HEAVY MOVABLE STRUCTURES, INC.
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Structural and Mechanical Construction Details for Replacement of a Bascule Span Superstructure with Minimal Impact to Rail & Marine Traffic

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Background

Introduction

Map of Project Location

The scope of work for the Loxahatchee River Bridge included superstructure replacement for a simple trunnion bascule span. The project was initially let using design-bid-build procurement to perform superstructure replacement of the bascule and approach spans with a single extended duration rail outage. The Contractor proposed an alternate plan to reduce the rail outages from 30 days to one 24-hour and one 48-hour outage by utilizing a flying jump span to maintain rail traffic during construction of the new bascule leaf. Marine outages were similarly limited.
The paper will describe the structural and mechanical construction details required to complete the project.

Project Description

As part of improvements to the Florida East Coast Railway (FECR) infrastructure needed to accommodate Brightline's premium passenger rail service between Miami and Orlando, the Loxahatchee River Bridge required rehabilitation of the 1920s era bascule span to restore it to double track service and replace aging components to ensure reliable operations in the long term.

Existing Bridge Description


Existing Bascule Span in the Raised Position

The Loxahatchee River Bridge was originally constructed circa 1924 by FECR to carry double track service, but at the outset of the project only the east track was in use. The 583 ft.-2 in. long bridge consisted of nine spans, one 70 ft.-5 in. long approach span north of the 55 ft.-1 in. long single leaf trunnion bascule main span and seven approach spans south of the bascule span, ranging from 60 ft.-2 in. long to 66 ft.-4 in. long. The open deck girder approach spans consisted of four riveted built-up steel beams. Girder depths varied from 6 ft. deep to 6 ft.-6 in. deep.

The bascule span was replaced in 1935 when the original span was struck by a train. The span was of riveted construction, consisting of four lines of steel stringers and four floorbeams that frame into two main girders of built-up I-shape construction in the forward section and counterweight box heel ends.

The existing substructure units consisted of wall piers founded on a mix of columns and timber piles.

The bridge's operating system consisted of a single induction motor connected via a belt drive to multiple stages of open gearing. The two main pinions drove curved racks mounted on the inboard face of each main girder.

The original and rehabilitated bridge is kept in the raised position to allow for unrestricted marine traffic until a train requires use of the bridge. The bridge is operated remotely by FECR train dispatchers.

Brightline used a design-bid-build delivery model for the Loxahatchee Bridge Reconstruction Project. TranSystems Corporation, under the direction of Brightline's program design manager HNTB, performed field evaluations of the existing bridge along with the design of the replacement structure. Originally scoped only as a superstructure replacement, as described further below after the award of the construction contract for the project Brightline and FECR made a late decision to expand the scope to include replacement of the interior bents of the bridge, leaving only the abutments, bascule pier, and rest piers to be used in place.

New Span Description

The new bascule span generally matches the geometry of the existing span to maintain load paths and allow for placement on the existing bascule and rest piers. It consists of two welded through plate girder main girders with I-shape sections of varying depth at the forward section of the span and counterweight heel sections connected via a bolted splice at the floorbeam closest to the trunnion. The girders are framed together with a series of four floorbeams and four lines of stringers.

The bascule span support machinery consists of simple trunnions mounted through each box section sitting in bronze-bushed, split-type pillow block plain bearings mounted on top of A-frame towers anchored to the bascule pier. The exterior tower on each end of the pier includes a transverse diagonal. The span drive machinery consists of a 25-horsepower motor for normal operation on one input shaft and an emergency drive gear motor on the other input shaft of a double reduction reducer with differential and dual extended input and output shafts. Each reducer output shaft drives an intermediate open gear set that drives the main pinion. Each main pinion engages a curved rack bolted to the inboard face of each main girder. The central machinery – reducer, motor, brakes, and gear motor – is mounted on a single steel weldment for palletized construction that allowed for alignment of those components to be completed in the shop. The intermediate gearset is also mounted on a steel weldment to simplify alignment in the field. New steel live load shoes and supports that include centering devices for the toe of the span at the rest pier are of welded steel construction.

Procurement

Bascule and Machinery Fabrication Procurement

Late in design, it was identified that the time required to go through the shop drawing process and fabricate the bascule span and machinery components was quickly becoming the critical path to completing the overall project. As a result, these items were expedited for bidders, knowing that minor details would be revised later when the full rehabilitation plan set was completed. Brightline solicited bids for the work. G&G Steel, Inc., located in Russellville, AL, was selected by Brightline as the fabricator in June 2019 and authorized to begin field measurements.

