ROUTE 46 OVER PIAGET AVENUE (CR 628) BRIDGE SUPERSTRUCTURE REPLACEMENT IN TWO WEEKENDS

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ABSTRACT

The bridge superstructure carrying Route 46 over Piaget Avenue had exceeded its useful service life. Its concrete was crumbling and had to be replaced. The high traffic volume did not allow closure of any lanes during peak hours. Widening the bridge, even temporarily, was cost prohibitive. Piaget Avenue was also the sole access to a nearby school and thus had to remain open during the school year. Accelerated Bridge Construction (ABC) kept all lanes open during peak hours and did not hinder school access when needed.

BACKGROUND

The original bridge carrying Route 46 over Piaget Avenue in Clifton, New Jersey, was constructed in 1940 as a single span structure comprised of concrete encased rolled steel stringers and was skewed at approximately 45 degrees. The span length of the bridge was about 60 feet, and the out to out width of the bridge was about 69 feet. The existing bridge had two travel lanes in each direction. As the Prime consultant, MP Engineers provided the design and construction support services for the replacement of the entire superstructure, including the girders, bearings, parapets, sidewalks, curbs, and bridge deck.

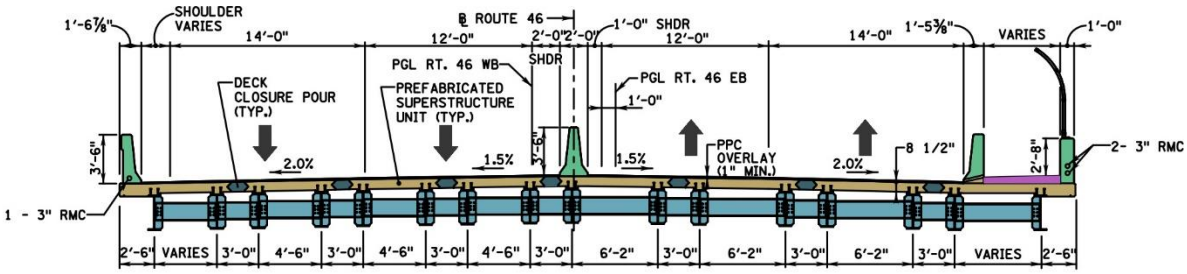
The bridge deck was in poor condition due to underdeck spalls with exposed reinforcing, underdeck cracking and efflorescence with water staining. The superstructure was in fair condition due to areas of spalled and hollow sounding concrete encasement with locations of rust on the exposed steel. The substructure was in satisfactory condition with several fine vertical cracks in the breast wall and backwall of each abutment and wide cracks in three of the wingwalls. Two areas of scaling in wingwall coping were also noted. Since the previous inspection, the condition of the approach slab/pavement was downgraded from very good to good due to minor wheel rutting at the east approach roadway and several fine longitudinal cracks at both approach roadways. There were no other major changes to the overall condition of the structure. The structure was classified as structurally deficient due to the condition of the deck and functionally obsolete due to the inadequate lateral underclearance.

THE CHALLENGE

The Route 46 Bridge is located in a congested, urban environment, with Average Daily Traffic of 39,000 vehicles. It was also adjacent to a middle school that has access only from Piaget Avenue. Any deck or superstructure replacement project would impact vehicular/pedestrian access to the school including the drop-off and pick-up of school children. Because of this, the staging of any work on the bridge during the school year would require that Piaget Avenue remain open. In addition, the existing vertical clearance under the bridge was already substandard, so the design and erection of underdeck shielding that would not further reduce the clearance would be a significant challenge. On Route 46, the traffic volume is so heavy that the existing two lanes of traffic in each direction would not be able to be detoured off-site and would have to be maintained during peak hours. If conventional staged construction was used, the bridge would have to be temporarily widened to maintain those two lanes of traffic during construction. Widening the bridge, even temporarily, would be cost prohibitive. This widening was made even more complex because of an existing on-ramp to the Route 46 eastbound lanes just before the bridge.

