SEPTEMBER 11 MEMORIAL BRIDGE – A SUSTAINABLE BRIDGE SOLUTION

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ABSTRACT

Located in the coastal region of the State of New Jersey, the Route 70 over Manasquan River Bridge is a gateway for the counties of Monmouth and Ocean. The need to replace the bridge presented the New Jersey Department of Transportation with an opportunity to provide a sustainable bridge design. To accomplish this, an extensive community outreach program was conducted to better understand the needs of the project stakeholders. As the design progressed and the tragedy of September 11 unfolded, the project need changed and memorial architectural treatments were incorporated into the project. The resulting design included: articulated parapets, sidewalks and lighting bosses, banner poles, a public access platform, monuments with memorial plaques, and 911 signage with plantings on the approaches. The new 724-foot long, 25-foot high, fixed bridge consists of twin structures, each having two three-span continuous superstructure units supported on five lines of architecturally treated piers. Environmental permit restrictions on the in-water construction activities and the requirement to maintain four lanes of traffic on this lifeline structure influenced the design and method of construction. To meet the project need and reduce the construction duration, a precast pier solution was developed. Precast concrete cofferdams, columns and pier caps were fabricated offsite, delivered and then assembled using post-tensioning. The use of precast bridge components not only allowed for the bridge architectural concept to be realized, but it resulted in a high quality, sustainable, memorial structure constructed over 700 days ahead of schedule.

Keywords: Sustainability, Highways for Life, Accelerated Bridge Construction, Precast Concrete, Piers, Cofferdams, Columns, Cap Beams, Rapid Construction, In-Water, Piers, Aesthetics, Post-Tensioning, Substructures

INTRODUCTION

Sustainability is a relatively new concept in bridge design, and it has only recently been defined in its current fashion. It incorporates a number of previous ideas, such as Context Sensitive Design, as well as the carbon and environmental footprint that a project can have on the environment. On the surface, a bridge might be considered sustainable if it is designed efficiently, requires little or no maintenance, and is expected to have a long service life. By its continued existence the bridge would be thought to be sustainable. However, as one's awareness of sustainability grows, it becomes apparent that sustainability encompasses much more than maintenance free structures. "To be truly sustainable, all aspects associated with a structure including design, location, materials utilized, construction techniques, maintenance, impact on the environment, overall energy consumption, and the effect on future generations must be considered."[1] All aspects of a project should be coordinated so that it best meets the needs of society.

The existing Route 70 over Manasquan River Bridge was structurally deficient and functionally obsolete. As a result, the New Jersey Department of Transportation (NJDOT) had programmed it for replacement. The bridge was located on a section of Route 70 that had recently been widened. The former bridge and its approaches now needed to be similarly upgraded to complete the ongoing widening program. The location of the bridge site makes a bridge at this location a gateway structure as it is located adjacent to businesses and serves as a vital crossing for the surrounding communities as well as the coastal region of the State of New Jersey. With this bridge site being situated in such a unique and environmentally sensitive river setting, it demanded that a sustainable bridge be provided.

Throughout the design and construction of the project, its effect on the surrounding communities, the environment and economy was considered. The needs of the project stakeholders had to be understood, and this was accomplished through an extensive community involvement effort. During design the project needs changed when the bridge was designated as New Jersey's "September 11 Memorial Bridge" and significant symbolic memorial treatments were added to the project. The goals of the Federal Highway Administration's (FHWA's) Highways for LIFE (HfL) initiative, which are to: improve safety during and after construction, reduce congestion caused by construction, and improve the quality of the highway infrastructure were addressed through the maintenance and protection of traffic plan and the application of the latest bridge and highway technology.[2] An attractive, low maintenance concrete bridge was constructed with minimum environmental disturbances. Lastly, FHWA and NJDOT have been advocates of a "Get in, get out, stay out" approach to bridge and highway construction projects.[3] One of the primary methods of implementing this strategy is to employ prefabricated bridge elements and systems to accelerate the bridge construction. All of these goals were accomplished on this project, with the result being a sustainable bridge design for the State of New Jersey.

BACKGROUND

The Route 70 over Manasquan River Bridge (Structure No. 1511-150) crosses a navigable waterway and is considered a gateway to both Monmouth and Ocean Counties in the coastal region of the State of New Jersey. The bridge serves vehicular, pedestrian and marine traffic at this crossing. The original bridge was constructed in 1936 and was 625-ft long with a single leaf bascule span over the navigation channel (see Fig. 1).

Fig. 1. Existing bridge bascule span.

The bridge was in poor condition due to a number of substandard elements. The pile bents were deteriorated at the waterline, the abutments had experienced movement and the deck exhibited cracks, spalling and efflorescence. The movable span had also been retrofitted with a sprinkler system to keep it cool and prevent it from becoming stuck during the summer. The bridge had a sufficiency rating of 20.6 out of 100. It also did not meet current geometric standards and only provided 11-ft travel lanes. Due to its low vertical underclearance of 15-ft, the bridge had to be opened on demand to allow for the passage of marine traffic, which impeded the flow of vehicular traffic and emergency vehicles along the Route 70 corridor.

