Case Study of Fulton 392.9:
Changing out a Double Track Through Plate Girder (TPG) Span crossing over a Double Track Mainline

Kevin R. Day
CN, Manager of Structures
2151 North Mill Street
Jackson, Mississippi 39202
Telephone: (601)-914-2647
Facsimile: (601)-592-1753
ABSTRACT

Over the weekend of September 9-10, 2006, the Canadian National (CN) engineering team successfully completed a challenging change out of a double track through plate girder (TPG) span on the Fulton Subdivision in Memphis, Tennessee. The new 41-foot TPG span replaced the vintage 1907 steel span crossing over the Burlington Northern Santa Fe (BNSF) double track mainline. The project was broken into three phases to allow for the least disruption to traffic on both railroads.

- Phase I – September 9 from 22:00 to 06:00
  - Removal of the east half of the existing span (Track 2). Operations were maintained on the west track. This phase included a one-hour track outage on the BNSF tracks for span removal.
  - Concrete abutment repairs and modifications.

- Phase II – September 10 from 06:15 to 16:45
  - Removal of the existing west track span.
  - Completion of remaining concrete abutment repairs and modifications.
  - Setting up the 500-ton hydraulic crane on the BNSF tracks for installation of the new double track steel span.
  - Track work to return the west track of the bridge to service.

- Phase III – September 10 from 16:45 to 19:15
  - Track work to return the east track of the bridge to service
  - Return both the CN and BNSF mainlines to full operation

The total amount of time to complete the project was twenty-one hours and fifteen minutes. Each planned outage on both the CN and BNSF was completed within fifteen minutes of the proposed schedule. Overall, it was a successful and safe project.
INTRODUCTION

In early 2005, the CN structures department began a review of their 2006 capital bridge program. One of the projects slated for construction in 2006 was a double track through plate girder (TPG) span located at milepost 392.9 on the Fulton Subdivision in Memphis, Tennessee. It carries the CN double track mainline Fulton Subdivision over top of the Burlington Northern Santa Fe (BNSF) double track mainline Thayer Subdivision. The existing double track, open deck TPG steel structure was put into service in 1907 (Figure 1). The bridge was rated as deficient for 286,000 pound loading in April of 2002 by the CN bridge rating group. Onsite testing was performed to confirm actual stresses in the bridge. The results of the testing showed that the actual stresses were greater than the theoretical stresses used to rate the bridge in 2002. A second assessment was performed on the bridge in July 2004, and it confirmed the span needed replacement. The riveted structure was also scheduled for a new tie deck as part of the 2005 capital bridge program. Considering the information obtained through the rating assessment and field testing, and the cost to replace the tie deck, the CN structures group decided to replace the existing structure with a new 41-foot double track, ballast deck TPG span.

In the summer of 2005, the CN bridge department began the in-house design of the new TPG span. Several different span options were considered, including the option of using two independent spans. However, the need to minimize track time on both railroads and control the cost of the project led CN to select a structure similar to the existing TPG with a common girder. The new span was designed to American Railway Engineering and Maintenance of Way (AREMA) 2005 specifications, including a live load of E-90 plus
impact. The out-to-out length of the new span was 41-feet, 4-inches (Figure 2), with a skew length of 53 feet. The lifting weight of the new span, including walkway and bearings, was approximately 160,000 pounds. The concrete abutments supporting both ends of the existing TPG were in good condition. Minor concrete modifications were necessary to match the increased height of the new span, but the good condition of the existing abutments allowed CN to avoid major costs associated with replacing the substructure. Span fabrication was issued for tender in January 2006. Fabrication of the span was awarded to North Texas Steel in Dallas, Texas, with a scheduled delivery date of mid-August.

CONSTRUCTION OPTIONS

With fabrication underway, the CN structures team reviewed the various construction options and finalized the sequencing of the installation plan. The main objective for removal of the existing span and placement of the new span was to minimize the impact to operations for both railroads. In reviewing the site location, CN decided the best access point for unloading and working on the new span was the southeast quadrant of property relative to the crossing of the BNSF and CN railroads (Figure 3). This location required clearing and grubbing, but it provided good access and enough room for a large crane to sit and perform all required lifts. Once the location for mobilizing a crane was determined, the CN structures team reviewed two possible options for placing the new span.
Option One – Place New TPG as One Unit

Option one was to set the new TPG span as one unit, with all steel connections completed prior to setting the span. The advantages of this option were making one lift for the new span and reducing the number of track closure windows for the CN. The disadvantages of this option were the size of crane required to make the lift of the new TPG in one piece, and the precision scheduling required for making the work windows compatible for both railroads.

