courtesy of Top Shots

The monumental $680 million Woodrow Wilson Memorial Bridge project, under construction on the Capital Beltway (I-495) for more than a decade, was undertaken to eliminate one of the nation's worst traffic bottlenecks.

NATIONAL AWARD SPECIAL AWARD
WOODROW WILSON MEMORIAL BRIDGE
WASHINGTON D.C.

The Woodrow Wilson Memorial Bridge is truly a new icon in a city of monuments. The $680 million project replaces an outdated bridge carrying I-95 across the Potomac River connecting Maryland and Virginia at the southern tip of the District of Columbia. It is a vital link on I-95 and the Capital Beltway (I-495), the circumferential freeway surrounding the core of the Washington metropolitan area. The new state-of-the-art structure eliminates one of the nation's worst traffic bottlenecks. The 12-lane bridge has separate local and express lanes, and capacity for future mass transit expansion. It also contains America's largest movable span.

The previous bridge had a vertical clearance of only 50 ft, but its drawspan over the Potomac River's navigational channel allowed larger marine vessels access to Washington, Alexandria, and other points north of the bridge. The decision was made to build new drawbridges rather than a higher fixed-span structure because many commercial, Navy, Coast Guard and recreational vessels on the river require high clearances. A fixed bridge would have required a vertical clearance of 135 ft.

The previous double-leaf bascule span bridge opened an average of five times per week. The new drawbridge is about 20 ft higher than its predecessor, reducing the number of bridge openings each year from approximately 260 to less than 60.

> This monumental bridge is packed full of innovation and is a trailblazer in the land of leaders. The engineering elements are amazing. This was a stimulus package before there was a need. The number of jobs created was incredible. It is an elegant, visually stunning bridge with good lines that enhances the surrounding architecture.
>
> *—Jury Comments*

The project includes two parallel bridges, each consisting of eight plate girders and three to four substringers to accommodate widths of up to 148 ft. Each bridge consists of two parallel double-leaf bascule spans for a total of eight leaves, which keeps the floor system and mechanical and electrical systems economical. By not connecting adjacent leaves, and providing separate machinery with the ability to operate each leaf independently, any one of the leaves can be taken out of service, if required, while maintaining a minimum of three lanes of traffic in each direction.

Each of eight drawspan leaves weighs approximately 2,000 tons and is designed to close within a ⅛-inch tolerance. Thirty-four million pounds of structure will move to clear a ship through the channel, representing the largest moving mass of any bridge in America and possibly the world. With 270 ft between trunnions, this span is among the longest in the world. It also is extremely wide: 249 ft from fascia to fascia.

The bascule span is a simple trunnion Chicago-type bascule. The front transverse beams of the piers serve as supports for the forward live load bearings at each bascule girder. The fixed deck beam of the bascule pier also serves as the rear live load anchor. Other design features of the bascule include a fully-composite lightweight concrete deck, fully counterweighted leaves, shear and moment-transferring span locks, and tail locks.

The span lock arrangement for the new Woodrow Wilson Bridge is unique in that the locks transfer moment as well as shear between the leaves of each double-leaf span. The tail locks work in conjunction with the span locks and relieve the operating machinery of live load transferred through rack into the main pinions. This will significantly reduce wear on the operating machinery.

The design of the bridge was decided by competition. The signature bridge that resulted from this process is an elegant, curving, haunched plate girder bridge supported by V-shaped piers. The combination of the curved V-piers and the girder haunches highlights the architectural motif of arches desired by the public. The steel plate girder/diaphragm/substringer framing system was used for overall economy, aesthetics and compatibility with the V-pier configuration.

The floor system framing and detailing were kept as simple as possible. Each bascule leaf consists of two bascule girders that support floor beams and stringers. Girder-to-


courtesy of Potomic Crossing Consultants

Thirty-four million pounds of structure move to clear a ship through the eight-leaf bascule arrangement on the Woodrow Wilson Memorial Bridge over the Potomac River.

girder distances vary for different leaves, ranging from 35 ft to 40 ft, 6 in. The typical floor beam spacing is 20 ft, 9 in. and stringer spacing is kept under 6 ft. Girders and floor beams are welded I-shaped members, and the stringers are rolled sections. Bolted connections are used throughout the span.

In all, 16 bascule girders are required. These girders are very large, with webs varying in depth from nearly 12 ft at the toes to 20 ft in the vicinity of the trunnions, and with 28-in.-wide flanges that range between 1½ in. and 4 in. thick. The overall length of each girder is 215 ft. To keep girder segments within sizes and weights that could be fabricated and to provide shipping and erection options, the girder design included two field splices. Each bascule girder weighs between 350 tons and 400 tons.

Approach Spans

The approaches on each end of the bridge consist of two continuous units, with 13 individual spans on the Virginia side and 19 spans on the Maryland side. They use haunched plate girders having a depth of 11 ft, 9 in. at the support points and 6 ft, 10 in. at midspan. The parabolic shape was developed to provide the continuous curved line of the V-pier and the superstructure varies with the span length.

The variable-depth girders in conjunction with the V-shaped piers provide the arch-like appearance that was desired in order to be visually similar to the other great bridges in the capital city. The plate girder spans vary from 100 ft to 209 ft. This variation in span length is due, in part, to the height of the structure above the ground surface. Plate diaphragms support the substringers and provide a clean appearance from the historic park below the bridge.

The plate girders were designed as hybrid girders. They were primarily fabricated from ASTM A709 Grade 50 steel, but some flanges used Grade 70 HPS steel to minimize the plate sizes, reduce girder weight and minimize constructed cost.

Co-Owners

Maryland State Highway Administration, Baltimore
Virginia Department of Transportation, Chantilly, Va.

Designer

Parsons, Baltimore

General Contractor (bascule)

American Bridge (AISC/NSBA, IMPACT and TAUC Member)/Edward Kraemer & Sons (IMPACT Member) Joint Venture, Coraopolis, Pa.

Detailer (bascule)

Tensor Engineering, Indian Harbour Beach, Fla. (AISC/NSBA and NISD Member)

Consulting Engineer (bascule superstructure design)

Hardesty & Hanover LLP, Annapolis, Md.

General Engineering Consultants

Potomac Crossing Consultants, Alexandria, Va.

Fabricator – Virginia Approach

Williams Bridge Company, Manassas, Va. (AISC/NSBA Member)

Fabricator/Detailer – Maryland Approach

High Steel Structures Inc., Lancaster, Pa. (AISC/NSBA and IMPACT Member)