project was fortunate in that R.S. Phillips Steel, a well-known steel fabricator, is located in Vernon Township, New Jersey. The customized details for each non-uniform pole top ensured that the saddle fasteners lined-up with the center of the cross arms and quarter points of the poles as well as providing maximum bearing surface. As the pole heights varied in elevation by 2.4 inches from bank to bank, the project engineer designed the apex of all four saddles to match in elevation by varying the radius of the bent pipe saddle. The saddles were to be attached to the poles via 3/4-inch lag screws and 5/8-inch bolts. Once driven, there was no room for adjustment, given the bore and bite of such large connectors. In anticipation of this, the project engineer had #12 nail bore holes drilled into the saddles to allow the saddles to be tacked down, checked, and then the major fasteners driven.

The project engineer arrived 10 minutes after the stalwart volunteers started work on October 5, 1995, the night of the saddle installation. By that time, the energetic and enthusiastic volunteers had installed the east tower saddles, driving the major connections first. Unfortunately, they confused east and west and installed the west saddles on the east tower. This is an example of communication problems that can be expected in a complex project, for which all the planning and detailed plans cannot prevent. The end result is that the cable saddles vary in elevation by 5 inches from one side of the river to the other. This shifted the sag low point 2.5 inches from dead center. This is not visible by eye. The subsequent change in the suspender lengths was accommodated by the built-in adjustment capability. See the suspender detail on Plan Sheet 8 and photographs 58-61. To ensure a good connection of the saddles to the towers, the top cross arms were doubled up, and 5/8-inch through bolts into the cross-braces were substituted for the 5/8-inch lag screws. A profile view of the installation of the saddle on the west tower is shown in photo 51 (page 45).

Catenary Cable Geometry

When suspended between two supports, a uniformly loaded wire rope assumes the shape of a catenary curve. The specific shape of the catenary curve is established by the sag-span ratio. The sag-span is the ratio between the sag of the wire rope to the span between the supports. The dilemma facing bridge engineers is that the larger the sag for a given span and loading, the lower the tension load in the cable. However, the reduction in the cable tension load (or cable size) comes at the expense of taller towers. The benefit in reducing the cable diameter within the safety factor of 4 to 5 is not just the cost savings in the cable, but also the cost savings in the multiple suspender attachments. Economics is very much an element of good engineering. Structural-practical economic criteria place most bridge sag-span ratios in the 1/8 to 1/12 range. For example, the Bear Mountain Bridge sag-span is 1/8, the Brooklyn Bridge is 1/12.5, the George Washington Bridge is 1/10.75. The USDA Forest Service Bridges at Jackson River is 1/10.0 and the Pemigewasset River is 1/13.0. The Pochuck Quagmire Bridge has a high sag (17.75 feet) to span (110.20 feet) ratio of 1/6.2. This is beneficial and allowed the use of 1-inch wire rope for the design loading. In lightweight pedestrian bridges, excessive sag should be avoided because it can lead to excessive side sway in the bridge.

A combination of physical constraints established the sag-span ratio of the Pochuck Quagmire Bridge. They were as follows:

- Donated 40-foot long Class I SYP transmission poles.
- Required 6 feet embedment of the pole.
- 57-foot wide Pochuck Creek.
- 25-foot clearance to eroding banks.
- Clearance to the 100-year flood level.
- Minimum practical suspender length at the cable lowpoint.