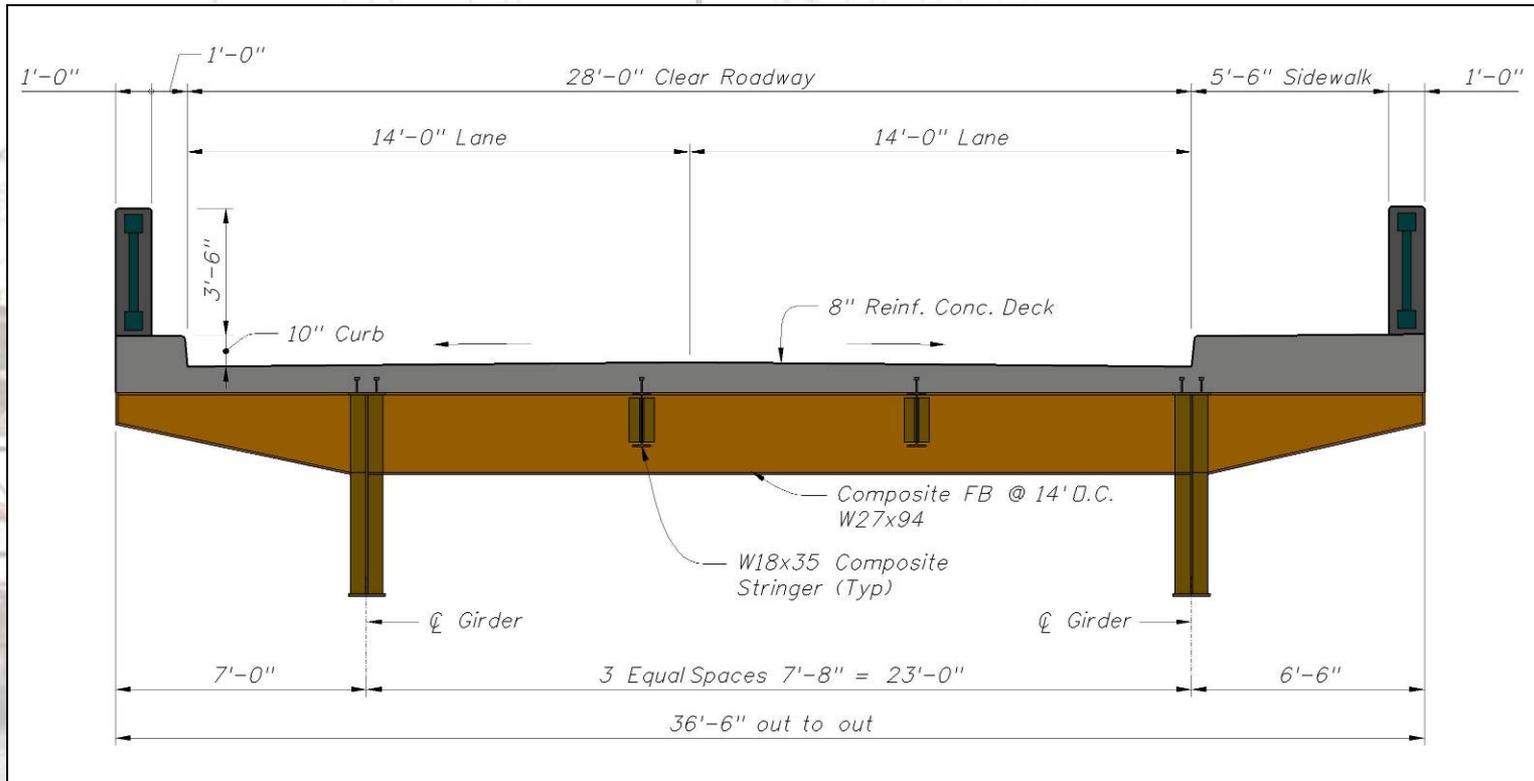
Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Substructure Analysis

- Substructure Service Load Analysis
 - Check to determine if existing foundations meets LRFD Code with heavier dead load (increase (15%))
 - Individual Pile Analysis required using original boring logs and pile driving data
- Seismic Analysis
 - SAP 2000 software
 - Response spectron analysis
 - Time history analysis
 - For 500 year return period event
 - Isolation bearings installed on new approach span superstructure
 - Pivot bearing designed for seismic load
- Results - Seismic Capacity/Demand
 - Range 1.04 (Rest Pier)
1.47 (End Bents)
1.18 – 1.42 (Intermediate Piers)
- Results – Non-Seismic LRFD Analysis
 - Resistance Factor Range
 - [0.26 – 0.36 (Piers)]
 - [0.41 – 0.44 (Abutments)]
 - AASHTO LRFD Requires 0.4 Resistance Factor or 2.5 Factor of Safety

