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Strauss Heel Trunnion Repairs Jacksonville Bridge

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Introduction

The Strauss Heel Trunnion Bascule bridge in downtown Jacksonville, Florida is owned by the Florida East Coast Railway (FEC) and has been in regular use and operation since the 1920's. Over the years, major and minor repairs have been performed to the structure, as well as the electrical power, control and machinery systems, extending the bridge's service life. This paper will highlight some recent repairs performed on key portions of the span drive machinery and describe the design constraints and construction challenges and successes during the repairs.

Bridge Information

The Jacksonville Bridge (see Photograph 1) is owned, operated, and maintained by FEC, headquartered in Jacksonville, Florida. Founded by Henry Flagler, FEC dates back to 1895 and still operates under its original name. The movable span of the Jacksonville Bridge is a Strauss Heel Trunnion Bascule bridge, built in 1925, and is 216' long, making it one of the longest bridges of this type (see Figure 1 for general elevation). The bridge carries two tracks across the St. Johns River which requires the trusses to be fairly large and heavy, resulting in large span drive machinery components. The span drive machinery is mostly original, all open gearing and bronze journal bearings (see Figure 2). The control system has been updated, and the two 225 hp motors are controlled by a modern variable frequency drive. This allows for smoother operation, decreasing the sharp starting and stopping loads and extending the life of the machinery components.

Photograph 1 - General view of FEC Jacksonville Bridge

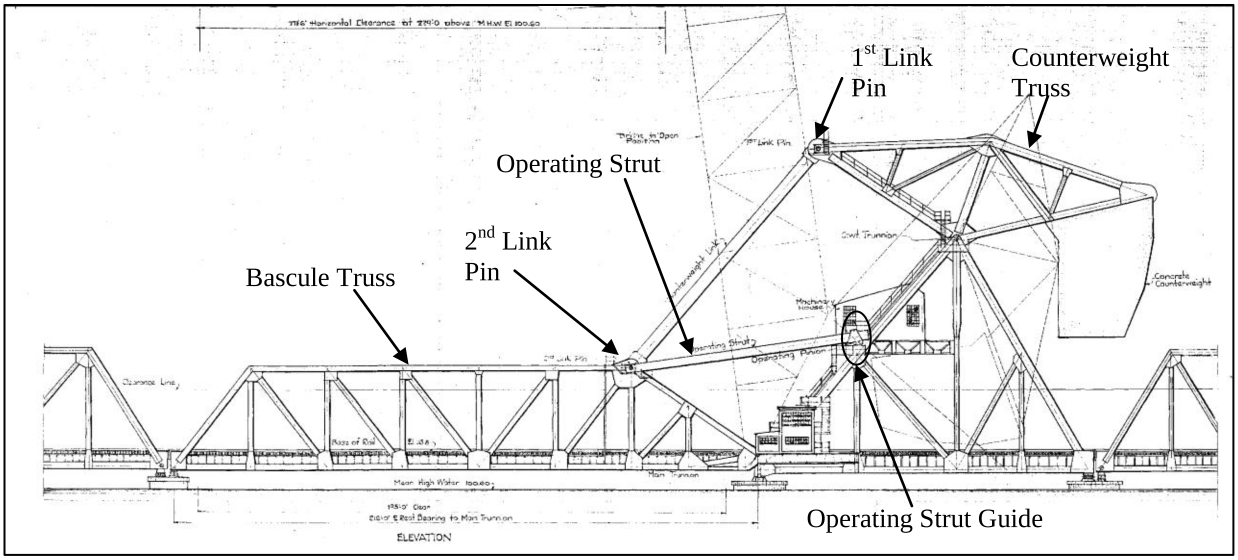


Figure 1 - General elevation of FEC Jacksonville Bridge

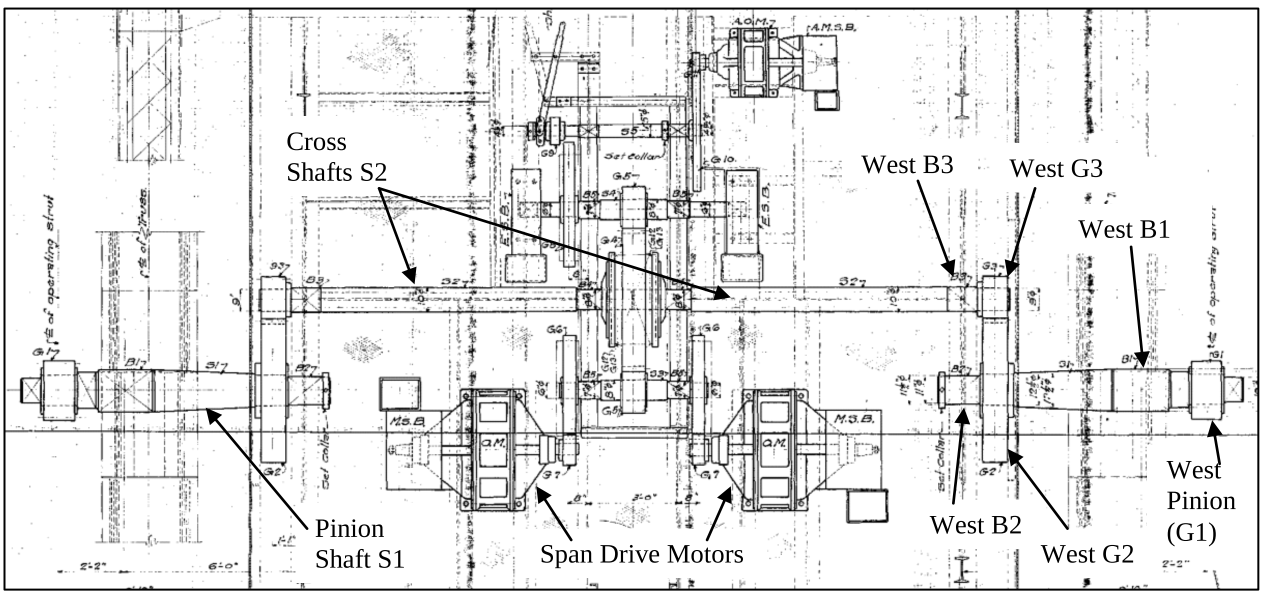


Figure 2 - Layout of existing span drive machinery

West Bearings, Shafts, Gears, Operating Strut Guides

While the majority of the machinery is in serviceable condition, several issues became troublesome recently. In August 2014, FEC called Modjeski and Masters, Inc. (M&M) to investigate the west main pinion bearing (B1), which appeared to have an excessive amount of clearance. Upon inspection, the clearance was indeed excessive at just over 1/2" on the 17" diameter journal (see Photograph 2 and Photograph 3), and concern was raised for the condition of the bronze bushing at the base of the bearing, which was originally 7/8" thick.

Photograph 2 - General view of West Bearing B1

Photograph 3 - Excessive clearance at West Bearing B1

The arrangement of the machinery at B1 does not allow for easy disassembly of the bearing and pinion shaft (S1). The shaft extends through the machinery house wall and the operating strut is supported within the Operating Strut Guide (OSG) on the outboard end of the pinion shaft. So inspection of the lower bearing half was not feasible without mobilizing large construction equipment and a marine navigational outage. This arrangement is common to all Strauss bridges of this type. Since the bridge was still operating without issue for the time being, a decision was made to create repair plans for the immediate future and operate the bridge on a fixed schedule until the repairs were made.

