Sellwood Bridge
Final Design of the Main River Crossing Arch Bridge

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Agenda

• Sellwood Site Background
• Bridge Replacement Project
• Bridge Type Selection
• Bridge Design Overview
• Construction Updates
Sellwood Site Background
Ferry at Spokane St

Sellwood Bridge
History

- Bridge opened 1925
- West approach moved 3ft by 1960
- Loads restricted in mid 1980’s
- Large cracks discovered in 2003
- “Band aids” installed
- Loads further restricted 2004
- NEPA process started in 2006
Issues

- West end slope instability
- Buses / trucks restricted
- General deterioration
- Bridge not designed for earthquakes
- Narrow lanes, no shoulders
- Narrow sidewalk
- No bike facilities / poor connections
- Tight turns at west end
Bridge Replacement Project
Project Team

• Agencies
  – Multnomah County
  – City of Portland
  – Oregon Department of Transportation
  – Federal Highway Administration

• Consultants
  – T. Y. Lin International, Prime Design Firm
  – CH2M Hill, Lead Subconsultant
  – Cornforth Consultants, Landslide Mitigation Consultant
  – Safdie Rabines Architects
  – David Evans and Associates, Owners Rep

• Contractor
  – Slayden/Sundt Joint Venture
Project Information

• Overall budget - $307.5 million
• About 20% complete construction
• Utilizing CM/GC delivery method
• Traffic on new span – Summer 2015
• East approach/OR 43 interchange complete – Summer 2016
CM/GC Decision Factors

- Cost
- Technical complexity
- Design developing
- ROW acquisition complex
- Schedule
- Risk
- Equity
- Sustainability
- Public involvement
Bridge Type Selections
Selection Process

• Conducted in 2010
• 12 bridge types evaluated
• 9 criteria scored in a matrix including:
  – Cost
  – Construction risk
  – Environmental impact
  – Aesthetics
• Public involvement: CAC ⇒ PSC ⇒ BCC
Bridge Type Selection

- Box Girder
- Delta Frame
- Deck Arch
- Through Arch
- Extradosed
- Cable-Stayed
Concrete Box Girder
Concrete Deck Arch
Steel Deck Arch
Architectural Features

Structural Lighting
Pedestrian Belvederes

Architectural Features
Architectural Features

Enhanced Protective Fencing & Street Lighting
Architectural Features

Gateway Art
Bridge Design Overview
Bridge Project Plan and Elevation

1977’-6”
Main Span Plan and Elevation

1275′-0″
Typical Arch Section

- Steel Girders
- Concrete Deck
- Steel Spandrel Cap Beam
- Bearings
- Steel Spandrel Column
- Arch Rib
- Arch Rib Brace
Structural Steel

- ASTM A709, Grade 50W structural steel
- 10 Million lbs
- ASTM A 325 and A490 Type 3 high-strength bolts

Sub Contractors
- Fabricator: Thompson Metal Fab Vancouver, WA
- Erector: Carr Construction Portland, OR
Arch Rib

- Arch Rib Box Section
  - Web Depth of 70” with plates ranging from 1.5” to 2.0”
  - Flange Width of 54” with plates ranging from 2.0” to 3.0”
Spandrel Columns

- Expansion Spandrels
- Fixed Spandrels
- Expansion Spandrels
Spandrel Columns

• Spandrel Column Boxes
  • Out-to-out: 3’-6” x 3’-0”
  • Plate thickness varies 1.25” to 2”
Spandrel Cap Beam

- Spandrel Cap Beams
  - Bolted built-up box members
  - 5’-0” depth x 3’-4” wide
Future Streetcar Provisions
Future Streetcar Provisions

Future Trackway Section

Luminaire Supports
Arch Springing Assembly
Arch Springing Assembly

**INITIAL STAGE**
Cast anchorage assembly, anchor rods, and bearing plate into footing.

**INTERMEDIATE STAGE**
Install Arch Rib and base plate into temporary pinned condition, using pin plate.

**FINAL STAGE**
After constructing sidewalk and bridge rail (end of Stage 111, See Dwg. nos. 0010–00 thru 0014–00):

1. Grout space between bearing and base plates.
2. Tension anchor bolts and grout ducts.
West Shore Pier
River Pier
Springing/Wall/Column/Strut Interface

CURVE "A"
R = 205.94'
Δ = 10°52'23"
T = 19.80'
L = 39.08'

CURVE "B"
R = 205.20'
Δ = 11°02'50"
T = 19.84'
L = 39.56'

* Note: Exterior side to and ce Arch Rib
Pier Wall Plan
Box Caisson Section

Courtesy of McGee Engineering Inc.
• A706 Grade 80 used for all drilled shaft reinforcing
• Permanent casing provided at Bents 4 and 5
• Slope inclinometers installed in (2) Bent 3 shafts
3D Rebar Modeling
3D Rebar Modeling
3D Rebar Modeling
Analysis and Design Criteria

LARSA 4D Global Analysis Model
Design Criteria

• **Seismic:**
  - Minimal damage allowed in a 500-year earthquake
  - Collapse is prevented in a 1000-year earthquake
  - Allowable material strains are defined and enforced for these events
  - Structure response is calculated via enveloped suites of site-specific acceleration response spectra and nonlinear static push analyses.

• **Landslide:**
  - Mitigation measures are being constructed to prevent movement in service conditions.
  - Finite element analysis was performed using scaled time histories of four earthquakes to predict soil-structure interaction with the proposed structure and mitigation in place.

• **Vessel Collision:**
  - Bridge design for vessel impact
  - Controlling vessel was the Portland Spirit, 150-ft long, 420 long ton

• **AASHTO Live Load:**
  - Bridge designed for trucks and pedestrians; conditions were evaluated with complete removal of sidewalks.

• **Streetcar Live Load:**
  - Streetcar vehicles were substituted into load combinations for HL-93 trucks.
Main span elements are subject to mass placement requirements and conformance with ACI 207.

An engineered thermal control plan is required. A performance-based approach to controls of concrete peak temperatures, temperature gradients, and induced cracking is acceptable.
Construction Update
First Shaft Installation at Bent 6
First Shaft Installation at Bent 5
First Shaft Installation at Bent 5
East Abutment, First Stage
East Approach Columns, First Stage