

CASE STUDIES

STONE ARCH BRIDGES

Johns Burnt Mill Bridge (Adams County Bridge No. 56), Mount Pleasant and Oxford Townships, Pennsylvania

Location and Description of Setting:

The Johns Burnt Mill Bridge (Adams County Bridge No. 56) carries Storms Store Road over South Branch Conewago Creek, within Mount Pleasant and Oxford Townships, Pennsylvania. The bridge is located in a rural agricultural setting. A historic stone masonry mill building is located in the vicinity of the bridge.

Description of Bridge:

The Johns Burnt Mill Bridge, constructed in 1820, is a one-lane, three-span stone arch bridge. The bridge's span lengths are 15, 18 feet, and 15 feet. The bridge width is 13 feet.

Figure 1. Johns Burnt Mill Bridge



Rehabilitation Project Information

Date/Cost for Rehabilitation:

The rehabilitation project was completed during the spring of 2006, at a cost of \$840,000.

Project Designer:

Pennoni Associates, Inc. (Pennoni), Mechanicsburg, Pennsylvania.

Bridge Owner/Client:

Adams County, Pennsylvania. The rehabilitation was contracted by the Adams County Commissioners.

Source for Additional Information:

Paula V. Neiman
Chief Clerk
Adams County Commissioners
117 Baltimore Street, Room 201
Gettysburg, Pennsylvania 17325

William D. Cameron, P.E.
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Pennoni Associates Inc.
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Mechanicsburg, Pennsylvania 17055

Project Information**1. Significant issues associated with project (e.g., bridge condition, reasoning behind decision to rehabilitate versus replacement, reasoning behind selected maintenance activity).**

In recent years, the bridge exhibited increased cracking in the arch barrels and spandrel walls, with a noticeable increase in cracking after a January 1996 flood. Inspection revealed that the fill above the arches had become saturated due to the flood waters. Freezing temperatures after the flood caused the saturated fill to expand, increasing the cracking in the arch barrels and spandrel walls. Scour of the stream bed at the piers also was observed during inspections.

Pennoni prepared a study of the alternatives associated with rehabilitating or replacing the bridge. The bridge is located in a Federal Emergency Management Agency (FEMA) floodway, so hydraulics were an important consideration in the alternatives study. The area is prone to flooding, and raising the profile grade of the roadway for a new bridge would have resulted in significant impacts to the floodway. The bridge is listed on the National Register of Historic Places (National Register), so replacement alternatives could result in adverse effects to this historic resource.

Through the public involvement process, Pennoni learned that the majority of the residents of the area wanted to maintain the picturesque setting of the stone arch bridge. Cost comparisons indicated that a rehabilitation alternative was cost effective for both design and construction. Given these study results, rehabilitation of the historic bridge was deemed the appropriate decision.

2. Project description, including purpose and need.

The project began with a series of load tests, in addition to test borings into the bridge in order to determine the make-up and condition of the bridge's foundations. Based on these tests, the project team decided to use precast concrete backing blocks to strengthen the arches. A structural analysis

demonstrated that installing the backing blocks would strengthen the bridge, eliminating the need for the existing 15 ton weight limit.

Construction plans for the rehabilitation project included:

- installing concrete aprons around the abutments, wingwalls, and piers;
- installing temporary centering to support the arches, and bracing to support the walls;
- removing the existing fill above the arches;
- installing the precast concrete backing blocks;
- installing a drainage system with weepholes;
- installing well-draining backfill;
- installing a heavy duty membrane;
- placing new bituminous pavement;
- repointing stone masonry;
- replacing the concrete parapet caps;
- installing new approach guide rail; and
- installing a standard one lane bridge signing.

3. Traffic levels, loading needs, and other related issues.

Traffic counts taken during 1995 and 2000 at the intersection of Storms Store Road and Stone Bridge Road, adjacent to the bridge, indicated that the number of vehicles per day (VPD) passing through the intersection was increasing approximately five percent per year. The current VPD is approximately 600, with no reported crashes in the vicinity of the bridge; however, a sharp vertical curve over the bridge, along with the single-file traffic flow across the bridge and its high parapet walls, created limited sight-distance.

After considering several alternatives, it was decided to rehabilitate the bridge with minimal approach roadway work. The approach roadways were improved, but not realigned. A new approach guide rail was installed, and the signage and pavement markings were upgraded, including the installation of new one-lane bridge signing. These improvements, while not extensive, were appropriate for the traffic volumes and speeds encountered at the intersection of Storms Store Road and Stone Bridge Road, and across the bridge.

4. Section 106 effects finding (no adverse, adverse). Major issues discussed with State Historic Preservation Officer, and how issues were resolved.

The selected rehabilitation alternative resulted in a No Adverse Effects finding, in consultation with the Pennsylvania State Historic Preservation Officer (SHPO).

5. Lessons Learned.

It was important to first install the concrete aprons and to specify that the arches and walls be supported by temporary centering and bracing during construction. High water events occurred while the rehabilitation was underway and the arch fill had been removed. The in-place concrete aprons, false work, and bracings provided important temporary support during high water events when the bridge was in a vulnerable state due to the removed fill.

Periodic routine inspections of the bridge after completing the rehabilitation found no evidence of significant stone or mortar cracking or stone movement. These inspections demonstrated the value of using concrete backing blocks to strengthen the bridge.