THE PROJECT

The proposed replacement bridge is the centerpiece of a $52 million project that will carry the dualized section of Route 70 across the Manasquan River (see Fig. 2). The project meets the long-term regional vehicular and marine transportation needs along the Route 70 corridor and the Manasquan River. In addition to these considerations, this structure accomplishes the goals of the NJDOT and FHWA of eliminating movable bridges, minimizing traffic delays, facilitating the passage of emergency response vehicles, reducing annual operating and maintenance costs, and providing for a more reliable transportation infrastructure.

Fig. 2. Architectural rendering of the proposed replacement bridge.

The bridge section for the new structure has a 2'-8" median, one 4'-8" inside shoulder, two 12-ft lanes and one 10-ft outside shoulder in each direction. 6'-0" sidewalks and 1'-4" parapets are included on each side of the bridge. The project widens the bridge from 56'-10" to 94'-8" and shifts the centerline of Route 70 by 28'-10" (see Fig. 3).

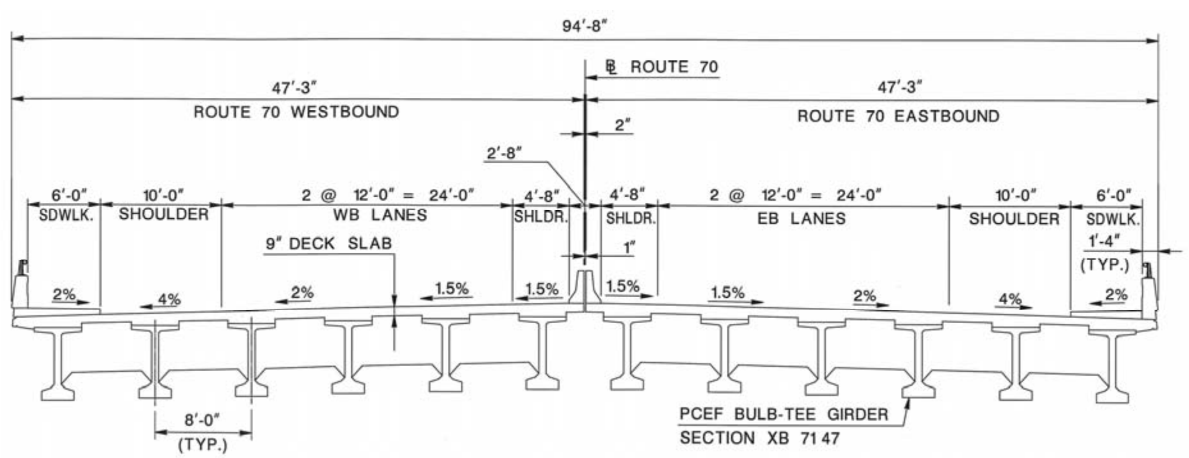

Fig. 3. Superstructure cross section.

The 724-ft long, fixed bridge consists of twin structures, each having two three-span continuous superstructure units (119'-120.25'-120.25') comprised of bulb tee girders at 8'-0" spacing. The superstructure is supported on two abutments and five architecturally treated in-water pier lines with pile foundations. With this span arrangement, the ten proposed pier foundations (5 EB and 5 WB) could be constructed adjacent to the existing bridge foundations. Increasing the bridge underclearance to 25-ft, widening the navigation channel from 50-ft to 75-ft and shifting the centerline of channel 15-ft towards the centerline of the river also accommodates marine traffic needs.

In addition to the bridge replacement and roadway widening, the project included many other elements. A new bridge fender system and an ADA compliant public fishing pier were designed using Fiber Reinforced Polymer (FRP) composite piles and lumber (see Fig 4).

Fig. 4. Public fishing pier constructed of FRPL and FRPP.

Retaining walls, noise walls, bulkheads, ramps, traffic signals, water quality stormwater management retention basins and manufactured treatment devices (MTDs) for improving water quality, highway lighting, ITS improvements and utility relocations were also included.

COMMUNITY INVOLVEMENT

Throughout the project, the NJDOT made a concerted effort to involve residents, stakeholders and public officials of Brick Township, Borough of Point Pleasant, Wall Township and Borough of Brielle in the development of the project. This transparent, continuous and open communication resulted in significant refinements to the project.

During Feasibility Assessment the NJDOT held five public meetings. The height of the bridge was set to provide a 40-ft vertical underclearance and the bridge structure was approximately 1,800-ft long. Three additional public meetings were held during Final Scope Development. As a result of the comments received from the public officials and members of the community, the NJDOT performed a new Vessel Height Survey using reflectorless survey equipment to accurately measure the true height of the vessels on the Manasquan River. The needs of local marinas, dock maintenance companies and dry dock facilities were also considered in determining the new bridge height. The footprint of the project was revised to provide a 724-ft long bridge with a 25-ft vertical underclearance and a traffic signal at the intersection of Route 70 and River Road/Riviera Drive on the west approach to the bridge.

The “right-sized” project was then presented to the public through a new series of three public meetings. The project gained broad-based support from the affected municipalities. However, requests were made to include a 1,677-ft long precast concrete noise wall in the Borough of Brielle and to create a cul-de-sac on a local roadway in Brick Township.

NJDOT then advanced the Preliminary Design of the right-sized project. After two additional public meetings the Borough of Brielle issued a Resolution of Support for the project and the Township of Brick indicated their support for the project as well. During Final Design, NJDOT held an additional meeting with the Borough of Brielle to discuss construction related noise issues, lane closures, night work, the construction schedule and a proposed detour.

