New England Bulb Tee Girder Brings Strength, Elegance and Economy to Jetport Interchange Bridge

The New England Bulb Tee (NEBT) girder played a prominent role in constructing the Jetport Interchange Bridge on the Maine Turnpike near Portland, Maine. The bridge has two 125 ft (38.1 m) end spans and an interior span of 106 ft (32.3 m), giving it a total length of 356 ft (108.5 m). An added feature of the design was the use of integral abutments, which reduced substructure costs by eliminating bearing devices and roadway joints. The NEBT girder provided structural efficiency, strength, aesthetics, lower construction cost and uninterrupted turnpike traffic during construction. This article presents the design features of the bridge and gives highlights of its construction.

The 105 mile (170 km) long Maine Turnpike is a high vehicular volume superhighway that has been serving the people of Maine, as well as thousands of visitors annually, for the past 50 years. The large majority of the more than 100 bridges along the expressway are built using structural steel beams. With the passage of time, many of these steel bridges are starting to deteriorate due to the use of deicing salts on the bridge decks and the bridges’ proximity to the salty coastal environment.

When it became necessary three years ago to build a 356 ft (108.5 m) long overpass at the Interchange 7A (a heavily traveled location in an area of poor soil conditions), the Maine Turnpike Authority turned to new technology to solve their problem. The obvious choice was to make use of
the New England Bulb Tee (NEBT) girder (see Figs. 1 and 2). This girder section had been developed by the PCI New England Technical Committee for Bridges about five years ago to replace the less efficient AASHTO Type V and VI girders.*

The NEBT girder was ideal because of its structural efficiency, aesthetics, and lower cost of construction, while providing uninterrupted turnpike traffic during construction. In addition, NEBT girders permitted the use of integral abutments, which reduced substructure costs by eliminating bearing devices and roadway joints.

The Maine Turnpike Authority chose HNTB Corporation to carry out the structural design of the bridge with the collaboration of Strescon Limited, who fabricated the NEBT girders. The general contractor was CPM Constructors.

HNTB compiled the costs of several bridge alternatives in 1997. A comparison of steel and concrete alternatives using conventionally reinforced concrete cantilever type abutments re-

Fig. 3. Site plan of Jetport Interchange Bridge.
Fig. 4. Framing plan of Jetport Interchange Bridge.
revealed that the concrete alternatives using AASHTO Type VI girders was only slightly less expensive than the steel plate girder options. However, with a total bridge length of 356 ft (108.5 m), integral abutments could be considered an option for the bridge substructure. The problem was that State of Maine bridge guidelines do not recommend the use of integral abutments for steel bridges with overall span lengths exceeding 200 ft (61 m).

Similarly, FHWA guidelines recommended limiting the use of integral abutments for steel bridges to lengths of less than 300 ft (91 m). As a result, the combination of a precast, pre-stressed concrete girder superstructure with concrete integral abutments proved to be the most cost effective and maintenance-free structure for this particular bridge site. Figs. 3 and 4 show the site plan and framing plan of the bridge.

Fig. 5. Typical deck section of bridge.

Fig. 6. Typical NEBT girder section showing reinforcement (left) and strand pattern (right).
Fig. 7. Typical beam elevation.

Fig. 8. Typical abutment section.
During the final design phase, the designers seized the opportunity to utilize the newly created NEBT shape. Since the wider NEBT flanges required a thinner deck slab, the actual design became even more cost effective.

The resulting design is a three-span bridge that comprises two 125 ft (38.1 m) end spans and an interior span of 106 ft (32.3 m), making a total bridge length of 356 ft (108.5 m). Each span consists of six precast, prestressed NEBT girders, 71 in. (1800 mm) deep, with a 7\(\frac{1}{2}\) in. (190 mm) thick cast-in-place reinforced concrete deck.

Fig. 5 shows a typical deck section of the bridge. Fig. 6 shows typical NEBT girder sections and Fig. 7 shows a typical beam elevation.

The superstructure was compositely designed and made continuous for live load (HS-25) by casting concrete at the ends of the girders over the piers. Conventional reinforced concrete integral type abutments and three-column rigid frame piers support the superstructure.

The total surface area of the superstructure is 15,300 sq ft (1423 m\(^2\)). The 43 ft (13.1 m) deck width accommodates two 12 ft (3.66 m) vehicle lanes, 8 ft (2.44 m) shoulders and 1 ft 6 in. (0.46 m) parapets.

The abutment and pier locations were set to accommodate the existing and future widening of the turnpike and associated access ramps. In addition, bridge foundations and embankments were set a sufficient distance away from three existing pipelines to reduce settlements. Fig. 8 shows a typical abutment section.

The unpainted concrete superstructure will require virtually no maintenance, unlike the steel options. Prestressed concrete girders offer excellent long-term performance and durability. This was an important consideration since this roadway carries heavy traffic volume through this area during the year.

The NEBT girders made the use of integral abutments a feasible option for this bridge. With integral abutments, there are reduced substructure costs due to simplified details (no bearing devices or roadway joints) and rapid construction (only a single row of piles beneath each girder and simpler concrete and backfill placement). With the elimination of the roadway joints, long-term maintenance costs are lowered, rider quality is improved and the bridge deck is less vulnerable to snow plowing damage.

Since the prestressed concrete girders were erected as single units between bridge supports, only one direction of traffic had to be redirected. Girder erection was performed at night, thus minimizing the inconvenience to motorists required to use a temporary crossover. Previous bridge projects with steel beams erected, which cantilevered over the pier during construction, impacted both directions of traffic. The contractor chose to slipform the concrete parapets to further minimize the construction effort.

Finally, because the superstructure and substructure are composed
of one homogenous material and integrally connected, this structure is more aesthetically pleasing than their steel counterparts viewed while driving along this turnpike.

The NEBT girders were fabricated in early 1999 by Strescon Limited at their plant in Saint John, New Brunswick, Canada. Normal casting procedures were used to produce the girders, which had a specified concrete compressive strength of 6500 psi (45 MPa) at 28 days.

The girders were shipped by truck-trailer to the bridge site – a distance of about 200 miles (324 km). The precaster was responsible for the production and transportation of the girders. The general contractor erected the girders over a two-week period using a 65 ton (60 t) capacity crane.

Figs. 9 and 10 show erection sequences of the bridge. The bridge superstructure was finished within six weeks. Figs. 11 and 12 show the completed bridge.

The total cost of the bridge was $1.2 million (substructure cost $20.8 per sq ft and superstructure cost $57.80 per sq ft)(15,300 sq ft of bridge). The precast concrete cost was $420,400.

At the PCI Convention in Reno, Nevada, this past October, the Jetport Interchange Bridge received a 2001 Design Award for “Best Bridge With Spans Between 65 and 135 ft (19.8 to 41.1 m).” The jury comments were as follows:

“This project presents an outstanding use of New England bulb-tee technology and is somewhat unique in its night-time construction. The design produced a simple but elegant bridge that fits the environment and offers outstanding long-term performance because of the integral abutments and simplicity of details.”

The bridge was opened to traffic in September 1999. During the past two years, it has been operating with total satisfaction and it is expected that maintenance costs of the bridge will be minimal. It is anticipated that as the bridges along the turnpike start to deteriorate due to normal wear and aging, they will be replaced by state-of-the-art prestressed concrete bridges.

CREDITS
Owner: Maine Turnpike Authority, Portland, Maine
Engineer of Record: HNTB Corporation, Westbrook, Maine
General Contractor: CPM Constructors, Freeport, Maine
Precast Concrete Manufacturer: Strescon Limited, Saint John, New Brunswick, Canada