Design Considerations

The scope of the West B1 repair was a balance of rail and marine traffic outages, lead times for parts and equipment, and cost. While reinstalling some existing parts would reduce cost and lead time, it may require longer traffic outages, so the parts to be replaced included more than just the parts that may have been damaged. Also, interfacing new machinery parts with existing parts usually requires some disassembly to allow precise measurements to be taken on the existing parts. These measurements are then used to make the final cut on the new parts so they fit properly once everything is assembled. The problem is the time required between disassembly of existing components to take measurements and installing the new parts. Sometimes putting the old parts back together in the interim is not feasible, so replacement of additional parts becomes more time and cost efficient.

The bushing for the West B1 Bearing was the primary concern and was first on the list of items to be replaced. The condition of the cast housing below the bushing was also unknown, and the new bushing must be fitted to the housing, so it too was planned to be replaced. The OSG is not easily disassembled from Shaft S1, and the condition of the Shaft S1 in the area of B1 was unknown. Also, the journal areas of the Shaft S1 within the OSG were unknown, as well as the fits between those journal areas and their bushings. The OSG "bounced" quite a bit during span operation, and there were signs of over-engagement between the main pinion and rack gear (the rack gear is mounted to the underside of the operating strut). This indicated the lower roller bushings in the OSG may be worn, allowing the strut to rest directly on the pinion instead of the rollers.

With the observed wear and deficiencies noted in the OSG, pinion, shaft and bearing, it was decided that all of these items would be replaced. Further investigation of the inboard pinion shaft Bearing (B2) revealed loose mounting bolt holes in the structure, which allows the bearing to move position over time. This bearing was added to the list of replacement items, as well as, Gear G2, since the teeth had signs of wear and this gear must be fitted to the new pinion shaft.

The total list of items to be replaced on the west side of the machinery included the Operating Strut Guide (OSG), Pinion Shaft (S1), Main Pinion (G1), Bull Gear at the inboard end of the Pinion Shaft (G2), and both Pinion Shaft Bearings (B1 and B2). With this plan, the new parts would interface with the existing parts at the rack/pinion mesh, and G2/G3 gear mesh. All parts between these interfaces would be new.

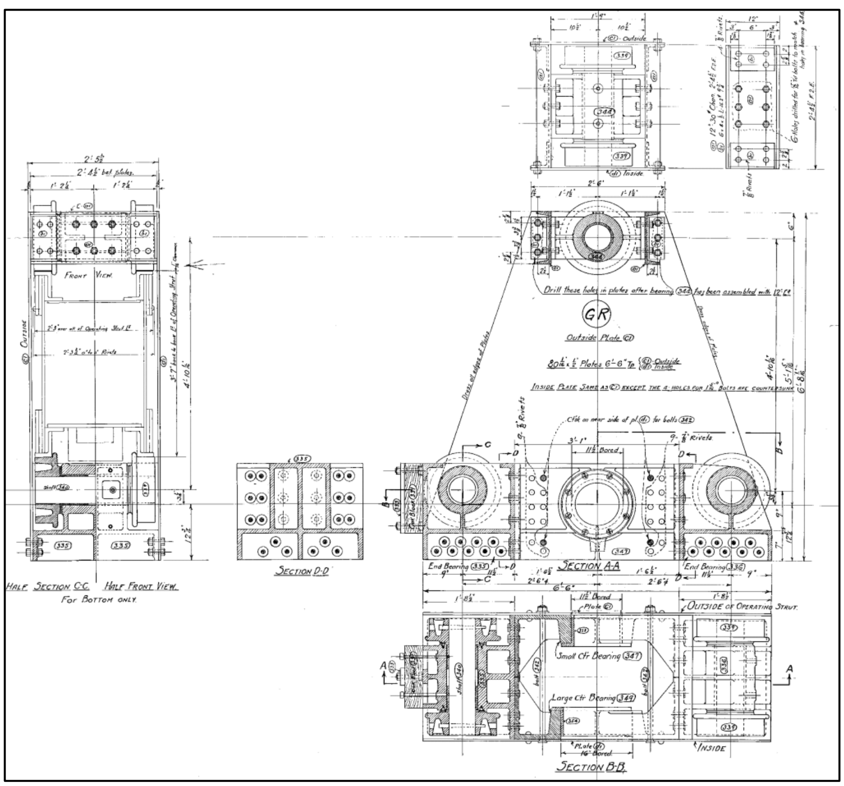


Figure 3 - Original Operating Strut Guide Assembly (OSG)

The new shaft and gears were to be fabricated as in-kind equivalents to the existing parts, using the original shop drawings to make the new parts. The two bearings were redesigned as weldments to be drop-in replacements for the existing cast bearing housings. The component that was changed more significantly from the original design was the OSG (see Figure 3). The existing guide assembly was pieced together onto the pinion shaft with the pinion. The inboard half was installed first, then the pinion was put on the shaft, then the outboard half installed and the assembly was fastened together. This cumbersome installation process would increase the field assembly time of the new parts, so the intent of the new OSG design was to simplify the installation process.

The first effort was to simplify the OSG-to-shaft installation. Instead of splitting the OSG vertically into inboard and outboard halves, the lower housing that is mounted on the pinion shaft was split horizontally, similar to a pillow block bearing arrangement. The lower housing rests on top of the pinion shaft, surrounding the pinion, and two bearings caps are installed from below the pinion shaft to attach the OSG to the shaft (see Figure 4).

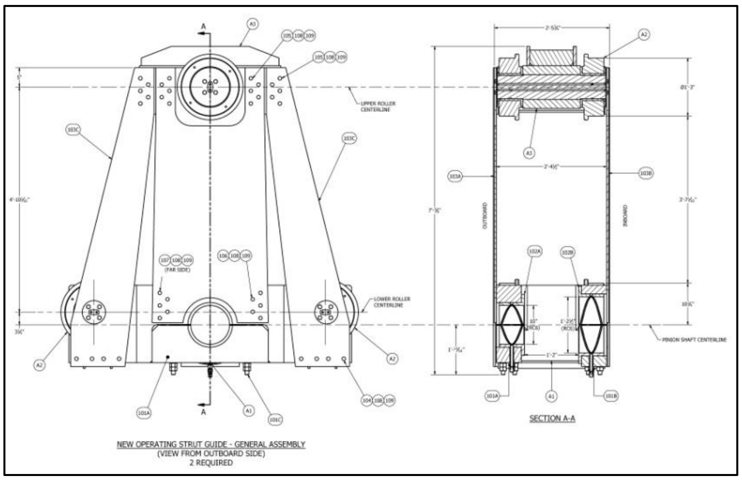


Figure 4 - New OSG Assembly

The next effort was to ease guide roller bushing replacement. The original OSG had bushings in the upper and lower housing portions, and the rollers were fixed to their axles, which rotated within the bushings. This made the roller bushings inaccessible to inspection and replacement. The new design placed bushings within the rollers, with axles fixed to the OSG upper and lower housings. The rollers could then be placed onto the ends of the axles and keeper plates installed to hold each roller on its axle. Also, the original OSG had no provision for adjusting the engagement between the rack and pinion gearing. To accomplish this adjustment, one of the lower roller shafts was made eccentric. Rotating the shaft within the lower housing adjusted the center of the roller vertically, which dictates the vertical position of the rack gear, with respect to the pinion (see Figure 5).

