HEAVY MOVABLE STRUCTURES, INC.
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Construction on the PGA Boulevard Bascule Bridge

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Background

The PGA Boulevard Bascule Bridge Rehabilitation Project in West Palm Beach, Florida involves two existing three lane bridge structures that are side by side (Figure 1). The owner of the bridge is the Florida Department of Transportation, District Four. The Engineer of Record for the design is Hardesty and Hanover, LLP. The project commenced in April 2005 and is scheduled to be complete in March 2007. The westbound bridge is scheduled to receive minor structural modifications and repairs, while the eastbound bridge will be systematically demolished down to water level and reconstructed. The demolition will consist of both eastbound bascule leaves, both bascule piers and both eastbound flanking spans. The PGA Blvd Bascule Bridge has four bascule leaves and five fixed approach spans. Currently, the existing eastbound bridge has been demolished and the new eastbound bridge is being reconstructed. Listed below are some of the major items of work:

- Removal and replacement of bascule structural steel and roadway grating
- Demolition and construction of new eastbound concrete bascule piers
- Construction of raised concrete sidewalks on existing approach span bridge decks
- Removal and replacement of steel and concrete traffic railing barriers
- Removal and replacement of electrical drive motors, machinery, motor brakes, and limit switches
- Replacement of bridge expansion joints
- Abatement of lead based paint and recoating of structural steel on the movable bridge spans
- Cleaning and coating of concrete surfaces
- Construction of temporary access bridge to control tower