THE SOLUTION

Keeping all of these critical items in mind, MP Engineers developed an Accelerated Bridge Construction (ABC) method using Prefabricated Superstructure Units (PSU). PSU's with precast concrete decks substantially reduced the construction time by eliminating long concrete curing periods for each construction stage. The joints in between the PSU's were to be filled with rapid curing Polyester Polymer Concrete (PPC), a procedure which had been used successfully in earlier New Jersey bridge projects. Polyester Polymer Concrete achieved a strength of 5,000 psi in 4 hours. A thin, one inch, PPC overlay was also to be placed during the ABC weekend, creating a durable superstructure system. By using this ABC method, the eastbound half of the bridge was constructed in one single weekend closure and the westbound half of the bridge was built in a second weekend closure. All construction was done during the summer months when the school and Piaget Avenue could be closed. By restricting critical work to weekends, peak hour traffic disruptions were eliminated. Also, because Piaget Avenue could be shut down during the summer weekends, this method greatly reduced the need for temporary shielding. See proposed superstructure below.



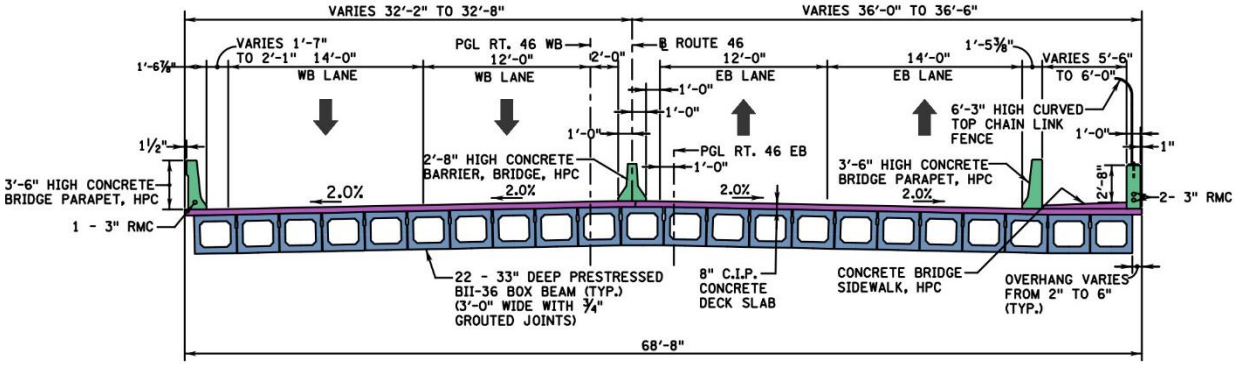
PROPOSED SECTION

- Prefabricated Superstructure Units (PSU's)
- 8 ½" Thick Precast Concrete Deck
- Two W30x99 Rolled Steel Beams - Grade 50W
- Closure Pours were Polyester Polymer Concrete (PPC)
- Roadway Covered with a 1" Thick PPC Overlay

THE VALUE ENGINEERING PROPOSAL

During construction, a Value Engineering (VE) proposal, which was accepted, changed the superstructure to precast concrete box beams with an HES concrete deck. However, the girder/backwall combination and the ABC construction scheme, schedule and traffic control plan, were kept the same.

The reasons for the change were as follows: The Prefabricated Superstructure Units (PSUs) would have required very large cranes, and the picks were made more complex by the large skew of bridge. Also, PPC requires substantial time and labor to mix and install. Though the Contractor had successfully installed PPC in another NJDOT project, this contract called for larger quantities which increased the schedule risk.