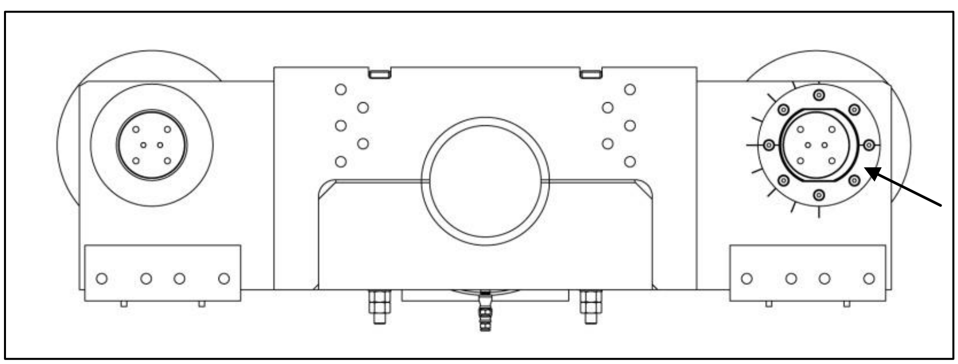


Figure 5 - OSG Lower lousing the eccentric shaft

Another goal was to add adjustability of the clearance at the upper rollers. As rollers or operating strut flanges wear, the clearance between the upper rollers and the operating strut increases, allowing the rack and pinion gears to disengage somewhat during operation (due to rack/pinion separating forces pushing the operating strut upwards). The original guide assembly had the upper housing attached to the side plates with horizontal bolts. This did not allow vertical adjustment of the upper roller. The new design incorporated vertical bolts with shims that allowed the vertical position of the upper housing to be adjusted.

In the end, the original operational intent of the guide assembly was retained, but maintainability and ease of adjustment and future part replacement was improved (see Figure 6).

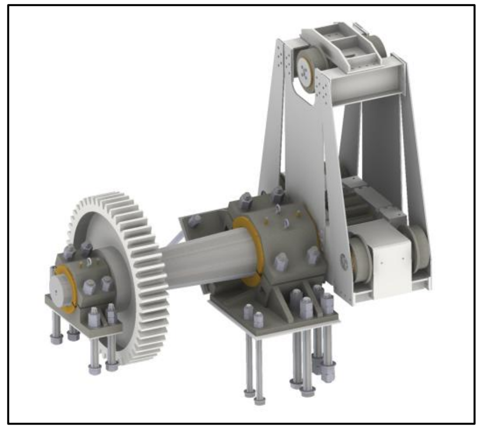
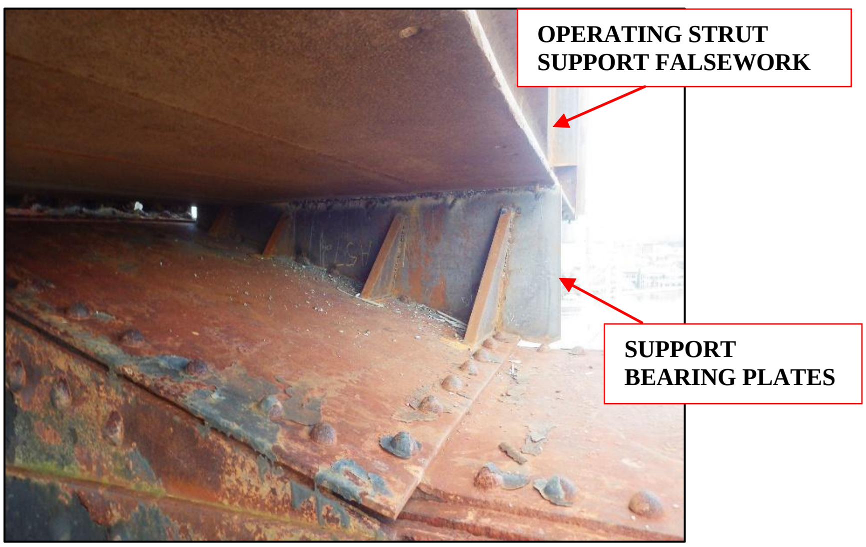


Figure 6 - General view of new components

West Pinion Assembly Repair Pre-Outage

The Project Team fully understood that it was critical to complete the repairs in a timely fashion. Due to the condition of the West Bearings B1 and B2, the decision was made to limit the number of openings per day until the new components were installed. The waterway users in the Jacksonville area were being affected by the limited openings awaiting these repairs. In order to assure the timely success of the repairs, the pre-outage planning was critical. Scott Bridge Company (SBC) developed a detailed step by step plan for performing the outage. Then, a list of tasks was created that could be performed prior to the outage.



Photograph 4 - View of the bearing plates that were welded to the top of the counterweight truss to support the operating strut falsework

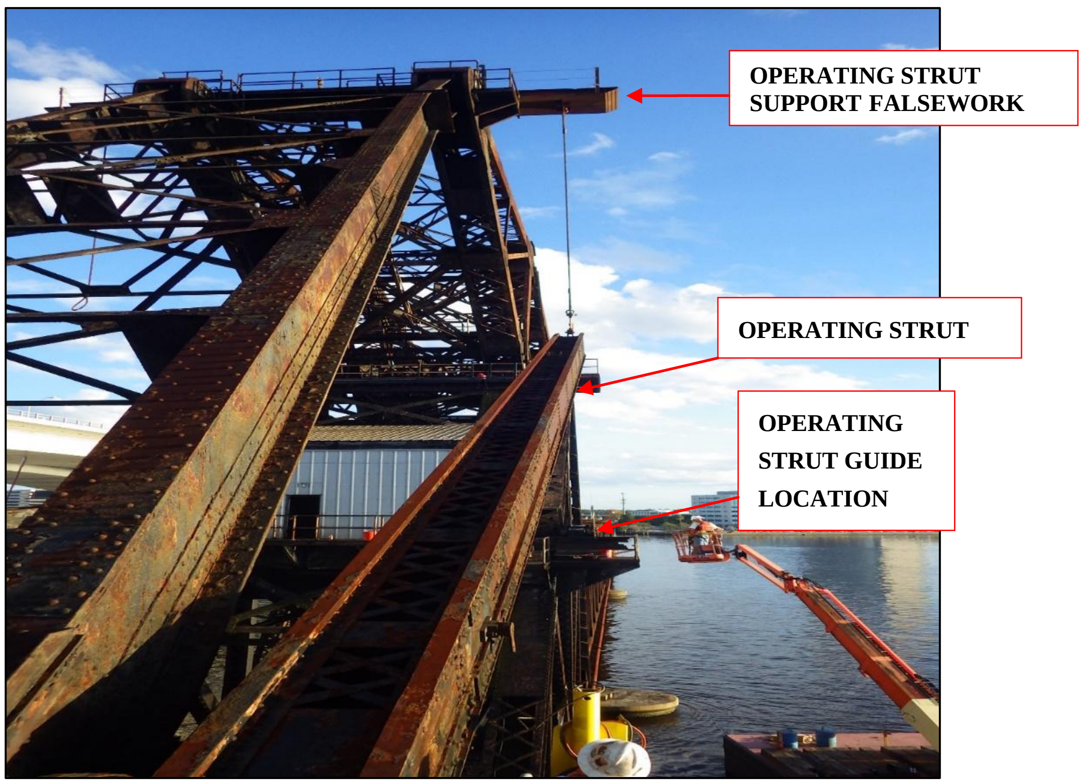
One of the biggest challenges of this repair was determining how to handle the removal of the existing operating strut. Each operating strut weighs approximately 70,000 lb. The operating strut would have to be removed from its current location in order for the pinion shaft to be removed. Multiple methods were investigated. One option was to remove the operating strut from the bridge and place it on a barge until all repairs were completed. The problem with completely removing the operating strut was that the connection of the strut to the truss at the 2nd link is extremely complicated. A pin connects the truss, operating strut, and tower truss. Removal of this pin would be extremely risky and would take more time during the outage. The method that was ultimately chosen for relocating the operating strut was to attach falsework to the top of the counterweight truss (see Photograph 4 and Photograph 5). The South end of the operating strut (which is normally supported within the OSG) would then be lifted and attached to the falsework above (see Photograph 6). The falsework was fabricated offsite prior to the outage. The falsework would sit on plate brackets that were welded to the counterweight truss. Crews were able to attach the plate brackets to the truss prior to the outage. By welding these brackets ahead of time, considerable outage time was saved. SBC mobilized a

