NEW HAMPSHIRE

Route 3A Bridge Over the Newfound River, Bristol

General Description The HPC bridge is a simple-span structure, 18.3 m (60 ft) long. The bridge consists of two travel lanes, shoulders, and one sidewalk. The bridge superstructure is 12.0 m (39.5 ft) wide and consists of four New England Bulb-Tee (NEBT) prestressed concrete girders spaced 3.5 m (11.5 ft) on center, with a 229-mm- (9-in-) thick deck. The NEBT girder section, which was recently developed for the region as a new economical section, incorporates the use of HPC and 15-mm- (0.6-in-) diameter low-relaxation prestressing strands. The bridge deck consists of 89-mm- (3.5-in-) thick precast prestressed deck panels overlaid with 140 mm (5.5 in) of cast-in-place HPC concrete. Conventional concrete, 28 MPa (4000 psi), was used in the at-grade approach slabs for comparison purposes.

Outline of HPC Features Concrete mixes for the bridge elements were varied according to the demands of the particular application. Concrete strength, durability properties, and other characteristics were selected for the bridge elements and were specified in the project documents. The design strength requirements were:

Element	Compressive Strength
Beams @ Transfer	38 MPa (5500 psi)
Beams @ 28 days	55 MPa (8000 psi)
Deck @ 28 days	41 MPa (6000 psi)

HIGH-PERFORMANCE CONCRETE

Concrete with enhanced durability and strength characteristics. Under the Strategic Highway Research Program (SHRP), more than 40 concrete and structural products were developed. To implement the new technology of using High-Performance Concrete (HPC), the Federal Highway Administration (FHWA) has a program underway to showcase bridges constructed with HPC. The objective is to advance the use of HPC to achieve economy of construction and long-term performance.

Actual average beam strengths exceeded 45 MPa (6500 psi) at transfer and 72 MPa (10,400 psi) at 28 days. Average deck strength exceeded 58 MPa (8400 psi) at 28 days.

The permeability requirements were:

Element	Permeability
Beams @ 56 days	Less than 1500 coulombs
Deck @ 56 days	Less than 1500 coulombs

Actual values were less than 600 coulombs for the beam concrete and less than 1300 coulombs for the deck concrete.

Concrete Evaluation The following concrete properties were measured in the HPC bridge:

- Slump.
- Air Content.
- Rapid Chloride Permeability.
- Water Content.
- Strength.
- Chloride Intrusion.
- Freeze-Thaw Durability.

In addition, evaluations of the performance of precast, prestressed, stay-in-place deck slabs, and concrete strains in the composite slab system and in the NEBT beams under load testing and service conditions are ongoing.

Instrumentation Two of the girders were instrumented with vibrating wire strain gauges located within the bottom flanges, and thermistors (temperature measurement devices) located throughout the girder depth. Girder strain measurements were taken at the release of the prestressing strands, prior to transportation to the site, after erection, and periodically after deck placement. Thermistors were also placed in the deck to measure temperature differentials within the concrete and to correlate ambient freeze-thaw cycles with those within the deck concrete.

Construction The general contractor of the bridge was R.S. Audley of Bow, NH, and the prestressed concrete beam and subdeck panel fabricator was Northeast Concrete Products of Plainville, MA. The ready-mix supplier was Persons Concrete, Inc. of Winnisquam, NH (Campton, NH plant). The HPC bridge construction began in October 1998. The girders were cast in April 1999 and the deck was completed in June 1999. The bridge was opened to traffic on June 25, 1999.

Benefits Greater durability with reduced long-term maintenance will be derived by using HPC in the girders. Also, by using HPC in the recently developed New England Bulb-Tee girders, the designers were able to achieve wider girder spacings and to use a shallower girder than if conventional concrete had been used. Experience from the first HPC bridge, the Route 104 Bridge over the Newfound River, showed that some difficulties were encountered with placing a fully cast-in-place deck across the long girder spacings. Therefore, the Route 3A bridge employed precast prestressed concrete deck panels as stay-in-place deck formwork that then became composite with the cast-in-place deck. The use of the subdeck panels aided the contractor immensely during construction. ■

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