M-100 over CN/GTW Railroad

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Photo by MDOT Photography Unit
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’
PROPOSED BRIDGE

• 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
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
SLIDING 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
SLIDING OPERATIONS

- 13/16 X 1 7/8"
- SLOTTED HOLE (TYP.)
- CUSHION PAD
- FILLER PLATE
- TOP PLATE
- C10X30 CHANNEL GUIDE
- BOTTOM OF CHANNEL GUIDE & TOP OF PERMANENT ABUTMENT & TOP OF TEMPORARY ABUTMENT
- 1/8" CLEARANCE (TYP.)
- BOTTOM FLANGE
- ROLLER GUIDE ASSEMBLY
- 11" MAX
- 1 1/16"
- 11 3/8"
- 2 3/4"
- 5 1/2" MAX
- Varies

Michigan Department of Transportation and AECOM
High-capacity steel roller with guide rollers under fascia beams

High-capacity steel roller under interior beams

Both photos by MDOT Photography Unit
SLIDING 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
SLIDING 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
SLIDING OPERATIONS
CONSTRUCTION INFORMATION

- Traditional design-bid-build
- Contractor – Davis Construction Company
- Contract amount – $8,654,000 (entire project)
- Engineer’s estimate – $8,535,000
- Cost of RR bridge – $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

- 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
• Verify vertical jack reactions at fascia beams
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
Questions?