The construction contract was awarded in December 2005. NJDOT then developed a project website, which was used to provide general project information, renderings of the proposed bridge, construction progress updates, traffic information, detour notifications, a construction photograph archive and an avenue for the public to submit questions and provide feedback to NJDOT. The Department continued to meet with local marina and business owners, public officials, police and fire personnel to discuss the proposed construction detours. During construction, NJDOT also advertised in regional newspapers and on local radio stations, utilized press releases to announce detours and project milestones, and provided additional public awareness notifications through variable message signs.

TRAFFIC CONTROL FOR A LIFELINE STRUCTURE

Route 70 is a heavily traveled regional corridor with a Two-Way A.D.T. (2005) of 32,300 vehicles. Since Route 70 is also a coastal evacuation route, NJDOT required that during construction two lanes of traffic be maintained in each direction on this lifeline structure. To address the maintenance and protection of traffic needs and minimize the right-of-way required, the project was constructed in stages and on a parallel alignment shifted approximately 29-ft south of the existing crossing.

After performing a partial demolition of the existing bridge, the eastbound bridge structure was constructed approximately 3-ft from the south fascia of the existing bridge. Traffic was then transferred onto the newly constructed eastbound structure (see Fig. 5).

Fig. 5. Traffic has been shifted onto the newly completed eastbound half of the bridge and the existing bridge is being demolished.

Traffic was maintained in four 10'-11" wide temporary lanes, which utilized the entire bridge deck surface including the sidewalk and shoulder areas. Pedestrian traffic was maintained on a temporary structure cantilevered off the south fascia of the eastbound structure. The existing bridge was demolished, followed by the construction of the westbound half of the bridge next to the north fascia of the eastbound structure. A final stage was required to remove the temporary sidewalk, shift traffic into its final lane configuration, and construct the eastbound sidewalk.

ENVIRONMENTAL

In-water work restrictions were stipulated in the environmental permits issued by the United States Army Corps of Engineers in their Nationwide Permit 23 and the New Jersey Department of Environmental Protection in their CAFRA and Waterfront Development Permits. To protect winter flounder and anadromous (alewife) fish during migration and spawning runs, a timing restriction was imposed from January 1st through April 30th to prohibit in-water construction activities and to reduce the possibility of increased turbidity. This in-water work restriction made it critical to construct the bridge foundations during the available window each season.

During the subsurface investigation, arsenic, beryllium and salt laden soils were found in the riverbed sediments. Therefore, it was desirable to develop a pier design that would minimize the bridge footprint in the riverbed and limit the amount of riverbed sediments that would need to be excavated.

ARCHITECTURAL DESIGN

The bridge is a gateway structure located on the border between Monmouth and Ocean Counties. During Preliminary Design, NJDOT requested that bridge architectural recommendations be developed to enhance this status and provide a well-balanced, aesthetically pleasing structure that would fit into this unique river environment. An architectural study was prepared for the bridge and the other structures included in the project. Traditional solid-shaft and multi-column pier types constructed on plinths were evaluated against more creative architectural concepts.[4] The preferred alternative, which resulted from the architectural study, was to use V-shaped piers with eased edges and punctured by symmetrical, sloped geometric voids. The large simple shapes would visually reinforce the pier's weight-carrying ability and provide a dramatic appearance from the water and the shoreline[5] (see Fig. 6).