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Approach Spans



Typical Section

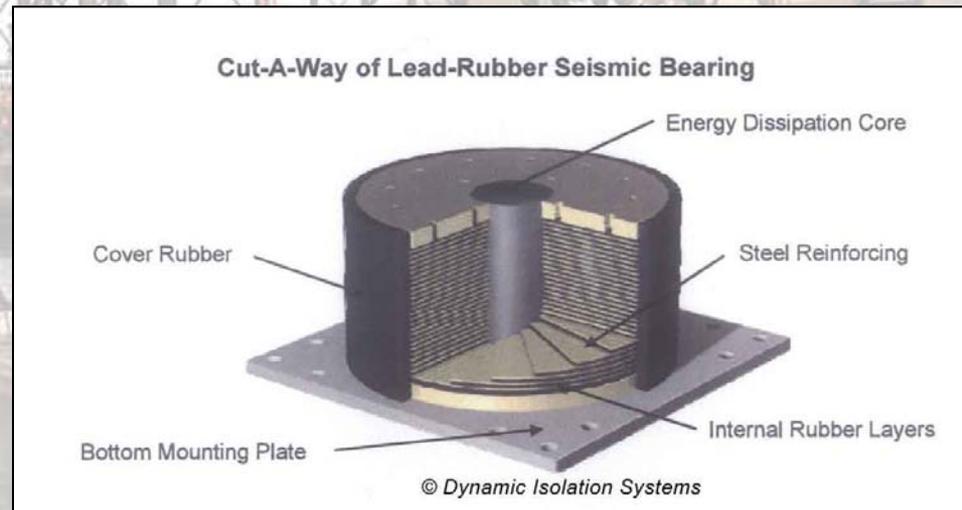
Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Approach Spans



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Approach Spans



Isolation Bearing

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Approach Spans



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Swing Span

In kind replacement with following modifications

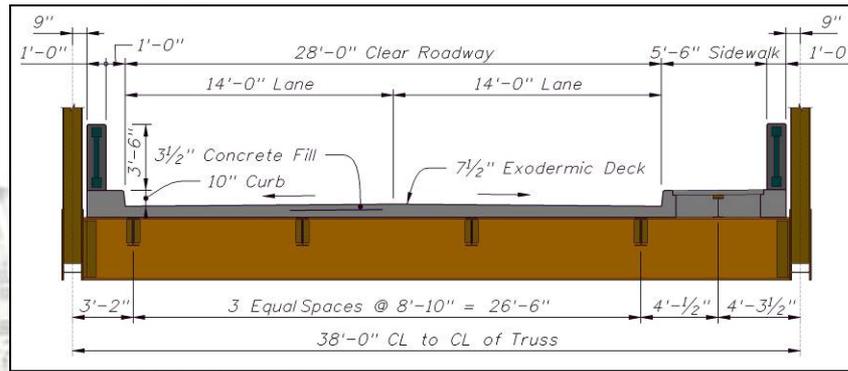
- Rolled truss members in lieu of built up lattice members
- Exodermic lightweight concrete deck vs concrete filled grating
- TL-3 bridge rail vs unrated bridge rail
- 5' 6" sidewalk vs no sidewalk
- 2 – 14 foot lanes vs 2 -13 foot lanes
- A709 Gr 50 steel vs A7 (Fy=36 ksi)
- LFRD design code vs allowable stress design
- Bolted connections in lieu of riveted



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Swing Span

Typical Section



Steel Posts & Railing

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW



Truss in Lay Down at FSS Shop

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Swing Span



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Swing Span



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Control House

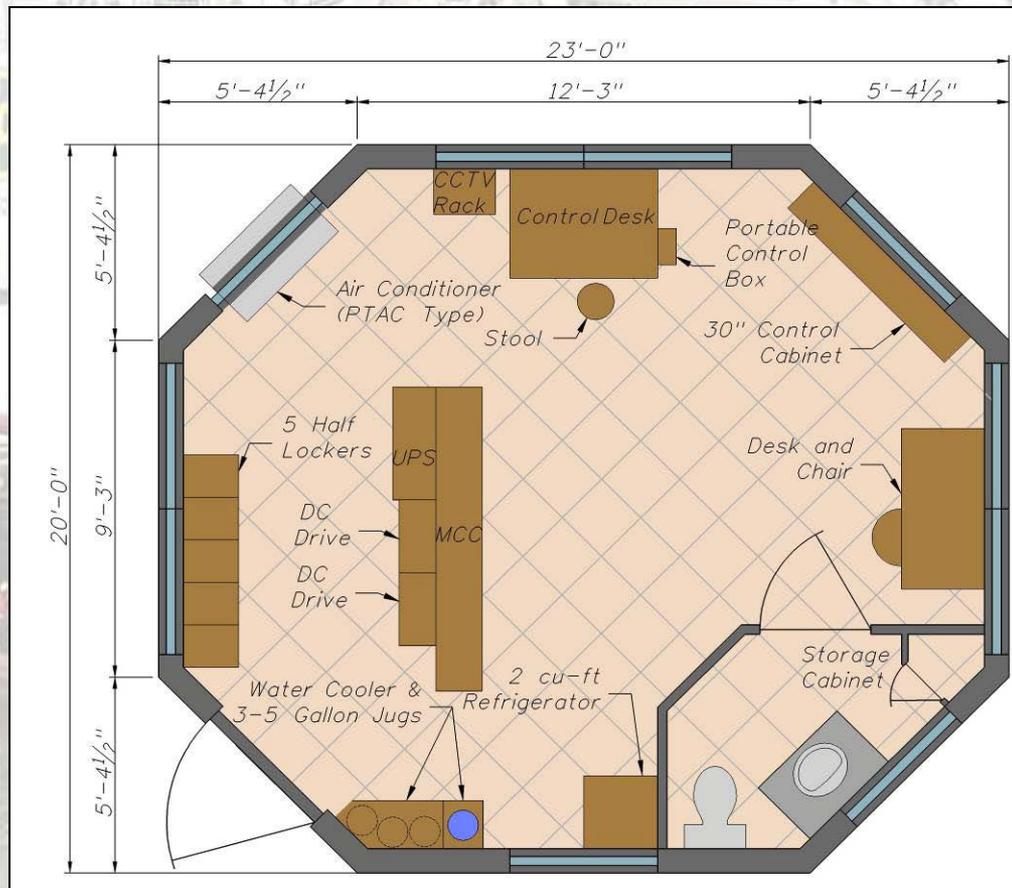
- Match appearance of existing octagonal shaped house
- House enlarged for improved view corridors, electrical equipment, bathroom



