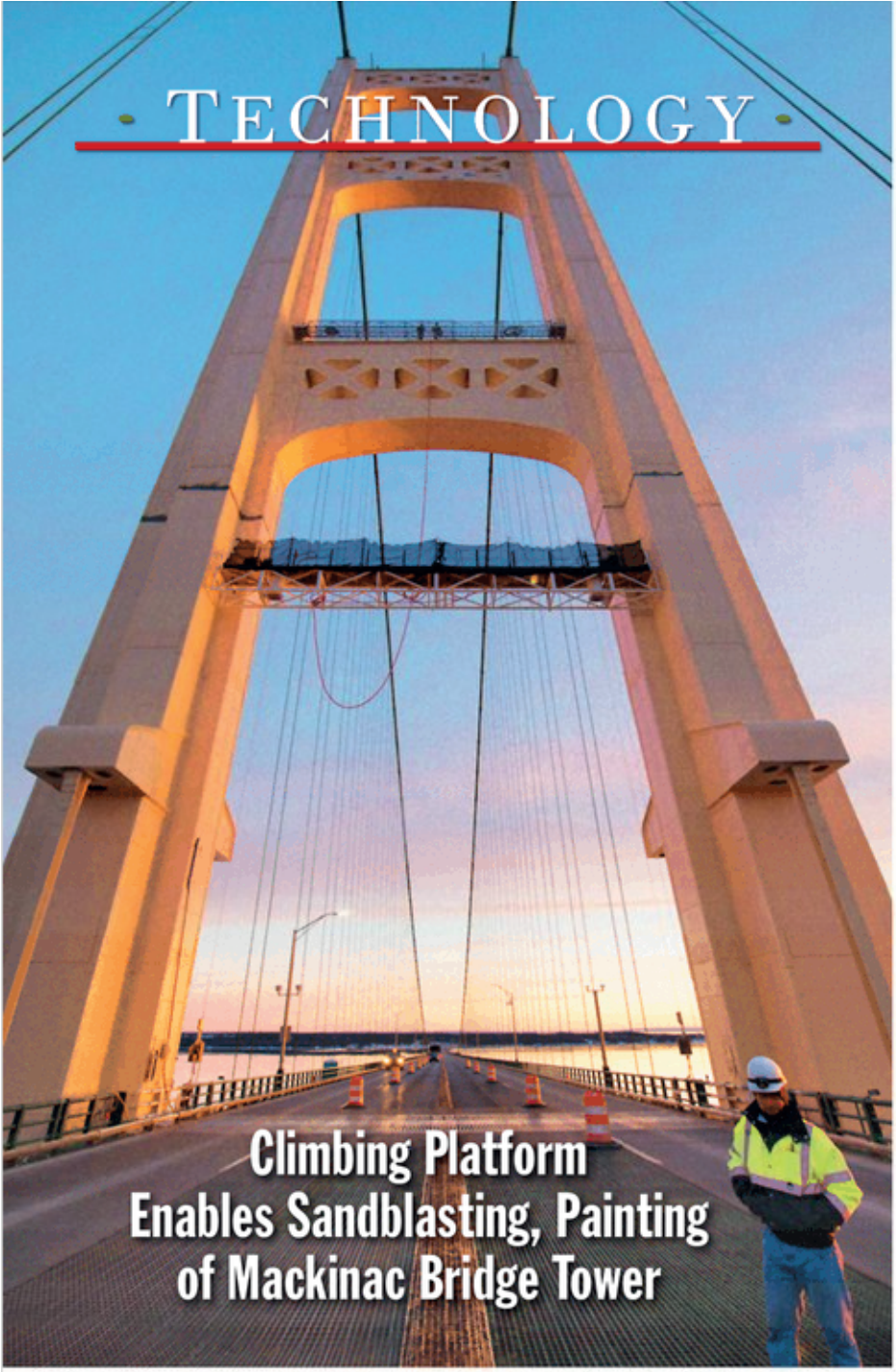


Climbing Platform Enables Sandblasting, Painting of Mackinac Bridge Tower

AT 5 MI IN LENGTH, the Mackinac Bridge is a behemoth. The suspension bridge connects Michigan's Upper Peninsula to the remainder of the state across the Straits of Mackinac—itself the connection point of two of the Great Lakes, Huron and Michigan. This stretch of water is so turbulent, due to weather and underwater terrain, that it has been designated by the state as a shipwreck preserve. The bridge opened for traffic across the straits on November 1, 1957, and it is the fifth-longest suspension bridge in the world and the longest in the Western Hemisphere, according to its managing organization, the Mackinac Bridge Authority.

As might be expected with a bridge of this age, size, and location, repainting it takes careful thought. The two main towers, from which the 8,614 ft long suspension portion of the bridge hangs, are 552 ft tall and are formed from two tapered legs connected above the bridge deck by three struts. As part of the bridge's repainting project, the structural engineering firm Ruby+Associates, in Bingham Farms, Michigan, was tasked with designing a platform that would enable a team to remove and collect the original lead-based paint and repaint the bridge's north tower.

