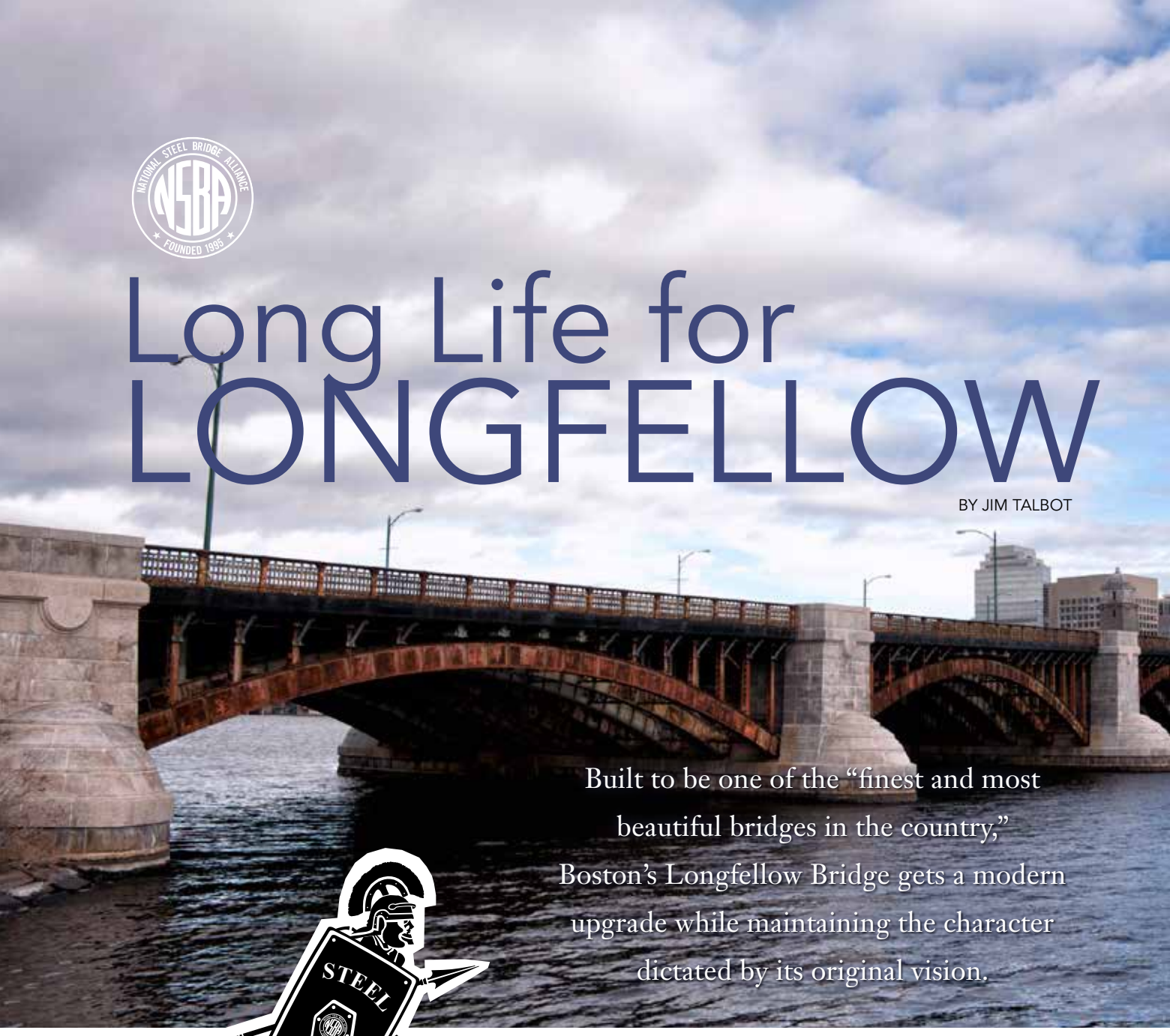
Long Life for LONGFELLOW

BY JIM TALBOT



Built to be one of the "finest and most beautiful bridges in the country," Boston's Longfellow Bridge gets a modern upgrade while maintaining the character dictated by its original vision.