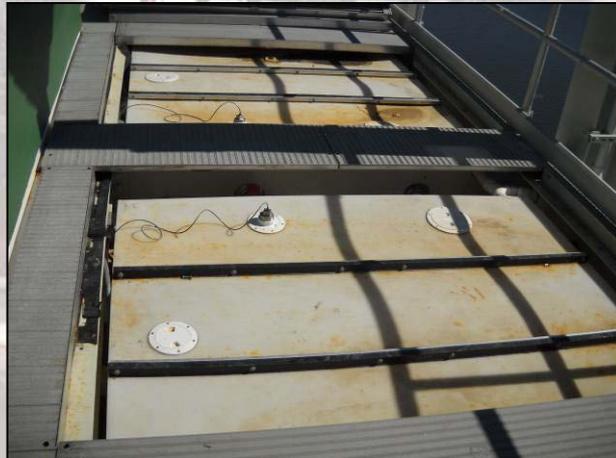
Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Control House

- Floor Plan layout allowed views from all windows from the control desk
- Bathroom provides working plumbing system



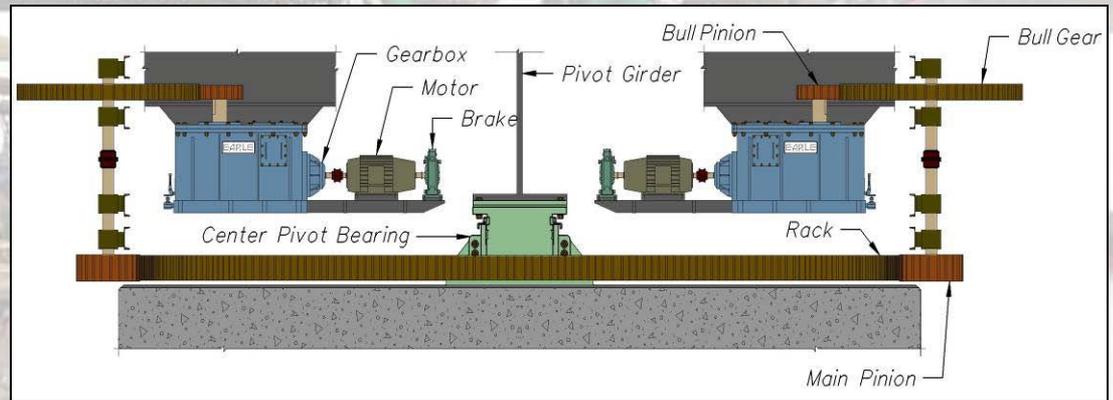
Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Control House



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Mechanical Systems

- Span drive machinery
 - 2 independent motors drive span mounted pinion
 - 1 motor capable of operating swing span
 - manual drive available w/ capstan through deck
 - disk brakes provided for motor and machinery



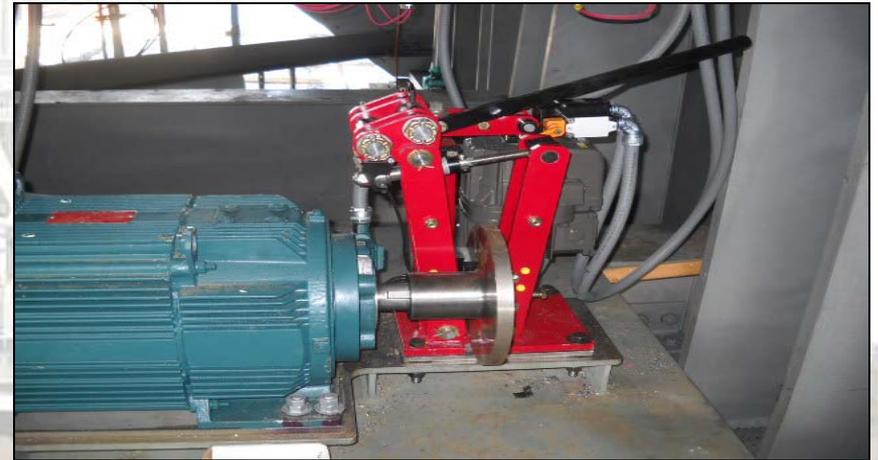
Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Span Drive Machinery