Option Two – Place the TPG as Two Units

Option two was to set the new TPG span as two units, with all steel connections between the floor beams and center girder for one side of the steel span completed under traffic. The advantages for this option were a smaller capacity crane to perform all lifts and less overall track window requirements for CN. The main disadvantage of this option was the increased amount of track windows on BNSF to support steel work being performed underneath the span once it was set in place. CN estimated six to eight hours uninterrupted time to complete all floor beam to girder connections and bolt the steel ballast plate to the top of the floor beams. Realizing BNSF runs approximately forty trains per day on their line, obtaining the necessary track time to complete the steel work in a timely manner was remote. Additionally, the second track for CN would not be put into service until all steel connections were made. This solidified the decision to choose option one.
CONSTRUCTION CHALLENGES

With the plan finalized, the CN structures team outlined the challenges associated with completing the project with the least amount of disruption to rail traffic. In consultation with the transportation group, the span removal/installation was scheduled for the second weekend of September 2006 to avoid increased traffic from the start of grain season.

With the general construction sequence determined and the project dates set, the CN structures team started preparing for the workblock.

There were multiple construction challenges involving outside parties, which often times requires extra effort and attention. For this project, these complexities included:

- Coordination with the BNSF for periodic track outages on their mainline during span removal and installation.
- Overhead utilities (electric, phone and cable TV) passing through the construction zone.
- Fiber optic cable attached to the existing bridge that needed to be supported temporarily, and then transferred to the new span.
- BNSF wayside signals that needed to be protected and avoided during construction.

The BNSF structures group was contacted in May 2006 to discuss the construction plan. Following an onsite meeting with their personnel, BNSF bridge personnel were satisfied with the scope of the project and requested that all necessary track outages on their railroad be sent for approval a minimum of two weeks in advance.
The electric company was contacted in April 2006 to begin the process of relocating the poles that were within construction areas. Since the electric, phone and cable TV companies all used the same poles in this area, each company was required to perform work at the site prior to, and following placement of the new poles. With three utility companies involved, this process took approximately five months to complete, with final relocation of all utilities finished by the last week of August 2006.

The fiber optic company with a cable attached to the existing steel structure was contacted in April of 2006. Their engineering consultant produced a drawing to temporarily support the cable using a W 6 x 25 beam held in place by pipe clamps, and tied down to the existing concrete abutments. The temporary supports were placed at the far east end of the abutments. This allowed the cable to be out of direct conflict with removal of the existing span and placement of the new span. The fiber cable, however, was still in the construction area, and required careful attention when making lifts. Shifting of the fiber optic cable was completed by July 2006, with final placement of the cable on the new span the third week of September 2006.

CONSTRUCTION PROCEDURE

Preparatory Work

The CN structures group began laying out their construction procedure for completing the project in April 2006. Any work that could be completed prior to major workblock was done ahead of time. Concrete abutment height adjustments were completed in July 2006
by CN forces. The new span was delivered to the site on July 29, 2006 in two pieces (Figure 4). All steel work, including connecting the girders, bolting down the cover plate and placing the walkway brackets, was done between August 22 and September 7. Two sixty-foot track panels were built during the week of August 29, to replace the open deck track panels used on the existing steel span. The BNSF track department placed crossing timbers between their tracks on the east side of the CN bridge during the week of August 29 in preparation for positioning the 500-ton hydraulic crane to set the new double track TPG span. The day before the major workblock, the entire work group, including CN bridge, track and transportation forces, and the crane operator from Barnhart Crane, got together for a job briefing and safety meeting. All aspects of the project were reviewed to ensure all employees working on the project understood their roles and responsibilities, especially pertaining to their personal safety. Once the preparatory work was completed, it was time to proceed with the major workblock.

