Roebling’s Wire Rope: A Clarification

The seminal idea that made all of John Roebling’s suspension-bridge designs so successful was his prior development of wire rope. He first made an iron wire imitation of hemp rope, a virtual copy of the then-normal process of laying up strands of hemp in a long open space called a “rope walk.” That was fine for pulling canal boats up an inclined plane at the Allegheny Portage Railroad near Ebensburg, Pa, where his wire ropes were first used. It was especially suitable for applications where the rope was used as a “running” line, for example where it had to curve around a capstan or pulley. For “standing” applications where the rope does not move but just bears a load, parallel wires are superior. But there was a major drawback when it came to building suspension bridges: any long wire rope is very heavy. How do you transport it from the ropewalk to the job site and once you get it there, how do you get it across the river before you build the bridge? Roebling solved that problem by building the rope on-site.

Some years ago I published an article in this magazine in which I simply got it wrong.1 I was led from the right direction by a display of Roebling’s rope in a museum at the National Park Service site commemorating the portage railroad. The label calls the display a piece of wire rope from the Brooklyn Bridge. Maybe so, but this twisted rope was NOT used to suspend the bridge. It may have been used to help prevent the deck from swaying or in many other places, but not in the main suspension cables. Those major ropes were laid up in parallel single strands, bundled into one very large mass of wires. Roebling patented the second process in 1847, two years after the building of his wire-rope suspension aqueduct in Pittsburgh.2 This patented process was also used in the Delaware and Hudson Canal Suspension Aqueduct, as is mentioned in the notes for which Roebling refers back to Pittsburgh, saying he is using the same process he had used there!

Here’s how it worked: support towers of a suitable height were erected on both shores of the river to be crossed and a continuous loop of rope (commonly twisted hemp or wire) strung over and between them, and around a large horizontal wheel a bit inland from the working-side tower. Then a rolling platform was suspended from the loop so it could travel back and forth carrying with it a
single continuous wire, building up strand by strand to form a wire cable comprised of perhaps two or three hundred individual parallel wires. The large horizontal wheel was turned by a horse walking round and round the vertical shaft. The resulting cable was “bunched” along its length with a fitting (an early version of a “cable clamp”) that held it in a stable format. The cable was anchored at each end with a cast iron fitting.

Roebling’s anchorages were also the subject of much careful development. It’s important to distinguish the two uses of rope in this rig: the twisted rope is “running,” that is, it has to move and bend, so the wires have to be free to move against one another. The rope that actually suspends the bridge is “standing,” that is, the wires are parallel and don’t normally move against one another.  