gorge. This may seem incredulous to anyone who has passed over the elevated bridge, but it should be recognized that while both the original and present bridge have significant clearance (32 feet) to the river, the gorge is a constriction in the river. On July 4, 1973, Robert J. Brugman, 17, a southbound Appalachian Trail thruhiker from Flemington, New Jersey, reached Clarendon Gorge. Because the bridge was destroyed, he attempted to cross the swollen river by means of a fallen pine tree. He slipped into the river, was swept downstream and drowned. His body was recovered on July 8, 1973. A new 65-foot span suspension bridge for Clarendon Gorge was designed by the Vermont Highway Department and installed by the Earle & Miller Construction Company. The new bridge, which opened on August 24, 1974, was dedicated to the memory of Robert Brugman. It has been in continuous use since.

Suspension bridges provide a structural solution to wide crossings, be it a rocky gorge or a quagmire. In many cases, floodwater clearance requirements dictate that the bridge be elevated. A properly designed bridge is vastly safer than fording a river, as demonstrated by the Brugman tragedy at Clarendon Gorge. The inherent characteristics of a wide span, elevated bridge require prudent common sense design, construction, and use.

The Pochuck Quagmire Bridge project volunteers were especially concerned about risk (liability) because of potential misuse of the bridge by the public. This is an especially valid concern for the Pochuck Quagmire Bridge as it is on the fringe of suburbia in a readily accessible but unsupervised location. In order for the bridge to be durable and to comply with NJDEP floodwater clearance regulations, it had to be elevated. Risk management by all project partners and on behalf of all project partners became a central element during project planning and construction.

The safety program and risk management for the Pochuck Quagmire Bridge had the following components:

- Proper bridge design from a structural and safety perspective.
- User education.
- Project construction safety plan – worker safety.
- Insurance for all project partners and participants.

Public Safety

The first step in risk management was to design a structurally sound bridge to applicable codes and public safety standards as well as normal and customary standards. This was difficult at first because there are no codes or customary standards for such a unique and peculiar structure. The literature search and bridge inventory by the project engineer was as much risk management as it was a practical and engineering exercise. Following is a listing of the bridge components other than structural elements that deal specifically with public safety. The listing is referenced to various codes.

- BOCA® 1014.6; staircases have a uniform 6 7/8-inch rise and an 11 1/2-inch thread. The stairs have a rounded bullnose (N.J.A.C. 5:23-7.18 (a) 2).
- BOCA® 1014.6.1; staircases have solid risers.
- BOCA® 1014.7 & 1022.0; staircases were designed to have a handrail that meets the grip and location standards.

A frustrating element was trying to obtain a definitive answer about which guard rail standard applies to the project: 1992 AASHTO 2.7.1.2.4 or BOCA® 1021.3. The BOCA® standard is the stricter standard. BOCA® focuses on making sure small children playing unattended on an elevated deck will be safe. Central elements of the 1993 BOCA® standard follow:

> ***1005.5 Open-sided floor areas:*** *Guards shall be located along open-sided walking surfaces, mezzanines and landings which are located more than 30 inches (762mm) above the floor or grade below. The guards shall be constructed in accordance with Section 1021.0.*
>
> ***1021.2 Height:*** *The guards shall be at least 42 inches (1067mm) in height measured vertically above the leading edge of the tread or adjacent walking surface.*
>
> ***1021.3 Opening limitations:*** *In occupancies in Use Groups A, B, E, H-4, I-1, I-2, M and R, and in public garages and open parking structures, open guards shall have balusters or be of solid material such that a sphere with a diameter of 4 inches (102mm) cannot pass through any opening. Guards shall not have an ornamental pattern that would provide a ladder effect.*

In practice, the BOCA® standard often is implemented by 1-inch wooden balusters spaced 3 7/8-inches as is typical for new residential decks.

The 1992 AASHTO standard is more consistent with the expected use of a pedestrian bridge. The dimensional requirements are presented below.

> ***Rail Spacing.*** *Within a vertical band bordered by the walkway surface and a horizontal line 3 feet 6 inches above the surface for pedestrian railing, and 4 feet 6 inches above the surface for bicycle railing, the maximum clear vertical opening between horizontal rail elements is 15 inches (AASHTO 2.7.1.2.4 and 2.7.2.2.2). Vertical elements of the railing assembly shall have a maximum clear spacing of 8 inches within this band. If the railing uses both horizontal and vertical elements, the spacing requirements apply to one or the other, but not to both.*

In 1996, after the Pochuck Quagmire Bridge was completed, the AASHTO standard was revised to a more stringent 6-inch and 8-inch spacing between the horizontal rail members. The 1996 AASHTO standard is presented below.

> ***2.7.3.2.1*** *The minimum height of a pedestrian railing shall be 42 inches measured from the top of the walkway to the top of the upper rail member. Within a band bordered by the walkway surface and a line 27 inches above it, all elements of the railing assembly shall be spaced such that a 6-inch sphere will not pass through any opening. For elements between 27 and 42 inches above the walking surface, elements shall be spaced such that an eight-inch sphere will not pass through any opening.*

The intent of the AASHTO standard is to prevent pedestrians from falling through the rail system. Aside from the spacing limitations, the major difference between the two standards is that AASHTO allows a horizontal rail system, which under BOCA would provide a “ladder effect.”

After much discussion, the bridge was built to both the AASHTO and BOCA® guardrail standards. This was prudent from a public safety and risk management perspective. The rail system at the platform at either end of the bridge was built to the 1992 AASHTO rail standard, but had 1-inch by 1-inch polycoated wire mesh attached to the inside face. This exceeds the BOCA® standard, but seemed appropriate because this is where people would tend to gather. The suspended walkway “truss” rail system was built to the 1992 AASHTO rail standard.