Reed Construction Data

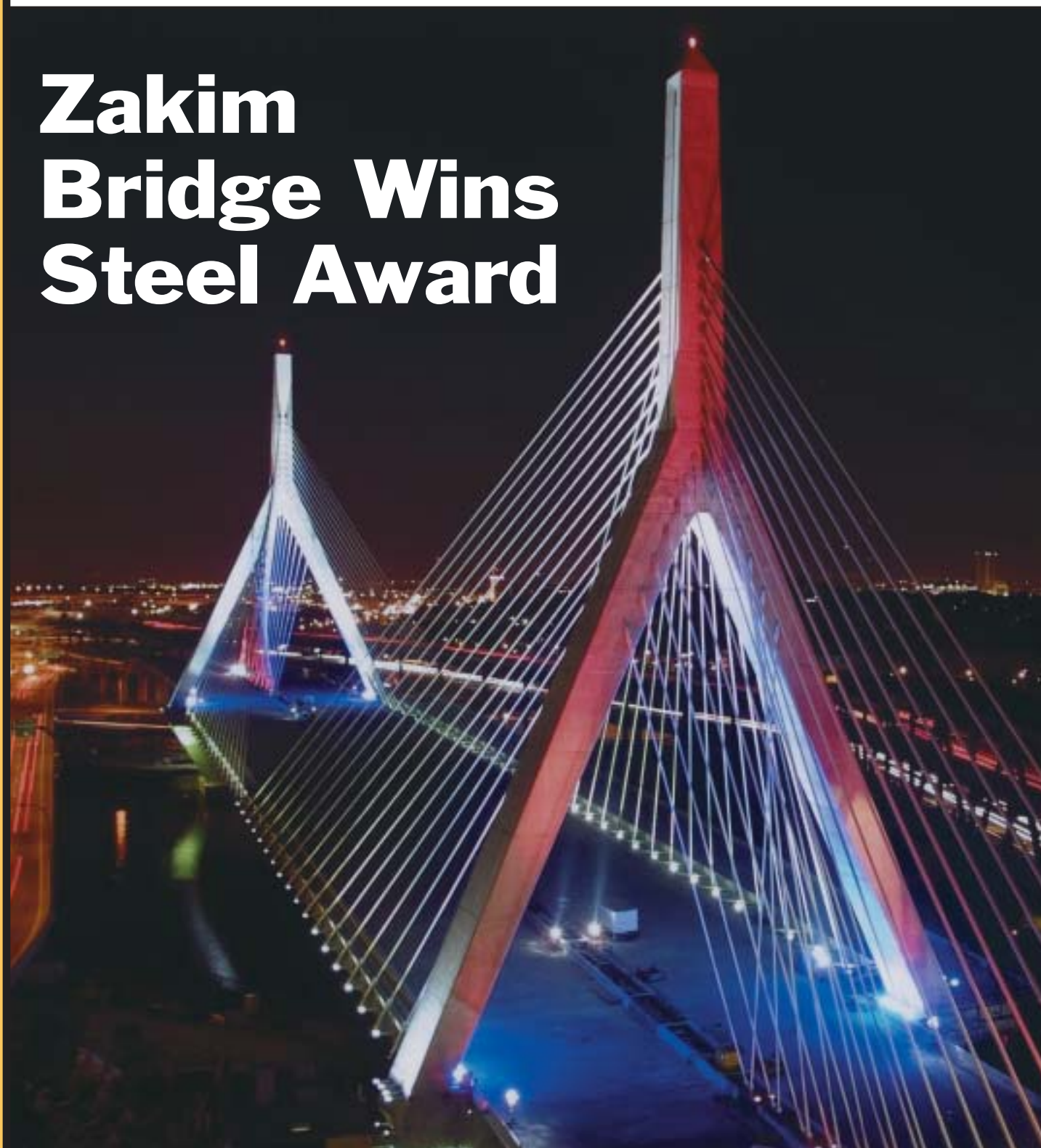
NEW ENGLAND Construction

February 23, 2004

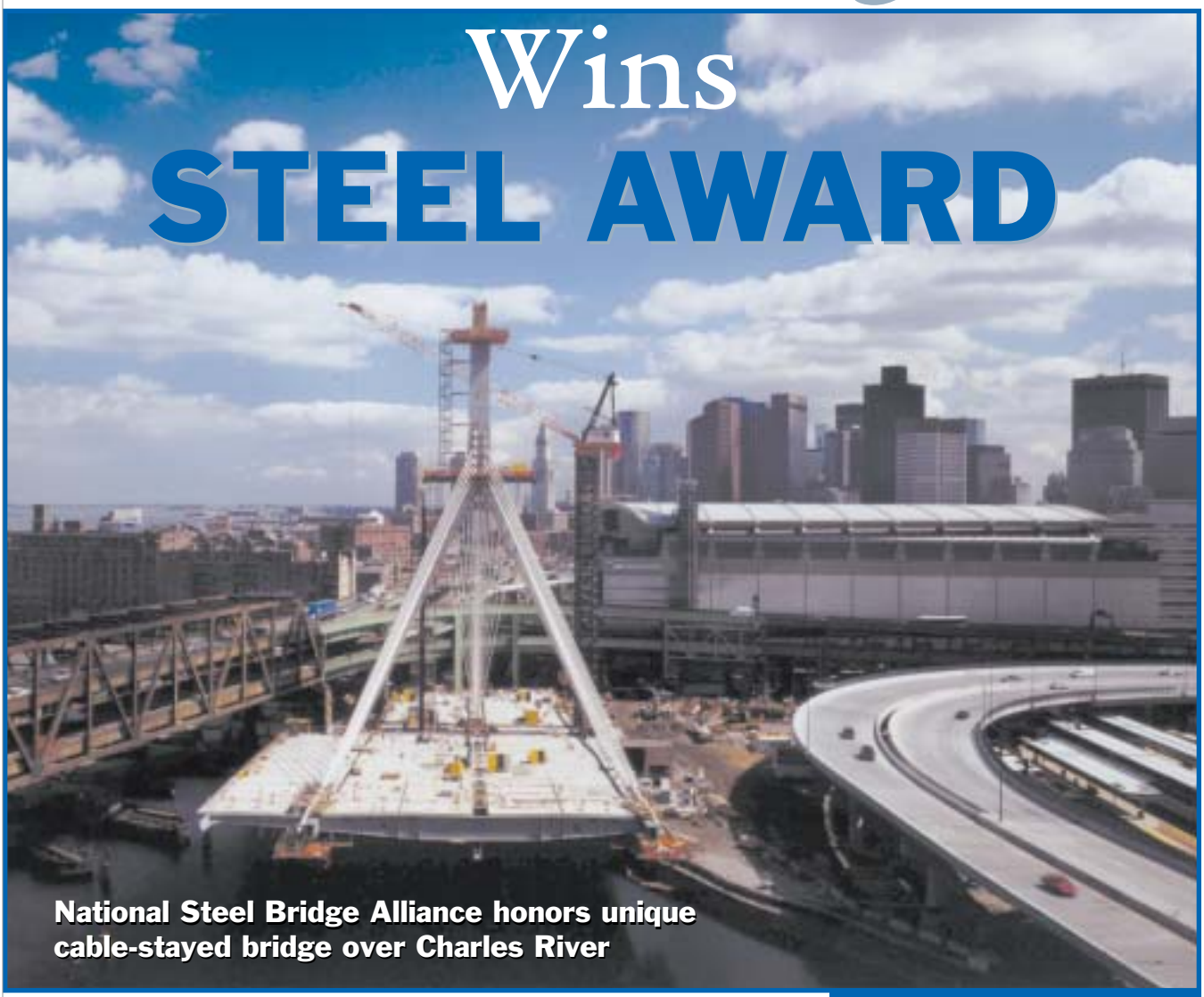
www.reedpubs.com

Edition serving Maine, Vermont, New Hampshire, Massachusetts, Connecticut and Rhode Island since 1936

Zakim Bridge Wins Steel Award



Zakim Bridge Wins STEEL AWARD



National Steel Bridge Alliance honors unique cable-stayed bridge over Charles River

Photo of South Tower construction shows deck, cables between tower and box girders, and transverse floor beams cantilevered on left (east) side.