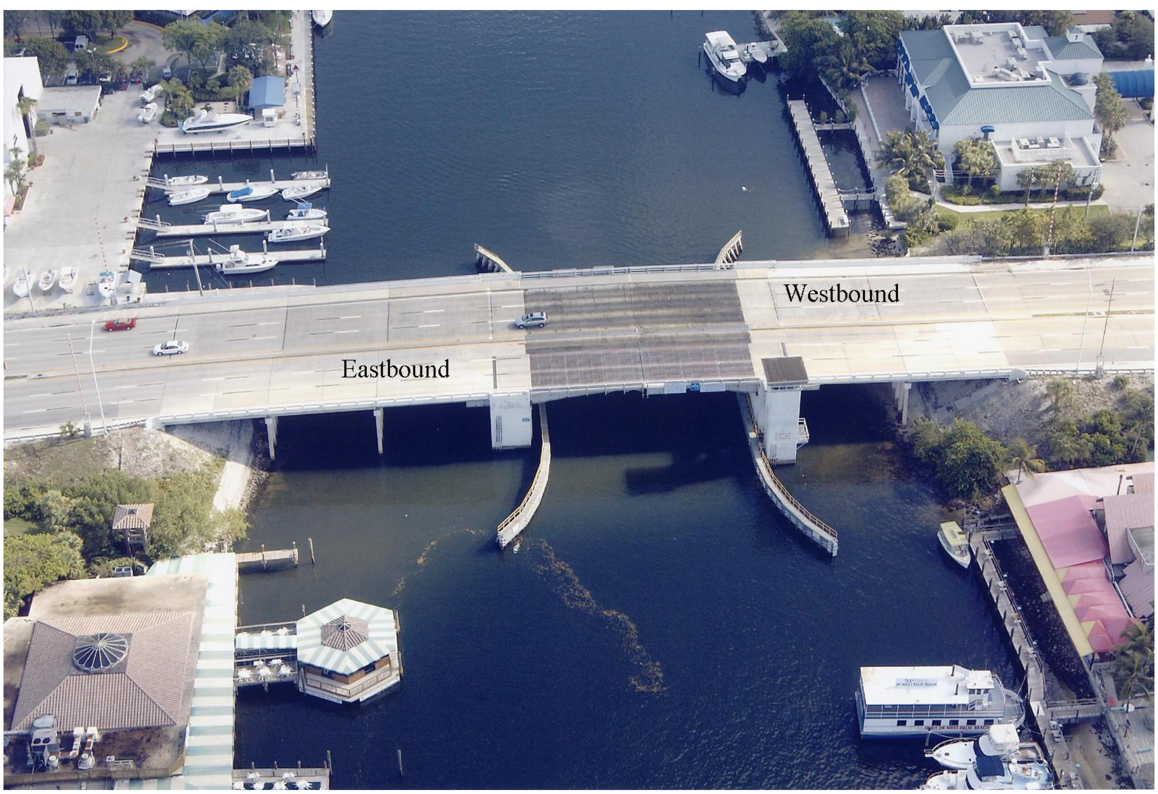

Figure 1: PGA Blvd. Bascule Bridge

Plan of Construction

Prior to the commencement of any demolition or reconstruction activities, work plans were developed to detail the plan of action for each item of work. The demolition plan was created to evaluate different styles of demolition, different pieces of equipment, personnel assignments, manpower requirements, and demolition schedule. Upon the evaluation and analysis of different styles and options, the final demolition plan was formally outlined for the project team to follow. A similar plan was created for the reconstruction of the new eastbound bridge.

Demolition

The demolition of the eastbound bridge was a very strategic and calculated process. All of the demolition and reconstruction activities were completed using a crane on barge. A great deal of calculation and thought was put into the demolition plan due to the critical crane picks that were required. The demolition began with the dismantling of the two eastbound bascule leaves. Each leaf was just over 80’-0” long and 36’-0” wide. The leaves were removed while in the down position and in sections small enough to place in dumpsters or hauled any for steel recycling. The leaves were secured with a tie down system designed to sit between the trunnion and floor beam 4 (Figure 3). Throughout the demolition process, we were required by the United States Coast Guard to maintain single leaf operations for marine traffic, thus demolishing one leaf at a time. The process began on the west bascule leaf, where the roadway grating and structural steel was precut by demolition crews in preparation of installing the leaf tie down system. This was required so that the leaf would not rotate once the steel on the forward side of the trunnion was removed. The first priority here was to demolish the leaf back to floorbeam four. At that point we were out of the navigable channel and did not disrupt the flow of marine traffic.

Figure 2: Demolition of Bascule Leaf

A great deal of caution was taken while torching the structural steel members due to the fact that the existing structure was coated with a lead based paint system. For the safety of the workers, supplied air units were used by the individuals that were cutting any lead coated material. This protected the worked from exposure to toxic lead fumes. While cutting in areas where ventilation or air flow was not high, all workers other than the individual performing the cutting were out of the work area to prevent exposure to the fumes.