Procurement of Construction Services

Due to the Project's high degree of technical complexity and the criticality of maintaining freight service and navigation during construction, Brightline elected to exclude the Loxahatchee River Bridge from the primary general contract for other work on the corridor, instead procuring work directly under a separate contract. While this increased the complexity of coordination between the two contracts, Brightline considered it crucial considering the degree of collaboration necessary for the highly specialized and technical nature of the scope represented by Loxahatchee River Bridge Reconstruction.

The specialized and technical nature of the work also led Brightline to undertake a two-step "best-value" selection of the contractor for the Project. In March of 2019, Brightline issued a request for letters of interest for the Project and received six responses, shortlisting four of the respondents. The shortlisted respondents were then invited to submit proposals for the Project which included evaluation on factors including price, construction engineering plan, and the number and duration of railroad outages necessary to complete the project.

Scott Bridge Company's Innovative Bid and Award

When the project bid, Scott Bridge Company (SBC), Opelika, AL, conceptualized an alternate plan to reduce the rail outages. Based on their work on other movable and fixed bridges on the FECR, they knew that this approach might not be the lowest cost but would provide the best value to all stakeholders. There were two keys to this concept:

- Removing the existing bascule leaf and maintaining rail traffic with a temporary jump span. This would require the design and fabrication of the span, development of the means and methods for removing it daily, and approval from the U.S. Coast Guard to revise the durations of the total navigation closures and agree to an extended period with a limited closure.
- Condensing the highly technical and risky process of installing the toe section of the bascule leaf, restoring rail traffic, and getting it operational for marine navigation in a very short window.

SBC contacted Wiss, Janney, Elstner Associates, Inc. (WJE), located in Doylestown, PA and Genesis Structures (GS) to validate the technical feasibility of the proposed concept and to determine what length of rail and marine outages would be required. In their bid, SBC proposed to limit rail outages to one 24-hour demolition outage at the beginning and one 48-hour final installation and commissioning outage 45 days later. A 72-hour waterway closure was needed concurrent with the final installation outage. The SBC bid also required TranSystems to work collaboratively with the SBC team to alter some of the structural and mechanical details to suit their means and methods, collaborating with WJE in the role of Movable Bridge Project Coordinator (MBPC) for SBC.

Three proponents submitted proposals for the project in September 2019. In November 2019, Brightline awarded a contract to Scott Bridge Company of Opelika, Alabama (hereafter referred to as 'the GC'), and issued a Notice to Proceed (NTP) for the project on February 3, 2020.

Construction Phase: Pre-Changeout Work

Mobilization Challenges

The Loxahatchee River Bridge project offered numerous interesting challenges that directly affected the approach to the work. First, available real estate for staging equipment and materials for this project was scarce. Access to the bridge by land consisted of a very narrow right-of-way corridor on the north end of the project. Luxury homes adjacent to the right of way had to be considered when designing access and parking at the project. Only 35’ of width was available on the FECR property beside the existing mainline track and 15’ of this width as the slope of an important drainage ditch that belonged to the City of Jupiter. the GC had to build a longitudinal bridge in the ditch at the very edge of the right of way to support one crane track while the other track walked on the ground along the edge of the mainline ballast. Once the crane reached the edge of the river, a full width 55’ access bridge was constructed into the edge of the river where a 100’ X 120’ steel platform was subsequently installed. This pile-supported structure was utilized to provide access to floatable depth water and create a storage area for equipment and laydown area for materials. A second storage platform measuring 30’ X 50’ was installed across the track on the northeast corner of the project for staging of new bridge components for the bascule span. These two platforms and the tight access configuration can be seen clearly on older Google Earth aerial pictures. From the larger platform, large cranes were walked onto barges to gain access to the west side of the bridge. the GC also leased two acres of property from FECR, which included an abandoned but usable rail siding located one-half mile north of the bridge on the east edge of the mainline track. This critical staging and receiving yard was supported with a 275-ton crawler crane and was key to the supply chain pipeline for receiving new items and disposal of demolished old bridge components. Access was gained between the bridge and staging yard via an 89’ flatcar pushed with a Trackmobile tug. All switching onto the mainline from the siding was performed by FECR workmen.