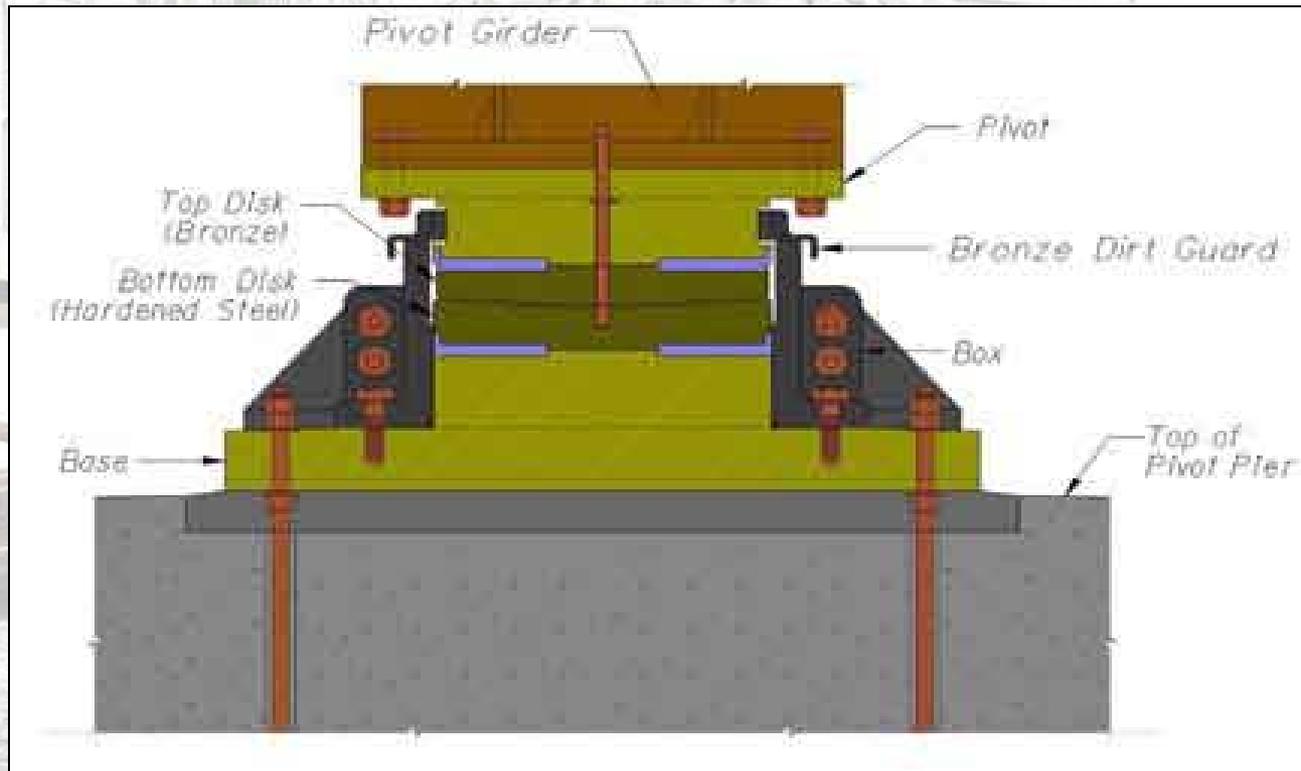
Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Span Drive Machinery



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Center Pivot Bearing

- Designed for seismic event lateral load (360k)
- Bronze/ Steel Pivot bearing



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Center Pivot Bearing



Existing



New

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

End Lifters

- Used in lieu of end wedges to minimize machinery weight and better access
- Eccentric roller system lifts span to meet approach roadway



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

End Lifters

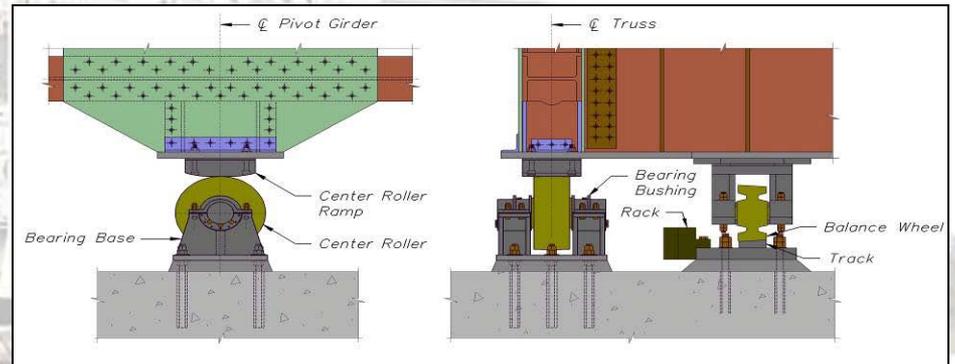


Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Mechanical Systems

■ Center Rollers

- used in lieu of mechanically driven center wedges
- used to resist live load on pivot girder



