Taconic State Parkway Ramp ‘X’ Bridge Project, Westchester, NY

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ABSTRACT: Constructed in 2007, the $15 million Ramp ‘X’ Bridge project was designed by Gandhi Engineering, Inc. as the final stage of the 5-stage Hawthorne-to-Pleasantville corridor improvement process initiated by the NYSDOT approximately 25 years ago. The project is located in a narrow north-south oriented ecologically sensitive segment of the Pocantico River, and is hemmed in by State Route 9A/100, the Taconic State Parkway, a wide bikepath, and Beech Hill Road, all of them framed by the surrounding Pocantico Hills, in the town of Mount Pleasant, Westchester County, NY, about 31 miles north of Times Square in New York City. The bridge connects southbound Route 9A to Southbound Taconic State Parkway. The central feature of this project is a sharply skewed flyover bridge tightly aligned on compound horizontal alignment involving a circular arc segment joined by a tangent. The irregular curvature of the bridge’s steel framing required detailed analysis of stresses and deflections using finite element method. The average span of the curved girders is about 51 meters (167 ft) as the span follows a pronounced vertical curvature which further complicated the detailing and fabrication of superstructure. The bridge deck crosses the 6-lane State Highway 9A joining its southbound lanes with those of the Taconic State Parkway. In addition to the bridge structural work, the project required the construction of long box culverts adjacent to bridge foundations and extensive use of tall retaining walls faced with granite veneers that secure the fills of bridge approach embankments and the embankments of relocated bikepath.

1 PROJECT BACKGROUND AND HISTORY

The project is located in a narrow north-south oriented ecologically sensitive segment of the Pocantico River flood plain, and is hemmed in by State Route 9A/100, the Taconic State Parkway (TSP), a wide bikepath, and the Beech Hill Road, all of them framed by the surrounding Pocantico Hills, in the town of Mount Pleasant, Westchester County, NY, about 31 miles north of Times Square in New York City (Figure 1).

In the past two decades, the Taconic Parkway corridor has experienced significant increase in traffic volume due to economic expansion and associated residential developments. On March 13, 1987 the New York State Department of Transportation (NYSDOT) and the Federal Highway Administration (FHWA) approved a Final Environmental Impact/4(f) Statement (FEIS/4(f)) (NYSDOT/FHWA 1987), which addressed the proposed improvements of the Taconic State Parkway from Hawthorne Interchange to Campfire Road.

As part of the preferred alternative, Ramp ‘W’ was constructed to connect the northbound TSP with the northbound State Route 9A/100 about 15 years ago. A companion Ramp ‘X’ connecting southbound Route 9A/100 with the southbound TSP was also included in this alternative. The original location of Ramp ‘X’ was approximately 245 meters (804 ft) north of the
exit ramp to the Saw Mill River Parkway at the Hawthorne Interchange. The configuration and location of Ramp ‘X’ as originally proposed is shown in Figure 2.

![Location Map](image)

Figure 1. Location Map.

However, further analysis and investigation of the original Ramp ‘X’ location identified undesirable operational traffic characteristics associated with the closely spaced weaving sections and the use of a left side exit. To resolve these issues, NYSDOT decided to shift the proposed location of Ramp ‘X’ to an area north of Route 117 adjacent to the existing northbound Ramp ‘W’. At this location the ramp junctions would operate free from the influence of adjacent ramp terminals, left side exits and weaving areas. The relocation would also provide standard acceleration and deceleration lanes for Ramp ‘X’. To accommodate the new ramp, a 285 meter (935 ft) long segment of the existing North County Trailway (NCT) situated on the western side of Route 9A/100 was relocated. The original proposed FEIS Ramp ‘X’ location and the new Ramp ‘X’ location are shown in Figure 2.

Gandhi Engineering Inc. (Gandhi) was retained by the NYSDOT - Region 8 for the fifth and final stage of the actions approved under the FEIS/4(f). Gandhi prepared a Reevaluation Statement (NYSDOT/FHWA 2004) addressing proposed changes to the preferred alternative and performed environmental analysis covering a wide range of issues including air quality, noise, water quality, wetlands and ecology, stream channel realignments, flooding, neighborhood
impacts, residential impacts, Right-of-Way requirements, parkland impacts, construction impacts, economic activity, scenic resources, energy study, cultural resources, endangered species and hazardous waste. The FHWA approved the Final Reevaluation Statement on June 25, 2004. Gandhi was authorized by the NYSDOT to proceed with the detailed design.

2 DESIGN DETAILS

During the preliminary design phase, a 3-span continuous structure alternative was studied and compared with the single-span alternative. It was found that the 3-span continuous structure alternative would be much more costly, and it would require a pier located at the narrow median between the northbound and southbound Route 9A/100. The NYSDOT selected the single span alternative. The bridge deck crosses the 6-lane Route 9A/100 joining its southbound lanes with those of the Taconic State Parkway. As a result, the average span of the curved girders is about 51 meters (167 ft.) as the span follows a pronounced vertical curve which further complicated the detailing and fabrication of superstructure.