Photograph 5 - View of the falsework installed at the top of the counterweight tower to support the operating strut during the repairs.

Manitowoc 2250, a 330 ton capacity crane, located on a crane barge to the project site to perform all of the required lifting.

The B2 bearing is located inside the machinery house, while the B1 bearing is located outside the machinery house. In order to remove these two bearings and the pinion shaft, modifications would have to be made to the West wall of the machinery house. Crews dismantled a portion of the wall during pre-outage setup. A temporary enclosure was installed to allow quick access during the outage.

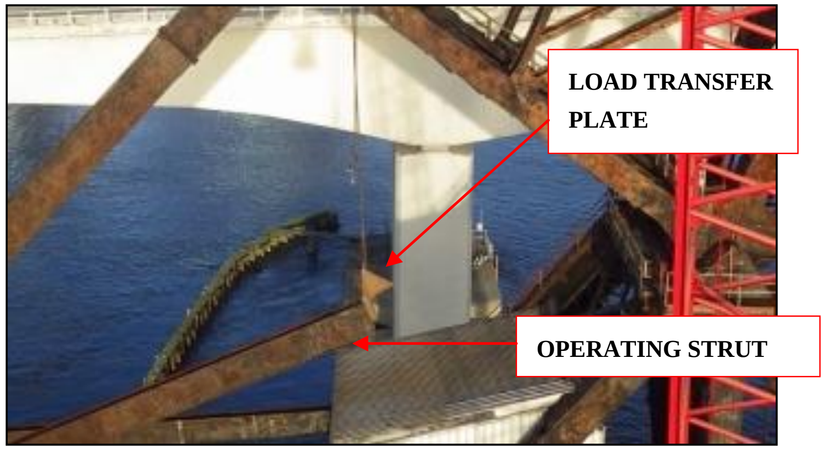
In the final days leading up to the outage, crews assembled all the tools, accessories, and rigging that would be necessary for the outage. The machinery system is equipped with auto-greaser supply lines. The supply lines that connected to the components being replaced were match marked and removed from service.



Photograph 6 - View of the operating strut hanging from the falsework

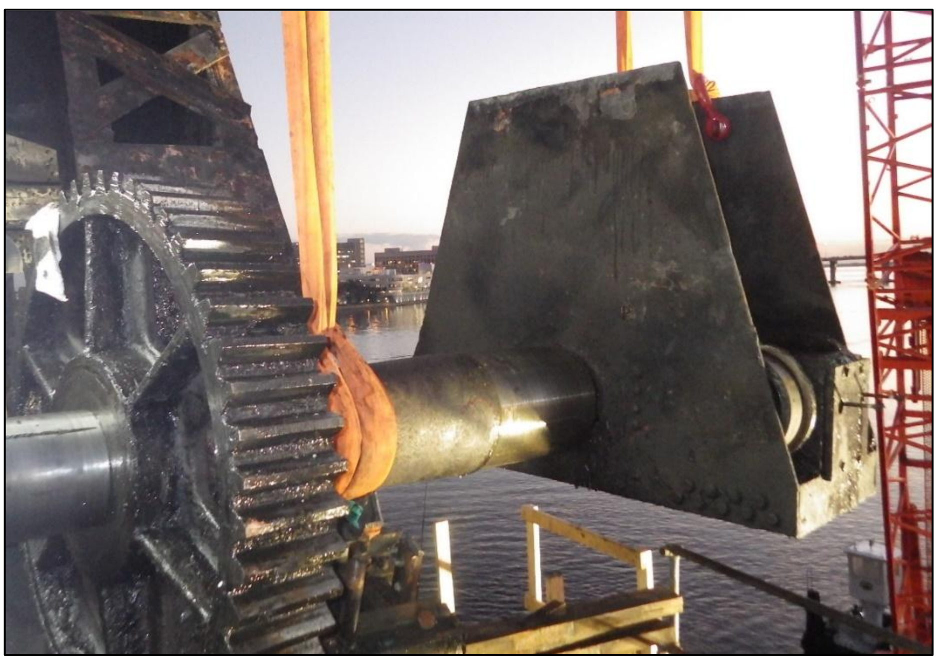
West Pinion Assembly Repair Procedures

The repairs were to be performed during a seven day outage. Once the outage began, crews went to work installing the falsework for supporting the operating strut. At the same time, other crews removed the temporary enclosure on the west wall of the machinery house.



Photograph 7 - View of the load transfer plate used to support the operating strut from the falsework

When the operating strut support beams were in place, blocking was installed beneath the west OSG to address a concern that the carriage may rotate as it was dismantled. After blocking the OSG, cutting torches were used to remove the top portion of the assembly. Once the top of the OSG was removed, the operating strut was then lifted out of the assembly. A specially designed spreader plate was used to lift the operating strut. The plate would allow for the load to be transferred in the air from the crane rigging to the rigging attached to the support beam (see Photograph 7). Once the operating strut was attached to the support beam above, crews could focus on removing the existing machinery components.



Photograph 8 - View of the existing pinion shaft being removed from the structure. Note that the carriage assembly is being removed at the same time.

The bearing caps at B1 and B2 were removed. Then, the west pinion shaft, with the OSG attached, was removed (see Photograph 8). The fact that the pinion shaft extended through the west wall of the machinery house made the rigging challenging. An overhead hoist was used inside the house to assist with lifting the shaft out of its original position. Once the shaft was passed through the west wall, the crane lifted the shaft away from the structure and lowered it to the barge deck. The tight clearance on some of the B1 bolts made it very difficult to remove the base. An arc gouger had to be used to remove some of these bolts.