PROPOSED SECTION

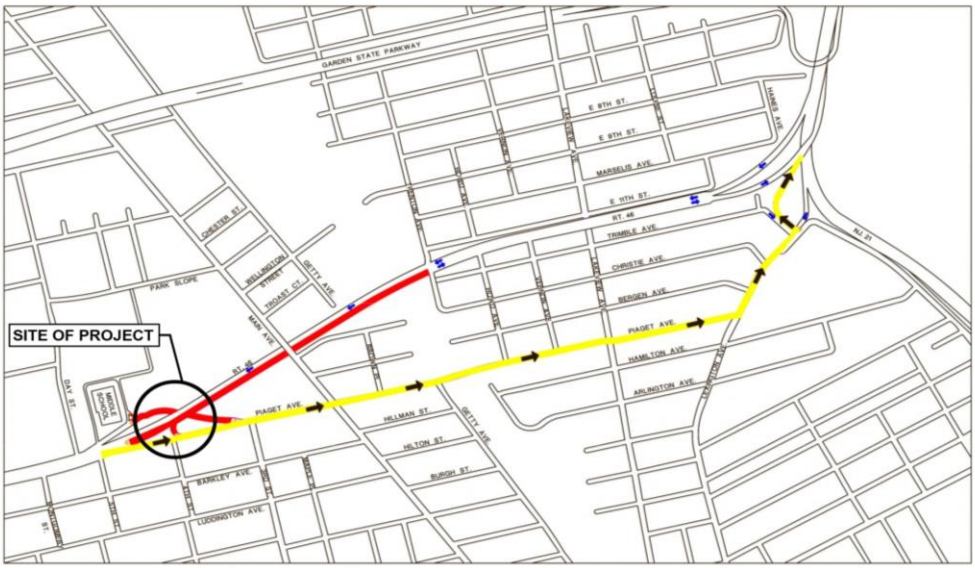
Value Engineering Proposal

- 22 - 33” Deep x 36” Wide Prestressed, Precast Concrete Box Beams
- 8” C.I.P. High Early Strength (HES) Concrete; 4,000 psi after 24 hours
- Approach slabs are also C.I.P. HES Concrete
- Instead of transverse prestressing, C.I.P. deck was increased to 8 in deep (from 5 in) to stiffen the superstructure and disperse the loads.

DETOURS

In order to carry out the two ABC weekends, both lanes of traffic being carried by the half of the bridge to be replaced, had to be completely detoured off-site and away from the project. This was accomplished with a local detour around the project; and also a regional detour to keep traffic far away from the site and its local road network.

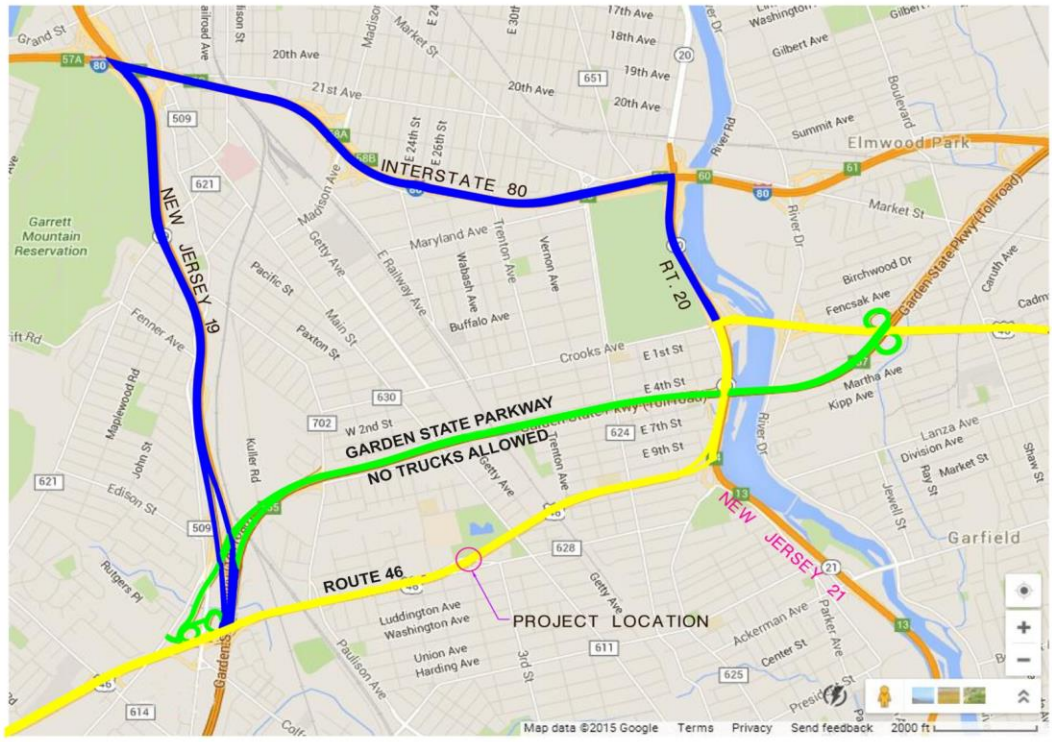
MP Engineers worked closely with NJDOT Departments of Traffic Engineering and Construction to create the best and least impactful detour routes possible. See the detour schemes used below.