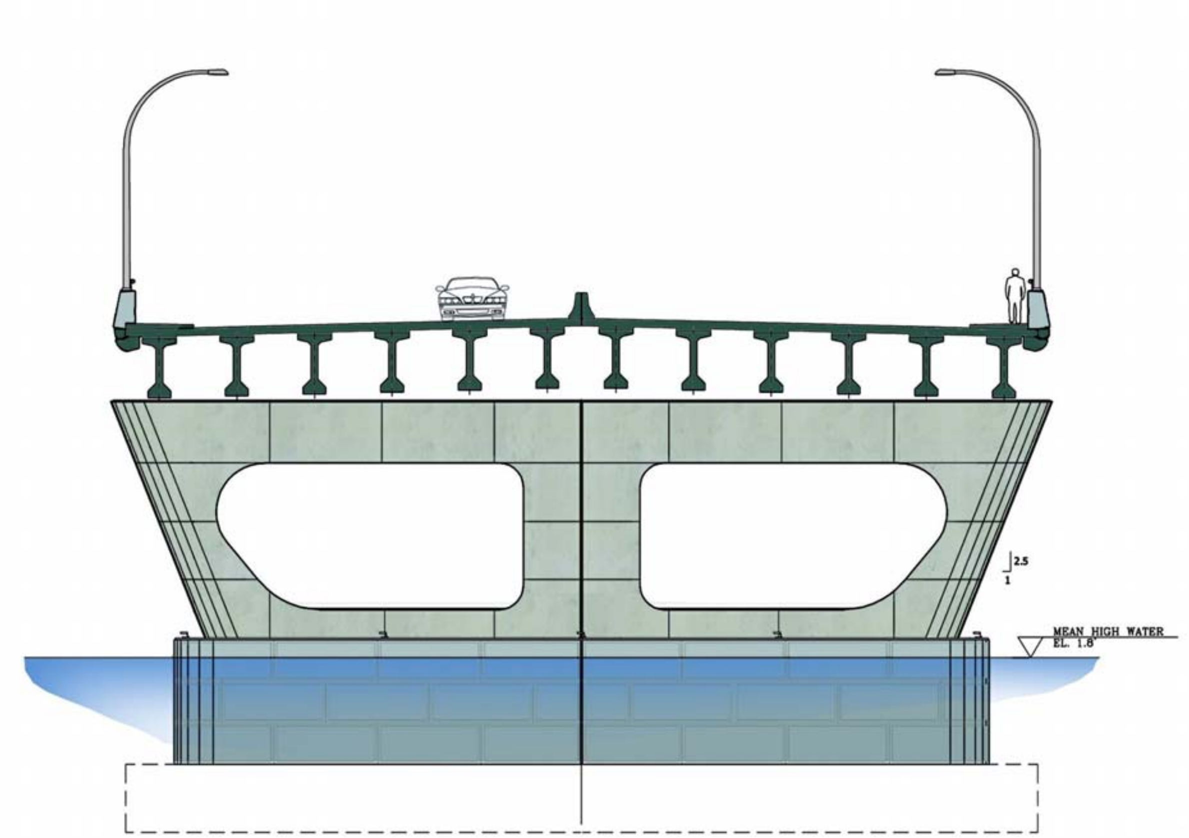

Fig. 6. Initial architectural recommendation for the proposed piers.

A precast concrete solution was studied to minimize the duration of the in-water construction activities while still capturing the intent of the architectural pier design concept. Precast concrete proved to be ideally suited to this purpose. The result is a unique architectural pier design. Each pier is supported at the waterline on a simulated masonry faced plinth. There is a pair of prismatic vertical columns at the centerline of the bridge, inclined tapered columns sloping outward towards the bridge fascias, and a cap beam connecting the tops of the columns. The piers appear bold and uplifting with two symmetrical trapezoidal openings (see Fig. 7).

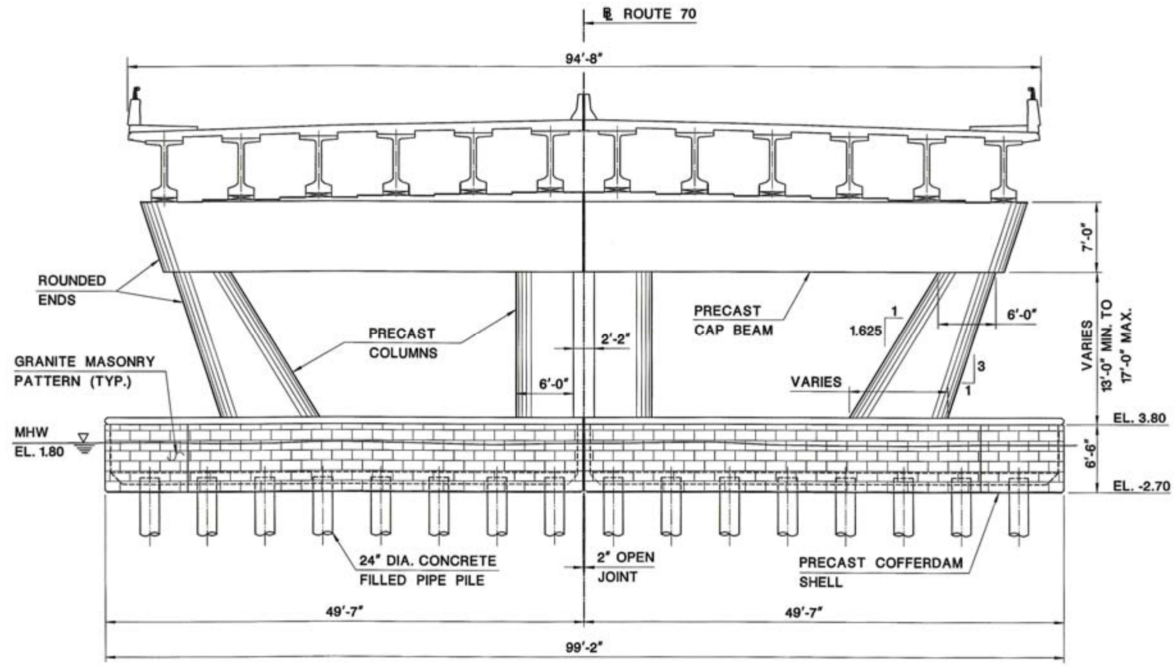

Fig. 7. Final precast pier configuration.

In addition to the distinctive pier treatment, a number of other bridge elements received architectural treatments (see Fig. 8).