Photograph 9 - View of the top portion of the OSG being installed.

Once all of the existing components that were to be replaced had been removed from the structure, crews began preparing the existing support structures for the installation of the new components. After the bearing support bases were sufficiently cleaned, new stainless steel shims were installed on top of the support bases. The new B1 and B2 bearing bases were set into position. Temporary all-thread bolts were installed at the bases to lock in their position during the installation of the new pinion shaft. Next, the new pinion shaft was installed. Extreme caution was taken as the new G2 gear meshed with the existing G3. Again, the alignment was checked, including the gear mesh between G2 and G3. As soon as the alignment was accepted, crews began the final drilling and reaming of the bolt holes at B1 and B2. Only one temporary bolt was removed at a time. The new bolt would be installed prior to proceeding to the next hole, to retain alignment. During the process of shimming the B1 bearing base, the shims would not stay in place on the side of the bearing that is angled, and the space for the shims was tapered. The angle of the structure did not exactly match the angle of the newly fabricated B1 bearing. Therefore, the Project Team made the decision to use Chockfast Orange epoxy to fill the space between the bottom of the bearing base and the support structure. After all bolts were installed, the new OSG was placed onto the pinion shaft (see Photograph 9).

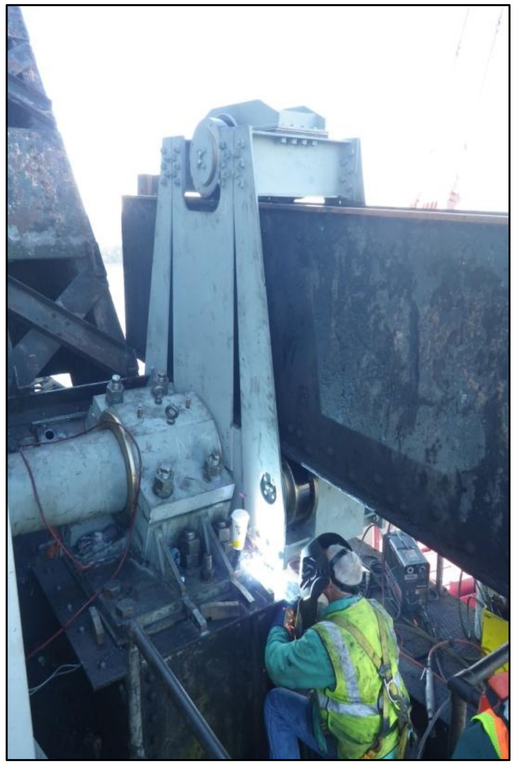
Photograph 10 - C-Hook used to place bearing caps on underside of OSG

A specially designed and fabricated c-hook was used to install the bearing caps on the underside of the OSG (see Photograph 10). These caps have a slight clearance fit on the sides and required careful placement to prevent binding during installation. The new OSG was designed so that the top section could be removed to facilitate installation of the operating strut. Once the OSG was in position, the operating strut was then lowered into position. Installation was completed by installing and adjusting the OSG upper rollers (see Photograph 11). The scheduled outage was from 8:00 a.m. on a Friday to 5:00 p.m. the following Friday. The bridge was returned to service several hours early on the last day of the outage.

Emergency East Pinion Replacement and East OSG Replacement

On September 9, 2014, FECR notified SBC that there was a major failure on the East Pinion G1. The bridge was completely shut down to all boat traffic requiring the bridge to open until the pinion could be repaired or replaced. The pinion had fractured in two places, one being at a keyway, and was no longer able to drive the rack gear (see Photograph 12).

After replacement of the West Pinion Assembly in 2013, SBC planned to take the components to the scrap yard. Fortunately, the components were still at the SBC yard in Opelika, Alabama, when the East Pinion failed. Due to the fact that the East and West Drive Systems are symmetric, the decision was made to install the old West Pinion shaft and gear to the East side. This would be a temporary solution to allow for the bridge to resume limited operation until new components could be fabricated.



Photograph 11 - View of newly installed OSG and Bearing B1

Photograph 12 - View of the damaged pinion gear that was removed from the East drive shaft.

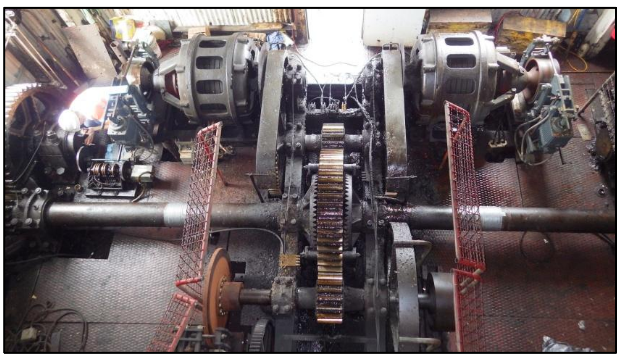
When preparing for the replacement of the West drive machinery components, FEC had ordered two OSG assemblies with a plan to replace the East machinery in the near future. As SBC proceeded with the temporary repairs, fabrication was begun on the rest of the components for East drive machinery.

Once fabrication of the new East components was completed, a seven day river outage was obtained from the Coast Guard to install the components. Similar to the West side, the entire pinion assembly was replaced including the B1 Bearing, B2 Bearing, pinion shaft, G2 and OSG. The outage procedure to replace the East components was the same procedure detailed above for the West components. The outage was completed successfully within the allotted time and the bridge returned to normal operations.

G3 Replacement

Following the replacements of the east and west pinion shafts, which included the G2 gears (large spur gears on the inboard end of the pinion shaft), FEC desired to replace the G3 pinions (pinion mating with G2 gear, refer to Figure 2) which were heavily worn and had experienced some damage over the years (see Photograph 13). The G3 pinions are mounted to the cross shafts, which extend from the differential assembly in the center of the room (see Photograph 14). Some structural bracing members are located above and on the outboard side of the G3 pinions, making removal from the shaft impractical in situ (see Photograph 15). Removing the cross shafts would require disassembling the differential assembly, which is made up of several large gears. FEC wished to avoid removing the structural members and disassembling the differential to replace the G3 pinions, so other replacement methods were investigated.

Photograph 13 - Existing condition of West G3 pinion with new G2 gear



Photograph 14 - View of central differential gearing and cross shafts from above

Design Considerations

Sensitivity to rail and marine traffic disturbances was key in determining the best method to replacing the G3 pinions. In this case, disassembly of the existing parts would have been very invasive to the structure (possibly requiring supplemental supports) or the drive machinery (disassembling the differential). Since this repair was able to be planned further in advance than the east B1 replacement, scheduling and performing the repair in stages allowed the work to be accomplished with replacement of fewer parts and minimal traffic outages. There was the typical issue of where to interface existing parts with new. It was determined that the quickest and least invasive way to replace the pinion was to cut the cross shaft and splice a new shaft/pinion assembly onto the remaining end of the cross shaft. This would allow removal of the existing pinion without disturbing the structure or the differential.

