

A New Bridge Over the Po River

BY MARIO UBIALI

An 18-month replacement project showcases bridge construction innovation in Europe.

ON APRIL 30, 2009, the largest river in Italy, the Po River, was at a frightening all-time high. Abundant rains had swollen the river to 23 ft above its usual level. While cars were still running over the historic bridge connecting the two shores at Piacenza, the structure suddenly collapsed and cars fell into the rubble. Luckily enough, nobody died. However, suddenly a large and very economically active part of the country was cut in two. The Milan division of ANAS, the state agency that presides over road and bridge administration, had to put together a plan to quickly rebuild a new, safer bridge. And do it in record time.

As often happens with stories that start with an unfortunate event, what followed turned out to be one of the most innovative steel bridge projects in Italy and one that is now regarded as a leading example in the entire European Community.

With a total cost of 42 million euros (\$60 million), the bridge was designed by MCA Engineering, which has offices in Milan and Rome. Michele Mele, who besides being president of MCA is also professor of construction technique at Rome La Sapienza University, led the project and also served as project manager. Mele faced a number of challenges: ANAS wanted the project to be quickly designed and then swiftly executed. Time efficiency in the construction phase was center stage and concerns about the existing historical pillars needed to be somehow reconciled with the need for an exceptionally strong and seismically compliant structure.

From day one Mele had steel in mind, but the entire project had to be planned and performed with a lot of thinking outside of the box. The new bridge would be made of 11 sections spanning between the original pillars, each of them weighing 1.5 million pounds. The total came to more than 8,000 tons of steel, stretching over a bridge measuring just 0.7 miles of length. The original foundations and pillars had to be preserved for historical reasons, so they were reinforced and restored. New foundations were put in place on the two sides of the river.

The height of the bridge itself could not be kept at the level it had been in the old bridge. Giving close consideration to the



Michele Mele

- ▲ The temporary guiding steel frame extends in mid-air beyond the section of the bridge that has reached the pillar.
- ▼ The bridge seen from below during installation showing the lean structure together with the large top platform, which spans approximately 30 ft from one side to the other.



Michele Mele



Michela Mele



▲ Detail of the reticular spatial structure that successfully combines a lean look with solid seismic resistance.

highest river level in the last 200 years, Mele determined to build at a minimum level of 5 ft above the all-time highest water level. Visual lightness and a certain direct reference to the previous design was also taken into consideration: the bridge was therefore designed with an extensive use of multifunctional elements, all combined in a reticular spatial structure that is just 13 ft deep for 85% of the bridge length, reaching 26 ft at the pillars locations, where it extends to give full vertical support. The resulting structure has a modern and extremely lean silhouette that also is reminiscent of the old bridge profile.

In compliance with modern bridge standards, the new project includes two 11.5-ft-wide lanes for large trucks and high speed vehicular traffic, accommodating a 60-mph speed limit, and two side lanes each approximately 4 ft wide devoted to both bicycles and walking. Side barriers also were designed to exceed the requested specifications.

The only way to achieve all of the ambitious goals set forward by ANAS was to assemble an extremely competent work group, in which each player would coordinate with others to maximize results. FIP Industriale, one of the leading European companies in bridge building, partnered with Errezeta and created a building consortium

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◀ Many of the old bridge's original pillars were completely restored and reinforced, allowing them to serve as supports for the new bridge.



▲ The bridge viewed from one side of the Po River, with new pillars visible where the collapse of the old bridge damaged the original supports.

▼ An internal view of the large fabrication facility that was specially built on site to reduce transport impact on the project.



Photos this page by Michele Mele



called Conser, which was in charge of the building and erection. Tenaris, a large multinational group with more than 25,000 employees worldwide and an annual income of \$7.7 billion, was elected to be the steel supplier through its mill in Dalmine, approximately 60 miles north of the bridge site. TenarisDalmine's steel-making expertise as well as pipe manufacturing for over a century would prove key in some of the most fundamental aspects of the project. However, ANAS didn't want just another steel project: it was going for durability and wanted to build something that would be both environmentally efficient and maintenance free. Mele brought in Nord Zinc Spa, a firm with more than 10 years experience on complex architectural and structural projects encompassing both hot dip galvanizing and powder coating, to provide steel coating and protection.