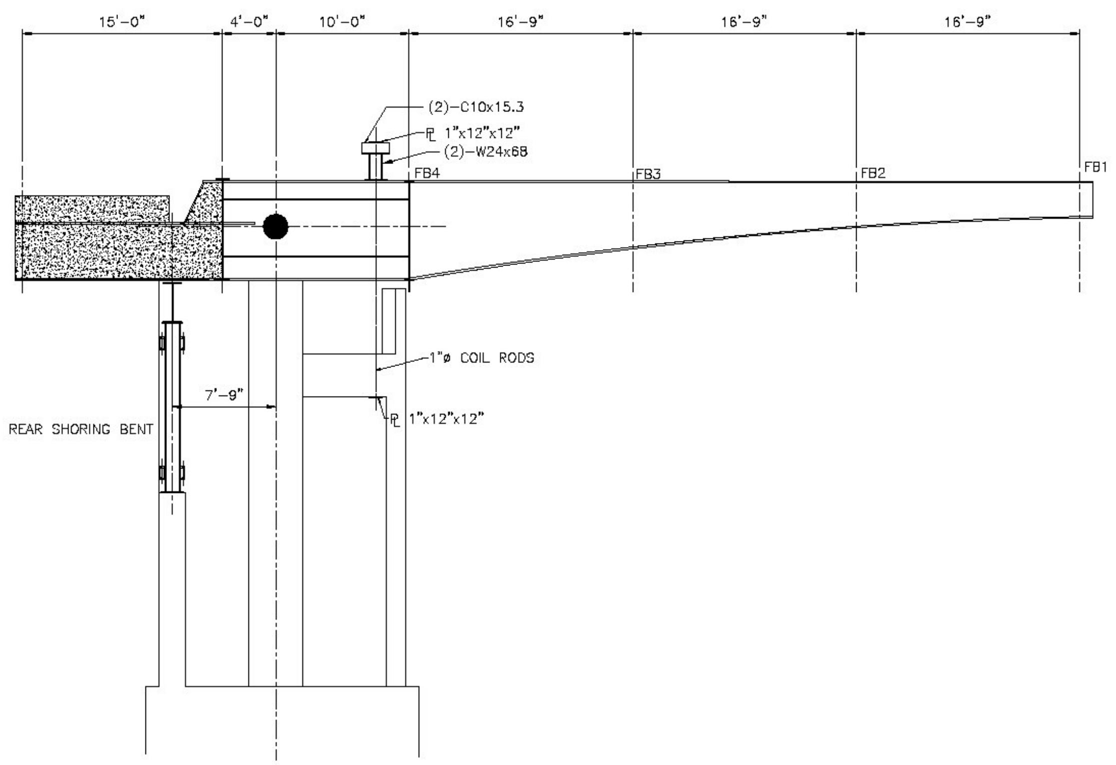

Figure 3: Bascule leaf demolition layout

Once the leaf steel was removed, the flanking span deck and beams were removed. The flanking span stretches 52 feet and is made up of six stringers set beneath a 7.5” concrete slab with a sidewalk and median curb. The span was cut longitudinally by a concrete deck saw in specific locations that allowed the deck to rest on top of the flanking span beams after being cut. A sequence was developed to maximize the efficiency of the saw cuts and crane picks required to remove the deck. The concrete deck sections were removed and placed on a material barge for placement at an offshore artificial reef, while the steel beams were cut up and recycled.

Temporary shoring beams were then placed beneath the counterweight for support while the large concrete section was wiresaw cut into seven pieces. Steel posts were installed on the back wall of the pier and existing flanking span beams were used as temporary shoring beams for the counterweight removal. The counterweight was shimmed to rest on the temporary beams and a series of holes were cored through the concrete section for rigging and placement of the diamond laced wiresaw strand. The coring of the holes for the counterweight removal was performed 24 hours a day for approximately four days. Following that was the wiresaw cutting process that was performed 24 hours a day for approximately eight days. Depending on the location of the cut, the durations varied due to cutting through steel. Wiresaw cutting is designed for concrete cutting and anytime the cut has to go through steel, the process is prolonged. The placement of the cut was determined based on the size of the counterweight section that could be safely removed by our crane. Based on previous experience, the density of older counterweight concrete varies greatly. We did not want to have a situation where the actual weight of a section was significantly larger than the calculated weight and our crane would not have the capacity to remove the section. We also had to be careful not to make the sections too large for the removal process on the material barge. The plan for removing the sections at the artificial reef site was to place a large long reach excavator on the material barge and push the counterweight sections off the barge. We had to ensure that the sections were not too large and could be pushed off with the excavator. As a result, we added a cut on the counterweight to reduce the size and weight to ensure the sections could be safely removed. The counterweight was cut into seven sections, which averaged 23 tons each.

Figure 4: Counterweight section being removed.

After the completion of the wiresaw cutting, the tie down system was then dismantled and the remainder of the leaf, which consisted of floorbeam four and trunnion girders, was removed. The machinery within the pier, which was a Hopkins frame, was then removed. At this point, the only thing left of the eastbound demolition was that of the bascule piers. To do this, a 3D model of the pier was created to help with layout and to visualize the task of demolishing the pier. The model was developed in AutoCAD and was created from existing drawings and field measurements.

The 3D model of the bascule pier was a highly beneficial tool that greatly impacted the project. The model was able to provide a visual interpretation for our field supervision of what needed to take place. It also allowed us to try many different scenarios of layout to achieve the most efficient and cost effective way of the concrete cutting. Once the layout was finalized, the cut lines were transferred to the pier. Holes were cored through the pier sections to allow for wiresaw strands to be pulled as well as rigging to be placed through the section for removal. Some of the sections were over six feet thick so the coring took several days. Afterwards the wiresaw machines were setup and the process was started. The cuts were organized so that a majority of the sections could be cut without removing any of the concrete. The edges were beveled so that the sections could rest on each other and stay in place. Approximately 90% of the pier was cut prior to any removal. We were able to remove all the sections on one pier in two days.