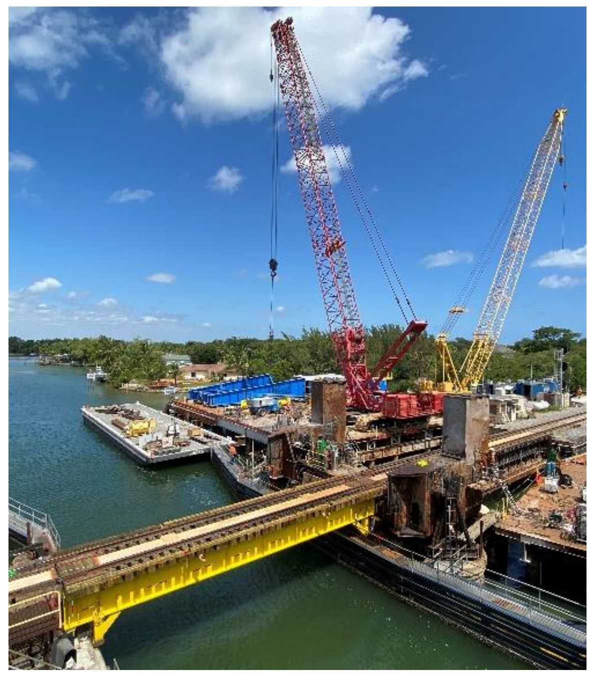
The second major mobilization challenge concerned limited available river access to the bridge site. Procuring the necessary construction spud barges available for rent along the East Coast and subsequent deliveries via the Atlantic Intracoastal Waterway were constrained at the destination by the very narrow boat channel width through the FECR Loxahatchee bridge. With a measurement of only 40’-3”, the necessary deck barges were too wide and could not gain access to the west side of the bridge. Due to the need for a very large crane to lift the superstructure spans, a catamaran barge was designed by procuring and tying two 40’ X 140’ barges together with structural steel girders. The two individual 40’ wide barges were pushed through the channel at high tide with less than an inch clearance on either side. Once the two barges were combined into one and the catamaran barge was fully assembled, an 800,000-pound crane was walked off the platform and onto the barge, where it remained for three years until the project was completed. the GC used truckable sectional barges to gain access to the river for other smaller cranes needed on the project.

Flying Jump Span

To facilitate the process of the upcoming bascule span changeout, a method was needed to accommodate the passage of both trains and boats for the 45-day changeout timeframe. After considering other options, the concept of using a removable span on the existing alignment was the most cost-effective and schedule-friendly option. This temporary span would be designed for an E80 loading with full impact and high longitudinal traction forces required by AREMA Chapter 15. This liftable span was nicknamed the Flying Jump Span (FJS) and was developed and designed in collaboration between the GC engineers and Genesis Structures of Kansas City, Missouri.

Flying jump span being removed from the channel

The FJS utilized W44 rolled beams with continuous cover plates on the top and bottom flanges needed to increase the strong axis inertia for this deflection-driven design. In addition, special bearings were designed and fabricated to bear on the existing narrow heel pier and toe pier bridge seats. A unique delta frame brace was added below the span at each end to transfer longitudinal train forces to the face of the pier.



Flying jump span installed and open for train traffic

New copper naphthenate ties were installed, and hook bolted to the span in preparation for reattaching the existing rail currently in service on the old bascule during the original 24-hour demolition outage. Lifting lugs were incorporated into the exterior web stiffeners of the FJS to facilitate quick connect and disconnect to a Manitowoc 16000 440-ton lift crane. This crane was positioned on the adjacent platform and was used to set the FJS in place and lift it out to pass boats. Spanning 55 feet over the Loxahatchee River the lifted weight of the FSJ was approximately 55 tons. In discussions with the USCG Miami office, it was agreed that the FJS would be lifted out once mid-morning and once late afternoon, 7 days per week, for one hour each during the outage to facilitate boat movements through the bridge. The railroad agreed to reschedule their freight trains to provide a reliable lift-out schedule for boaters to plan their morning and afternoon trips. Guide plates were incorporated into the lower delta frame brace and on each pier to facilitate easy and accurate removal of the span.