LOCAL DETOUR PLAN FOR CLOSURE OF RT. 46 EASTBOUND LANES STAGE 2

LEGEND: CLOSED ROADS; DETOUR ROUTE

The local detour plan for the Route 46 westbound lanes in stage 3 was similar.



REGIONAL DETOUR ROUTES

LEGEND: DETOUR ROUTES RT. 46

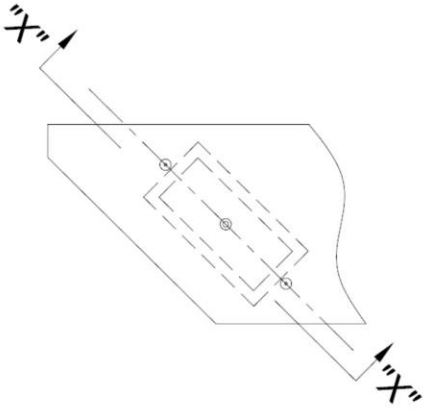
Traffic was given the option to use the blue route above to avoid the local detour around the work site work during both ABC weekends.

STAKE OWNER INVOLVEMENT

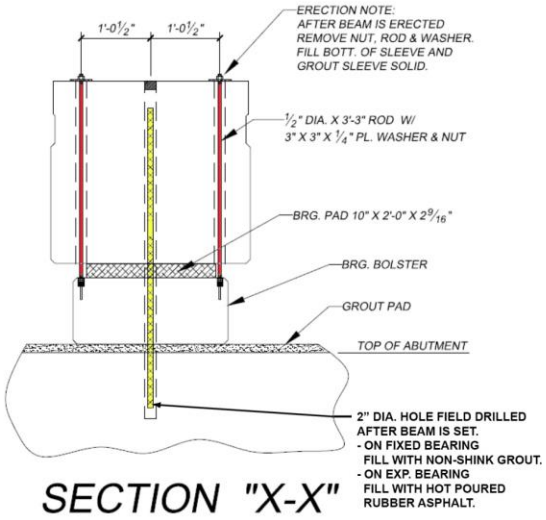
Communication and coordination with all project stakeholders was started early in the design's final phase. Meetings were held with representatives of the adjacent school, the township of Clifton and first responders. Later in the design phase a Public Information Meeting was held wherein MP Engineers explained the issues that conventional construction would cause and how the ABC construction method would solve those problems. Handouts were made available and poster boards where displayed with photos and relevant plan views and maintenance of traffic schemes for the public to review before and after the presentation. Very few objections were raised during the course of the meeting and those that were, were satisfactorily addressed. One of the most important results of these public outreach efforts was the disclosure that in the middle of the summer, the township holds a Peruvian Day Parade on the last Saturday in July. It was therefore, clearly spelled out in the special provisions of this project that the ABC weekend could not take place on this weekend. It would have been potentially disastrous if one of the ABC weekends had been scheduled at the same time as this event.