Connecting two shafts together is usually done with some sort of coupling. The cross shaft is

Photograph 15 - Structural bracing members above G3 pinion impede removal supported at both ends in plain journal bearings, with an open gear attached to each end. The load in the gearing applies bending loads at both ends of the shaft, producing a moment that varies along the length of the shaft. Since bending exists in the shaft, a rigid type coupling is required. Due to the direction of the gear loads, the bending moment changes from positive to negative near the middle of the shaft. To minimize the bending that needed to be transferred, the coupling was located near the point of zero bending. However, a typical rigid coupling only has a low capacity for transmitting bending. AREMA recommends coupling hubs be installed onto shafts with a press fit (FN2), which for the 10" diameter cross shaft is about 0.005" of interference (bore is smaller than the shaft). To achieve this fit, both parts must be machined to a fairly tight tolerance. Also, a key is typically used to transmit the torque between a shaft and a coupling hub. The surface of the existing cross shaft was very rough and would need to be machined in place to allow for the required fit. Also, a keyway would need to be machined into the shaft. At installation, the hub would need to be heated to allow it to be installed on the shaft. All of these factors would add to construction time, requiring a long marine traffic outage.

To avoid some of these issues, a sleeve type coupling was chosen, which would use shrink discs to attach the sleeve to the shaft. A sleeve has higher capacity to transmit bending than two flanges bolted together. And using shrink discs to mount the sleeve eliminated the need to machine keyways and install the coupling with heat. The only machining process required would be to turn down the outer surface of the cross shaft to a clean, known diameter. The new shaft and pinion could then be preassembled with the new coupling pushed completely onto the end of the shaft. Once the shaft is positioned in the machinery room, the new coupling can be moved onto the existing shaft and the shrink discs tightened to complete the splice (see Figure 7).

Similar to the B2 bearings, the B3 bearings (located adjacent to the G3 pinions) had loose mounting bolts in places and the condition of the bushings was unknown. FEC decided to include replacement of the B3 bearings as part of the work to ensure the bushings had the correct fit with the shafts and that the bearings were mounted securely. This also allowed some flexibility in adjusting the G2/G3 gear mesh during the installation.

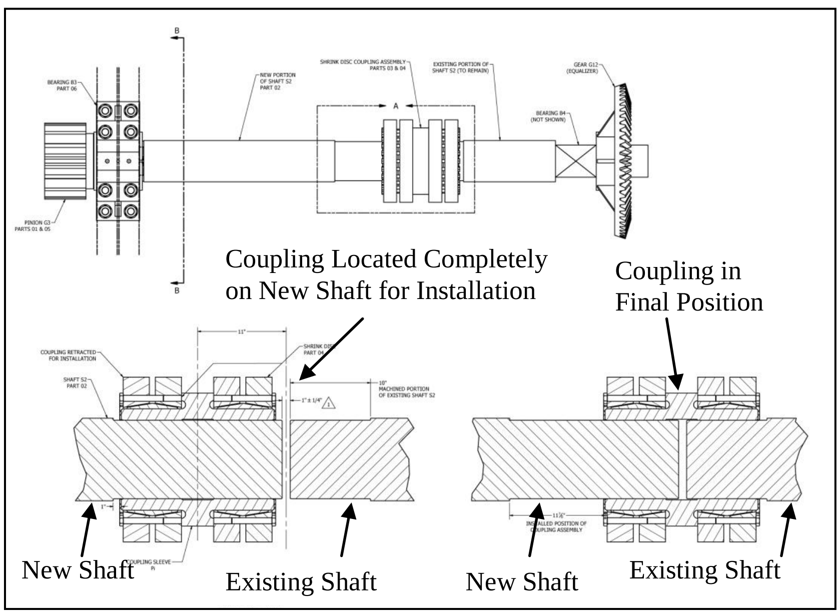


Figure 7 - New Pinion G3, shaft and coupling assembly

Execution of G3 Replacement

G3 Pre-Outage Preparations

Due to limited time during the actual outage, it was imperative to perform any work possible prior to the start of the outage. One of the difficulties involved with this project was determining how to remove the shaft from the machinery house and how to get the new shaft into the machinery house. There were overhead obstructions that prohibited the use of a crane to take the shafts through the ceiling of the house. The final location was inset from the outer edges of the house which complicated lifting the components through the side walls. The solution was to remove a portion of the house floor to allow the components to pass through the floor. An electric chain hoist would be used to lift the components. During pre-outage setup, a 5' x 7'-3" section of the existing concrete floor was cut out and removed from the structure. A temporary wooden floor was installed to provide protection until the outage was complete.

In order to provide the required fit between the existing shaft and new coupling, the existing shaft had to be machined in place. The existing shaft diameter was approximately 10-1/4". A 10" long portion of each shaft was machined to 9.750" (-.0006"/-.0017"). To reduce the planned outage time, both of the existing shafts were milled prior to the outage. In the days prior to the outage, crews installed the temporary shaft support blocks and the temporary alignment fixtures. By pre-installing these items, valuable time would be saved during the outage.

Photograph 16 - Adjustable V-block to support shaft and align the cross shafts

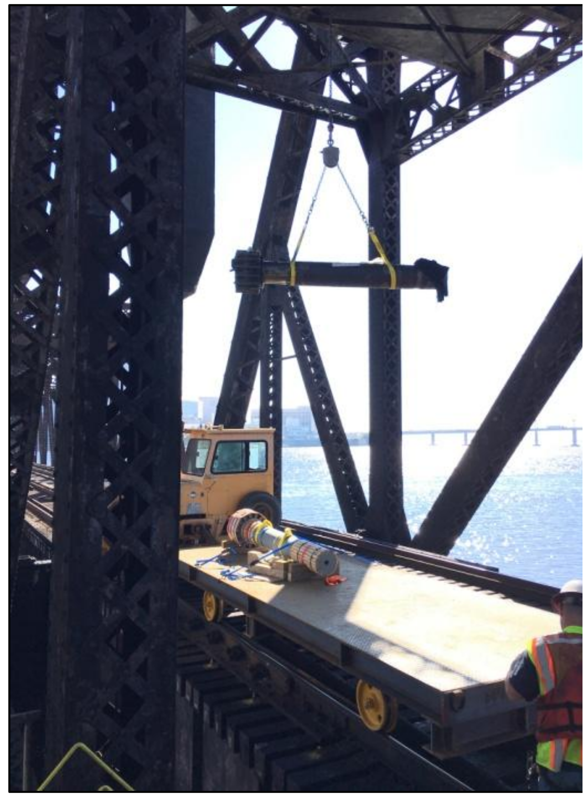
Photograph 17 - View of the 13" band saw cutting the existing cross shaft