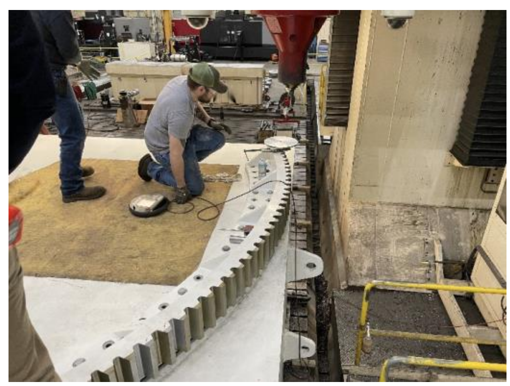
Bascule Leaf Counterweight Girder Detail Changes

Machining a counterweight girder

The design of the bascule leaf provided splices between the toe section and the two independent counterweight box girder sections. Since they were behind the fender, the counterweight girders did not infringe on the channel. They were also outboard of the train clearance envelope, so they could be erected while running trains. This led to a natural strategy to erect the towers and counterweight girders at the site first, then splice the toe section.

The goal for the bascule leaf was to fabricate the bascule leaf accurately enough that the critical alignment of the trunnions in the girders would not be disturbed when the splice was made. G&G led the process of proposing fabrication details to achieve this goal. They changed the splice between the counterweight girders and the bascule girders from a structural connection to a machinery connection with the faying surfaces machined and tight tolerance bolts for alignment. After the main box section was fabricated, the trunnion hub bores, the rack mounting surface and bolt holes and the toe splice surface and bolt holes were all machined in one setup on their 10m gantry mill in Cordova, AL.

Bascule Leaf Rack Connection Detail Changes



Checking rack alignment on the mill

The design drawings called for installation of the racks on the counterweight girders with undersize bolts to allow for field adjustment after the alignment was verified under full dead load. This incremental approach to mounting the racks did not align with the contractor-proposed outage durations and installation plan. G&G was confident that they could fabricate the counterweight girders to a level of precision that would not require field adjustment of the racks. They proposed to perform very detailed alignment checks of the racks relative to the trunnions after assembly of the components with the counterweight girders using two independent means: Laser tracker measurements performed by IPM and measurements performed by G&G using their gantry mill as a coordinate measuring machine. TranSystems mechanical engineers accepted this approach. The shop checks were so critical to the project that both the GC and the MBPC attended the checks to verify what measurements were taken before approving installation of the final turned bolts in the shop.

Trunnion Tower and Operating Machinery Fabrication Detail Changes

The trunnion tower details were modified to include machining of the tower bases to be flat, parallel, and precisely located relative to the trunnion bearing mounting surface. The plans called for field installation of the turned bolts for mounting the machinery components, including the trunnion bearings, bearings for open gearing, reducers, motors, and brakes after acceptance of the bearing alignment. This was revised so that all final turned bolts were installed in the shop. In the case of the pinion bearings, details were developed for undersize shop-installed turned studs that were accepted by TranSystems to leave as permanent bolts if the plan to align machinery without field adjustments succeeded, but also allowed for some adjustment, field reaming and replacement with a larger turned bolt if necessary. Anchor bolt locations were revised to ensure that anchor bolts could be installed with the tower on the pier and jack screws were added to facilitate vertical shim adjustments at the base of the tower.

Bascule Leaf Shop Assembly

Layout of sole plates to support towers at shop assembly

As is typical for movable bridge projects, shop assembly of the bascule leaf and operating machinery was required, along with a no-load spin test of the machinery. The GC team agreed to enhance the shop assembly to include a full simulation of the field assembly of the leaf supported by the towers at the shop down to the details of the field means and methods for supporting the towers.

- Sole plates that would support the towers were laid out and grouted in place.
- The sole plate elevations were surveyed with a laser tracker, and then shim packs were made up so that the top of the shim pack was at a precise elevation, ready to accept the towers and open gear frames.
- The main pinions were installed.
- The tower assemblies and open gear frames were set on the sole plates/shim packs, and it was verified that the machinery elements were at the proper elevation.
- The towers were adjusted so that all four bearings were in line with the required position, verified via laser tracker and piano wire, and secured to the shop floor.
- The counterweight girders were set in the bearings and supported so that the toe splice was vertical.
- The trunnion alignment between the two counterweight girders was verified via laser tracker and piano wire to ensure that the sole plate support scheme was adequate.
- The toe section was assembled, lifted with a crane, and spliced to the counterweight girders.
- The crane was released and the trunnion-to-trunnion alignment was rechecked via piano wire to confirm that it was not disturbed. The trunnion-to-bearing alignment was checked as well. The backlash and alignment were checked at the rack and main pinion. The backlash was adjusted so that there was more backlash vs. the final criteria to account for the dead load deflection of the towers once fully loaded with the counterweight boxes full.