COMBINED BEAM/BEARING/BOLSTER TRANSPORT

To expedite construction, the Contractor shipped the box beams with the bearings and bolsters attached. This assembly would rest on steel shim plates leveled to the correct height so that the top of the beams would be at their correct height after their installation. After this, the bearing area under the beams and around the steel shims are filled with grout. The assembly is held together with temporary threaded rods that were removed after installation. See sketches below.



TOP OF BEAM
PLAN @ EA. END



SECTION "X-X"

LEGEND:

TEMPORARY 1/2" DIA. RODS
TO HOLD BEARING AND BOLSTER
TO BEAM DURING TRANSPORT

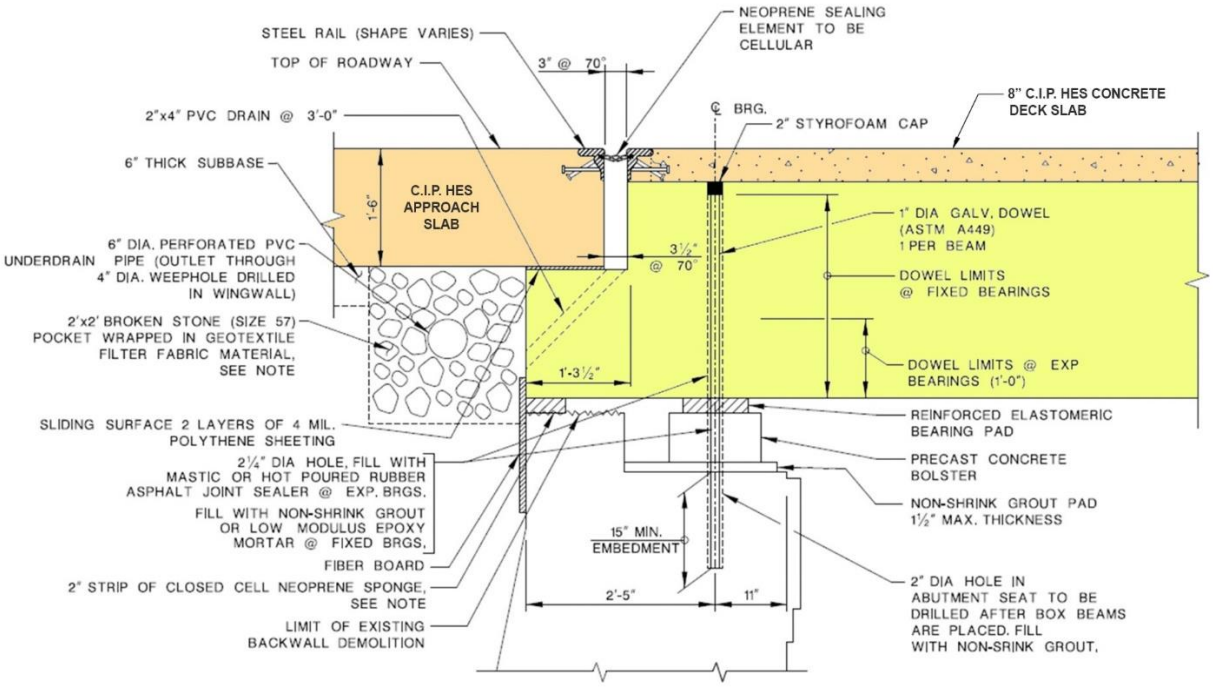
FINAL 1" DIA. GALVINIZED DOWEL INSTALLED IN FIELD

Beam/Bearing/Bolster Assembly

Another View of Beam/Bearing/Bolster Assembly During Installation

JOINT DETAILS MINIMIZING POSSIBLE FUTURE LEAKS

In conjunction with NJDOT, a joint detail was developed that minimized any possible joint leakage in the future. A standard strip seal was installed, but it was located over a concrete corbel extending from the superstructure beams. These corbels had PVC drains so that any water from possible future holes in the strip seal membranes, took place away from the bearings and bearing seat, and was directed to a perforated PVC underdrain that was behind the backwall. See detail below.