For maximum schedule efficiency, the system needed to be enclosed so that workers could sandblast and paint a complete section during the course of one shift, according to the engineering firm. After an iterative design process, the result was a two-story, lightweight, movable steel and aluminum platform system that can encircle the individual legs of the tower. Canvas walls ensure that all debris can be gathered and work can be completed in winds of up to 60 mph. "After extensive research early in the project, it dawned on us that these were first-of-a-kind platforms we were designing and detailing without any examples or guidance," said Myles Badour, P.E., a project engineer for Ruby+Associates, who sent a written statement to *Civil Engineering*. Moran Iron Works of Onaway, Michigan, fabricated the platforms.

A davit-like "outrigger" system at the top of the tower supports the paint platform, which raises and lowers along the upper 320 ft of the tower's legs, above the bridge deck. The outriggers had to be transported to the top of the tower using only a tiny existing elevator that could fit only two to three people.

"It's not like building something at ground level. At every step of the process we had to ask ourselves, 'How do you actually carry, or connect, or tighten, or build this 500 feet in the air?'" noted Andrew Twarek, P.E., S.E., M.ASCE, the engineering team's project manager for Ruby+Associates, in a written statement provided to *Civil Engineering*. "The outriggers had to be made of light aluminum pieces that would fit in the elevator and could be bolted together at the top of the bridge," he said. "Those could then be used to hoist larger pieces."

Because the hoists selected and purchased by the painting contractor—Seaway Painting LLC, of Livonia, Michigan—had a rated capacity of 5,800 lb each, the weight of the platforms also had to be limited, according to material from the engineering firm. The system is 24 ft tall comprising two rigid aluminum platforms and is attached to the outriggers by four separate traction hoists. The system was used sequentially to paint both legs of the north tower.

Painting the north tower of Michigan's 5 mi long Mackinac Bridge required specially built platforms with canvas walls that enabled workers to strip and repaint the tower's legs and struts.

MORAN IRON WORKS INC.

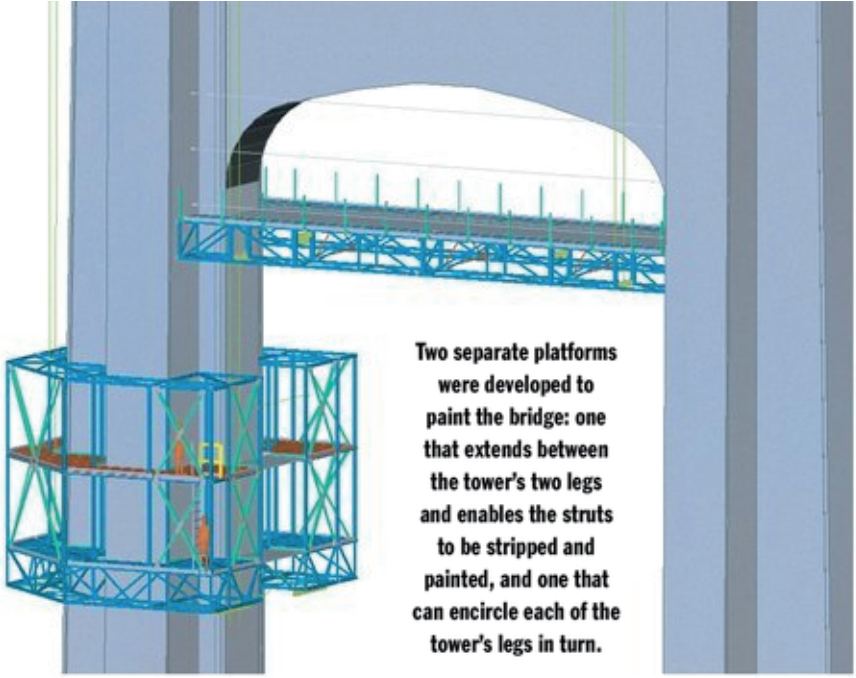
The paint system is formed from 4 ft deep by 4 ft wide C-shaped steel box trusses that support the aluminum platforms. The two ends of the C truss are attached to each other with cabling during painting operations so that in plan, the system resembles a *D*, according to the engineers. To centralize the debris-gathering process, the top platform's work surface is made of grating so that all debris falls through to the bottom platform where it can be vacuumed up.

Removable planks in the platforms ensure that workers can adjust their proximity to the tower's surface as necessary as it tapers near its top, and a strut platform with its own dual 4 ft deep and 4 ft wide steel box trusses was used to work on the tower's struts. The canvas tarps that enclose the platforms attach to the tower legs and create 55,000 cu ft of work space.

"A real challenge was designing for the anticipated wind loads," said Bruce Burt, P.E., the vice president of engineering at Ruby+Associates and the firm's principal in charge of the project. Burt provided a written statement to *Civil Engineering*. "The 40-foot canvas shrouds that contain the blasting sand and lead-based paint act like a giant sail, and wind loads are magnified 500 feet above the water." The lightweight space-frame design of the system worked to counteract the wind loads, and spring-loaded guide rollers were also incorporated into the platforms' design to limit side movements during climbing operations, according to Burt.

Repainting of the north tower was completed in September. Repainting of the south tower is currently anticipated to be complete in 2020.

—CATHERINE A. CARDNO, PH.D.



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Two separate platforms were developed to paint the bridge: one that extends between the tower's two legs and enables the struts to be stripped and painted, and one that can encircle each of the tower's legs in turn.