Completed shop assembly of leaf supported on towers

The shop assembly was witnessed by the GC and the MBPC, and independent verification of critical alignments was done via laser tracker measurements performed by IPM. The shop assembly was successful, and no major changes were made to the plan for field assembly.

Construction Phase: Bascule Span Changeout

Bascule Span Changeout - Schedule Overview

The 45-day bascule span changeout began at 1:30 am on April 10, 2022, beginning with a 24-hour total closure of both the rail and river. This was permitted to facilitate partial demolition of the bascule leaf to make room for the installation and commissioning of the Flying Jump Span. To expedite trackwork, the existing mainline rail in place on the old bascule leaf was removed and reinstalled on the FJS at the completion of the outage. Reusing the existing rail ensured that the lift rail joints on the FJS would properly engage with the existing rail joint components on the fixed elements of the existing bridge that remained when flying the FJS in and saved time making cuts and adjustments to different lift rail components during the outage.

Prior to the span demolition, the existing counterweights were securely blocked up on temporary falsework previously constructed behind the heel pier. This falsework consisted of 4 driven 24" pipe piling per counterweight box, with very heavy W 18 crossbeams and hardwood blocking. After the span was secured to prevent rotation, the leaf main girders and end stringers were torch-cut. Specially designed rigging was fitted to each girder for tandem lift-out using one 330-ton barge-mounted crane and a 440-ton capacity crawler crane on the north work platform. The 160,000 lb leaf was set down on the same platform for further cutting and removal later in the outage. After this lift-out was completed, the FJS was hoisted into position, surveyed for line and grade, then bearings secured using rapid-set high-strength grout. As the grout cured, trackwork was reinstalled. Several test lifts of the FJS were successfully conducted and trains were restored to service after the grout had cured for 2 hours. The FJS began service on Tuesday morning April 12th and continued opening twice a day for 42 consecutive calendar days.

Outage days two through nine were a continuation of demolition of the remaining components of the old bascule span including the counterweight boxes, trunnion towers, drive machinery, and old bearings. The existing plans did not provide much information regarding the contents of the counterweight boxes other than the upper half of the box contained 280 pcf fill and the lower box contained 305 pcf fill. Test coring indicated these high unit weights were achieved by using stacked and nested rail pieces supplemented by steel punchings, all encased in a cement and sand grout fill. Coring these counterweights for lift rigging proved to be very difficult, time consuming, and expensive. Much time was also spent cleaning 100-year-old grease from the pier tops, followed by bush hammering and patching defects in preparation for installing new bascule components.

Outage days 10 through 21 were used for layout and preparation of bearings and anchor bolts for 4 four new towers, one primary drive skid, two final drive bull gear weldments, toe pier bearings, and machinery room roof system. Precision was required to ensure the global geometry of the bearings were correct in order to start the installation error free. On day 22, all 4 new trunnion towers were initially set on these bearings. In addition, the new bascule leaf was fully assembled on the platform, with new ties, rail, and track joints installed.

The following nine days were used to align the four trunnion towers to achieve the stringent requirements for coaxiality of the four bronze trunnion bearings. Both lower counterweight box girders were set afterward with the rear of these boxes being each supported on temporary falsework by two 150-ton locking collar hydraulic jacks. These were used to hold the load and make small rotational adjustments to each girder to provide proper alignment for leaf installation. The primary drive skid was installed and initially aligned to match the global station and elevation requirements.

Outage days 32 through 42, leading up to the final three- day river closure leaf installation outage were spent grouting bearings on all components following final alignment. Lead plates were installed in the lower counterweight boxes using a suction cup lifter mechanism. The new leaf was also relocated closer to the span in preparation for the outage. Final drive gear skids were flown into place and set on prealigned bearings. All other electrical, mechanical, and signal preparations were concluded prior to the final outage.

