M-100 over CN/GTW Railroad

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Photo by MDOT Photography Unit
OUTLINE

- Project overview
- Accelerated Bridge Construction decision factors
- Proposed bridge
- Temporary abutments
- Approach slabs
- Slide operations
- Construction information
- Lessons learned
PROJECT OVERVIEW
PROJECT LOCATION

• Potterville, MI
• ADT – 5400
• Project consisted of roadway improvements and replacement of 3 bridges along M-100
EXISTING BRIDGE

- 3-span steel superstructure
- Constructed in 1940
- Reinforced concrete counterfort abutments and steel pier bents on spread footings
- 157’ long with a clear roadway width of 40’
- Poor condition
- Functionally obsolete
DESIGN RESPONSIBILITIES

- MDOT
  - Permanent bridge
  - Geotechnical engineering
  - Traffic engineering
  - Road design
  - Railroad coordination
- AECOM
  - Temporary abutments
  - Modifications to permanent bridge
  - Slide specifications
ABC DECISION FACTORS
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- MDOT and city officials didn’t want the bridge out for an extended period of time
- Part width construction not feasible
- Emergency services located on the opposite side of tracks from the majority of the population
- Minimize user delay costs due to detours
- Bridge location
- Car detour route – 4.5 miles
- Truck/semi detour route – 20 miles
ABC DECISION FACTORS

- Slide-out vs. slide-in
- West side vs. east side
- Existing utilities
PROPOSED BRIDGE
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• Single span steel superstructure
• 107’-6” span on a 37.6° skew
• Full height concrete abutment on steel H-piles
• 44’-0” clear roadway width and a 10’ wide pedestrian path
• Temporary alignment located 76’-5” west and parallel to the existing alignment
PERMANENT ABUTMENT CROSS-SECTION
TEMPORARY ABUTMENTS
TEMPORARY SUBSTRUCTURE

- Studied concrete vs. steel and driven piles vs. micropiles
- Wire face MSE wall behind frames used to retain road fills
- Frame braced in each direction with channels and angles
- Field-welded connections
- Longitudinal triple W18x76 beam was the main load carrying member
TEMPORARY SUBSTRUCTURE

- Drop-in span used to span the gap between the temporary and permanent abutments
- C10x30 used to guide the steel rollers
- Welded to top of triple beam and bolted to top of concrete abutment
APPROACH SLABS
• Temporary concrete approach slab tied to temporary abutments using shear studs
• 2” open “expansion” joint at each abutment
• Level bottom of deck to eliminate crown in permanent backwall
• Permanent approach slabs were cast-in-place using early strength concrete used to allow traffic as soon as possible
• Threaded inserts installed in end of deck to facilitate connection to permanent approach slab
Both photos by AECOM
SLIDE OPERATIONS
SLIDE OPERATIONS

• Steel rollers instead of PTFE pads
• Horizontal guide rollers used under fascia girders
• Larger top plate with slotted holes to allow for more construction tolerance
• Cushion pad used
• Variable filler plate
• Designed for coefficient of friction of 0.07
• No lubricated needed nor recommended
SLIDE OPERATIONS

- **SLOTTED HOLE (TYP.):** $\frac{13}{16} \times 1\frac{7}{8}$
- **CUSHION PAD**
- **FILLER PLATE**
- **TOP PLATE**
- **C10X30 CHANNEL GUIDE**
- **BOTTOM OF CHANNEL GUIDE & TOP OF PERMANENT ABUTMENT & TOP OF TEMPORARY ABUTMENT**
- **$\frac{1}{8}$ CLEARANCE (TYP.)**
- **BOTTOM FLANGE**
- **ROLLER GUIDE ASSEMBLY**
- **GUIDE ROLLER (TYP.)**
- **VARIES**
- **5 1/2 MAX**
- **1 MAX**
- **11" MAX**
- **1'-2 3/4"**
- **11 3/8"**
- **11 1/16"**
Both photos by MDOT Photography Unit

High-capacity steel roller with guide rollers under fascia beams

High-capacity steel roller under interior beams
SLIDE OPERATIONS

- Synchronous vertical jacks placed under each end diaphragm
- End diaphragms designed for 1/16” deflection
- Superstructure lifted and rollers placed under each beam
- Superstructure lowered onto rollers
- Jacks and rollers located in the channel guide in front of permanent bearings prevented conflict
SLIDE OPERATIONS

CHANNEL
HIGH CAPACITY ROLLER
HYDRAULIC JACK
SOLE PLATE

BEAM
SLIDE OPERATIONS

- Independently controlled double-acting horizontal jacks at fascia girders
- Saddle assembly connected to guide channel by means of (3)-7/8”Ø pins
- Removed a section of channel flange to clear low fascia beam only
- Horizontal jack stroke required to be 48” minimum in order to slide past the removed section of channel flange
SLIDE OPERATIONS
CONSTRUCTION INFORMATION
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- Traditional design-bid-build
- Contractor – Davis Construction, Inc.
- Contract amount – $8,654,000 (entire project)
- Engineer’s estimate – $8,535,000 (entire project)
- Cost of bridge over railroad – $3,955,000
- Cost related to superstructure slide – $1,944,000
SCHEDULE

• Construction letting date – December 5, 2014
• Start construction – March 18, 2015
• Traffic shifted – August 14, 2015
• Road closed – Friday, November 13 at 7 PM
• Vertical jacking – Friday, November 13 at 11 PM
• Bridge slide – Saturday, November 14 from 1 AM to 10 AM (slid approximately 100’ in 9 hours)
• Pour approach slabs – Saturday, November 14 at 2 PM
• Road opened to traffic – Monday, November 16 at 6 PM
LESSONS LEARNED
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• High-capacity steel roller system worked very well
• Actual static friction approximately 0.034 (recommend designing for 0.07)
• Use conservative design
• Draw everything in plan and elevation views at all the stages of construction, especially with skewed bridges
• Survey and measure using different methods, to confirm fit-up
• Detail bridge to account for construction tolerances (pin holes could have been bigger)
LESSONS LEARNED

- Specifications should address weather conditions during slide and having an action plan
- Placement of hydraulic lines
- Prefer hinge point of hydraulic jack saddle to have been per plan
- Require hydraulic jack manufacturer provide an on-site representative during slide to trouble shoot any issues
- For a single span, design to be moved by one jack if possible, but still specify two on the plans
LESSONS LEARNED

• Extend channel guide out long enough to store roller at completion of slide

• Temporary road drainage needs to be analyzed

• Require template when drilling holes in beam flanges or require rollers to be shipped to beam manufacturer

• Designers should visit site periodically during construction
CONFLICT WITH RAILING
Questions?