Louisiana’s Longest Steel Girder Double Leaf Bascule Bridge

Presentation by
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2008 Louisiana Structures Conference  Louisa Bridge
**Project Location**

**Route LA 319**

**St. Mary Parish, LA**

Near Future I-49 Corridor

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Existing Bridge

Gulf Intracoastal Waterway
GIWW (Mile 134) at Louisa
East to West Navigable Corridor
Existing Bridge

Average Daily Traffic ➔ 1,200 Vehicles
Unequal Arm (Bobtail) Swing Span
Long Arm at 160 Ft and Short Arm at 80 Ft
125 Ft Horizontal Clearance When Opened
6 Ft of Vertical Clearance When Closed
Number of Openings ➔ 1,050 / Month (35 / Day)
Structurally Deficient 20 Ton Limit
Existing Bridge

Closed

Opening

Opened

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Existing Bridge

Vertical: 22.2 m (73 Ft) Clear
Horizontal: 61 m (200 Ft) Clear
Project Corridors
Alignment Study

Alternate 1
250 m (800 Ft) East of Existing Bridge
Additional 24 Acres of ROW

Alternate 2
198 m (600 Ft) West of Existing Bridge
Additional 28 Acres of ROW

Alternate 1A
30 m (100 Ft) East and Adjacent To Existing Bridge
Additional 24 Acres of ROW

Port Bypass
Ships Enter Port Without Passing Bridge
Discounted Because of Environmental Impact & Roadway Cost
Additional 70 Acres of ROW
Alignment Study

Alternate 1, 2, 1A
Navigation Study

Intracoastal Waterway - Sabine River To Houma
5 Major Bridges (3 High Level Fixed, 2 Movable)
High Levels Have 22 m (73 Ft) of Vertical Clearance
Existing Swing Span Averages 1,050 Openings/Month

Close Proximity To Port of West St. Mary
1500 Acre Complex With Total Intermodal Operations
Import/Export Business for International Trade
Constructed and Shipped the Largest Offshore Drilling Deck
Navigation Study

Majority Barge/Tug Vessels
Some Shallow Draft Ships

Drilling Platforms
## Navigation Study

### Existing Swing Span Average Number of Openings Per Month (1993 – 1994)

<table>
<thead>
<tr>
<th>No. of Vessels</th>
<th>No. of Openings</th>
<th>0' – 40'</th>
<th>41' – 50'</th>
<th>51' – 60'</th>
<th>61' – 73'</th>
<th>Over 73'</th>
</tr>
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<tbody>
<tr>
<td>1,714</td>
<td>1,050</td>
<td>872</td>
<td>132</td>
<td>33</td>
<td>6</td>
<td>7</td>
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</tbody>
</table>
Navigation Study

Horizontal 61 m (200 Ft) Clear

Vertical 22.2 m (73 Ft) Clear
Geotechnical

Borings To 39.6 m (130 Ft)
  9.1 m (30 Ft) Soft Clay Over Stiff Clay

Bascule Pier Foundations
  50 Steel Pipe Piles
  762 mm (30 inch) Diameter x 42.7 m (140 Ft) Long
  50 Ton Design Capacity
  Reinforced Concrete Footing / Seal

Adjacent Approach Pier Foundations
  33 PPC Piles
  450 mm (18 inch) Square x 25 m (82 Ft) Long
  50 Ton Design Capacity
  Reinforced Concrete Footing
Pier Protection System

AASHTO Vessel Collision Design
Design 4 Barges with 1 Towboat (LOA = 1200 Ft)
Flow Is Tidal with Water EL 0.0 To 3.0 Ft
1967-1995 Vessel Collisions to Existing Bridge (26 Barge Tows) 3 Barge Collisions In 2001
Classification - Critical
Vessel Impact Speed = 6 MPH (4 to 6 MPH recorded)
Method II (Method I) Force = 3,800 (4,100) Kips

Two Bascule Piers In Navigable Waterway

Pier Protection Alternates
Drilled Shaft ➔ Elastic/Not Destroyed
Guide Wall ➔ Plastic/Partial Breakup
Dolphin System ➔ Plastic/Partial or Complete Breakup
Pier Protection System

Source: Vicksburg COE
Pier Protection System

32-1370 mm (54") Diameter Drilled Shaft within a Concrete Cap System
Bascule Pier Alternates

Open Pier
- Counterweight Under Approach Span
- Counterweight Will Not Dip Into Water
- Approach Spans Need To Be Two Girder Systems
- Bascule Span Live Load Anchors Mounted On Approach Span
- Approach Spans Mimic Bascule Haunch To Hide Counterweight

Enclosed Pier
- Counterweight Enclosed
- Simplified Approach Spans
- Higher Pier Cost
Bascule Superstructure Alternates

Alternate A

Double Leaf Trunnion Bascule

Two Steel Girder

Open Bascule Pier
Bascule Superstructure Alternates

Alternate B

Double Leaf Trunnion Bascule

Three Steel Girder

Enclosed Bascule Pier
Bascule Superstructure Alternates
Alternate C
Double Leaf Trunnion Bascule
Two Steel Deck Truss
Enclosed Bascule Pier
Bascule Superstructure Alternates

Alternate D

Single Leaf Trunnion Bascule
Two Steel Through Truss
Enclosed Bascule Pier
## Bascule Superstructure Alternates

