TIGHT CONSTRUCTION WINDOWS FOR BNSF RAILWAY BRIDGE 24.8 REPLACEMENT IN CAMAS, WASHINGTON

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HISTORY OF RAILROAD CONSTRUCTION

- Rapid Early Construction due to incentives and rules around land grants
- Generally built in wilderness areas with no permitting concerns
- Only way to deliver material was on newly built track
HISTORY OF RAILROAD CONSTRUCTION
HISTORY OF RAILROAD CONSTRUCTION

- Linear On-Track equipment
- Utilized local material to build timber spans
- Steel shipped out from eastern plants
- Field engineering and decisions made on the fly to build substructure
- Use of Standards due to lag in communication
HISTORY OF RAILROAD CONSTRUCTION

BNSF Bridge 24.8
RIGHT-OF-WAY (ROW) IMPACTS
RIGHT-OF-WAY (ROW) IMPACTS

- Limited ROW
  - Usually not more than 100’ wide
- Limited Staging Areas
- Limited ability to “shoo-fly”
- Utilize on-track equipment if possible
- Permitting benefits
  - Can pre-empt state/local permits
BUSINESS IMPACTS

- Trains = Revenue
- Track time is priority
- Work must be completed within dedicated windows
  - ~6 hrs for a small bridge (spans less than 35’)
  - ~12 hrs for a long bridge of shorter spans
  - ~24 hrs for a large bridge (long steel spans)
  - ~48 hrs if you want to be laughed at
METHODS - DESIGN

- **Standard Design**
  - Developed standard plans that allow modular type construction
  - Utilize similar details as much as possible
  - Design around “traffic impact” as primary concern
  - Details must incorporate existing bridge layout limitations

- **Non-Standard Design**
Construction methods that limit track time are valuable

- Sliding or rolling
- Setting pieces with single crane picks

**On-Track equipment**

- Cranes on rail
- Material delivered by car

**Construction foundations**

- Through and around existing bridge structure
- Impact pile driving over vibratory
BRIDGE HISTORY

- Built by the SP&S Railway in 1911
- Designed by Modjeski as a Standard
- New construction from Portland to Spokane
**PROJECT OVERVIEW**

- **Span Arrangement**
  - Two 50’ Deck Plate Girder Spans
  - Two 200’ Through Truss Spans
  - Pin Connected

- **40 Trains Per Day**
  - Passenger and Freight

- **Cast-in-Place Concrete Piers and Abutments**

BNSF Bridge 24.8
100+ Yr. Old Pin Connected Trusses
In-Line Replacement
Planned for Two 32 Hour Track Windows
No Reuse of Existing Substructure
New Substructure Spaced Around Existing
New Single Track Bridge 545’ Long
- 200’ Through Truss
- 162’ & 92’ Through Plate Girder
- Two 42’ Conc. Double Cell Box Girders
PROJECT OVERVIEW

- **Design, Bid, & Build Contract**
  - Select Contractors to Bid (Owner Approved)
  - Selection Basis
    - Price
    - Contractor Specified Changeout Window Duration

- **TranSystems**
  - Designer
    - Estimate Changeout Window Duration
  - Bidding
  - Construction Management
**PROJECT OVERVIEW**

**Design Life**
- 100+ Yrs.

**Design Loadings**
- Cooper E-80 Live Load
- Alternate Live Load
  - (4-100 Kip Axles)
- Diesel Impact for Rolling Equipment w/o Hammer Blow for Ballast Deck

*Figure 15-1-2. Cooper E 80 Load*

*Figure 15-1-3. Alternate Live Load on 4 Axles*
PROJECT OVERVIEW

Design Loadings

- Stream Flow – 4.3 ft/second at 50 Year Water Surface
- Wind Loads – 50 psf Unloaded Structure & 30 psf Loaded Structure
- Scour – 100 Year and 500 Year Flow Scour Depth
- Seismic Design

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<th>RETURN PERIOD (YEARS)</th>
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SITE COEFFICIENT $s=1.2$
**Material Types**

- **Structural Steel**
  - A709 Grade 50W (No Paint)
  - Impact Requirements - T2 (non-FCM) or F2 (FCM)

- **Cast-In-Place Concrete Pier Caps/Drilled Shafts**
  - 4,000 psi

- **Prestressed Concrete Double Cell Box Beams**
  - 4,000 psi at Transfer - 5,000 psi at 28 Days

- **Reinforcing Steel**
  - A615 Grade 60 (uncoated)
BRIDGE ELEVATION

BNSF Bridge 24.8
ABUTMENT DETAILS

- Piles Welded to Embed Plate in Precast Abutment Cap
- Bolted Precast Wingwalls
AERIAL OF TEMPORARY WORK BRIDGES
PRELIMINARY CHANGEOUT WORK

- Abutment Piles Driven During Daily Track Windows
  * Up to 4 hour windows
Substructure Construction

- Drilled Shafts Installed Prior to Window
  - Spaced to Clear Existing Superstructure
- Cast-In-Place Concrete Cap Installed Under Existing Bridge Truss
  - About One Foot Clearance to Low Chord
Preliminary Changeout Work

- Truss Assembly on Falsework
TRUSS DEMOLITION PEDESTALS
FIRST 32 HOUR TRACK WINDOW

- Translation Frames Utilized
  - Truss Roll Out
  - Truss Roll In
- Skid Shoes Supporting Each Chord of Truss
- Moved Using A Threaded Rod Jack Attached to Skids
- Translation Beams Coated with Graphite Paint
NEW TRUSS SLIDE-IN
AERIAL PHOTO DURING TRACK WINDOW
FIRST 32 HOUR TRACK WINDOW VIDEO
SECOND 32 HOUR TRACK WINDOW

- **Translation Frames & Skid Shoes Utilized**
  - Truss Roll Out
  - Through Plate Girder Spans Roll In
TRUSS DEMOLITION PEDESTALS
AERIAL PHOTO DURING TRACK WINDOW
SECOND 32 HOUR TRACK WINDOW VIDEO
COMPLETED BRIDGE
LESSONS LEARNED

- Contingency Planning (What If Planning)
- Detailed Track Window Construction Schedule
- Adjustments For Second Track Window – Additional Equipment For Excavation and Demolition
- Overlapping Tasks Rather Than Linear Tasks
- Review Material Orientation For Crane Picks
- Test Slide of Spans
AWARD WINNER

2017 Best ABC Project in Lateral Slide Technology (Railroad Bridge)

In-Line Replacement of BNSF Bridge 24.8

- **Owner:** BNSF
- **Designer:** TranSystems
- **Contractor:** Hamilton Construction Co.

- **Construction Cost $20M**