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Center Rollers



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Balance Wheels

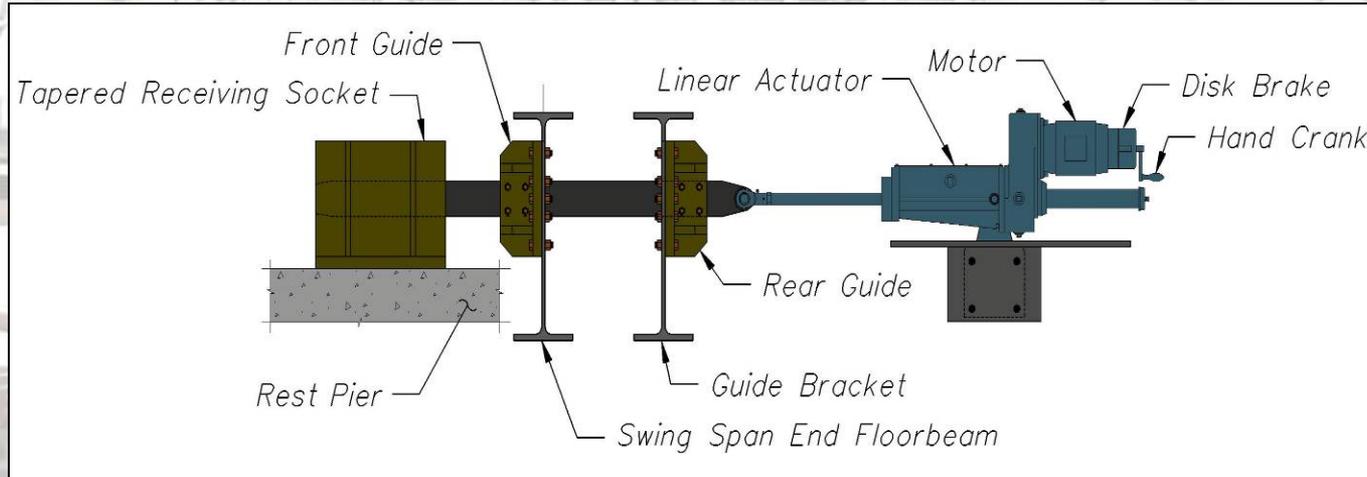
- Eight provided for counter over turning moments induced by wind



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Span Lock Machinery

- New to AASHTO LRFD
- Hold swing span in closed position
- Designed to resist full opening force of machinery



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Fender System

- Fender system replaced and realigned
- Realigned fender system to north due to wider swing span



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Construction



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Construction Plan

- Temporary Crane Trestles: North & South Approaches
- New Approach Spans: Constructed on Temporary Erection Bents west side of existing bridge and translated into position on existing substructure
- Existing Approach Spans: Translated onto east crane trestle
- Swing Span: Float-out/in for Removal of Existing and Placement of New