There were around 30 concrete pier sections removed for each pier, totaling approximately 560 tons. The average section weight was 29 tons. The process of picking the concrete sections off of the pier was very delicate. It was critical that the crane operator, rigging foreman, and barge foreman were in constant communication during the picks. The crane operator had a limited sight line for many of the picks and the lines of communication were critical while picking and setting the pier sections.

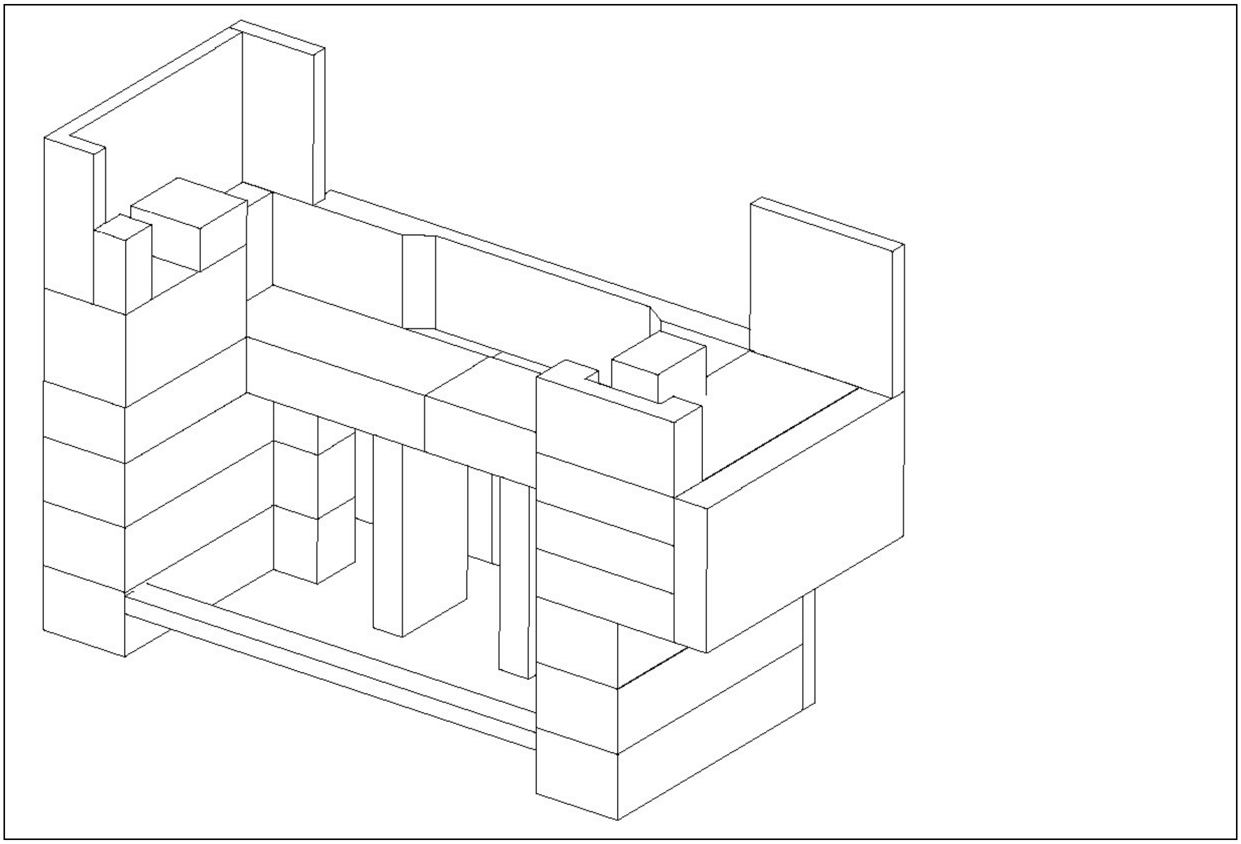

Figure 5: 3D Model of bascule pier

The piers were demolished to elevation 1.0', which was near the water line elevation. This presented several issues for the demolition crews, as the water elevations changed with the tides. The wiresaw cutting equipment could not be installed beneath the water, so the time frame for cutting the lower sections was limited. All of the other sections were cut and cored 24 hours a day, seven days a week to maintain the projects accelerated schedule.

Reconstruction

Once the bascule pier demolition was complete, the reconstruction process commenced. The first task was to widen the existing foundation by adding to the footer. This proved to be one of the greatest challenges for our concrete crews. The underwater nature of the work was difficult to predict due to the extreme late summer tides. The production rates of our concrete forming and placement accelerated significantly after we were above the water line. We were required to modify work schedules to correspond with the areas tide charts.

To expedite the reconstruction schedule, the formwork was prefabricated to minimize the durations of formwork installation. The east pier construction was able to commence three weeks prior to the west pier, but rather than wait for the east pier to be completed before moving on to the west pier, additional crews were brought in to begin the west pier construction directly following the demolition. This accelerated our schedule by approximately four weeks. The east bascule pier was completed and ready for structural steel erection within eight weeks after the first concrete pour.

The main support for the bascule leaf was structural steel columns erected within the bascule piers. The unique column design was connected with trunnion and forward columns. The anchor bolts for the steel columns were cast deep within the concrete and placement of the bolts was critical. Survey layout was completed prior to placing the bolts and was verified throughout the placement of concrete and structural steel. The survey for the entire bridge had to be complete to ensure the two bascule leaves would operate correctly with each other and with the existing westbound bridge.