STEEL CENTURIONS
SPANNING 100 YEARS

Our nation's rich past was built on immovable determination and innovation that found a highly visible expression in the construction of steel bridges. The Steel Centurions series offers a testament to notable accomplishments of prior generations and celebrates the durability and strength of steel by showcasing bridges more than 100 years old that are still in service today.

SOME BRIDGES are downright poetic.

The Longfellow Bridge, which opened on August 3, 1906—and was formally dedicated on July 31, 1907—joins Boston and Cambridge over the Charles River. Originally called the Cambridge Bridge, it became the Longfellow Bridge in 1927 to honor Henry Wadsworth Longfellow; his poem *The Bridge* celebrated its timber predecessor, the West Boston Bridge, built in 1793. Locals often call the Longfellow Bridge the "Salt and Pepper Bridge" because the four ornate central granite towers look like shakers.

At the turn of the century, 33,000 people a day passed over the old West Boston Bridge. In modern times the steel and granite Longfellow Bridge carries 28,000 vehicles, 90,000 transit users and numerous pedestrians and bicyclists daily. However, this has temporarily changed during the $255 million, three-and-a-half-year project to rehabilitate the bridge and restore its historic character.

This project, scheduled for completion in 2016, will repair structural deficiencies, restore historical features and widen pedestrian walks and bicycle lanes. To maintain historic accuracy, rivets rather than high-strength bolts will replace failed rivets. The project will also restore or replicate the original ornate pedestrian railings (some of which were stolen and sold for scrap).

Boston's Longfellow Bridge opened in 1907 and is currently undergoing a rehabilitation project, which is scheduled for completion in 2016.

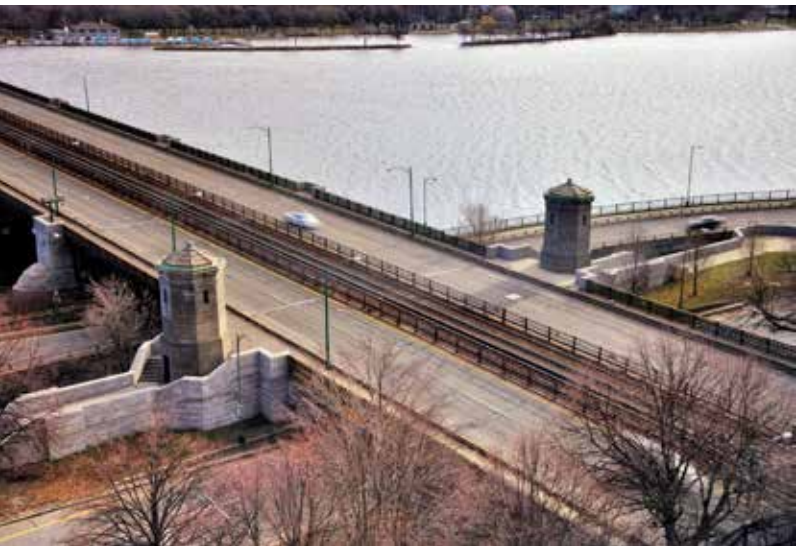
The bridge is colloquially called the "Salt and Pepper Bridge" thanks to the ornate granite towers that resemble shakers.

Powering Up

In 1889 the street railways of Boston switched from horse-driven to electrical power. Traffic from Boston into the suburbs dramatically increased. By 1894 gridlock slowed service and became a constant irritation to railway commuters. Elevated railways alleviated conditions for a few years, but by the end of the 19th century, Boston, Cambridge and the Boston Elevated Railway Co. requested that the state authorize construction of a new bridge at or near the West Boston Bridge that connected the two cities. The request was granted and led to the formation of the Cambridge Bridge Commission.

The legislation called for the new bridge to be suitable for all the purposes of ordinary travel between the cities, including the elevated and surface cars of the railway company. It also specified a drawbridge no less than 105 ft wide with masonry piers and abutments, along with a superstructure of iron or steel or both. The Commission appointed

Jim Talbot is a freelance technical writer living in Ambler, Pa. You can reach him at **james.e.talbot@gmail.com**.



Including approaches as well as an extension in 1959, the bridge is nearly a half-mile long. A 105-ft deck accommodates two railway tracks down the center, two traffic lanes on each side and sidewalks for pedestrians and bicycles.