At 12:01 am on May 22, trains were stopped for 48 hours, and the river was closed concurrently for 72 hours as the final outage began. The FJS was lifted out for the last time and carried away to the north laydown yard on the 89’ flatcar. Additional demolition work was done on adjacent DPG spans to make room for the installation of new DPG spans on the new piers. Coring for anchor bolts was conducted overnight to complete bearing installation that was inaccessible and unavailable while the FJS was in service. At noon on May 22, the new bascule leaf was lifted in tandem and flown into position, and partially released onto the four manipulators. Incremental adjustments were made, and the leaf finally aligned to both counterweight girders. When match marks confirmed that alignment was correct, bolting began to final connect these two components. At the end of the first 24-hour period, the leaf was finish bolted.

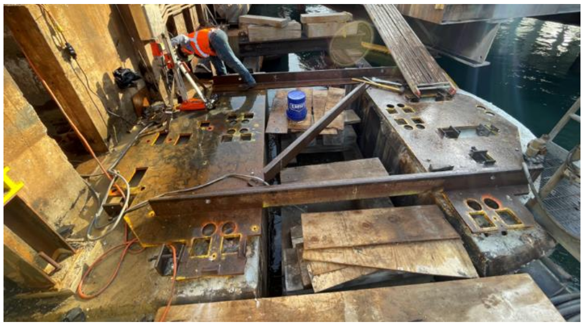
The following 24 hours consisted of completing toe pier bearings, setting adjacent fixed spans and completing trackwork for the east mainline. Electrical connection and power up activities took place along with installation of proximity and rotary cam limit switches. Track circuits were confirmed operational and trains were allowed to pass across the new leaf at midnight on day two, at exactly 48 hours closure time.

The final 24-hour period consisted of final commissioning, including span balance, lubrication, test openings, and proximity switch adjustments. For span balance checks, a large external toe weight was added on the west main alignment to ensure the span would not be counterweight-heavy. Afterward, the four 150-ton locking collar hydraulic jacks were released at the temporary falsework allowing the span to rotate for balance measurements. A 25-ton toe jack was also used to weigh the reaction at the toe to empirically confirm a satisfactory span balance condition in the seated position. Finally, the span locks were finished, and marine navigation lights were made operational. These final days’ work items were conducted around heavy catch-up train traffic that was continuously crossing the new bridge.

The river was opened at 7 am on May 26th to conclude this final outage. The new bascule span opened and closed on demand thereafter.

The sections below provide more detail of selected elements of the bascule span replacement work.

Bascule Span Changeout – Template Details



Tower template installed on bascule pier

A single steel template was used for the two towers and one open gear frame on each side of the bridge. The template was set in place, precision aligned using a laser tracker and anchored in position. The template had features to locate:

- Anchor bolt holes, which were drilled with core drills.
- Kicker fixtures that were anchored to the pier with mechanical anchors.
- Sole plates that would support the towers and open gear frames until they were grouted.

Bascule Span Changeout – Tower Installation and Alignment Details

Towers installed and aligned on pier

After removal of the templates, the sole plate elevations were surveyed with a laser tracker and then shim packs were made up. The towers were then installed on the sole plates and shim packs. All four towers were set in a similar manner. Elevations were verified with a laser tracker and minimal adjustments were needed. The laser tracker was then used to adjust the four bearings into precise alignment.

Installation of the open gear frames followed a similar process as that used for the towers. In addition to the laser tracker, a bore telescope was used to verify the coaxial alignment of both pairs of bearings that support the main pinion shaft on each side of the bridge. Once all four towers and both open gear frames were installed, the anchors were installed and tightened and the main pinion shaft was installed, followed by installation of the counterweight boxes. The trunnion alignment was verified with a bore alignment telescope as an independent check of the laser tracker alignment checks.
The trunnions were aligned to within .010-in., half of the specified tolerance. The towers were grouted at this stage and the anchors tightened. In preparation for the second rail outage, the counterweight boxes were filled. As this loaded the towers, the trunnion alignment was monitored. The increased load also caused the girder to rotate as the support deflected. Prior to the outage, the girder was adjusted so that the splice was vertical to a high level of precision.

Checking trunnion alignment after setting counterweight girders on towers

Bascule Span Changeout – Second Rail Outage, Installation of Toe Section Details

When the final 48-hour track outage began, the jump span was removed for the final time, initiating a concurrent 72-hour navigation outage.

After the painstaking effort to achieve trunnion alignment, a major risk was that a counterweight box would get bumped by the toe section, and the alignment of the trunnions would be lost. The toe section was lifted into place using two cranes, one of which was barge-mounted and would be subject to movement due to wave action in addition to wind loading of the large structure. To mitigate the risk of a collision, a plan was devised to land the structure on four manipulators to stabilize it. The cranes would still support a portion of the load to make adjustment straightforward and precise.