Following the installation of the bascule pier steel, the leaf structural steel was erected. A great deal of planning and coordination was required for the installation of the bascule girders and counterweight. For the leaf installation activities, a larger crane was obtained due to the very large weight of the steel counterweight box. The largest possible crane for our barge was used to set the bascule girders and counterweight box during a complete bridge and channel closure. The first girder was delivered to the bridge on a special delivery dolly and prepared for the installation. All of the delivered loads of the bascule girders and counterweight boxes were trucked to the site with the use of special permits that restricted the travel times and routs that were made. Communication with the delivery contractor was vital to ensure the material was on site for the scheduled closure dates. The girders weighted around 84,000 lbs and were well below the capacity of the crane. The highly anticipated first bascule girders were set on the east pier. Floorbeam four was then installed to add some rigidity to the girders and allow for the counterweight box. The counterweight, which was delivered on a special low level, wide load trailer, was then moved into place. The steel box consisted of mostly 2 inch thick

material and weight over 130,000 lbs. The process of installing the box was very intense due to the critically heavy pick. Not only did the crane have to pick the large counterweight box, it had to hold the box for a lengthy period of time before being bolted to the girders. The entire process of erecting the two bascule girders and the counterweight box took approximately 12 hours. Within the following week, the remainder of the floorbeams were installed, followed by the stringers and all of the miscellaneous steel support members. The roadway grating was then welded to the leaf and sidewalk railing was installed.

It was now time for concrete placement into the roadway grating and counterweight box. This posed a challenge to the project team due to several construction phase changes. The project team completed detailed balance calculations that uncovered an error in the contract drawings and required us to add weight to the counterweight section prior to adding concrete to the counterweight. The original project scope involved erecting the bridge as far as the north bascule girder and completing everything north of that during a subsequent phase. While keeping with that thinking, the counterweight concrete was placed and temporary shoring posts were used to support the heavily unbalanced leaf. It was then discovered that critical alignment problems were possible if the current procedures were maintained, therefore construction was ceased until the decision was made to revise the current MOT plan and create enough work are to complete the eastbound bascule spans and flanking spans in one single phase. Work was then resumed and after the installation of the remaining structural steel and roadway grating, concrete was placed in the roadway grating and flanking span.

