I-70 over SR 121
Bridge Slide Construction and Engineering
March 6, 2018
Kevin Gorak, American Structurepoint
Pete Jerrell, Walsh Construction
Project Overview

• Project Location
  I-70 in Richmond, IN
Project Overview

• Project Location
Project Overview

• Existing Bridge

  – Twin - 3 Span Structures (Total Length 140’-10”)
    • End Spans: Reinforced Concrete Girders (35’-10” Clear Spans)
    • Middle Span: Steel W-Beams with Concrete Deck (49’-6” Clear Span)
Project Overview

• Existing Bridge

  – 39’-6” Clear Roadway
    • 2 – 12ft lanes width
    • 5’-6” and 10’-0” Shoulders
Project Overview

• New Bridge
  – Twin – Single Span Structures (71’-0” Span Length)
Project Overview

• New Bridge

  – 40’-8” Clear Roadway
    • 2 – 12ft lanes width
    • 5’-8” and 11’-0” Shoulders
Project Overview

• Design Options Considered (INDOT / BLN)
  – Do Nothing
  – Conventional Construction
  – Self Propelled Modular Transporter (SPMT)
  – Slide-In Superstructure Installation
  – Hybrid Slide-In Superstructure Installation
Project Overview

• Do Nothing Option
  – Bridge Condition was in too bad of shape
Project Overview

• Conventional Construction
  – Two-Construction Seasons (4 Phases of Construction)
  – Build half of the bridge per phase
  – No Lane Closures
Project Overview

- Self Propelled Modular Transporter (SPMT)
  - One Construction Season
  - Single Lane Closure for limited time
  - Available staging area on the south-east area of the project
Project Overview

• Self Propelled Modular Transporter (SPMT)
Project Overview

• Bridge Slide-In
  – One Construction Season
  – Single Lane Closure for limited time
  – Room in between bridges to construct bridge
Project Overview

• Bridge Slide-In
Project Overview

• Hybrid Bridge Slide-In

– One Construction Season
– One Conventional Bridge Construction and One Bridge Slide-In
– Use Slide-In bridge as temporary structure during demolition of existing bridge
Project Overview

• Best Options for final Design
  – Conventional Construction, SPMT and Bridge Slide-In Options were within 5% estimated construction cost of each other
  – INDOT received grant money for ABC project
  – SPMT and Bridge Slide-In will continue to Final Dual Design
Bid Process

• Project overview
• Self Propelled Modular Transporter (SPMT) or SLIDE?
• Days?
Bid Process - SPMT Project Plans

• SPMT Movement (Westbound Bridge)
Bid Process - SPMT Project Plans

• SPMT Movement (Westbound Bridge)
Bid Process - SPMT Project Plans

• SPMT Movement (Eastbound Bridge)
Bid Process - Slide-In Project Plans

- Site Layout
Bid Process - Slide-In Project Plans

• Remove Overhang
Bid Process - Slide-In Project Plans

• Build New Bridge
Bid Process - Slide-In Project Plans

- Shift Traffic, Slide New Bridge
Bid Process - Slide-In Project Plans

• Build New Bridge
Bid Process - Slide-In Project Plans

- Shift Traffic, Slide New Bridge
Bid Process - Days

A + B Contract

A Component = Cost of construction (SPMT or Slide)

B Component = Closures

• I-70 Closure
  – Allowed 13 days at 15 hours/day (195 total hours) of lane closure per installation
  – Only one Friday closure is allowed
  – Hours only charged for Peak Hours: 6 AM – 9 PM
  – Incentive and Disincentive: $2,500/hour on Fridays
  – Incentive/Disincentive: $2,000/hour on all other days

• SR 121 Closure
  – Allowed 60 Days at $4,000/Day
Bid Process – SPMT vs. Slide

SPMT

– Pros
  • Room to build new bridge
  • No temporary demolition to existing structure
  • Keep an extra lane open during construction phases
  • 1 less Lane Closure = $307,500 savings

– Cons
  • Cost to use SPMT
  • Construct temporary supports for bridge construction
  • Walk EB bridge under new WB bridge
  • Construct supports for EB Bridge to raise into to position because amount of leg stroke on SPMT
Bid Process SPMT vs. Slide

Slide-In

– Pros
  • Experience with bridge slide
  • Use simple equipment to slide bridge
  • Slide equipment cheap

– Cons
  • Need to remove bridge overhang to construct bridge between existing structures
  • Tight work area between and beneath bridges
## Bid Process - Decision

- **B Component for Slide**

### PHASE III - SLIDE 1

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**TOTAL COST**

- **PHASE III - SLIDE 1**: $427,500
- **PHASE IV - SLIDE 2**: $427,500

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**TOTAL COST**

- **PHASE III - SLIDE 1**: $427,500
- **PHASE IV - SLIDE 2**: $427,500

**TOTAL**: $855,000
Bid Process - Decision

• Decided to bid Slide-In
  – Engineer’s Estimate = $6,800,000
  – Walsh Bid Estimate = $6,484,900
    • 24 Days of I-70 lane closure (26 days allowed)
    • 30 Days of SR 121 road closure (60 days allowed)
    • B Component = $855,000
Bridge Slide Design

• Existing Bridge with New Abutment
Bridge Slide Design

• Build a New Bridge Between Existing
Bridge Slide Design

• Build a New Bridge Between Existing
Bridge Slide Design

- Demo Existing and Slide Over
Bridge Slide Design

• Bridge Slide Design Options
  – Slide the bridge on rollers

Pros
- Slide system on a track
- Allows for low friction
- Control geometry tolerances