Manipulator to aid alignment of toe section

The manipulators were comprised of a double stack of Hillman rollers with a jack on top for vertical adjustment to permit very precise 3-dimensional adjustments of the leaf position.

The toe section had been pre-assembled on the adjacent work platform and was lifted and swung into the channel, landing on the manipulators within inches of final position. The position of the toe section was adjusted with the manipulators relative to the counterweight girders until both gaps closed and all splice bolts could be installed by hand.

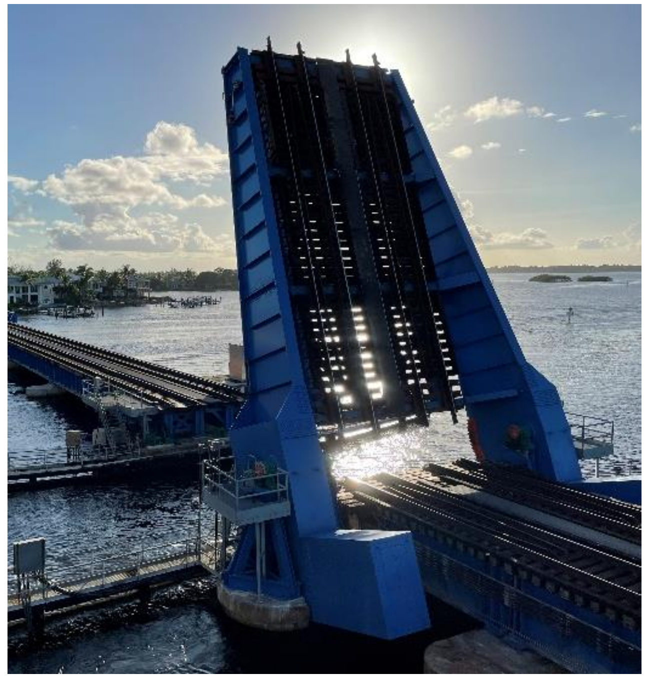
Once the splice was complete, the rail was installed on the bascule span and rail traffic was restored by the end of the 48-hour track outage window.

Lifting toe section into place

Bascule Span Changeout – Initial Operation of Bascule Leaf Details

The installation of counterweight ballast was staged prior to the installation of the toe section so that the leaf would initially be toe-heavy. Additional ballast was installed in the counterweight boxes and periodic checks of the toe reaction were made until it was verified that the seated imbalance was within acceptable limits to attempt operation of the leaf. Once the structure was fully loaded, the trunnion alignment was re-checked and found to be satisfactory. Static checks of rack and pinion alignment were found to be satisfactory with no changes to the shimming of the main pinion bearings required.

An initial test opening was performed using the main motors at reduced speed, stopping incrementally to perform checks of machinery alignment and evaluate the machinery operating loads as measured with strain gages. The initial opening was a partial opening because of the access platforms mounted to the counterweight boxes but this opening was sufficient to evaluate the balance.



Once the mechanical checks were completed, adjustments to the bridge control system were performed and the marine channel was opened at the end of the 72-hour navigation outage. The dynamic alignment checks, including the open gearing contact checks, were judged to be acceptable by the Engineer with no adjustments required. With the alignment checks complete, the open gear frame and the primary support were grouted and finalized, then final ballast adjustments were made so that the leaf could raise to full open.

Lessons Learned

Any plan, no matter how well engineered, must confront the reality of execution. It is critical to the success of any project of similar complexity to work with general contractors, fabricators and trades including ironworkers, millwrights, and electricians with the highest capabilities.

The challenges associated with the span replacement were great and took a significant effort to overcome to meet the needs of all stakeholders, from Brightline to FECR to waterway users.

Due to the limitations that could be placed on rail outages, performing significant shop testing and mock installation adequately predicted deflections and rotations, allowing the span to be installed within a very short timeframe, with minimal impact to the railroad and without sacrificing quality. Although these efforts do come with a cost, if the outage finishes on time and to the satisfaction of the bridge user, their use should be considered.

The successful outcome of this project would not have been possible without a high level of collaboration and openness between the Owner, Engineer and Contractor team. Great things can be accomplished when everyone involved is working toward a common goal.