G3 Outage Procedure

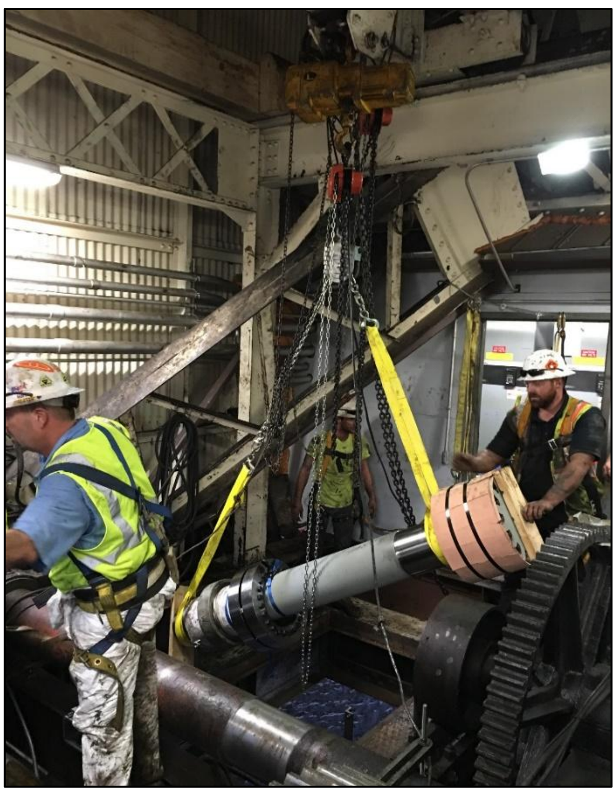
Once the outage was underway, crews went to work removing the West shaft. The first step was to block up between the shaft and the pre-installed supports. The fixture used was called a v-block. The v-blocks not only provided support for the shafts but also allowed for the shafts to be shifted in any direction for alignment purposes (see Photograph 16). After getting the blocking underneath the West shaft, the electric hoist was used to position the saw over the West shaft and the shaft was cut. A 13" horizontal band saw was used to make the cut (see Photograph 17).

The electric hoist was then used to lift out the existing portion of shaft with G3 attached. Extreme care had to be taken when lifting out the shaft in order to not damage the portion of shaft that would remain in place. Specialized rigging had to be used to lift the shaft because the shaft was longer than the hole in the floor. Therefore, the shaft had to be raised out of level in order for the shaft to pass through the floor (see Photograph 18 and Photograph 19). Once the shaft was lowered to the rail cart below, crews removed the existing B3 from the structure and lowered it to the track. Then, crews began cleaning the existing B3 structural support.

Once the existing West components were removed from the machinery house, the electric hoist was used to raise the new West B3 bearing from the track below into the house (see Photograph 19). The bearing was installed using temporary all-thread bolts to lock it into position during the initial installation process. Next, one of the new Tollok shrink disk couplings was installed onto the new portion of Shaft S2. The new shaft was machined with an additional length to allow for the coupling sleeve to be located completely onto the shaft during installation. After installing the coupling onto the shaft, the electric hoist was used to raise the new Shaft S2 up to the machinery house. Again, the shaft was longer than the hole in the concrete floor. This meant that specialized rigging was needed to allow for adjusting the shaft out of level to pass through the floor.

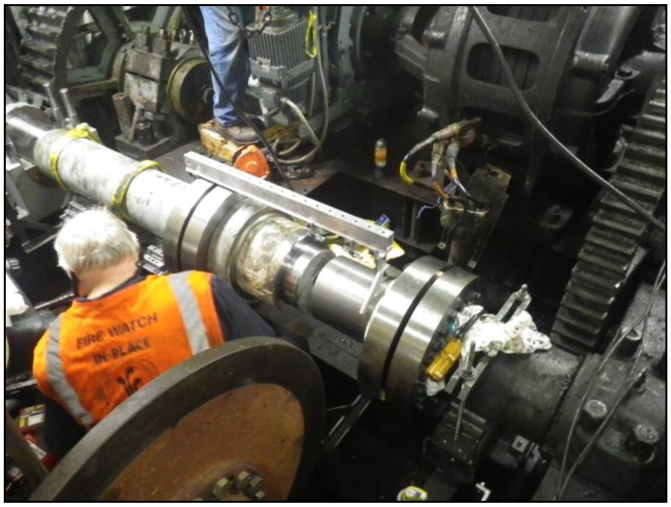


Photograph 18 - Removed pinion shaft, being lowered to rail cart



Photograph 19 - View of the new pinion shaft being raised into the machinery house. Notice that the shaft had to be out of level in order to fit through the hole in the floor

Once the shaft was in the house, the rigging had to be adjusted back to level in order to be installed. During the process of installing the new shaft, crews had to exercise extreme caution to not bump the new shaft on any of the bridge components. When working with the tight tolerances involved, the slightest bump on the shaft or gear could mean the pieces would not be able to be installed. While lowering the new shaft into position,

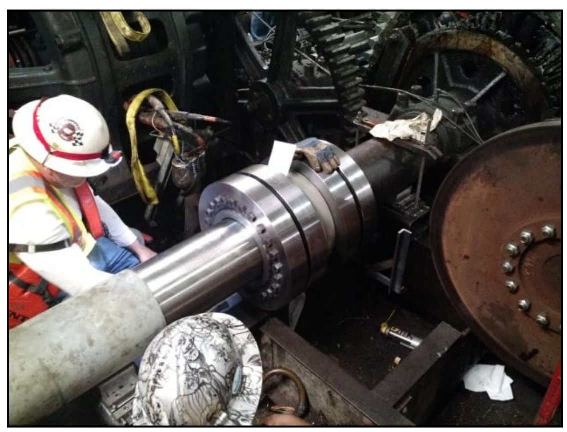


Photograph 20 - Concentricity gauge used to align two ends of Shaft S2

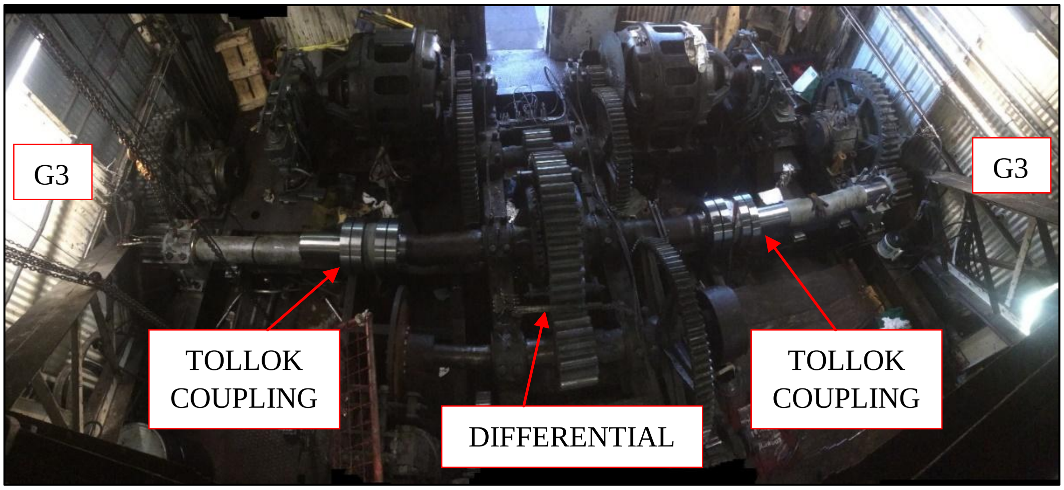
the G3 pinion teeth had to mesh with the G2 gear causing yet another challenge. The new shaft was set on the v-block supports. After the shaft was set, the v-block supports were then used to align the end of the new portion of Shaft S2 to the end of the existing portion of S2. The maximum allowable clearance between the coupling sleeve and the shaft was 0.0035". Therefore, the alignment of the ends of the shafts had to be correct so that the sleeve could slide from the new shaft onto the existing shaft. A concentricity gauge was used to align the shafts to less than 0.005" T.I.R. around the shaft (see Photograph 20).