The central feature of this project is a sharply skewed flyover bridge tightly aligned on compound horizontal alignment involving a circular arc segment joined by a tangent (Figures 3 and 4). The compound horizontal curves were a result of tight geometry constraints in the available space between Route 9A/100 and the Taconic State Parkway. The irregular curvatures of the bridge’s steel framing required detailed analysis of stresses and deflections using the SAP2000 (Computer & Structures) general purpose finite element program. The irregular framing, including the girders and diaphragms, which are considered primary structural members in a horizontally curved structure, was imported into the SAP2000 program directly from the CAD drawings.
Figure 3. Ramp X Bridge framing plan and typical cross section

Figure 4. View bridge underside
Environmental sensitivity of the project site is derived from the presence of eight NYSDEC-designated freshwater wetlands, and four US Army Corps of Engineers wetlands. One of the important aspects of this project was the creation of 18.2 acres of new wetlands in order to compensate the 15.6 acres of wetland lost as a result of the ramp construction. To minimize the adverse impacts on wetlands and the Beech Hill Road, a local access facility serving a residential enclave, the project required extensive use of tall retaining walls that secured the fills of bridge approach embankments, and the embankments of the relocated bikepath. Two types of retaining walls were used in the project including cast-in-place reinforced concrete retaining walls supported on steel H-piles for the bridge approaches, and a proprietary T-Wall system supported on fills for the relocated bikepath.

As mandated by NYSDOT, the bridge abutment wingwalls and retaining walls of the bridge approaches and those bordering the relocated bikepath were faced with granite veneers matching the color and pattern of those used in the adjacent Ramp W Bridge. This created an aesthetically pleasing and consistent design which blended in perfectly with the surrounding park-like setting of the Taconic State Parkway, without changing the landscape adjacent to the residential areas bordering Beech Hill Road. (Figures 5 and 6)

Another feature was the construction of a 2.40m (8 ft) wide temporary bikepath during construction as part of the traffic control plans. This feature provided uninterrupted access to the North County Trailway (NCT) by the general public. Attesting the overall success of the project engineering and construction, NYSDOT received letter from members of the local citizens complimenting the agency on the temporary bikepath, which was a pleasant surprise to all participants in the project’s creation at a time when the public’s reaction to infrastructure jobs is often adverse.

Figure 5.View of west abutment wingwall and approach retaining wall
3 CONSTRUCTION ASPECTS

The biggest challenge of this project was to maintain vehicular traffic on Route 9A/100 and the Taconic State Parkway with minimal disruption, because both facilities are multi-lane divided highways and carry approximately 71,000 and 84,000 AADT volumes, respectively, with a combined volume of 155,000. Much of this traffic load includes peak hour commuter flows destined for the New York City metropolitan area. Since no erection of any superstructure framing component is allowed by NYSDOT over live laneage, and the lane closure period was limited to \( \frac{1}{2} \) hour between midnight and 5AM, the design drawing provided a suggested steel erection method involving field-splicing of pairs of oversize curved steel girders on the ground and installing fully connected diaphragms to allow for the speedy lifting of the package on the prepared bearing assemblies, all done within the \( \frac{1}{2} \) hour of lane closure period at night. During construction, the Contractor negotiated with the NYSDOT an alternative method based on using steel falsework in the very narrow median strip which allowed the erection of girder pairs in about half lengths for splicing in the air combined with lane closures during night hours (Figures 7 and 8). The selected construction method was executed skillfully by the Contractor without any mishaps or complaints from the public.

Another challenge was that due to the need for reverse superelevation as a result of the compound horizontal alignment, finishing of the bridge deck to the design profile and superelevations required careful setup and calibration of the screed machine.

The presence of existing Con Edison overhead electrical transmission lines within the project limits was another factor required careful planning during construction.

The Contract (D259968) was awarded to CCA Civil/Halmar Internation LLC joint venture. Construction began in April, 2006. As a result of the team work between the Region, the Design Consultant, the Resident Engineer and his staff and the Contractor, the project was successfully completed on time and within budget. The ramp opened to traffic in December, 2007.
The project team was awarded the 2008 “Tappan Zee Award” (Project of the Year) by the Lower Hudson Valley branch of the ASCE Met Section. In addition, the project was nominated by the NYSDOT to the 2008 America’s Transportation Award co-sponsored by AASHTO, US
Chamber of Commerce, and AAA for “On time, On budget and Innovative Management”. Figure 9 shows the completed bridge.

The project was also well received by the community. The relocated bikepath with improved access and standard bike railing enhanced the existing facility, and blended in nicely with its surrounding environment (Figure 10).

Figure 9. View of completed bridge

Figure 10. View of relocated bikepath
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REFERENCES