Route 104 Bridge Over the Newfound River, Bristol

General Description The HPC bridge is of simple-span construction, nominally 20 m (65 ft) long. The bridge consists of two through-traffic lanes, a shoulder, a left-turn lane, and a sidewalk. The width of the deck is 18 m (57 ft-6 in) and the thickness of the deck is 229 mm (9 in). Load-carrying elements consist of five Type III American Association of State Highway and Transportation Officials (AASHTO) prestressed concrete I-girders. The Route 104 HPC bridge was completed in 1996.

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 strengths were:

Element	Compressive Strength
Beams @ Transfer	45 MPa (6500 psi)
Beams @ 28 days	55 MPa (8000 psi)
Deck @ 28 days	41 MPa (6000 psi)

All mixes included a set retarder and high-range water-reducing admixture. Silica fume was used as the mineral admixture. Temperature-match curing was used to evaluate beam (cylinder) concrete strength before transfer of prestressing for the beams.

Preliminary Deck HPC Evaluation Three bridge deck concrete mixes were selected from laboratory tests for field trials. For each mix, two slabs 4.9 m (16 ft) long by 1.2 m (4 ft) wide by 2.4 m (8 ft) thick were constructed, one with epoxy-coated reinforcement and one with uncoated reinforcement. These slabs were exposed to truck traffic over the winter of 1995/1996 at a Waste Management, Inc. site. After a winter's exposure, the slabs were qualitatively checked for cracking and the condition of the reinforcement using core samples. Research conducted by the University of New Hampshire found that one of the three concrete mixtures attained superior durability performance with respect to freeze-thaw durability, scaling resistance, abrasion resistance, and moment capacity. No significant differences were found between the structural performance of epoxy-coated and uncoated reinforcements. The capacities of the slabs were tested in the laboratory after exposure to truck traffic. All slabs exhibited excellent ductility, even after the exposure to truck traffic, attaining more than 50.8 mm (2 in) of mid-span deflection before failure for simple spans of 3.2 m (10 ft-6 in). All slabs also exhibited excellent strength, exceeding the design strengths by more than 30 percent in all cases.

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.

Concrete Evaluation The following concrete properties were measured in the preliminary deck HPC evaluation and in the HPC bridge:

- Slump
- Scaling
- Air Content
- Rapid Chloride Permeability
- Water Content
- Strength
- Chloride Intrusion
- Freeze-Thaw Durability
- Abrasion Resistance

Deflection of the slabs in the preliminary HPC deck evaluation and in the HPC bridge under dead and live loads was measured to determine creep and shrinkage effects and stiffness under the applied loads. Temperature and strain measurements continue to be recorded hourly and downloaded weekly.

Construction The HPC bridge contract was awarded in 1995. The bridge was constructed in 1996 and evaluation of the structure is ongoing. Weaver Brothers Construction Company, Inc. (Concord, NH) was the prime contractor, and Beck and Belucci, Inc. (Franklin, NH) was the bridge subcontractor. Unistress, Inc. of Pittsfield, MA was the beam fabricator. The ready-mix concrete supplier was Persons Concrete, Inc. of Winnisquam, NH (Campton, NH plant). Cotton mats used in the deck curing process (similar to what is done in Texas), led to good results, with no cracks in the bridge deck observed for the first year.

Benefits The bridge is performing well. The exposed concrete deck surface is virtually crack-free and has shown no scaling or freeze-thaw damage after four winters. Excellent long-term durability and structural performance is expected.

In 1999, the New Hampshire Department of Transportation constructed a second HPC bridge. This second bridge is located upstream from the first and carries traffic on Route 3A over the Newfound River.

U.S. Department of Transportation
Federal Highway Administration

Updated August 2000
FHWA-RD-00-119

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