Crane and Barge

The major construction activities throughout the project were completed with the use of a crane set atop a 54’ wide and 180’ long barge. During the demolition activities, a Manitowoc 4100 Series II, a 230 ton crane, was used to dismantle the bascule leaves and remove the concrete sections from the flanking spans

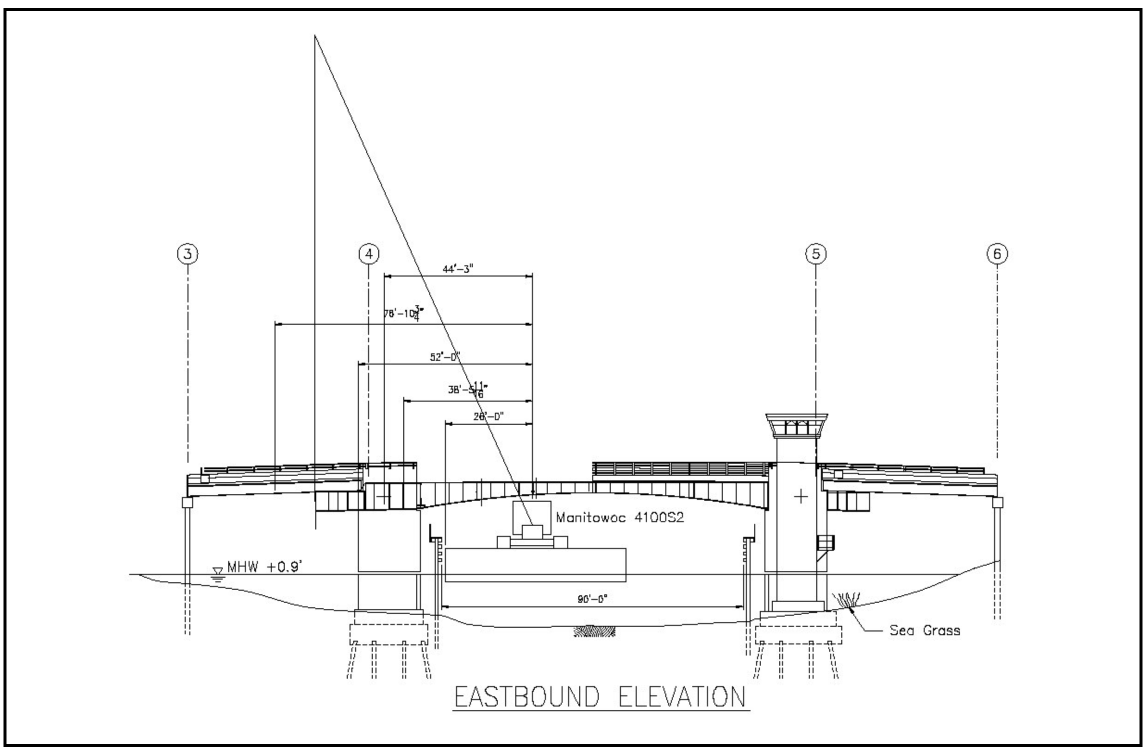

Figure 6: Crane drawing layout

and bascule piers. As previously noted, the 3D model for demolition provided a means of layout for the pier concrete cutting, while the weights were calculated based on the capacity of the crane. Specific crane layout drawings were created to depict actual picking locations to verify crane radius and capacity. While removing the structural steel components of the bridge, the steel was placed on the approach spans and then placed in recycling bins and scrap. The concrete sections of the flanking span decks and bascule piers were placed on the crane barge and once the barge was fully loaded, the material was offloaded on to a material barge.

For typical demolition activities, the material barge would be located at the site and the material would be placed directly on the barge, however, due to the limited space surrounding the PGA Blvd Bridge, this was not an option. After the crane barge was full of material, the barge was moved to an open area within the channel and the concrete sections were transferred to the material barge. This was repeated until the material barge was full of concrete, then the barge was pushed to the offshore artificial reef.

