For a full century, Pittsburgh's name was synonymous with steel. Making steel at the Pittsburgh scale required that many components come together in one place: raw materials; easy access to transportation for the materials and the finished product; visionary, risk-taking leadership to think bigger than anyone else in the world; willing manpower to carry out those visionary plans; and money to push all these components into high gear. But with all that immense productivity came a price in livability: Pittsburgh was monumentally dirty.
The first Pittsburgh "Renaissance" started the clean-up process in the early 1950s. But since the local demise of "Big Steel" in the 1970s, a second fundamental makeover has been under way. By a series of disconnected steps — the next one not foreseen by its predecessor yet each one heading towards a previously unthinkable goal — the city is being transformed into a real gem of an urban space, a place of great natural and man-made beauty.

One of the threads that makes Pittsburgh so unusual is its location at the intersection of two large rivers, which come together almost in the center of the downtown area to form the Ohio. Between these rivers, downtown Pittsburgh remains compact and comprehensible, a people-friendly space. You can walk from one side to the other of the very-much-alive downtown in a half hour or so.

But until recently, its industrial past still ruled, limiting planners' visions of what was possible for a less-industrial future. The rivers had been used for more than a century for two main purposes: cheap transportation and waste disposal. People at first couldn't see beyond this ugly past. Then as the water cleared up in response to "de-industrialization," sparks of vision went off in different minds as to how the rivers could assume a more graceful role in the city's life. Three-term mayor Tom Murphy has provided both vision and political support for a renewed focus on riverfronts as a vital city amenity.

One of the first bold moves was the founding of the Three Rivers Rowing Association by Mike Lambert in 1989, leading today to Pittsburgh's hosting the exciting Head of the Ohio crew races. Another early step was the forming of Friends of the Riverfront, with a courageous plan to develop an 11-mile-long walking trail right through the city along the banks of the river ... and they began to succeed. The nationwide intercity warfare for big-time sports venues resulted in a bold plan to create two new stadiums on the river's edge in central Pittsburgh's North Side. They have been designed and built in record time, making major changes along the downtown skyline along the Allegheny River.

A surge of cries of "Whoa! Wait a minute!" came from an awakening urban leadership outside the sports and recreation field who said, "We've got a chance to do much more here." The Riverlife Task Force was formed to re-envision the whole development process in a more comprehensive fashion, inviting much wider participation from the citizenry. Originally led by John Craig, long-time editor of the Pittsburgh Post-Gazette, and Paul O'Neill, then president of Alcoa, now Secretary of the U.S. Treasury, the group has ambitious plans. They were charged by historian and Pittsburgh native David McCullough to "do nothing but the best, nothing short-term, and nothing insipid. Instead, make this a place where you want to bring the people you love." Paul O'Neill himself led out on that path, with the spectacular new Alcoa headquarters building between Seventh and Sixth streets on the North Side. Another exciting development with a river focus has been the complete revamping of Herrs Island into Washington's Landing, with a world-class rowing center, marinas, and Tony condominiums offering spectacular views of downtown.

Part of that renewed river focus included a commitment to a
...THE CITY IS BEING TRANSFORMED INTO A REAL GEM OF AN URBAN SPACE, A PLACE OF GREAT NATURAL AND MAN-MADE BEAUTY.

new world-class convention center as a sort of upstream anchor to the new 10th Street Bypass river-edge park. The design competition was won by Rafael Viñoly, an Argentine-born, New York-based architect who created a futuristic design for the new center, complete with a tensioned-cable roof. The building is growing out of the demolished old center, right on the bank of the Allegheny River. When it's fully bloomed out, it will be about as startling as a square-rigged ship on the riverfront!

Viñoly's design was chosen above competitors for a variety of reasons, foremost that it tied the city into the river so strongly. It also has an enormous column-free exhibition space, thanks to the roof design. One benefit of this design not often mentioned is the city's requirement that buildings close to the river be lower than buildings farther away, a perfect description of the Convention Center's shape.