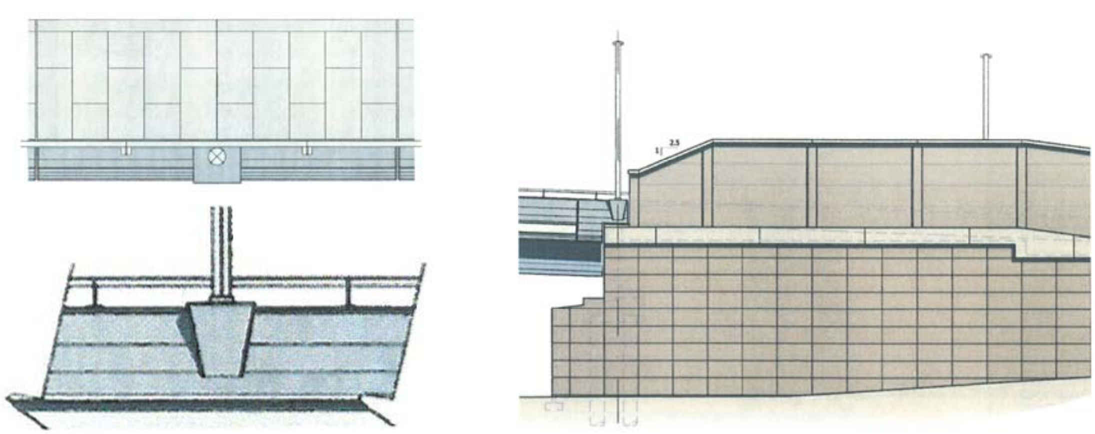

Fig. 8. Sidewalk, parapet, retaining wall and noise wall architectural treatments.

The post and panel noise walls have a “2-inch brown and root” texture on the roadway side and a “fuzzy” raked finish on the residential side. The proprietary retaining walls utilize a stacked bond pattern for the precast panels. Both the noise walls and the retaining walls have a stain finish in the range of colors #30279 to #30315 in accordance with the federal standard 595B color chart. The sidewalks are stamped with a simple alternating block pattern. The parapets have a tapered outside face, trapezoidal lighting bosses, and a horizontal recess to provide a shadow line. The recess is also stained to match the abutment retaining walls and provide a continuity band of color across the bridge.

SEPTEMBER 11 MEMORIAL DESIGN

During the final design phase of the project, the bridge was designated as the “September 11 Memorial Bridge” by the State of New Jersey in remembrance of the 166 people from Monmouth and Ocean Counties who died in the September 11, 2001 terrorist attacks. The project scope was then enhanced to include additional memorial architectural treatments (see Fig. 9).

Fig. 9. September 11 Memorial Bridge sign, “Let Freedom Ring” parapet quote and patriotic bunting were incorporated into the project.

Cast aluminum signs displaying the bridge name “September 11 Memorial Bridge” are located on the east and west approaches to the bridge with suitable landscaping and decorative plantings. The signs feature a silhouette of the World Trade Center against a field of stars and stripes. As a reminder to all about what makes America special, the words "Let Freedom Ring" have been repeated along the length of the bridge on the inside face of the parapets. The quote is recessed into a horizontal band that will be stained to match the band on the outside face of the parapet. Banner poles with patriotic bunting have been interspersed with the highway lighting standards in a zig-zag pattern along the length of the bridge. At the four corners of the bridge there are monuments, which echo the locations of the crash sites of American Airlines Flight 11 (WTC North Tower), United Airlines Flight 175 (WTC South Tower), American Airlines Flight 77 (Pentagon), and United Airlines Flight 93 (Pennsylvania). Symbols representing each of these locations are incorporated into the monuments. The top of each monument extends 16-ft above the adjacent sidewalk area (see Fig. 10).

Fig. 10. September 11 Monuments located at the corners of the bridge.

On the sidewalk faces of the monuments a pair of cast bronze "We Remember" plaques will be mounted on each side of the bridge (see Fig. 11).

Fig. 11. September 11 Memorial Plaques mounted on the monuments at the corners of the bridge.

Both plaques feature the unforgettable image of three firemen raising an American flag at Ground Zero. The first plaque provides a description of the events of September 11, 2001 and displays the poem “My Country, `Tis of Thee”, which is the source of the “Let Freedom Ring” quote displayed on the parapets. The second plaque lists the names of the Monmouth and Ocean County residents who lost their lives during the September 11 attacks. The list of names was posted on the project website where family members could verify the accuracy of the list. We will never forget those who perished.

PRECAST PIER SYSTEM

The precast concrete pier system utilized precast cofferdam, column and cap components, which were fabricated offsite, delivered via trucks and loaded onto barges for erection. To provide added strength and durability 8,000 psi HPC is used for all of the precast bridge elements. Using precast bridge elements provided better quality, accelerated bridge construction and increased worksite and roadway safety.

The piers are founded on 24-inch diameter concrete-filled steel pipe piles driven to an estimated pile tip elevation of –110. To construct the foundations, the contractor drove test piles and pilot piles with a template around the perimeter of each pile group. After a 7-day setup period, each test pile was restruck to verify the minimum 800 kip ultimate pile driving resistance had been achieved. By utilizing the setup characteristics of the sandy subsurface layers, the required pile capacities were developed without the necessity of driving to a lower stratum. The perimeter piles were then used to construct a temporary frame to support the precast cofferdam sections, which were hoisted into place and connected with couplers (see Fig. 12).

Fig. 12. Precast cofferdam section being hoisted into place.

