# Bridge Replacement Overcomes a Host of Challenges

## When even solutions present difficulties

By Stephen W. White, Sr.

The Route 300 Bridge in Newburgh, NY, was in a dangerous state of disrepair, but designing and constructing a replacement would be no easy matter. Ordinarily routine issues, such as the relocation of utilities, the rigid frame design, and bridge instrumentation, were beset by unusual conditions that posed thorny problems for the design and construction teams.

The bridge, which spans the New York State Thruway (I-87) in Orange County, was built in 1954, and its asphalt wearing surface was replaced in 1996. But a recent biennial inspection by the New York State Department of Transportation (NYSDOT) uncovered the existence of serious deterioration in one or more structural elements, with specific bridge components no longer functioning as originally designed. The concrete components of the structural deck, sidewalks, and all five substructures had decayed badly. In particular, the outer columns and pedestals of two of the piers had spalled to the extent that the fascia girders were temporarily supported with steel columns.

Replacing the Route 300 Bridge entailed: establishing two separate detour routes, relocating utilities, demolishing the existing structure, constructing new piers and abutments, setting steel, placing the concrete bridge deck, constructing geosynthetic reinforced earth systems and mechanically stabilized earth systems, constructing a permanent concrete bridge barrier, constructing approach slabs, paving approaches, installing guide rail, and striping the project.

These tasks were complicated by several project requirements that called for the close cooperation of the members of the design team. In addition to the tight schedule, some of the major challenges included the need to relocate numerous utilities, the rigid frame design of the bridge, and the need to imbed sensors in the structure.

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### Utility Relocation

Before demolition of the existing structure could begin, the utilities had to be removed from the bridge and relocated. While relocating utilities is not ordinarily a burdensome procedure, in this instance there were complications. The contract called for a casing to be installed underneath the Thruway using trenchless technology methods. However, attempts to drill deep at three locations were thwarted by the exceptional hardness of the soil; the glacial till was comparable to bedrock. As a result, an open cut was employed, as all other options would have slowed the schedule and prevented the project from being completed in one construction season.

This procedure presented new difficulties. Due to the high volume of traffic on the Thruway, precautions had to be taken to ensure that the open cut would not settle and adversely affect the traveling public. Temporary recessed steel plates with asphalt overlays were used, allowing traffic to pass over the trench after work hours, minimizing the short-term inconvenience to the public. In addition, "flowable" concrete fill was used in the trench with a subsequent asphalt pavement, which prevented roadway settlement once the work was completed. While that work was under way, temporary utility towers were constructed to support the existing telephone lines so that demolition of the bridge could proceed without delay.

### Rigid Frame Design

A rigid frame structure was found to be the best means of gaining the required vertical clearance over the

Thruway while minimizing the degree of reconstruction needed on Route 300. The existing structure had a vertical clearance between the Thruway and Route 300 that was unacceptable under current New York State Thruway standards. With the rigid frame design, shallow steel girders embedded in the piers and abutments were used, increasing vertical clearance to the required 16 ft.

The actual construction of the rigid frame design introduced myriad problems, which became apparent as construction proceeded. The original plan for installation of the rebar near the abutments and piers proved to be unfeasible, and continued analysis was required to determine how the bars could be made to fit.

The dramatic skew of the bridge—58.5 degrees—affected all phases of construction and added to the complexity of the project. In addition to the difficulties with the rebar, the connections at the piers between the two girders and the connection at the abutments also raised concerns. At the pier, bolted field splices had to be installed and rebar had to be passed through all the girders after a significant portion of the rebar had already been installed. Space constraints, often unforeseen, also contributed to the difficulty of proceeding with construction and keeping the project on schedule.

One problem that was foreseen right from the start was that time restrictions for closures to the Thruway's mainline beneath the bridge were more conservative than for conventional construction projects. The project required that removal of the existing bridge girders and erection of the new steel girders be completed at night. During erection, the new girders had to be interlocked at the pier and linked to the connecting columns at the abutments. Because of the rigid frame design, this operation required more time to hold each girder suspended over the Thruway than was ordinarily necessary.

## Bridge Instrumentation

After the contract for the project had been let, the NYSDOT and the Thruway Authority decided that the project was well suited to determine how bridges utilizing the combination of structural steel and reinforced concrete in a rigid design react to various loading conditions. As a consequence, the agencies decided to locate sensors that could record critical information. More than 100 sensors were installed on various structural elements, including piles, connecting columns between the deck and the abutments, steel reinforcement, superstructure steel beams, splice plates, and abutment faces. Continuous adjustments were made to assure that the sensors were properly installed at each corresponding bridge construction stage.

The bridge instrumentation will produce valuable information for both the short- and long-term. Data was gathered throughout the construction of the project and will continue to be collected for about five years. The readings from the sensors will aid engineers in future designs by providing hard data to help them understand how construction stages and live loads affect critical portions of the bridge structure.

## Completion Aided by Partnering

While partnering is often required as a formal agreement on larger projects, collaboration in this instance was employed on an informal basis. The three members of the team—the Thruway Authority, owner; Vollmer Associates, construction inspectors; and Harrison & Burrowes Bridge Constructors, Inc., the contractor—worked closely from the inception of the project to its conclusion.

The collaboration between the contractor and the construction inspectors was reflected as well in the working relationships with others involved in the project, including the utility owners and members of the community. Meetings were held with business leaders and residents in the community as well as local officials and emergency personnel. Among the issues discussed and resolved were the two separate detours—one for trucks and one for passenger cars—signage, emergency access, and access for local property owners. The authority also developed timely press releases announcing important activities and tracking progress. The cooperation among all parties involved allowed the project to be completed on time and under budget. GE

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***All phases of construction were affected by the dramatic skew of the bridge — 58.5 degrees.***

***The completed project stands as testimony to the effectiveness of the informal partnering and collaboration of all agencies involved.***