Eads Bridge - Engineering Miracle and Work of Art
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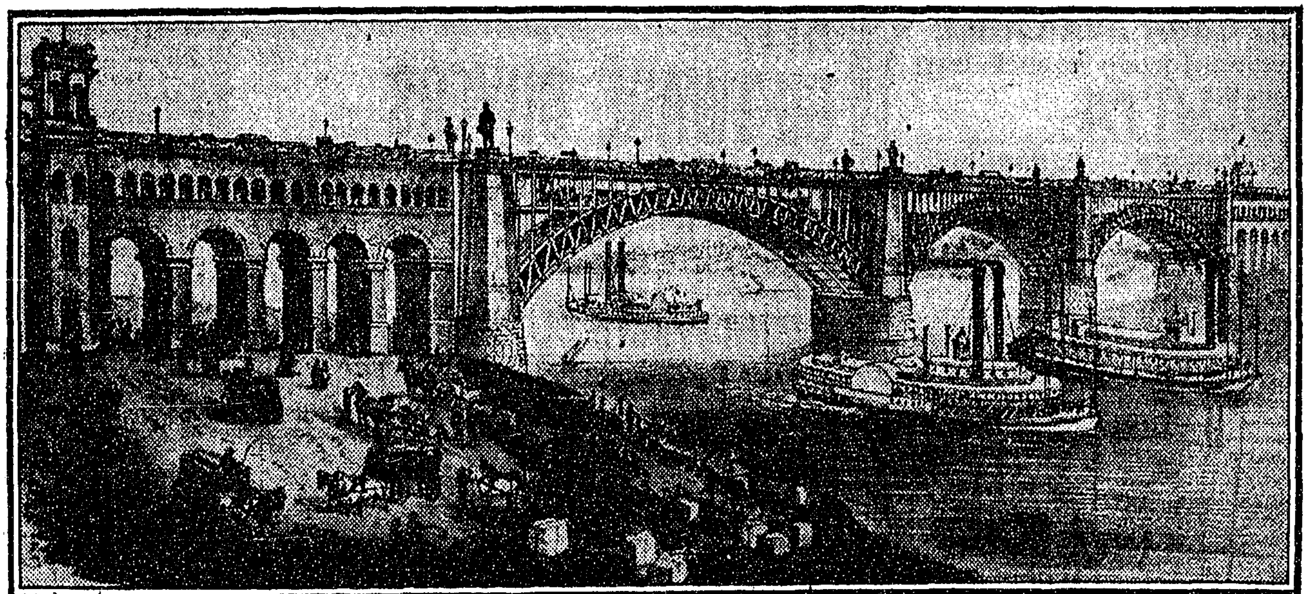
"BRIDGES should be convenient, beautiful and durable," Palladio wrote in the 16th century. But it took the 19th century to make them spectacular as well, through a series of engineering miracles carried out by men of singular, stubborn vision that sent unprecedented iron and steel spans across rivers and gorges in pragmatic gestures that also invoke the poetic and the sublime.

The best bridges are among the most beautiful works of man. The romantic structural drama transcends complex technology to enchant the eye, the heart and the mind. And among the best and most important bridges ever built is the Eads Bridge in St. Louis, celebrating its 100th anniversary this month. It is a genuine spectacular.



Currier and Ives

The Eads Bridge in St. Louis, Mo., spanning the Mississippi River, was begun in 1867, completed seven years later, and turned 100 this month. The bridge, "a landmark engineering achievement," according to the Encyclopedia Britannica, was the largest bridge of any type built up to that time. Also, it was the world's first bridge ever built almost entirely of steel.

The bridge was begun in 1867 and dedicated on July 4, 1874, at a cost of about $10 million, and it was an obstacle race and dime thriller all the way. It had its hero—like the Roeblings, father and son, for the Brooklyn Bridge—in the person of its designer and contracting engineer, James Buchanan Eads, a self-educated, self-made man who had already become rich raising lost cargo from the bottom of the Mississippi with ingenious equipment of his own invention. (For whatever it is worth, his maternal cousin, James Buchanan, for whom he was named, later became President of the United States.)

The Eads Bridge embodies numerous firsts. It was the largest bridge of any type built up to that time. A three-arch, truss bridge, it has a center span of 520 feet, with side spans of 502 feet each, firmly fixed to stone piers. (Hinged arches came later.)

Second, it was the first such bridge ever built almost entirely of steel. Hollow steel tubes make the upper and lower chords of the trusses. There is a minimum amount of iron used, but only because the art of steel construction was limited and experimental. In fact, professional skepticism was common about steel at that time, which was still a cheap, unproven material.

These chrome steel tubes were supplied by Andrew Carnegie, and every piece used in the bridge had to be individually checked. Incredible as it seems now, there were no standards for structural steel, and Eads's pioneering techniques meant the analysis and solution of new problems of stress and erection. Carnegie was forced to take several shipments back and reroll them to meet Eads's rigid specifications—the source of some spectacular disputes between the two men.

The bridge also marked the introduction to the United States of the pneumatic caisson method of founding piers and abutments. These underwater pressurized chambers made the extensive river-bottom work possible at depths never attempted before—almost 100 feet to bedrock below the water's surface.

Another innovation was the cantilevered method of constructing the arches. To keep the waterway free, Eads built elaborate timber framing hung from the towers to support the steel during erection. The steel was then joined at midspan.

The joining became a half-million-dollar drama. In cliffhanger fashion, a loan of that amount depended on closing the first span by September 19, 1873. It was an unseasonably warm September, and the steel expanded, so that it was impossible to insert a connecting tube, as planned. "Ice poultices" were applied frantically and failed. Finally, Eads devised a threaded wrought-iron plug, and by shortening the last two ribs by five inches, the adjustable plug did the job. The arch was closed on September 17.

The human drama is as notable as the technological achievement. The men who built the bridge were icebound in winter, and tornados struck in the spring. The two years—1869 to 1871—when the piers and abutments were sunk and built abounded with disasters. Inside the caissons on the river bottom, oil lamps gave off heavy, sooty smoke and candles burned rapidly. If fire started, the compressed air made it almost impossible to extinguish.

But the most mysterious and awful effect was the dread new "caisson disease," or "the bends," which claimed the lives of a dozen men before its causes were understood. Eads installed a floating hospital under the supervision of his personal physician, and when the trouble was analyzed medically, he instituted a special lift with slow decompression.

The problems above water were as great as the problems below. An explosion wrecked the steel rolling mill, delaying production. The steel staves took months to make in acceptable and uniform quality; a year passed before the material for the anchor bolts was satisfactory; more than six months went by in unsuccessful attempts to make the brace bars; and a total of two and a half years was spent trying to roll steel couplings for the tubes, with wrought iron finally substituted as a compromise.

Eads's feat did not go unacknowledged. The Encyclopedia Britannica refers to the immediate recognition of the bridge as "a landmark engineering achievement." B. H. Spinner, of the St. Louis engineering firm of Sverdrup and Parcel and Associates, now characterizes it as a "quantum jump."

On July 4, 1874, the opening of the bridge was marked by a 100-gun salute that started days of parades, speeches and fireworks. And this year, a July 4th 100-gun salute marked its centenary celebration. Both as engineering and as esthetics, the Eads Bridge has stood the test of time; technical innovation produced a work of art.

(Portions of this account are taken from the Progressive Architecture in America series prepared by the writer, with the permission of Progressive Architecture magazine.)