Once the alignment was confirmed, ceramic heaters were installed around the coupling sleeve to expand the sleeve. The heat was able to expand the sleeve approximately 0.012". As soon as the sleeve had expanded, a specially fabricated hydraulic pusher was used to push the sleeve onto the new shaft. In the final position, the sleeve is positioned equally between the two shafts. Next, the two Tollok couplings were installed. In order to tighten each coupling, 24 bolts had to be tightened gradually to 361 ft-lb so the shrink disc rings were drawn together evenly (see Photograph 21). After the couplings were installed, final alignment of the shaft was performed. This alignment was confirmed by checking the mesh between G3 and G2. Finally, the crew drilled and reamed the final bolts at the B3 bearing base (see Photograph 22).

After completing the West side, crews moved over to the East side and repeated the same process, which was completed in slightly less time (see Photograph 22). The scheduled outage was from 7:00 a.m. on a Monday to 5:00 p.m. on Thursday. The bridge was returned to service at about Noon on Thursday, several hours early before the end of the outage.



Photograph 21 - Sleeve coupling with Tollok shrink discs installed



Photograph 22 - View of the machinery room after the completion of the installation of the new shaft and G3 gears

Operating Strut 2nd Link Joint (Future Repair)

The next big effort at FEC's Jacksonville Bridge will be rehabilitation of the joint between the operating struts and the bascule truss at the 2nd Link. The counterweight is attached to the bascule truss by a link. The upper link is commonly referred to as the 1st Link and the lower link is called the 2nd link.

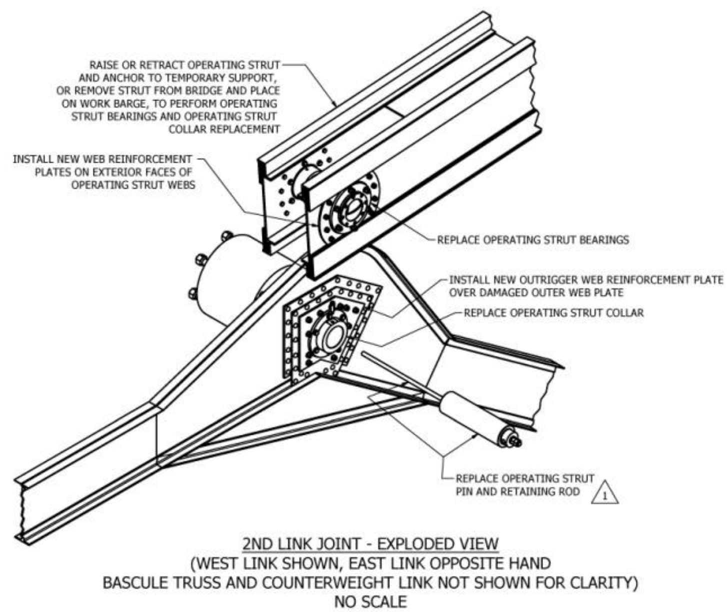


Figure 8 - Exploded view of Operating Strut to 2nd Link Joint

The east connection between the operating strut and the truss exhibits a significant amount of movement during operation. The operating strut rotates somewhat around a horizontal axis, moves side-to-side and bounces when the span raises and lowers. The makeup of this joint is fairly complex (see Figure 8 and Figure 9). The web of the outrigger that is attached to the bascule truss has lost its tight fit with the collar around the operating strut pin. The loose fit has allowed unintentional movement and accelerated wear of the outrigger web plates. Also, several of the fasteners between the collar and the outrigger web are broken and not accessible for replacement. The amount of movement of the operating strut suggests that the bolt attaching the operating strut pin to the

2nd Link truss pin has failed. This was confirmed by FEC personnel by pulling the bolt on the inboard side of the joint. The bolt on one side of the bridge was able to be pulled out only an inch or so, while the bolt on the other side was able to be pulled completely out of the 2nd Link pin.

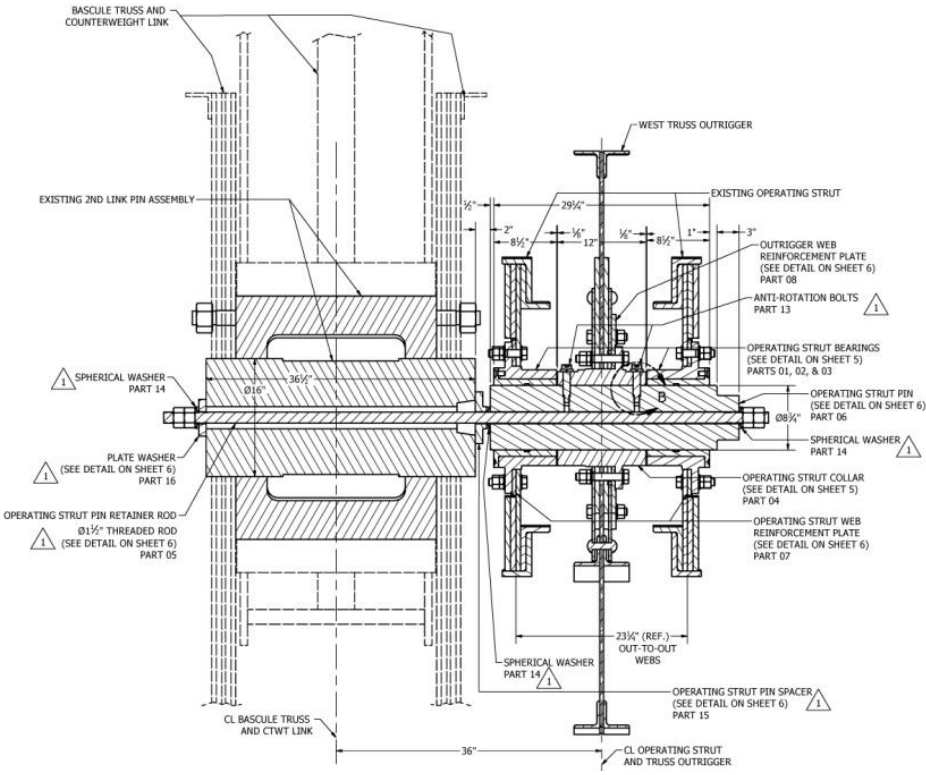


Figure 9 - Proposed repair of Operating Strut to 2nd Link Joint

This bolt helps provide some restraint to the inboard end of the operating strut pin. With the bolt connection severed, the operating strut pin has very little resistance to rotate about the center of the collar at the outrigger.

The repair of this joint will be fairly invasive. The operating struts will be disconnected from the 2nd Link joint and either raised and supported, or removed completely from the bridge and placed on a work barge. The portions of the joint on the outrigger and the operating strut will be rehabilitated separately before re-installation of the operating struts.

Conclusion

All of the Team Members involved in the repairs described above were very pleased with the outcome of the work done. As a result of close coordination between the parties involved, good planning and scheduling, the FEC's requirements were met for both the functionality of the repairs and accomplishing all of the work necessary on-time. With the successful completion of these repairs, everyone involved is more confident in facing some of the more challenging work on the horizon. This level of care and attention is making for a bright future for FEC's Jacksonville Bridge.