This dramatic roofline is created in a way much similar to that in which suspension bridges are built. A tall mast goes up amidships (or mid-building). From each end of the building — bow and stern, as they are actually called in the Pittsburgh site — a 7-strand twisted cable is fed up and over the mast top to the other end and back, over and over until there are 169 cables up there in a fat parallel array. They are each fed into a huge cast "weldment" and grabbed there by fittings to keep them in place. The weldments are attached to the frame of the building, then additional special fittings bind the cables into one large hexagonal mass, fittings which are then used to pull the big cable mass into the correct tension.

The tensioning process is extremely precise. It actually bends the steel frame of the building into the ideal structural form, deliberately introducing tension and compression into the system, as if the entire building were a traditional steel truss. During the tensioning process, there is physical motion of some of the steel members by as much as 15 inches. This whole complex process creates a tight network of cables upon which the roof can then be built from hollow steel members. The end result is a graceful asymmetrical curving roofline, much like half a suspension bridge, jutting out toward the river's edge. One major difference between this roof and a typical suspension bridge is that it will be several hundred feet wide! Under this roof will be an open floor space as big as a football field.

You may imagine that putting this complex array of cables into correct interrelationships is no simple process. It is overseen by experienced engineers from Birdair, Inc., a Buffalo-based company that builds these tensioned-cable structures all over the world. (For other examples of their work, check their Web site at www.birdair.com). The actual hands-on work is carried out by iron workers from Pittsburgh Local #3 and operating engineers from Local #66. While the design and engineering are important starting points, without the real genius of the on-site supervisors and workers, jobs such as this simply would never be completed.

In his delightful book, A Connecticut Yankee in King Arthur's Court, Mark Twain called men such as these "mechanics," which he meant as a highly complimentary term. Twain's 19th-century "mechanics" were seen as practical men who could do just about anything with their hands and tools. On a daily basis, the skilled
and creative 21st-century “mechanics” on this job face and solve problems never envisioned by the paper-and-computer-based architects and engineers. As an example from this particular job, the mast-top suspension harness had been designed within tight tolerances to receive the 169 individual twisted-strand cables, but the miniscule thickness of the galvanizing on each strand had not been taken into account in the design. Field modifications were undertaken to accommodate this additional thickness — and that after the cables were already in place over the mast! But it was taken care of by the men on site, the “master mechanics” who make such jobs possible.

A BRIDGE TO THE PAST
All of this is interesting, but there is a historical twist that is just fascinating. The whole project is almost a re-play, from politics to engineering, of a similar project which took place within 200 yards of this spot some 155 years ago. In 1844, the then-unknown John Roebling, 20 years later to become the engineer-designer of the Brooklyn Bridge, got a contract from the city of Pittsburgh to build the world’s very first wire-rope suspension aqueduct across the Allegheny River. The aqueduct, actually a bridge for water and cargo, was to carry the Pennsylvania Main Line Canal up in the air across the river to its terminus in downtown Pittsburgh. The original wooden aqueduct had been washed out by ice jams during the preceding winter and a replacement was needed in a hurry. Roebling’s proposal was so radical and new that it was tough to get the City Council to agree to it. But his price was so modest and his enthusiasm and reputation so convincing, even at that early date, that they finally bought his proposal.

Roebling had to solve all of the engineering problems “de novo.” He even had to evolve the engineering principles themselves. First, he had to design and make the wire rope from which to suspend the load. Then he had to design the tower and suspension system to transfer the load from the rope to the ground. And he had to design the attachment system to hold the ends of the ropes. All of these problems he faced virtually alone.

One of the major wonders of this project is the wire rope itself. First Roebling had to get the wire, and there were certainly no catalogs to order from! One of the earliest technical businesses in the area (the very first had been a glass factory) was a so-called “rope walk,” a big flat open area in which hemp fiber was made into hemp rope by a process of winding, basically an oversized thread-making operation. Rope was needed for the boat-building which was another important local industry, making everything from flat-bottomed boats to steamboats for going down the Ohio to the West.

One of the greatest challenges in the 400-mile-long Pennsylvania Main Line Canal had been to get the canal boats over the Allegheny Mountains, about half way between the end points of the canal, Philadelphia and Pittsburgh. After much technical and political debate, the engineering solution to that huge problem had been to build a 37-mile-long so-called “portage railway” to carry the canal boats up and across the 1,500-foot-high mountain barrier. Long inclined planes were built, on which rail cars loaded with the canal boats would be pulled up by stationary steam engines.