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Approach Span Construction



West Crane Trestle under Construction

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Approach Span Construction



West Crane Trestle & Temporary Erection Bents

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Approach Span Construction



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Approach Span Construction



Temporary Approach Span Erection Bent Adjacent to Existing Substructure

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Approach Span Construction



Temporary Bent for Displaced Existing Bridge on East side of Bridge



50Ton Tension Jack & Pull Rods



Hillman Roller Supports & Guides

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Approach Span Construction



Hillman Rollers Supporting Existing Approach Span on Erection Bent

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Approach Span Construction



Approach Span 50 Ton Jack Pulling System

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Approach Span Construction

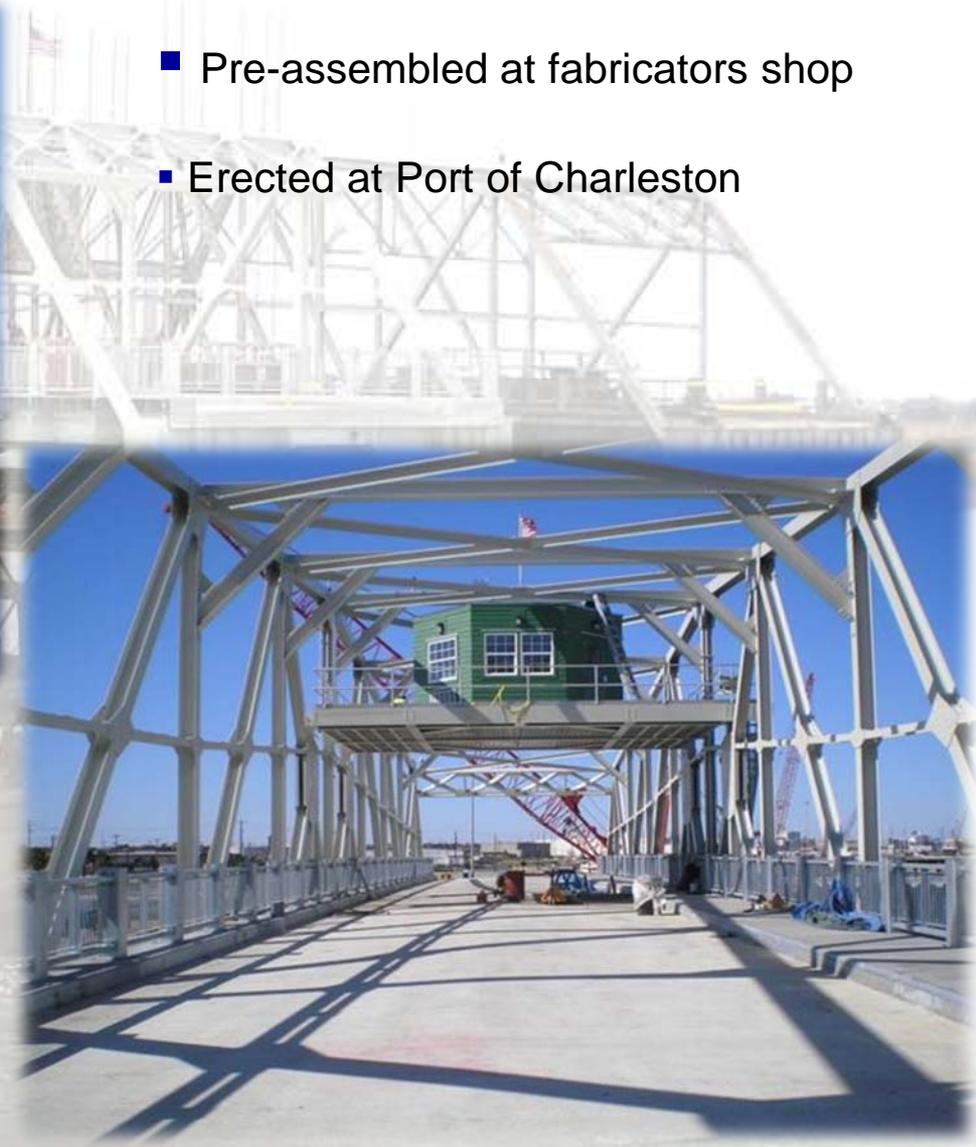


New Approach Spans in Place and Existing Displaced on East Crane Trestle

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Swing Span Construction

- Pre-assembled at fabricators shop
- Erected at Port of Charleston

- All machinery installed at erection site
- Control House erected and installed



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Swing Span Construction



Swing Span in lay-down at Florida Structural Steel Fabrication Plant

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Swing Span Construction



Swing Span Erection at FSS Fabrication Plant

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Swing Span Construction



Swing Span Framing and Exodermic Deck Erection at the Port

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Swing Span Construction



Swing Span Near Completion at the Port

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Swing Span Construction



Swing Span at the Port being Moved to the Float-In Barge

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Closure



Swing Span Float-in

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Closure



Swing Span Float-in Barge Approaching Pivot Pier

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Closure



Barge Tower Lifting Existing Swing Span for Removal from Pivot Pier

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Closure



Rack, Track and Pivot Pier Anchor Bolt Templates for Pivot Pier

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Closure



Swing Span and Flanking Spans are Demolished at Joints to Clear for Float-Out

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Closure



Pivot Pier being cleared for New Pivot Bearing, Rack and Track

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Closure



Barge turned around 180° to place New Swing Span in Position

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Closure



Swing Span Barge Moving into Position over Pivot Pier

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Closure



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Closure



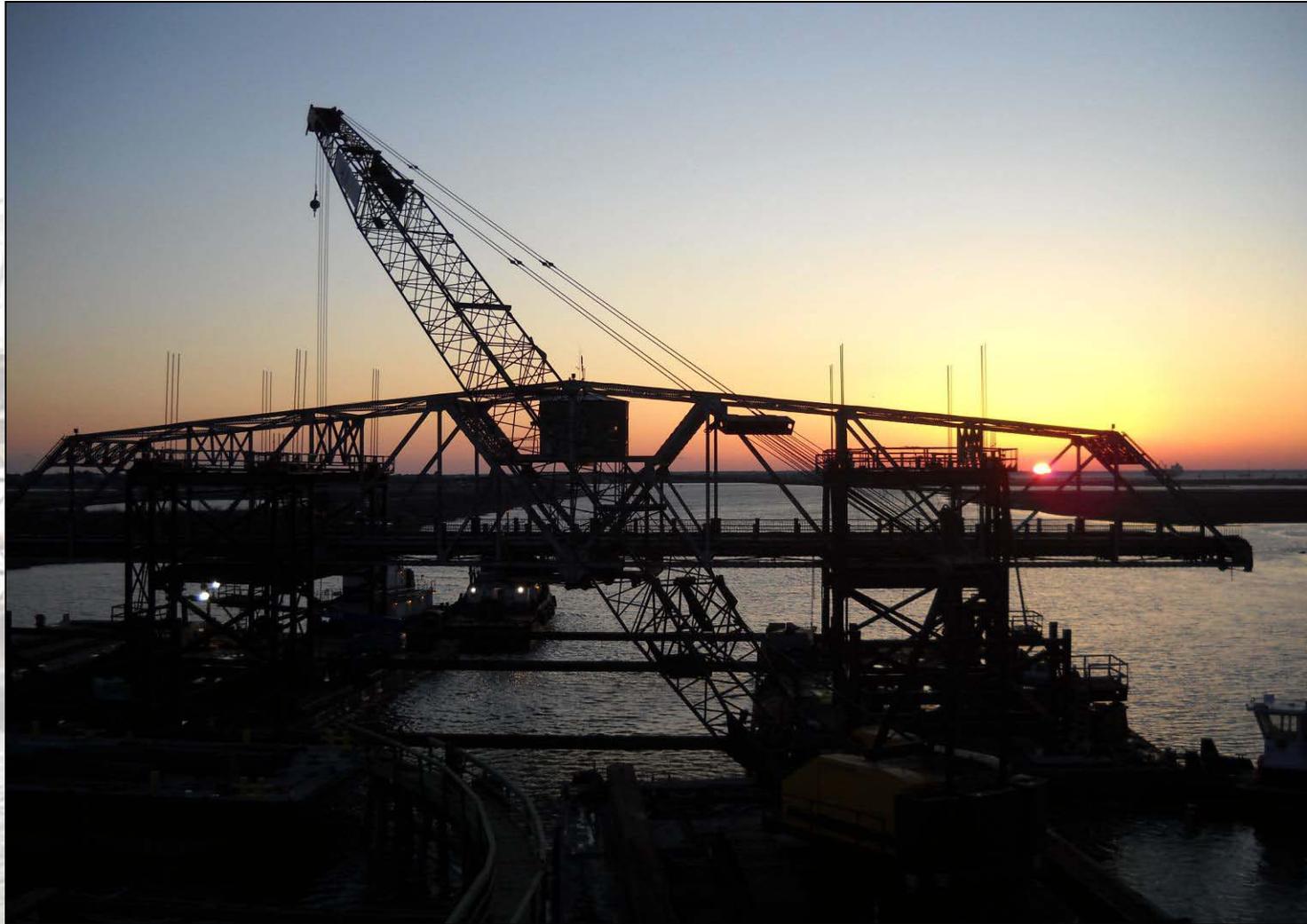
Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Closure