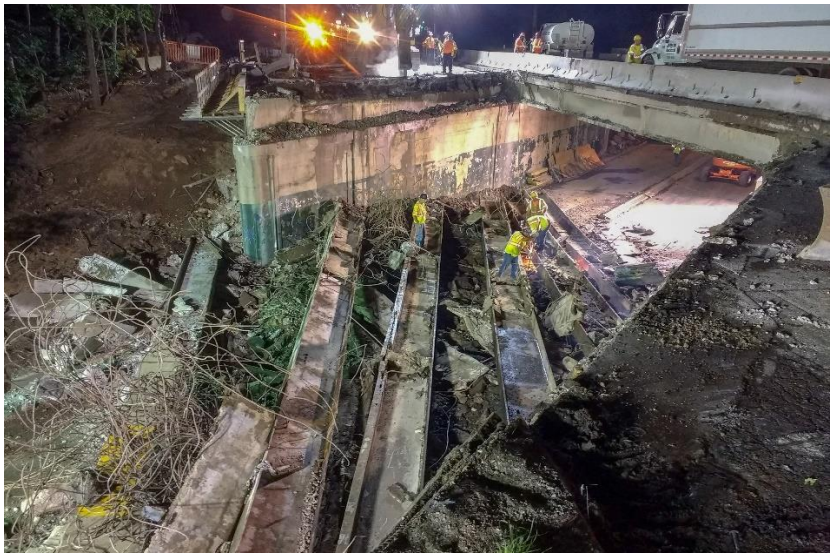
Joint Detail

UTILITY ISSUES

Communication/coordination with utilities was started early in the design phase. While no utilities were located on the bridge, there were three in close proximity. They were from PSE&G, Verizon, and Cross River Fiber. All three had overhead lines adjacent to the structure. Both Verizon and Cross River had lines carried by nearby PSE&G poles. PSE&G lines, running along the westbound lanes only a few feet from the structure, were carrying high voltage lines and had to be moved away from the structure before any construction was done. This required installing four new sixty-five-foot poles. Holes had to be dug, Sonotubes had to be installed, and many existing trees had to be cut down or trimmed in advance of the pole installation.

Though discussions with the utilities were started over two years before the first ABC weekend, and fifteen months before this, a final plan had been approved by the state; the required new poles were not installed until four weeks before the first of the ABC weekends.

Installation of New Poles for High Voltage Electrical Line Relocations



Construction Activities

The above photo highlights one of the advantages of ABC. By doing the construction in the summer, Piaget Avenue, under the bridge does not have to remain open. Therefore, the old beams can be dropped onto the roadway and no expensive shielding or staged construction is required to demolish the superstructure.

Installation of Concrete Box Beams

The photos above show the two 265-ton cranes working together to install the concrete box beams.

CONCLUSION

The main lesson learned is that ABC construction works, and it is a viable and cost-effective option when minimizing construction duration and potential construction related impacts are critical factors to be considered. Conventional construction methods would have resulted in many months of staged construction, complicating rush hour traffic. Keeping two lanes of traffic open during rush hours would have required at least a temporary widening of the structure, with complicated roadway geometry. Keeping Piaget Avenue open to school traffic would have resulted in the need for expensive shielding. Instead, the Contractor was able to construct the new superstructure in just two weekends, eliminating these scenarios.

Other lessons learned also include the need for early and continuous coordination with all project stakeholders. The feedback that was received prevented a potential angry township confrontation, had one of the ABC weekends been scheduled on the same weekend as the Peru Day Parade.

Also, the importance of starting work on identified utility conflicts as soon as possible cannot be emphasized enough. The shift of the overhead high voltage electrical lines was not done until four weeks before the ABC weekends. Not much of a margin of safety for the time critical weekend construction.

It has to be emphasized that the one essential element that allowed this ABC project to come together so successfully was the true partnership forged between the designer, NJDOT and the Contractor.

Completed Project

Completed Project

ACKNOWLEDGEMENTS

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