Wilham Jackson as chief engineer, who then engaged Edmund M. Wheelwright as consulting architect.

A controversy erupted over designs for a draw versus a draw-less bridge. Commerce on the Charles River had substantially slowed and been replaced by railroads, but the U.S. War Department would have to approve a draw-less bridge, which was considered doubtful and would take years. Despite this, the Commission voted for the draw-less design and petitioned the state to permit the change, which was granted. In early February 1900, bills were introduced in the U.S Congress for a draw-less bridge, the War Department agreed to it on February 14 and Congress voted to approve the bridge, signed by President William McKinley, on March 29.

Best Bridge

Wheelwright was said to have been inspired by the 1893 Chicago World's Fair, which celebrated the 400th anniversary of Christopher Columbus' arrival in the New World, and wanted to emulate the great bridges of Europe. Additionally, the Commission intended to make the new bridge "one of the finest and most beautiful structures in the country." The four central towers are the bridge's most distinctive feature and bear the granite seals of Boston and Cambridge set above ornate carvings of a Viking ship's prow, a reference to a voyage by Leif Eriksson up the Charles River at the turn of the first millennium.

The superstructure over the water consists of 11 open-spandrel steel arches, ranging in length from 101 ft at the abutments to 188 ft at the center. The arches, weighing nearly 8,000 tons, rest on the ten piers and two large abutments and provide about 26 ft of clearance over mean high water under the central arch. Two large central piers—188 ft long by 53 ft wide—feature the architecturally prominent ornamental stone towers.

Including approaches as well as an extension in 1959, the bridge is nearly a half-mile long. A 105-ft deck accommodates two railway tracks down the center, two traffic lanes on each side and sidewalks for pedestrians and bicycles. The graceful 3% grade rising and descending from a central point was considered the limit for heavy teams of horses.

Each arch span consists of 12 two-hinge steel girder ribs. The plate girders range in depth from 3 ft to 4 ft, with the larger depths toward the center. Rib spacing depends on the expected design loads—one under each sidewalk, three under each roadway and four under the railway tracks. Lattice struts and diagonal rods brace the ribs, and a cast steel shoe weighing about 2 tons supports each side of a rib.

Vertical posts spaced evenly along the arches extend from the top rib flanges. Transverse 15-in. steel I-beams riveted to the top of the posts serve as floor beams. Longitudinal 12-in. I-beam stringers are framed to the floor beams or rest on them. Except for the space allocated to the railway tracks, buckle plates were riveted to the floor beams and stringers to serve as roadway surface and as lateral bracing for the floor system. Contractors paved the original roadway with granite blocks, 6 in. deep, to provide purchase for horses. The blocks rested on sand over a concrete base, which in turn covered the buckle plates.

The piers and abutments consist of concrete masses of similar design supported by piles driven into the bolder clay to bedrock. Heavy facings of granite cover the piers and abutments above the foundations. The piers are hollow and concrete cross walls connect the two sides of the piers on the lines of the ribs and skewbacks that transmit the arch thrust to the foundations; the cross walls opposite the four center ribs merge into one thick wall. The masonry above the foundation capstone and arch skewbacks serves to carry the deck as it passes over the piers. These are also hollow, containing concrete interior walls where necessary to stiffen the walls and support deck loads.

Recent Rehabilitation

The Massachusetts Department of Transportation is undertaking the three-and-a-half-year rehabilitation project, which includes improving multi-modal access and bridge-to-city-street connections to meet ADA accessibility guidelines. The deteriorated structural elements will be carefully rehabilitated while preserving and restoring the bridge's distinctive architectural features. The project includes:

- Upgrading the structural steel elements supporting the bridge deck
- Restoring or replicating the bridge's ornate pedestrian railings
- Replacing the rail transit tracks
- Cleaning and conserving masonry
- Designing an appropriate new lighting system

Work has already begun on the upstream "salt and pepper" towers, which involves dismantling them to sidewalk level for storage, cleaning and repair. During this time the contractor will add interior stainless steel rods for seismic reinforcement and to prevent further shifting. The fully restored upstream central tower stonework will be reassembled on the bridge later this year, and the two downstream towers will be dismantled and restored when that side of the bridge is rehabilitated during the final phase of construction, which is planned to begin in the fall of 2015. ■