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Closure

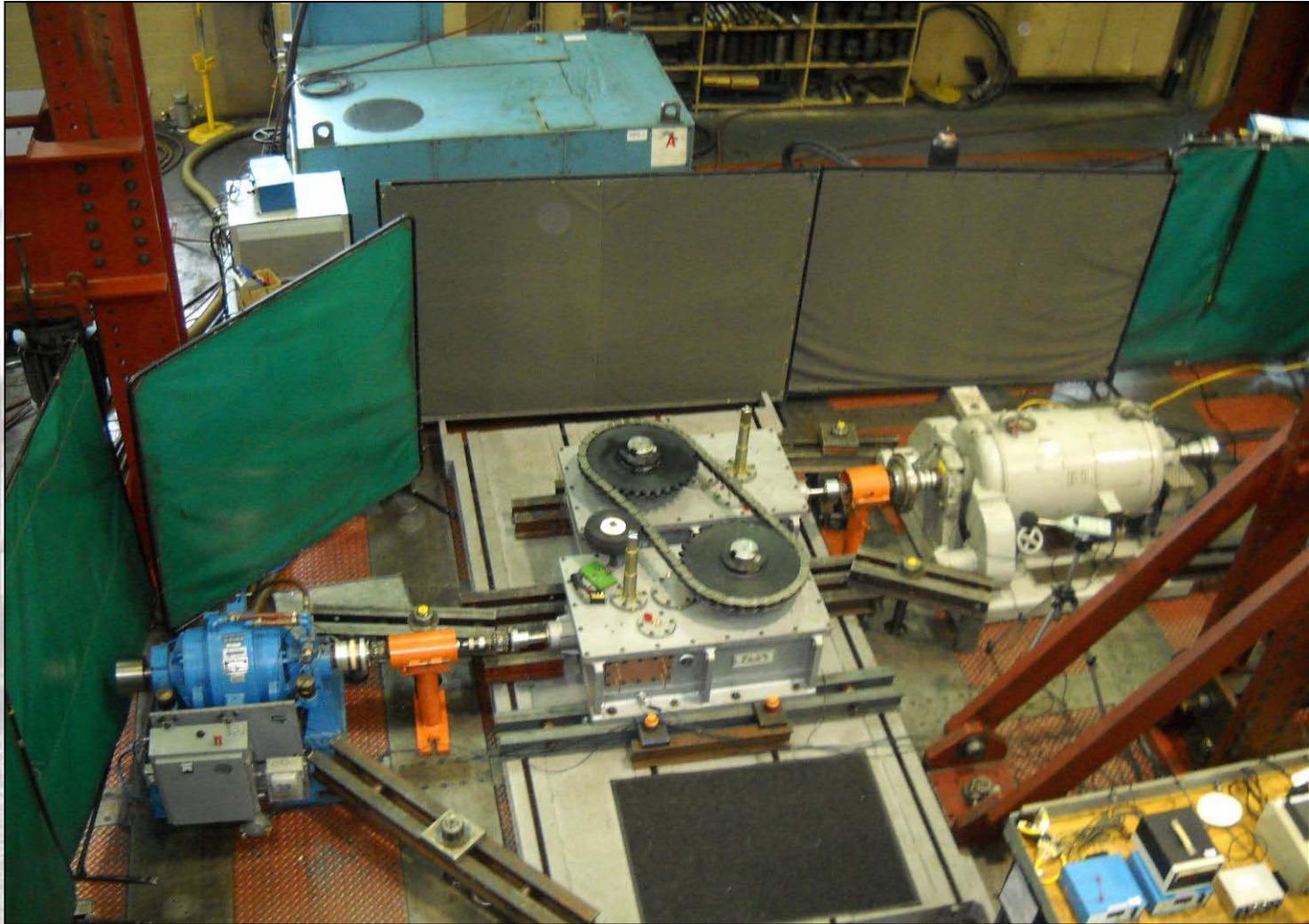


Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Closure



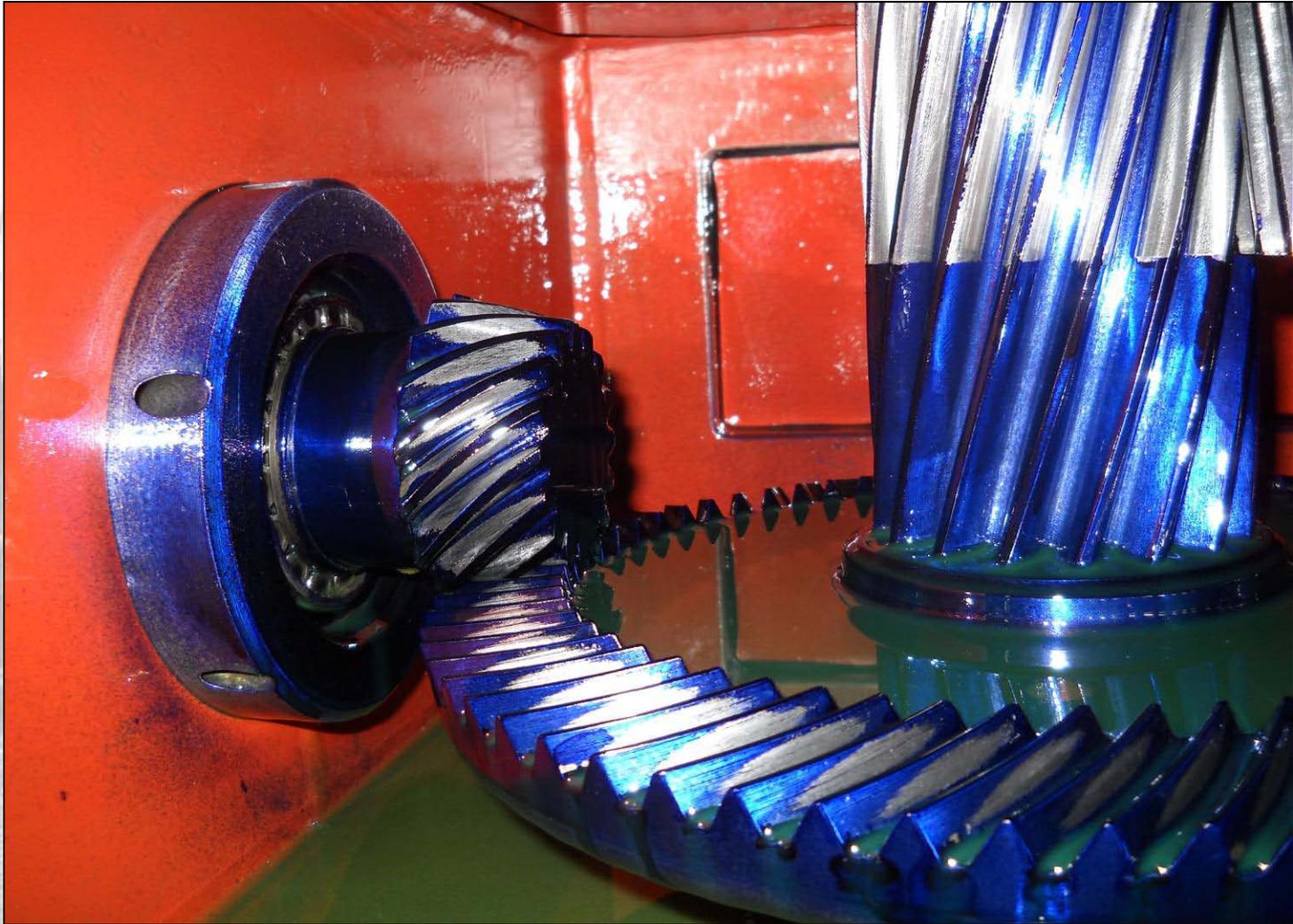
Barge moved out of channel with old swing span

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Machinery Installation



Gear Box 150% Load Test

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Machinery Installation



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Machinery Installation



Temporary Pivot Bearing Struts for Rack & Track

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Machinery Installation



New Machinery including Rack & Pinion Aligned with undersized temporary bolts

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Machinery Installation



Machinery in Position Ready for Grouting over Pivot Pier

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Machinery Installation



Rack Grouted in Place

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW Machinery Installation



Temporary shims for final Grouting



Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW



