NORTH CAROLINA

U.S. 401 Over the Neuse River, Raleigh

General Description This HPC bridge consists of two parallel structures, each with four spans—two spans of 28.0 m (91.9 ft) and two spans of 17.5 m (57.4 ft). Each bridge is 14.4 m (47.1 ft) wide and carries a 12.0-m (39.4-ft) roadway section and a 1.9-m (6.2-ft) sidewalk. The bridges used simple-span prestressed concrete I-girders made continuous for live load. American Association of State Highway and Transportation Officials (AASHTO) Type IV prestressed concrete I-girders were used in the 28.0-m (91.9-ft) spans, while AASHTO Type III prestressed concrete I-girders were used in the 17.5-m (57.4-ft) spans. Girder spacings were five girders per span at 3.12 m (10.25 ft) on center and the deck thickness was 215 mm (8.5 in).

Outline of HPC Features HPC was used in the girders and in the deck. The HPC has the following strength requirements:

Element	Compressive Strength
Girder@Transfer	48 MPa (7000 psi)
Girder@28 days	69 MPa (10,000 psi)
Deck@28 days	41 MPa (6000 psi)

In addition to the strength requirements, the HPC mix was formulated to provide resistance to chloride ion intrusion, freeze-thaw durability, and resistance to internal chemical attack.

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.

Pretensioned Girders The AASHTO Type IV prestressed concrete I-girders are 1372 mm (54 in) deep, while the AASHTO Type III prestressed concrete I-girders are 1143 mm (45 in) deep. All of the girders are pretensioned with 15.2-mm- (0.6-in-) diameter straight and draped strands. They are all simple-span girders made continuous for live load. The concrete mix proportion for the HPC girders is shown below:

Girder Mix	Per m^3	Per yd^3
Cement (Type I)	534 kg	900 lb
Silica Fume	30 kg	50 lb
Fine Aggregate	537 kg	905 lb
Coarse Aggregate	1187 kg	1961 lb
Water	164 L	43 gal
Retarder	1393 mL	47.1 fl oz
Air Entraining Agent*	66 mL	2.2 fl oz
High-Range Water Reducer (Superplasticizer)	3133 mL	106.0 fl oz

**The air entraining agent is varied to maintain 3 percent to 6 percent air content.*

Deck The 215-mm (8.5-in) normal-weight concrete deck is formed with metal stay-in-place forms and is subject to a mandatory 7-day wet cure. The 28-day strength of the concrete is 41.3 MPa

(6000 psi) and includes 20-percent substitution of Class F fly ash for portland cement.

Concrete Tests The following properties are being measured by North Carolina State University researchers for both the girder and deck concretes:

- Compressive Strength
- Modulus of Elasticity
- Chloride Permeability (deck only)
- Shrinkage
- Creep
- Internal Concrete Temperature (heat of hydration)
- Coefficient of Thermal Expansion

Instrumentation Internal and external instrumentation are being installed on four girders. The temperature will be monitored during girder curing and during the structure's life at critical locations on the girders. Structural behaviors, such as camber deflection, prestress losses, and continuity reinforcement stresses, are also being monitored/evaluated. Measurements are also taken to determine strand transfer length. Monitoring was initiated at the fabrication plant and will continue for a period of 3 years after the structures are completed.

Construction The bridges were let to contract in November 1998. The general contractor for the bridges is W.C. English, Inc. of Lynchburg, VA. The prestressed concrete girder fabricator is Carolina Prestress, L.L.C. of Charlotte, NC, while the ready-mix concrete supplier is Southern Concrete Materials of Charlotte, NC. Fabrication of the girders began in Spring 1999 and the deck of the first structure was cast in Fall 1999. The first structure was completed in Spring 2000, but is not yet open to traffic. Construction for the second of the two bridges has not yet begun.

Benefits A reduction in the number of girders, diaphragms, and bearings offset the additional cost of the high-performance concrete. The life-cycle cost-savings are expected to be significant due to enhanced durability. Instrumentation of the girders will provide valuable insight into future use of 15.2-mm- (0.6-in-) diameter strands, fly ash in bridge decks, and mix design requirements for 69-MPa (10,000-psi) concrete. ■

U.S. Department of Transportation
Federal Highway Administration

Updated August 2000
FHWA-RD-00-125

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