The typical footing size for each half of each pier was 30-ft wide by 49.5-ft long, and they are made up of sections varying in length from 7.2-ft to 14.5-ft. Rather than constructing the footings inside traditional braced steel sheeting cofferdams below the riverbed, they were constructed at the waterline within precast concrete cofferdam shells. The cofferdam shells provided driving templates for the remaining piles, served as architecturally treated formwork for the footings and minimized disturbances to the riverbed. The cofferdam shells are faced with a #1104 random cut stone pattern and coated with a clear epoxy waterproofing seal coat. This gives the pier footings the appearance of being faced with wet granite masonry at the waterline. The precast concrete cofferdams offered significant cost and schedule advantages over traditional cofferdams.

Once the cofferdams were in place, the remaining work for each footing was to:

- Seal the annular spaces around the pile heads,
- Place tremie concrete,
- Dewater the cofferdam,
- Cut the piles off 6-inches above the floor slab,
- Support the cofferdam on the pile heads,
- Concrete the piles, and
- Make a mass pour of footing structural concrete (see Fig. 13).

Fig. 13. Work being performed inside a cofferdam. Piles are being filled with concrete.

The pier columns were fabricated as complete units approximately 16-ft in length rather than smaller segments. Using complete column units simplified the column erection sequence. 7-ft deep by 5-ft wide hollow prestressed concrete box beams with rounded exterior ends were designed for the cap beams. The contractor had mobilized a number of large land-based and barge-mounted cranes, which provided flexibility in handling the large concrete members. Working from barge platforms, the individual pier components were easily hoisted into place (see Fig. 14).

Fig. 14. Precast pier columns and a cap beam being prepared for erection.

Once the columns and cap beams were erected, they were connected by post-tensioning from anchorages cast in the footings to tie points in the cap beams. The post-tensioning utilized 1¾" diameter, ASTM A775, Grade 150, threadbar. The threadbar was preferred over strands because they were easier to install in the sloping outer columns. The erection and post-tensioning of the precast pier components was accomplished in a matter of hours for each operation, and the architectural form of the piers quickly took shape. (see Fig. 15).

Fig. 15. The precast columns and cap beam have been erected to complete the first pier.

GIRDERS

The bridge was designed to accommodate either Prestressed Concrete Economic Fabrication (PCEF) Bulb Tee girders or New England Bulb Tee girders. The contract plans were detailed using the PCEF XB 71 47 section, which is the section that was ultimately supplied by the contractor. The existing bridge was used as a working platform during Stage 1 to set the girders for the eastbound structure. During Stage 2, the newly constructed eastbound structure was used to set the girders for the westbound structure. Galvanized steel intermediate diaphragms were used to quickly secure the girders at the time of erection. CIP continuity diaphragms were later constructed at the piers (see Fig. 16).

Fig. 16. All piers have been completed and the PCEF Bulb Tee girders have been erected.

CONSTRUCTION SCHEDULE

Since in-water construction operations were prohibited from January 1st through June 30th, every effort was made to maximize each in-water construction season. An added difficulty was that cold weather concrete provisions would be in effect if the pier construction extended into the winter months. Therefore, the substructures and the superstructure of the first half of the bridge had to be completed as quickly as possible so that traffic could be shifted onto the new structure and in-water construction activities for the second half of the bridge could begin at the start of the following in-water construction season.

To achieve this, the contractor operated on a six-day workweek and employed several crews, which moved from one pier location to the next, performing the same tasks for each pier. Once an element of a pier was constructed the crew performed the same series of tasks on the next pier, and this was repeated for each step in the pier construction process (see Fig. 17).

Fig. 17. Crews work on multiple piers at the same time. Piers are shown in various stages of completion.

The eastbound pier construction activities occurred between July 1, 2006 and October 23, 2006. Since the five eastbound piers were being constructed concurrently, the contractor's goal was to optimize the construction of all five piers rather than any single pier. The construction duration for the individual piers ranged from 69 to 86 working days (WD) with an average duration of 78 WD per pier. However, these construction durations all contained some float. The total duration of the eastbound pier construction was 96 WD, so the rate at which the five eastbound piers were completed was approximately 19 WD per pier (see Fig. 18).

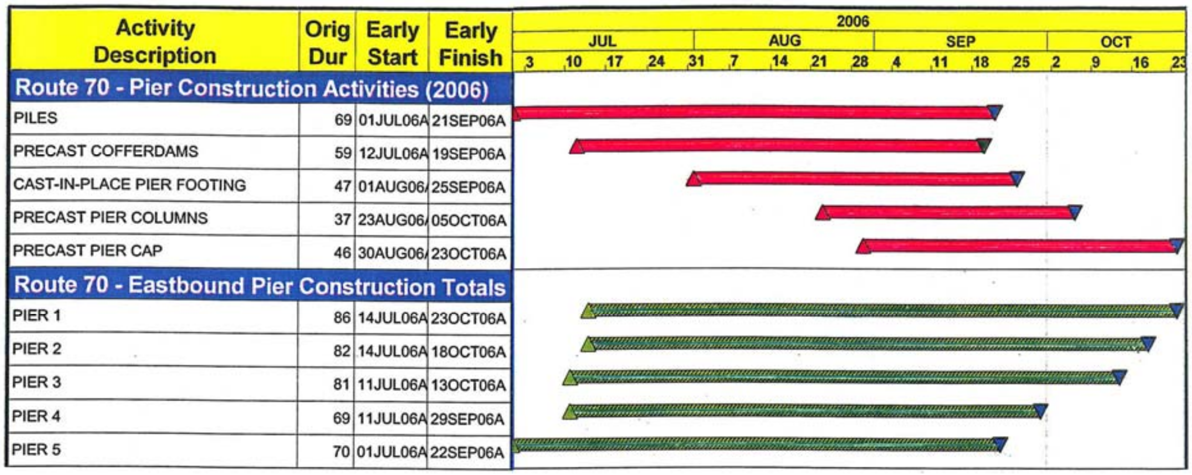

Fig. 18. Construction schedules for the eastbound precast pier operations and the durations of Piers 1EB through 5EB.