When the reconstruction phase of the project began, the Manitowoc 4100 Series II crane no longer had the capacity to perform all of the required picks. We then demobilized the 4100 Series II crane and acquired a Manitowoc 2250 Series III, a 330 ton crane. This much larger crane posed serious concerns throughout the project team. The physical size of the crane was significantly larger than the previous crane and the largest crane we have had on a 54 feet wide barge. There was a time period in which the crane operator and workers had to adjust to the size of the crane and its capacities. The crane, for example, had to be boomed down or the massive counterweight sections would cause the barge to list. Once the crews were adjusted to the new crane, the picks were made efficiently and safely.

There were restrictions that had to be followed while working with the barge inside the navigable channel. Because the channel was over 50% blocked with the barge in place, we were required to relocate the barge at the end of every shift. Imagine relocating a 54’x180’ barge that was loaded with a crane and material. There are not too many places along the Intracoastal Waterway in Palm Beach County where a barge of this size can be parked. The few places where it can actually fit, is undesirable for the residents. The project team had a challenging task at the start of the project of finding a location for the barge to park during no work hours. Each time we found a location, local residents voiced there displeasure with the choice. A decision was finally made where to place the barge and the FDOT public relations office had to attend several meetings with us to persuade the local residents to not fight the decision. This challenging situation persisted throughout the project while the barge was on site. It was a celebrated day when we were able to demobilize the crane and barge from the site.

Rehabilitation

The rehabilitation process in this project will consist of the westbound bridge and will focus primarily on the bascule span. There will be new bicycle railings installed on the approach spans and roadway joints will be repaired. Many of the rehabilitation activities for the bascule span will overlap and occur simultaneously. Some of the activities have already been started in the effort to minimize the length of the rehabilitation phase of construction, which is scheduled for eight weeks. The activities will involve structural steel, concrete, mechanical and electrical repairs. The major structural steel repairs involve the removal and installation of new lateral bracing in the bascule leaves, sidewalk brackets, roadway and sidewalk grating, installation of new light poles and traffic gate relocation. The counterweight pits will also be cleaned of any debris and existing concrete blocks. New cast iron blocks will be placed into the pits to rebalance the leaf once all major rehabilitation has occurred. The major concrete repairs include new pilasters for roadway lights, new foundations for relocated traffic gates and the pouring of concrete wheel paths within the newly installed roadway grating. Mechanical and electrical repairs will include the installation of new limit switches, brakes, motors, lockbars and the replacement of the spans centering guide.

Safety

The most important aspect of all the construction activities on this project and all of PCL projects is safety. The project team strives to create a safety culture that encourages our workers to work safely and with zero incidents. We strive for continuous improvements to achieve and maintain our goal of zero incidents. Before each shift and prior to any major change of work activity, we perform pre-job safety instructions that identify safety concerns of potential dangers. We also complete job hazard analysis prior to any major work item, such as structural steel or concrete demolition. This analysis provides a detailed look at the work ahead and outlines safety hazards as well as proper measures that will be taken to avoid an incident. Safety inspections are completed weekly, at a minimum. Quarterly safety meetings are held with senior management to ensure that all projects are maintaining the safety goals.

We actively enforce our safety culture to all of our workers and subcontractors. If someone is not 100% dedicated to our safety policies, no matter how important they are to the projects success, they will be removed from the project. Our safety goals are a team effort. No work is so important, that it cannot be done safely.

Summary

The PGA Blvd Bascule Bridge project has provided many challenges as we progress through the different construction phases. We are currently on schedule to be completed with the project by early March 2007, several months ahead of schedule. The reconstruction of the eastbound bridge is scheduled to be completed by the end of November 2006.

The demolition of the eastbound bridge required a great deal of planning and coordination within the project team. The plans were made months prior to the work being performed. Once the demolition is underway, the planning and coordination begins for the reconstruction phase of the project. The planning throughout the project was completed ahead of all the construction activities to maintain proper productivity. The challenges that were faced throughout the project were collectively resolved with the coordinated help of the construction team, the designer, and the owner. The positive relationship that has been created as a result of the project will carry on for years to come.