120th Street and Giles Road Bridge, Sarpy County

General Description This HPC bridge was built within 1 km (0.62 mi) of a very similar newly completed bridge of standard construction. The bridge consists of three equal 22.9-m (75-ft) spans and is 25.8 m (84.7 ft) wide. The HPC bridge used seven NU1100 (1100-mm-high) simple-span girders made continuous for live load using negative-moment reinforcement in the deck. The NU girder series is metric. These Bulb-Tee girders were developed in a girder optimization program conducted by the University of Nebraska at Omaha. Girder spacing is 3.8 m (12.4 ft) on center and the deck thickness is 191 mm (7.5 in). Sarpy County in Nebraska conducted the project, in cooperation with the Nebraska Department of Roads (NDOR) and the University of Nebraska.

Outline of HPC Features The HPC components had both compressive strength requirements and chloride permeability requirements, depending on the application in the structure. The strength requirements for the HPC elements were:

Element	Compressive Strength
Girders @ Transfer	38 MPa (5500 psi)
Girders @ 56 days	83 MPa (12,000 psi)
Deck @ 56 days	55 MPa (8000 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.

A chloride permeability requirement of less than 1800 coulombs at 56 days was specified for the deck. The water-to-cementitious material ratio for the girders was specified as less than 0.28. The cementitious material included portland cement, fly ash, and silica fume.

Pretensioned Girders The girders were pretensioned with thirty or thirty-four (depending on the span) 12.7-mm- (0.5-in-) diameter strands at 50-mm (2-in) center-to-center spacing. Either 10 or 12 strands were debonded near the ends of the girders. The beams were steam-cured, but the steam temperature and the concrete temperature at the centroid of the bottom flange were not allowed to exceed 71°C (160°F).

Substructure The interior bents and the abutments were constructed using concrete with f'_c = 21 MPa (3000 psi).

Deck Silica fume was used in the deck concrete to meet the chloride permeability requirement of less than 1800 coulombs at 56 days. The deck concrete after finishing was kept damp by nozzles creating a mist such that the water did not flow or accumulate on the surface for at least 5 h. Afterwards, wet-mat curing was used for 8 days. Air content was between 5 percent and 7.5 percent, and permeability was less than 1800 coulombs at 56 days.

Concrete Tests The following properties were measured for both the girder and the deck concrete:

- Compressive Strength.
- Chloride Permeability.
- Flexural Strength.
- Modulus of Elasticity.
- Splitting Tensile Strength.
- Shrinkage.
- Abrasion Resistance.

Instrumentation The girders were instrumented to provide data on behavior from placement of concrete through long-term performance under dead and live load in the completed bridge. Instrumentation included embedded thermocouples, electrical resistance strain gauges, and vibrating wire gauges. Measurements at the surface were made using external mechanical gauges. Girder camber, end rotation, prestressing force, and shrinkage were also measured. The deck had clusters of gauges at 12 locations. These gauges included vibrating wire gauges, electrical resistance strain gauges, and thermocouples. Diaphragms had points mounted on the surface to measure strain using mechanical gauges.

Construction The bridge contract was let in April 1995. The general contractor was Hawkins Construction Company. The girders were produced in Fall 1995, and the deck was cast in Spring 1996. Wilson Concrete Company was the beam fabricator and Ready Mixed Concrete Company of Omaha was the ready-mix concrete supplier. The bridge was opened to traffic in 1996.

A visit to the bridge in May 2000 found some transverse cracks along the bottom of the deck, but these cracks were similar to those observed on decks constructed with traditional concrete. The cracks were not evident along the top of the deck. The conclusion of the visit was that the deck was performing well.

Benefits The benefits are apparent as fewer girders were required in the HPC superstructure. The nearby bridge constructed without HPC provides a direct comparison of the durability aspects of HPC.

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