When the Ohio Department of Natural Resources (ODNR) evaluated the Kreis Dam in Sharonville, Ohio, they became concerned with the deterioration and stability of the structure. "We knew we were in for a major undertaking," says Kevin Brill, Project Manager for the Hamilton County Park District. The Park District's previous remedial repairs were not a long-term solution. "We had to find a solution that met the needs of three departments – the Park District, the Water Quality Department, and the Recreation Department – while preserving the historical nature of the structure and working in a tight time frame."

Unique Renovation at Kreis Dam

The Original Structure

The Kreis Dam, in Sharon Woods Park, holds 946 acres of water. The bridge above the dam provides the main vehicle access to the golf course and is a vital link in the 2.6-mile long extensively used scenic path around the lake. The WPA built the dam and bridge in 1936, which is upstream of an historical village, visitor center, and the City of Sharonville.

The structure of the bridge over the dam is composed of three galvanized corrugated metal arches that span approximately 16 feet each between stone-faced concrete piers and abutments. The upstream and downstream walls are constructed of stone. The dam, with a steeply sloped spillway below the bridge arches, creates a lake to the north. Concrete piers that extend up through the spillway support the arches which were covered with earth backfill and a paved roadway.

Previous Study

An earlier assessment recommended that the asphalt roadway be removed, a waterproof membrane be placed below its surface and the cracked concrete in the piers repaired. That assessment also questioned the overall integrity of the bridge and reported that a full replacement might be required. "This early option seemed inadequate in terms of needing to add considerable life to the existing structure. And, replacing the corrugated arches would be very costly and might not ultimately provide a long-term fix", says Mr. Brill. So, the Hamilton County Park District requested an additional proposal from our firm, Steven Schaefer Associates of Cincinnati, Ohio.

A Thorough Evaluation

We knew that one of our first challenges would be accessing the bridge to evaluate it. The underside of the metal arches were directly over the steeply sloped spillway, and not accessible. Our proposal included designing a temporary scaffolding system supported from the concrete at the top of the spillway and steel beams bolted to the downstream side of the piers. This scaffolding was also designed to be used as a work platform during the restoration. We believed this would result in significantly lower bids, as the bidders would not need to make a conservative allowance for constructing the work platform.

The bridge was constructed with the bases of the three corrugated arches set into steel channels that were embedded into the tops of the concrete piers. Over the years, the lower portion of the arches, and the base that was embedded in the concrete piers, had rusted. The resulting expansion of the embedded portions caused the concrete at the top of the piers to crack. Water freezing in the cracks caused the cracks to enlarge. Left unattended, the problem compounded over time. Repairing the concrete piers alone would not solve the problem. With continued rusting of the base of the arches, and re-occurring cracking of the pier, the arches' ability to support the backfill and roadway would be in jeopardy.

To evaluate the present stability, we needed to know the remaining thickness of the rusted steel arches. We tried ultrasonic testing; however, the results were extremely erratic. The solution was to remove samples for measuring by core drilling. We found that the rust was isolated to the base of the arches. However, even in the worst areas, 75 percent of the thickness remained.

Finding the Best Solution

A number of repair methods were considered. Steven Schaefer Associates' solution was to remove the pavement and back-filled earth from above the corrugated metal arches, and replace the earth with reinforced concrete, converting the arches to a reinforced concrete structure. By doing this now before the base of the arches rusted any further, the arches could serve as forms for the new concrete arches. The stone walls and railings on the sides of the bridge would remain in place and contain the concrete over the arches. Once the structure was changed to reinforced concrete, it would be self-supporting and the metal arches would no longer be necessary. The rusted base of the metal arches could then be cut out, without worrying about supporting the weight of the bridge above. After the rusted bottom portion of the metal arches were removed, along with all deteriorated concrete, dowel bars were epoxy grouted into sound concrete and additional reinforcing was placed in the piers before replacing the concrete. If rusting of the remaining metal arches ever becomes unsightly, the scaffolding system can be re-installed to remove the now non-structural metal arches.

The repairs by Steven Schaefer Associates, including the tuck pointing and repairs to the stone retaining walls, came in under the original estimated cost and far below the cost of replacing the structure. The scaffold system used to do the repairs can be reinstalled when future maintenance is required. The restoration added an estimated 75 years to the life of the bridge, while maintaining its historic look. The repairs were completed in less than five months while the golf course was closed for the winter.■

Steve Schaefer is President & Founder, Steve Schaefer Assoc., Inc. From 1976 through present, the firm grew from a one person office to a staff of over 30. Steve received his BSCE & MBA from the Univ. of Cincinnati and is also a Speaker, Lecturer and Author. Mr. Schaefer is registered in 30 states.