Despairing of ever making a decent living farming after several years of trying, the professionally trained German immigrant Roebling had gotten himself a job as an engineer on the portage railway in about 1835. One day the 2-inch thick hemp rope that pulled the railway cars up the mountain had broken, and in the ensuing debacle, two men had been killed right before his eyes. His engineering instincts rose to the occasion, and the first wire rope in America was soon born. It was hard to sell it to the railway at first, but it proved to be a huge success, and led to the eventual founding of the Trenton, N.J., family firm that bore the Roebling name for more than a century, which made wire ropes for the entire world.

But before that, Roebling was making them by hand in the back yard of the family farm in Saxonburg, north of Pittsburgh. As mentioned before, first he had to get the wire. It was made by a small Pittsburgh firm in short lengths which he joined together to make continuous strands, then hand laid up into bundles of individual wires some 1,100 feet long in a process reminiscent of the first “rope walk,” not too far away from this very place. The resulting
"wire rope" Roebling made then was composed of 1,900 wires and ended up being about 7 inches thick. Can you imagine moving such a cable without hydraulic or motorized equipment?

There was much discussion about how to build the rope. In the first Roebling projects, the wires were parallel rather than twisted, and he made much of the value of wrapping the cable with an impermeable coating to prevent corrosion. In later days, he came to accept spiral-wound wire rope. You can actually see a short piece of the original rope at the National Park Service's Allegheny Portage Railway site, just off U.S. Route 22, east of Ebensburg, Pa.

Prior to his wire-rope projects, suspension bridges had been primarily made with chains. The problem with chains, of course, was that the weakest link giving way had a disastrous effect on the structure. Roebling made a great issue out of laying out his ropes to conform to their final shape before making them up, thus assuring that each strand of the rope took its proper share of the whole load, then transferring the entire rope into position on the structure. He also developed anchorages in which the ropes actually went underground before attaching to the "eyes" of the anchors, and carefully worked out the angles at which the ropes came into the attachment, to assure proper distribution of the load. He estimated the structure's actual capacity to be about five-fold over the loads, surely an adequate safety margin!

In Roebling's first suspension project, the aqueduct over the Allegheny, the canal was 4-feet deep and 1,100-feet long. The load of the water alone was about 2,000 tons. There was a huge collective sigh of relief when the canal was filled with water and the structure stood firm. It lasted until 1861, when the canal was abandoned, replaced by the railroad.

Roebling made $3,500 on that job for a year's work, including removal of the wreckage of the old aqueduct, design of the new bridge, erection equipment, the management, and the responsibility and risk of the entire project ... not to mention much of the physical labor. It was a huge gamble for a young man, but it led him into many other projects. The first of those was another short-time replacement project, a 1,500-foot bridge over the Monongahela River just a short distance from the aqueduct. In only nine months, he designed and built a wire rope suspension bridge that stood on the site for almost 40 years. In 1859, he also designed and built Pittsburgh's Sixth Street suspension bridge, for a total of three suspension projects.

Following this, he built the famous Niagara Falls bridge, then during and after the Civil War, the great bridge over the Ohio at Cincinnati. He died in 1869 in a freak accident, a crushed toe and subsequent tetanus poisoning, before his magnum opus, the Brooklyn Bridge, could be fairly gotten underway. His son, Washington Roebling, finished that project, although he too almost died from atmospheric poisoning in one of the caissons for the towers.

One of the most interesting points of this whole interconnected story of past and future is that Rafael Viñoly knew very well of the Roebling connection with his roof design. Viñoly says that "the form of a suspension bridge pays homage to the early bridge designers, and the building's technology celebrates modern innovation and focuses on the future of urbanism in Pittsburgh." What he did not know was that the very first Roebling suspension structure had been built only a few hundred yards from the spot of his new structure. The new one is an elegant and fitting commemoration of the old, and an excellent reminder of Pittsburgh's very special contribution to the story of the nation's bridge architecture.

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