The westbound pier construction activities occurred between August 24, 2007 and November 27, 2007. As on the eastbound structure, the contractor's goal was to optimize the construction of all five piers rather than any single pier. The construction duration for the individual piers ranged from 53 to 67 WD with an average duration of 61 WD per pier. The contractor was still bound by the same in-water environmental permit and cold weather concrete provisions that were present for the eastbound construction. The work was further complicated by the in-water demolition of the existing bridge, which could not begin until July 1, 2007. This resulted in a late start and late finish of the westbound pier construction activities. To make up for this, the contractor was able to reduce the average time of construction for each pier from 78 WD on the eastbound structure to 61 WD on the westbound structure. The total duration of the eastbound pier construction was 93 WD, which was an improvement of 3 WD, but the rate of pier completion remained approximately 19 WD per pier (see Fig. 19).

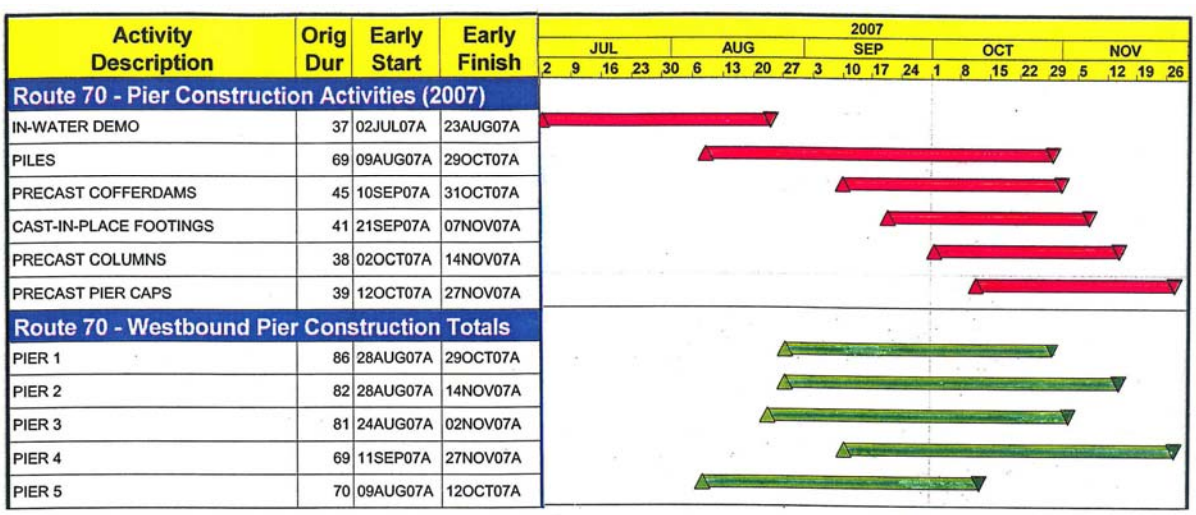

Fig. 19. Construction schedules for the westbound precast pier operations and the durations of Piers 1WB through 5WB.

Since the contractor was able to replicate this pier completion rate of 19 WD per pier, it is reasonable to conclude that this rate of construction could be achieved on other projects with multiple in-water piers.

To better understand the efficiency of the precast pier construction, a typical precast pier should be compared to a typical cast-in-place (CIP) pier. This comparison should also be made with pier construction schedules considering all construction activities to be on the critical path. For comparison purposes, the same pile foundations were used for each type of pier. Optimum precast pier construction duration was arrived at by starting with the actual schedule for the most efficient pier (Pier 1WB), eliminating the days when no construction activities were occurring, and substituting the most efficient durations for each individual task to eliminate the float. In this way, optimum precast pier construction duration of 34 WD was arrived at. It was then estimated that a single CIP pier could be constructed in 72 WD. The difference is more pronounced if the 19 WD for the similar pile foundations are deducted. This yields durations of 15 WD and 53 WD for the precast and CIP piers, respectively. Excluding the pile driving operations, a precast pier can be constructed 3.5 times faster than a CIP pier. Schedules for the typical optimized precast and CIP piers are shown below (see Fig. 20).