The intertwined aspects of the project lent themselves to an integrated approach to the entire operation: the project was not just for the building of a new bridge, but started with planning the demolition of the collapsed, original construction. Time and cost were issues, but the demolition procedure had to allow both preservation of the historic pillars for their subsequent use and reclamation of all the materials used for the construction of the top part of the original bridge. The procedure was so complex and well executed that it became the recipient of the Demolition Award in 2010 and the object of a "Mega-Demolition" documentary by the National Geographic Channel, aired in 2011.

In the meantime, the environmentally efficient approach was already in place: all of the reclaimed steel from the collapsed bridge was sent to TenarisDalmine to be recycled for the making of the new structural elements. Recycling the old steel was just a small part of the entire sustainable approach. In close cooperation with Nord Zinc, Mele wanted to achieve a slightly more ambitious goal: to guarantee ANAS that the bridge would not require maintenance for a period of time that would be at least three times longer than the current specifications in public sector projects. That would mean monetary savings as well as a prolonged life cycle for the bridge itself, which would in turn mean a lower environmental impact. But how would it be possible to achieve a maintenance-free period of 50 years? The answer was a completely customized approach to steel coating. Most of the structural elements and the outer railing was coated with a targeted combination of hot dip galvanizing and powder coating called Sistema Triplex, which Nord Zinc calibrated upon the life expectancy requirements and coordinated with TenarisDalmine in relation to steel properties.

Reclaiming the old steel and protecting the new bridge were certainly two very significant aspects of the environmental efficiency of the project. However, the team was worried that such benefits would be hindered by the great

◀ After completing the fabrication of a full section of the bridge in the on-site facility, it is pushed out and installed onto the support pillars.

- A new section of the bridge starts the slow journey from the on-site fabrication facility to its final destination.

impact of fabricating elements somewhere far from the construction site and using hundreds of trucks to transport parts. Why not build the bridge where it was being erected? Mele had now another project within the project: he designed a temporary steel construction facility that was erected on the Lombardy end of the bridge. There 160 workers rushed through the record-breaking 18 months of frantic construction activities, for a total of 450,000 hours of work.

The on-site construction facility not only positively impacted the environment, helping the entire project to achieve a 10% CO₂ reduction over a 50-year life cycle in comparison to a traditional project, but also facilitated efficiency and timing. The Po River bridge was the first large project in Italy to include a complete and preliminary calculation of the carbon footprint of each and every phase, leading to key choices in structural, protective and construction matters. The result was not just environmentally friendly, but really environmentally efficient—and proven to be so by Italy's first complete Life Cycle Assessment.

Although the environmental aspects were of great importance to the customer, the project team had to overcome other engineering structural challenges. The old pillars that would support the bridge had to be relieved, as much as possible, from the load and strain coming from the steel structure. Using RM Bridge and Strauss 7, Mele and his engineering team ran parallel calculations to analyze loads and came up with another interesting and innovative solution. Rather than going for the traditional steel structure where some elements are considered structurally primary while others are secondary, Mele designed a reticular spatial structure, where all elements are equally important in load and stress distribution and bearing.

The resulting steel structure distributes the load through the entire length of the bridge and discharges on the two shores, minimizing the impact on the old original pillars. Large sections were assembled in the on-site construction facility, coated according to the targeted specs, and positioned in their final location across the river.

Today, the steel bridge on the Po River at Piacenza stands tall while hundreds of drivers cross the water for their daily tasks. At night, special lights help it stand out in the darkness, illuminating it as a symbol of unification, as the country celebrates the 150th anniversary of its independence. The choices made in the project should make this bridge stand firm for many other anniversaries to come.

MSC



- ▲ A guiding steel structure extends beyond the leading section of the bridge, which cantilevers as the structure is advanced until it lands on the next pier.
- ▼ A night view of the walkway and adjoining automotive lanes, with a view of the double barrier protection at the lane and walkway boundaries.