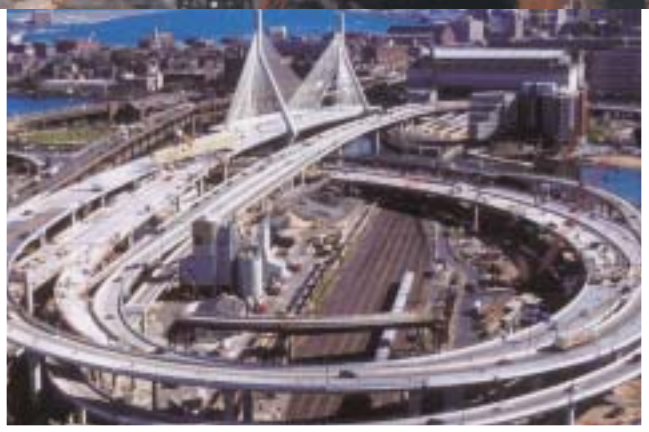
STORY BY PAUL FOURNIER

The Leonard P. Zakim Bridge, that towering new landmark spanning the Charles River near the end of Boston's Big Dig, has won an award for innovative design from the National Steel Bridge Alliance (NSBA).

NSBA announced the selection of the bridge as the winner of the Major Span category in its 2003 Prize Bridge Competition and will formally present the award at the Bridges and Structures Annual Meeting of the American Association of State Highway and Transportation Officials (AASHTO) in June in Orlando.

The Zakim Bridge stands at the northern end of the Depressed Central Artery (Big Dig tunnel) near the Fleet Center, home of the Boston Bruins and the Celtics. The new 1,460-foot bridge replaced a six-lane double-deck bridge that used to join the Charlestown section of Boston to downtown.

NSBA recognizes the Zakim Bridge as the world's widest cable-stayed bridge (10 lanes), with the first asymmetrical design in North America and the first hybrid



Left: Earlier photo shows Cornell tower crane placing concrete for workers forming inverted-Y tower leg.

Below: Photo shows Boston Harbor and city skyline in background as construction crews near completion of Zakim Bridge.

towers. In commenting on the bridge, the judges noted that it is visually striking, has well-executed three-dimensional detailing, and effectively utilizes high-performance (HP) 70W steel. They pointed out that the bridge's structural form was borne out of many functional requirements and stringent site constraints.

Key project team members cited by NSBA include the owner, the Massachusetts Turnpike Authority; the designer, HNTB Corporation; the general contractor and steel erector, Atkinson/Kiewit Joint Venture; the fabricator, Grand Junction Steel; the steel detailer, Tensor Engineering Co.; the management consultant, Bechtel/Parsons Brinckerhoff; and the design subconsultant, Figg Bridge Engineers.

Atkinson/Kiewit retained TY Lin International to provide engineering services during construction of the cable-stayed bridge.

Under a $90-million contract with the state, the contractor built the Zakim Bridge within a busy transportation corridor that includes the Orange Line and Commuter Rail of the Massachusetts Bay Transportation Authority, and the Storrow Drive Connector Bridge, a structure built by Daniel O'Connell's Sons Inc., which employs 80-foot-wide steel box girders – the largest in the United States.

Among the many constraints on design and construction that had to be considered by the Zakim project team were an Orange Line ventilation building next to the south main bridge pier, a subway tunnel that had to be straddled by the legs of the north main pier, and a 36-inch water main beneath the south pier. Another challenge was a required 5-percent grade between the entrance to the I-93 tunnel on the south bank of the river and the tie-in to a three-level interchange on the north bank.

The team also had to keep the existing I-93 double-deck bridge and its ramps open to traffic, and protect and keep in operation the lock and dam system of the Charles River Pump Station just east of the bridge.

> "This bridge is the first in the United States with a tower incorporating a core of high-performance grade 70 steel."

