

Sharon Woods is a 730-acre park owned and operated by the Hamilton County (Ohio) Park District. The park is home to hiking trails, an 18-hole golf course, a 35-acre lake and a Historic Village featuring 19<sup>th</sup> century buildings. In early 2002, Hamilton County suffered a significant rain storm that flooded a large portion of Sharon Woods. That flooding sent large debris, including dead tree trunks, down a stream that subsequently blocked the upstream opening of a historic triple-stone-faced corrugated metal arch bridge built in 1934. The subsequent increased stream velocity through the bridge openings severely undercut the foundations for the upstream spandrel wall, causing it to drop more than 18-inches. As a result of the damage to the bridge, the Park District officials hired Steven Schaefer Associates, Inc. (SSA) to investigate the damage and propose ways of repairing the structure.

By Steven E. Schaefer, P.E.

## Restoring the Sharon Woods Stone Arch Bridge

The 70-year-old bridge had three arched spans – the middle 22-foot wide surrounded by two 12-foot wide openings. Shallow concrete foundations and abutments supported the galvanized corrugated metal arches, and the spandrel walls were made of mortared stone of varying thickness with stone arches at the openings. The original construction used bank run stone backfill between and over the arches. The bridge surface had concrete sidewalks and asphalt pavement. The bridge was actively used for pedestrian access to trails, parking lots, and the Historic Village, as well as emergency vehicles access.

For the preliminary design, SSA provided several different options for repairing or replacing the bridge. Because of the historic significance and aesthetic value of the bridge, the Park District wanted to repair the bridge “in kind.” This meant keeping as much of the original structure intact as possible, spe-

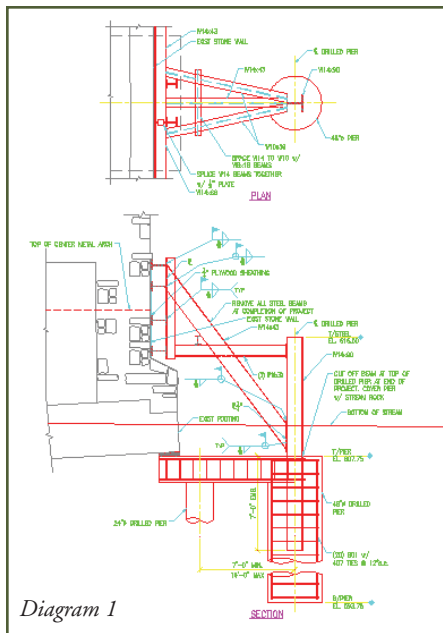
cifically the downstream spandrel wall, and reconstructing the rest of the bridge to match the original. “Prior to this unprecedented flash flood, the bridge was in good sound condition” notes Kevin Brill, Project Manager for the Park District, “but we had to make immediate remedial repairs to protect it from further damage while we were considering options to repair the bridge.” (See *Diagram 1* for details of the bracing)

“One of our early challenges was to determine a way to replace the existing arch foundations and corrugated arches without damaging the downstream spandrel wall.” notes Jim Graham, Project En-

gineer for Steven Schaefer Associates, Inc. “We knew that, during construction, the downstream spandrel wall would be completely vulnerable. As part of the total design, we needed to consider how to brace the free standing wall as well as how to support the remaining foundation portions under the downstream spandrel wall.”

The final plans called for demolishing all of the existing bridge except the downstream spandrel wall and the two abutments. A series of steel buttresses anchored to drilled concrete piers acted as temporary bracing for the down-





stream wall during construction. In addition, SSA required that all arch stones salvaged from the upstream wall be marked and stored to allow for reconstruction of the arches in the same configuration and location as the original. The remaining face stones were stored for reuse to keep the original patina on the exterior face of the bridge.

Prior to working on the foundation, the contractor needed an effective upstream dewatering operation to keep water levels low in the work areas. Sunesis Construction, the bridge contractor, could not have excavated for the grade beams without dewatering first. Sunesis devised a method for managing the stream water flow during the foundation excavations by digging and constructing a 15-foot deep well in the stream bed upstream of the bridge utilizing a circular steel multi-plate shoring system and backfilling with gravel. They diverted the stream flow to the well, and used a high capacity portable pump to pipe the water past the bridge to outlet downstream. Even with this, water contained



within the surrounding ground flowed out from under the abutments when the underpinning haunches were excavated, causing great difficulties for the men who were hand excavating this area.

The original foundations supporting the corrugated metal arches were large monolithic concrete masses that provided a challenge for removal. After the bracing was installed on the downstream wall, the upstream wall was carefully dismantled, the fill over the corrugated metal arches was removed and the arches collapsed and removed. The arch foundations were removed with a hydraulic rope saw from the rest of the bridge.

Because of the previous creek bottom scour, FEMA mandated that the reconstruction include installing drilled concrete piers to protect the structure from future undercutting. New 48-inch diameter piers were installed with a concrete pier cap for the center arch foundations, and 36-



inch diameter underpinning piers with haunches were installed to support each of the existing abutments. Once the new foundations were constructed, new corrugated metal arches were slid into place below the existing downstream stone arches. After a new upstream stone spandrel wall was constructed, it was anchored to the low strength concrete infill used to backfill over the arches. Concrete sidewalks were then placed, and the roadway surface was paved to match the original.

The success of this project was due to an exceptional team effort between the Hamilton County Park District, Steven Schaefer Associates,



Inc. and Sunesis Construction Company. All three were familiar with the challenges involved with this type of construction because of their previous experience with a similar stone bridge restoration project for the park. The Ohio Department of Natural Resources reported to the Park District that the Sharon Woods Stone Arch Bridge was the best managed project they had in the State of Ohio that year. "The park district has worked with SSA and Sunesis before and, as expected, this project went smoothly" says Kevin Brill, Project Manager "...and we were able to restore a bridge that many park visitors consider to be a park icon." ■



*President & Founder, Steve Schaefer Assoc., Inc. 1976 through present. Firm grew from a 1 person office to a staff of over 30. BSCE & MBA from the Univ. of Cincinnati and is also a Speaker, Lecturer and Author. Registered in 30 states.*