### Preliminary Cost Estimate 1996 ($ millions)

<table>
<thead>
<tr>
<th>Alternate</th>
<th>Bascule Span</th>
<th>Pier Protection</th>
<th>Mechanical / Electrical</th>
<th>Approach Structure &amp; Roadway</th>
<th>Mobilization / Contingencies</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Super</td>
<td>Sub</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>2.7</td>
<td>2.7</td>
<td>1.5</td>
<td>6.4</td>
<td>8.5</td>
<td>3.9</td>
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<tr>
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<td>2.1</td>
<td>4.1</td>
<td>1.5</td>
<td>6.4</td>
<td>8.5</td>
<td>4.1</td>
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<td>1.5</td>
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<tr>
<td>D</td>
<td>4.8</td>
<td>3.7</td>
<td>1.5</td>
<td>5.7</td>
<td>7.5</td>
<td>4.2</td>
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</tbody>
</table>

Alternate A Chosen
Environmental Assessment

Land Use - **Alignment 1A Smallest Impact**

Farmland Protection Policy Act (FPPA)
USDA Ranked **Alternate 1A As The Lowest Impact**

Air Quality – No Impact    Noise – No Impact

Water Quality – Little Impact Chicot Aquifer (300 Foot Wells)

NEPA Permits - Wetlands
Much of It Prior Converted To Agriculture
Bypass Has The Highest Impact
Alignment 1A Is Second Highest
LADOTD Responsible For Mitigation

Floodplains – Project Lies In A 100 Year Floodplain

Endangered And Threatened Species - USFWS **No Effect**

Archeological/Historical

Visual Impact - Public Hearing - **Alignment 1A Preferred**
## Environmental Assessment

### Impacts To Wetland Habit

<table>
<thead>
<tr>
<th>Impact Categories</th>
<th>Alternate</th>
</tr>
</thead>
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<tr>
<td></td>
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<tr>
<td>Area (ac)</td>
<td>2.17</td>
</tr>
<tr>
<td>BHW</td>
<td>2.17</td>
</tr>
<tr>
<td>FSWP</td>
<td>2.17</td>
</tr>
<tr>
<td>AAHU’s</td>
<td>.5</td>
</tr>
</tbody>
</table>

1 Bottomland Hardwood; 2 Fresh Swamp; 3 Average Annual Habitat Units

FONSI Determined
Proposed Bridge Rendering
New Louisa Bridge
Construction Team

Louisiana DOTD / HNTB

Coastal Bridge Company – General Contractor

CEC/Huvall Associates – Bascule Span Erection

Steward Machine – Bascule Span Steel and Machinery

IKG Industries – Bascule Span Steel Grating

Carolina Steel – Approach Span Steel

Orleans Material – Bascule Pier Trunnion Support Steel

J.H Menge & Co. – Pier Protection Fendering

E. P. Breaux – Electrical
New Movable Span Bridge

2-Lanes 11.4 m (37 Ft) Wide Roadway/No Sidewalks

84 m (276 Ft) 2 Steel Girder Double Leaf Fixed **Trunnion Bascule Span**

Bascule is French for “Seesaw”
Trunnion is French for “Trunk” or “Stump”
Bascule Span Girders vary in depth 2.3 m to 5.3 m (7.5 to 17.3 Ft)

64 m (210 Ft) 2 Steel Girder Adjacent Span

Adjacent Span Girders vary in depth 2.5 m to 5.0 m (8.3 to 16.4 Ft)
Approach Spans

38 – 37 m (121 Ft) Spans (Typical Units are Two Span Continuous)

5 Girder BT Sections 1830 mm (72″)

2 Column Reinforced Concrete Bents
Bascule Girders

Trunnion Inserted After LN2 Bath
Class 7 Fit with Trunnion Medium Drive Fit

Photos courtesy of Steward Machine Company

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Bascule Piers
Bascule Piers

Steel Pipe Pile Foundation
Reinforced Cast In Place Concrete
Bascule Span Steel Support Structure
Pier Protection

Concrete Filled Steel Pile

Reinforced concrete cap

UHMW-PE

Ultra High Molecular Weight Polyethylene
Bascule Span Erection

Tail Erected
Toe Added
Deck Placed
Steel and Concrete Filled Steel
Box Counterweight

3. 28. 2003

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Machinery Erection

Trunnion Bearing
600 mm (24″) To 760 mm (30″)
Bronze Bushing

Rack Bolts To Bascule Girder
Flange Plates
Drive Machinery

Simple Arrangement
2 - 25 HP Two Speed AC Motors
Single Central Reducer
# Rack Alignment Analysis

## Tooth Finite Element Analysis

<table>
<thead>
<tr>
<th>Condition</th>
<th>Root Stress (ksi)</th>
<th>Loading Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – Load Applied Full Width</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>2 – Load Applied 20% Width</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>3 – Load Applied 20% Width at end of tooth</td>
<td>60</td>
<td></td>
</tr>
</tbody>
</table>
Finished Span 2005
Finished Span 2005

$12.7 M Approach
$22.2 M Bascule
$34.9 M Total
Intracoastal Waterway Bridge at Louisa

2007 Prize Bridge Award - Movable Span Category
Presented at the 2007 World Steel Bridge Symposium

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