Activity Description	Orig Dur	Early Start	Early Finish
Construct Single Precast Pier (Typical)			
DRIVE TEST & PRODUCTION PILES	19	28AUG07	18SEP07
INSTALL PRECAST COFFERDAM	10	10SEP07	20SEP07
POUR FOOTING CONCRETE	5	21SEP07	26SEP07
ERECT PIER COLUMNS/PT	1	27SEP07	27SEP07
ERECT PIER CAP	8	28SEP07	06OCT07
Construct Single Cast-In-Place Pier (Typical)			
CONSTRUCT COFFERDAM	15	28AUG07	13SEP07
EXCAVATE AND DEWATER	3	14SEP07	17SEP07
DRIVE TEST AND PRODUCTION PILES	19	18SEP07	09OCT07
SETUP - PLACE TREMIE CONC	2	10OCT07	11OCT07
TREMIE CURE	5	12OCT07	16OCT07
CONSTRUCT FOOTING	4	17OCT07	20OCT07
CONSTRUCT PIER COLUMNS	5	22OCT07	26OCT07
CONSTRUCT PIER CAP	11	27OCT07	08NOV07
REMOVE COFFERDAM	8	09NOV07	17NOV07

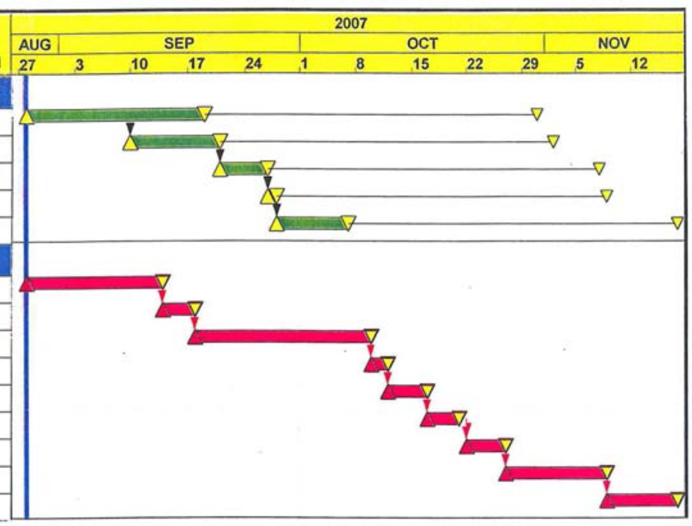

Fig. 20. Construction schedules for a typical cast-in-place pier and an optimized precast pier.

The effect of using precast components can also be quantified by comparing the construction duration of five conventional piers to the actual duration of the precast piers. Since the pile driving operations in this illustration take 19 WD and they are the longest duration task, this is the stagger that should be used when considering the overall duration of constructing multiple piers together. Assuming that the contractor could optimize the construction of all five CIP piers, the construction duration would be 148 WD. This is 55 WD longer than the actual westbound precast pier construction duration of 93 WD. If CIP construction had been used, then construction of both the eastbound and westbound structures would have extended into the following calendar year and could have been even further impacted by cold weather. Since the pier construction on this project was on the critical path and the schedule effects are cumulative, it is likely that the contractor would not have been able to beat the baseline construction schedule by two whole construction seasons.

With the implementation of the precast pier system, the contractor was able to begin work on the eastbound superstructure, and the first girders were erected on September 29, 2006 (see Figure 21).

Fig. 21. Piers 1EB through 5EB have been completed and bulb tee girders erected.

This early start on the bridge superstructure allowed the eastbound bridge to be completed on April 10, 2007. Traffic was switched onto the eastbound structure and demolition of the existing bridge superstructure commenced. After the in-water demolition was significantly advanced, construction on the westbound structure began on August 9, 2007. The westbound piers were then rapidly advanced (see Figure 22).

Fig. 22. Westbound bridge piers are shown in various stages of completion.

The westbound bridge was opened to traffic on May 7, 2008, and the third and final stage of construction commenced. Because of the accelerated bridge construction using precast components, the project is approximately 737 calendar days ahead of schedule and is anticipated to be complete in December 2008.

CONCLUSION

The Route 70 over Manasquan River Bridge Replacement Project provides a sustainable bridge design that meets the project need. A precast concrete substructure solution achieves the architectural goals while allowing for the acceleration of the bridge construction. In addition to the bridge structure itself, the sustainable design features provided for this project included: transparent community involvement; right-sizing the project; incorporation of the latest technology and construction methods; manufactured treatment devices and detention basins to improve water quality; minimization of environmental impacts; reforestation; optimization of the pile foundations through a test pile program; maintenance of traffic along a lifeline corridor; use of FRP lumber and piles for secondary in-water structures; a public fishing pier for improved access to the river; a noise wall to reduce or eliminate highway noise in residential areas; and September 11 memorial architectural treatments.

The precast concrete components, including the precast pier system and bulb-T girders, were detailed on the contract plans to allow the contractor and his fabricator to modify the design for maximum economy. This allowed the contractor to select the most efficient method of construction, which reduced costs to the owner. Over two construction stages, 10 in-water piers were constructed in a total of 189 WD with an average completion rate of approximately 19 WD per pier. This rapid rate of pier construction and the acceleration of the overall project minimized the amount of energy required for construction. Since this efficient rate of construction was achieved in two separate stages, this type of efficiency can be expected on future projects with multiple in-water piers. As contractors continue to gain experience with precast substructure construction, it is expected that even greater efficiencies will be realized. The use of precast substructures will have resulted in a high quality, sustainable, signature bridge being constructed 24 months ahead of schedule (see Figure 23).

Fig. 23. View of the north fascia of the completed September 11 Memorial Bridge.

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- Jeff Brantly – Sr. Project Engineer, George Harms Construction Co., Inc.

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