Adverse weather during Float-in and Approach Span Transition
Sub Freezing Temperatures
Snow/Rain
30+ MPH Winds

Rehabilitation of the Ben Sawyer Bridge (SR703) over the ICWW

Construction Project Teams



• [FHWA](#)

•

• [SCDOT](#)

•

• [Parsons Brinkerhoff \(PB Americas Inc.\)](#)

Owner's Representative
Construction Management & CEI



•

• [PCL Civil Constructors, Inc.](#)

Contractor
Project & Construction Management
Construction Engineering



•

• [Hardesty & Hanover, LLP](#)

Design Management
Bridge Design
Seismic Design



•

• [Florence & Hutcheson](#)

Roadway Design
Environmental Services
Design Surveys
Existing Bridge Assessment
Bridge Design Support



•

• [STV/Ralph Whitehead Associates](#)

Utility Coordination



•

• [S&ME, Inc.](#)

Geotechnical Design



•

• [Civic Communications](#)

Public Information and Community Outreach



•

• [Edwards Electric](#)

Electrical Subcontractor

Civic Communications Inc

•

• [Electrohydraulic Machinery](#)

Electrical Control System Subcontractor



•

• [Florida Structural Steel](#)

Structural Steel Fabricator



•

• [Steward Machine Co., Inc.](#)

Bridge Machinery Supplier