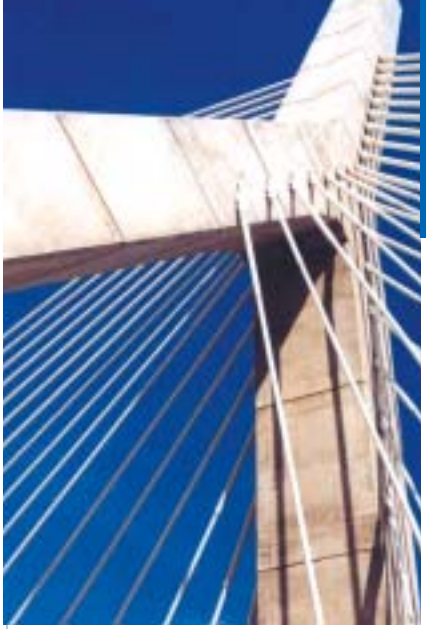
Conceived by Swiss designer Christian Menn, the cable-stayed structure has two inverted Y-shaped towers supporting the main span. Eight lanes of traffic pass through the legs of the giant towers, and two additional lanes are carried on a cantilevered section, creating the novel asymmetrical shape. Two longitudinal steel box girders and two planes of cables support the bridge's 745-foot-long, 183-foot-wide main span. The cables run from the box girders to the slender inverted-Y towers.

Rising 266 feet above the roadway level, the towers are constructed of cast-in-place reinforced concrete, with an internal fabricated steel core at the top for anchoring the stay cables. According to NSBA, this bridge is the first in the United States with a tower incorporating a core of high-performance grade 70 steel.

Developed through a collaboration of the Federal Highway Administration (FHWA), American Iron & Steel Institute and the United States Navy, high-performance steel is said to be lighter, stronger, tougher, more durable, and more weldable than conventional steel. Its presence in the tower core and also in cable-anchor boxes, coupled with refinements in cable-stay geometry, accommodates the differences in east and west cable loads caused by the cantilevered roadway. Transverse steel floor beams spaced 20 feet on center extend 45 feet beyond the eastern box girder to shoulder the cantilevered lanes.

Adding to the uniqueness of the Zakim Bridge, while its main center span is framed of steel box girders and floor beams, its 295-foot and 420-foot back spans are made of cast-in-place, post-tensioned concrete box girders. Designers chose this combination because steel minimized weight in the main span, while concrete provided extra weight in the back spans to act as a counterbalance.

In contrast to the two planes of cables supporting the main span, a single plane supports the back spans. An estimated



Twelve-inch-thick cable stays are anchored to high-performance grade 70 steel in tower core.

1,820 miles of steel wire were required to form the seven-wire strands that are in turn bound together to form support cables. The largest cables are up to 12 inches thick.

The Zakim Bridge was first covered in New England Construction magazine in 1999 (July 12 issue) when the contractor was constructing the cast-in-place towers. As explained in that article, due to the poor soil of the river bottom, the towers of the cable-stayed bridge are supported on 30 deep-drilled shafts filled with reinforced concrete.

Workers drilled the 8-foot-diameter shafts 50 feet into rock, resulting in total lengths of about 150 feet. To allow drilling to proceed, the contractor first installed and dewatered large cofferdams.

Approximately four years later, the northbound lanes of the award-winning Zakim Bridge were opened (March 2003), while the southbound barrel opened on December 20, when, in a ceremony presided over by Boston Mayor Thomas Menino and Massachusetts Turnpike Chairman Matthew Amorello, the new southbound lanes of the depressed Central Artery opened to traffic. ■

The National Steel Bridge Alliance

A non-profit division of the American Institute of Steel Construction, NSBA was founded in 1995 with the goal of making steel the material of choice for bridges through marketing, technology, education, and legislative action. Active members include steel producing and fabricating companies while affiliate members consist of engineering firms, DOTs and companies supplying parts and materials. The group collaborates with such groups and agencies as AASHTO, FHWA, state DOTs, academia, and various industries related to steel bridge design, fabrication and inspection. Conn Abnee is NSBA executive director, and John Grzybowski is NSBA chairman. More information on the group can be obtained by visiting ***www.aisc.org***.

Reprinted from the February 23, 2004 issue of NEW ENGLAND CONSTRUCTION