Cons
- Needs a temporary separate slide structure
- Cost for temporary structure
Bridge Slide Design

• Bridge Slide Design Options
  – Slide the bridge on Teflon pads

Pros
- Use existing abutment for slide surface
- Allows for low friction
- Little modification to abutment

Cons
- Teflon bearings could walk
- Cost for multiple temporary Teflon bearings
Bridge Slide Design

• Bridge Slide Design Options
  – Slide the bridge on stainless steel surface

Pros
- Use existing abutment for slide surface
- Fewer Teflon bearings req’d
- Stainless steel provides level and smooth surface

Cons
- Cost for stainless steel plate
- Abutment would need to be modified
Bridge Slide Design

• Bridge Slide Design Options
  – Slide the bridge on stainless steel surface

PROCEED TO FINAL DESIGN
Bridge Slide Design

• Temporary Slide Bearings will be located at the final bearing locations
Bridge Slide Design

• Now we have to pull the bridge
  – Friction Coefficient for Lubricated Teflon on Stainless Steel: 3% - 5% (Dawn Soap)
  – Total Structure Weight
    • EB Structure - 830,000 lbs (415,000 lbs per abut)
    • WB Structure – 771,000 lbs (385,500 lbs per abut)
  – Lateral Sliding Force (Per Abutment)
    • EB Structure – 20,750 lbs (5% Coeff of Friction)
    • WB Structure – 19,275 lbs (5 % Coeff of Friction)
Bridge Slide Design

• Keep the lateral slide system design simple
  – Use 25% Coefficient of Friction for Design
  – Lateral Sliding Design (Per Abutment)
    • EB Structure – 104,000 lbs
    • WB Structure – 96,000 lbs
  – Use 150 ksi 1 ¼” diameter all thread bar
    • Ultimate Strength = 188,000 lbs
    • $0.6 \times f_{pu} = 113,000$ lbs
Bridge Slide Design

- Lateral Slide Anchoring System
Bridge Slide Design

• Lateral Slide Anchoring System
Bridge Slide Design

• Lateral Slide Anchoring System

Stressing Frame Model

C 15X33.9

Jack Force = 83.0 kips

MC 18X42.7

9 - 1" dia D32 Dayton Superior threaded rods

3 - 1" dia D32 Dayton Superior threaded rods
Bridge Slide Design

• Lateral Slide Anchoring System

Deflection of Stressing Frame
(83 kip Load)
Bridge Slide Design

• Lateral Slide Anchoring System
Bridge Slide Design

• Lateral Slide Anchoring System
Bridge Slide Design

• Lateral Slide Anchoring System
Bridge Slide Design

- Lateral Slide Anchoring System
Bridge Slide Operations

- Pre-Slide Construction Work & Challenges
Bridge Slide Operations

- Pre-Slide Construction Work & Challenges
  - Drilled Shafts – Wet conditions in spring & minimal room
  - End bents – Forming and Pouring beneath existing bridge
  - MSE Walls – Undermining existing bridge
  - New Bridge – Access and tight space in between existing bridges
  - Pre-slide Preparations – Anchoring system, jacking equipment, test pull
Bridge Slide Operations

- Pre-Slide Planning – Jacking System Preparation
  - Vertical Lift System
    - Enerpac RCS, Low Height Cylinders X8 – 4 Jack ports/Abutment
    - Used to remove temporary bearings and install permanent bearing pads
    - Jacks plumbed through a manifold to apply equal pressure
  - Horizontal Pulling System
    - Pulling Jacks x2 – 60 Ton Enerpac RPH-3010 Hollow Plunger with electric pump
    - Pulling rod – 1.25” Diameter 150 KSI Rod
  - Test Pull
Bridge Slide Operations

- **Pre-Slide Planning**
  - Detailed schedule broken down by hour
Bridge Slide Operations

• Bridge Demolition
Bridge Slide Operations

• Slide Tolerances - Laterally
  – Tape measure installed on the back side of abutment
  – Lath with pointed tip used to measure lateral progress
  – PE monitor as bridge is slid and convey to operator
  – Operators have ability to pull more or less to stay even

• Slide Tolerances – Along Center of Abutment
  – Centerline of Abutment marked
  – Center of Abutment Marked
  – Monitor as bridge is being slid
Bridge Slide Operations

- Slide
  - Lubricate Stainless steel – Dawn Dish Soap
  - Breakout – Each abutment is initially moved independent of each other
  - Slide – Bridge pulled at 2” – 3” increments
  - Monitoring – 6 People on each bent monitoring
  - Bridge within 1” of plan location
Bridge Slide Operations

• Post Slide
  – Jacking onto new bearings
  – Pour restrainer block
  – Grout jacking ports
  – Backfill abutments
  – Pavement
Bridge Slide Operations

I-70 Bridge Slide
Over State Road 121
Richmond, Indiana
SUCCESS!

WB I-70 Closure Bid = 12 Days or 180 Hours
WB I-70 Actual Closure 8 Days or 120 Hours

WB I-70 Incentive = 60 Hours x $2,000/Hour = $120,000

EB I-70 Closure Bid = 12 Days or 180 Hours
EB I-70 Actual Closure 8 Days or 120 Hours

EB I-70 Incentive = 60 Hours x $2,000/Hour = $120,000

SR 121 Closure bid = 30 Days
SR 121 Actual Closure = 17.5 Days
*3 Separate Closures

SR 121 Incentive = 12.5 Days x $4,000/Day = $50,000
QUESTIONS?