**Major Workblock**

To minimize the impact on train operations, the CN structures group put together an aggressive construction plan. The total amount of time scheduled to complete the workblock was twenty one hours and fifteen minutes. To simplify the work procedure, the detailed construction sequencing was divided into three phases. Each phase was broken down into one-hour increments to determine the impact on both CN and BNSF operations, and to show the exact times that cooperation would be needed from BNSF (Figure 5). In consultation with transportation, CN determined the optimal start time for the window to be 22:00 on Saturday, September 9. Since there were two major phases of bridge work, CN bridge forces were divided into two work groups, one beginning at
22:00 to complete phase one, and a second group beginning at 06:00 to complete phase two. Barnhart Crane followed suit and provided two operators, one for each phase.

Phase One

Phase one was eight hours in duration. It started with a job briefing at 22:00 on Saturday, September 9\textsuperscript{th}, and lasted until 06:00. CN track #2 (east track) was closed during this phase of the project. The main work tasks accomplished during phase one were:

- Cut the existing double track bridge between the west edge of the floor beams for the east track and the shared center girder (Figure 6), allowing CN to remove the east half of the existing bridge (Track 2) while maintaining operation over the west track.
- Removal of the east track section of the bridge (Figure 7), including a one-hour outage on the BNSF tracks for crane access and span removal.
- Cored anchor bolt holes and levelled the east side of both the north and south abutments with grout.

Phase two

Phase two was 10.5 hours in duration. It started with a job briefing at 06:15 on Sunday, September 10\textsuperscript{th}, and lasted until 16:45. Both mainline tracks on CN were closed during this phase of the project, and there were two significant track outages on the BNSF double track mainline for span removal and installation. The main work tasks accomplished during phase two were:

- Removal of the existing west track span (Figure 8), including a one-hour outage on BNSF tracks for crane access and span removal
- Cored anchor bolt holes and levelled all remaining areas of both the north and south abutments with grout. (Figure 9)
- Positioned the 500-ton hydraulic crane onto the BNSF mainline for installation of new double track steel span (Figure 10 and 11), including a 2.5-hour outage on BNSF tracks
- Installed a track panel on the west side of the new double track TPG, dump ballast and surface, restoring west track (Track #1) to service.

**Phase three**

Phase three was 2.5 hours in duration. It started at 16:45 and lasted until 19:15 on Sunday, September 10\(^{th}\). The west track for CN was in service during this phase. The main work tasks accomplished during phase three were:

- Installing the track panel on the east side of the new TPG span
- Dumping ballast, surfacing and restore east track (Track #2) to service

Each phase of the project was completed according to the schedule. BNSF met all required work windows requested by CN within fifteen minutes of the plan. There were no unexpected delays to CN or BNSF traffic, and there were no incidents or injuries to report.

**CONCLUSIONS**

There were many factors associated with this project that made it challenging. As with all construction activities, it is wise to review the successes and failures to determine areas for improvement on future projects. Some of the lessons learned during this project included:
• Planning and preparation is one of the most important steps in being successful, especially when there are many entities involved with completing the work. Putting together an action plan six months in advance for a project of this magnitude proved to be the right amount of time to make sure each preparatory step was completed ahead of the major work window.

• Making contact with all utility companies that affect construction as soon as possible is imperative. For this project, we contacted the affected utility companies in April 2006. It took five months, the last of which involved intense follow up, to have the utilities moved.

• Opening communication with affected third party companies allows each group to provide input on the final construction plan. Discussing the construction plan with BNSF early on allowed enough time for the schedule to be approved by the proper operating personnel, and it allowed local track forces to accomplish all necessary pre-work prior to the major work window.

• Holding a pre-workblock job briefing and safety meeting provided all workers the opportunity to understand their role and responsibility during the work window. Discussing the specifics of the plan provided a sense of direction for the entire team, and an expectation of the overall objective, to complete the project safely and on schedule.

This project was a success due to the effort put forth by the employees, both in preparation and during the major workblock. Each employee understood the magnitude of the project and provided their best effort to make it successful. BNSF also cooperated
by meeting all planned outages for their mainline within fifteen minutes of the proposed schedule. Preparation and attention to detail prior to the large work window were two keys in making the project run smoothly. Executing the plan brought the project to fruition.
ACKNOWLEDGEMENTS

I would like to thank all the people who contributed to making this project a success including: the CN structures team on the Memphis and Gulf Zones – Eric Gagnon, Allen Dunn, Terry Ellington, Jack Burrell and the bridge crews completing the work, Greg Roberts, Sandro Scola, the CN design team – Christophe Deniaud, George Nowak, Peter Willette and Jim McLeod, the CN track department – Monte Chapman, Clarence Whitehill and the track forces that supported the work, CN transportation – Derek Taylor and CN service design for coming up with a workable schedule, the BNSF railroad, especially Jim Renschler for his assistance in obtaining the necessary work windows from BNSF operations, and Dave Crockett from Barnhart Crane. This venture was truly a team project. The hard work and dedication of these individuals, and all personnel involved with the project, made it a precision engineering success.
LIST OF FIGURES

Figure 1 – Photograph of existing double track TPG span ..............................................
Figure 2 – General arrangement drawing for CN Bridge Fulton 392.9 .............................
Figure 3 – Photograph of southeast quadrant of project site............................................
Figure 4 – Photograph of the new span being unloaded at the project site ......................
Figure 5 – Construction schedule for the major workblock............................................
Figure 6 – Photograph of the floor beams being cut to allow the east half of the existing bridge to be removed........................................................................................................
Figure 7 – Photograph of the east half of the existing bridge being removed.................
Figure 8 – Photograph of the west half of the existing bridge being removed...............  
Figure 9 – Photograph of the anchor bolt holes being cored in the south abutment.......  
Figure 10 – Photograph of the installation of the new TPG span .................................
Figure 11 – Photograph of setting the new TPG span in place ..................................
Figure 1 – Photograph of existing double track TPG span
Figure 3 – Photograph of southeast quadrant of project site

Figure 4 – Photograph of the new span being unloaded at the project site
<table>
<thead>
<tr>
<th>BNSF Window</th>
<th>CN Work Block</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work in coordination with trains</td>
<td>East Track</td>
</tr>
<tr>
<td>Hard window</td>
<td>Unbolt rail splices</td>
</tr>
<tr>
<td>22:00</td>
<td>East Track</td>
</tr>
<tr>
<td>22:30</td>
<td>Cut Floorbeams</td>
</tr>
<tr>
<td>01:30</td>
<td>Pick East Half Span out</td>
</tr>
<tr>
<td>02:30</td>
<td>Clean &amp; level bridge seat</td>
</tr>
<tr>
<td>04:00</td>
<td>Position and drill new holes for anchors</td>
</tr>
<tr>
<td>06:00</td>
<td></td>
</tr>
<tr>
<td>06:15</td>
<td>East &amp; West</td>
</tr>
<tr>
<td>06:45</td>
<td>Track</td>
</tr>
<tr>
<td>07:45</td>
<td>Clean &amp; level bridge seat</td>
</tr>
<tr>
<td>09:15</td>
<td>Position and drill new holes for anchors</td>
</tr>
<tr>
<td>10:45</td>
<td>Lift &amp; Install new span in place</td>
</tr>
<tr>
<td>13:15</td>
<td>Install cover plate on both tracks</td>
</tr>
<tr>
<td>14:15</td>
<td>Install the West track pannel</td>
</tr>
<tr>
<td>15:15</td>
<td>Dump Ballast &amp; Surface West track</td>
</tr>
<tr>
<td>16:45</td>
<td></td>
</tr>
<tr>
<td>16:45</td>
<td>East Track</td>
</tr>
<tr>
<td>18:00</td>
<td>Dump Ballast &amp; Surface East track</td>
</tr>
<tr>
<td>19:15</td>
<td></td>
</tr>
<tr>
<td>19:15</td>
<td>End of Work Block</td>
</tr>
</tbody>
</table>

**total** | 21.25 hrs

Figure 5 – Construction schedule for the major workblock
Figure 6 – Photograph of the floor beams being cut to allow the east half of the existing bridge to be removed

Figure 7 – Photograph of the east half of the existing bridge being removed
Figure 8 – Photograph of the west half of the existing bridge begin removed

Figure 9 – Photograph of the anchor bolt holes being cored in the south abutment
Figure 10 – Photograph of the installation of the new TPG span

Figure 11 – Photograph of setting the new TPG span in place