High-Performance Concrete Bridges- Nebraska 120th Street And Giles Road Bridge, Sarpy County

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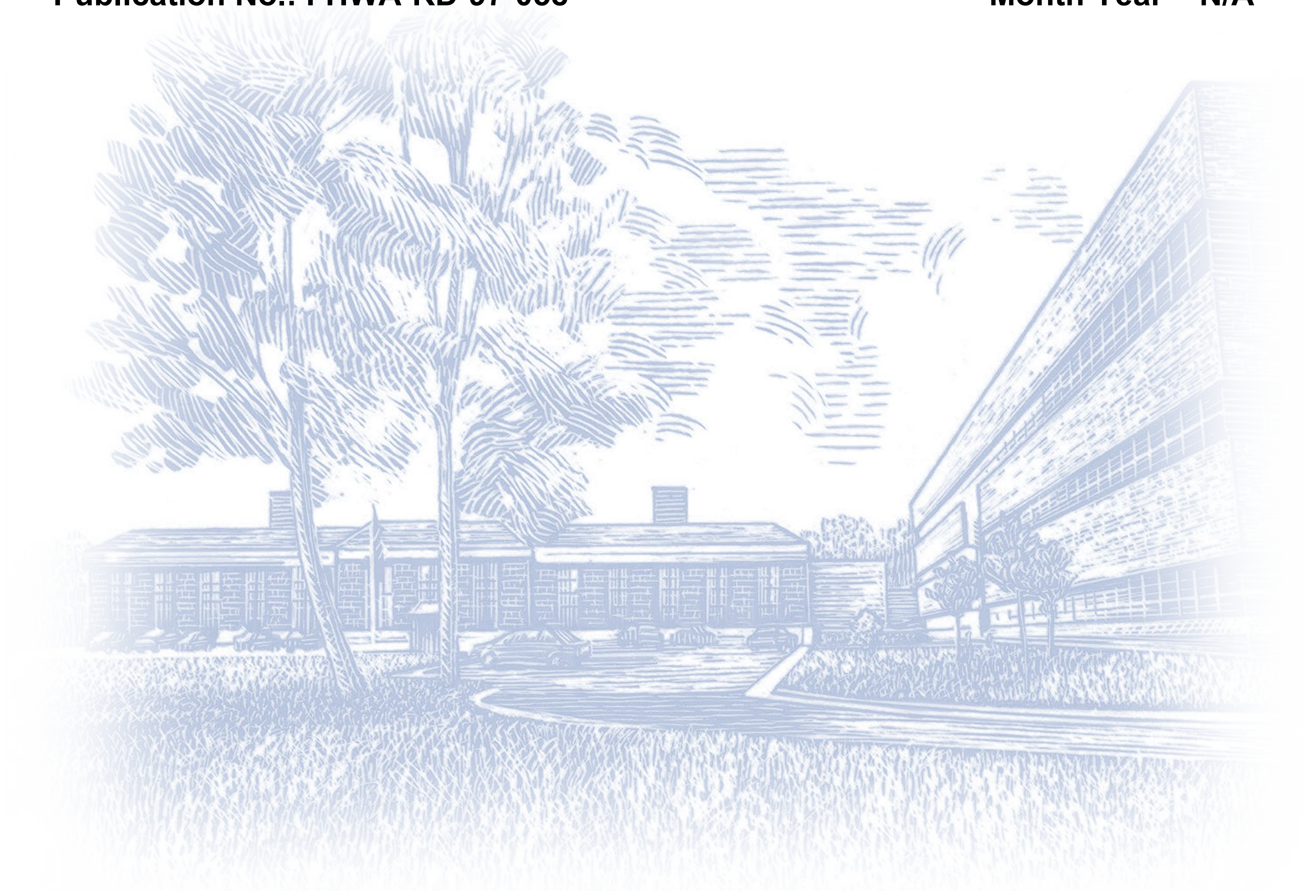

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Foreword

High-Performance Concrete - Concrete with enhanced durability and strength characteristics. Under the Strategic Highway Research Program (SHRP), more than 40 concrete and structure 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.

General Description

The HPC bridge was built within a kilometer 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 7 NU1100 (1100-mm-high) simple-span girders made continuous for live load using negative-moment reinforcement in the deck. The NU girder series are metric, theses Bulb-Tee girders were developed in a girder optimization program performed by the University of Nebraska at Omaha. Girder spacing is 3.8 m (12.4ft) on centers and the deck thickness is 191 mm (7.5 in). Nebraska Department of Roads (NDOR) conducted the project in cooperation with the University of Nebraska.

Outline of HPC Features

The HPC components have both compressive strength requirements and chloride permeablility requirements depending on the application in the structure. The strength requirements for the HPC elements were:

Element	**Compressive Strength**
Girders @ transfer	38 MPa (5,500 psi)
Girders @ 55 days	83 MPa (12,000 psi)
Deck @ 56 days	55 MPa (8,000 psi)

Silica fume was used in the deck concrete to meet the chloride permeability requirement of less than 1800 coulombs at 56 days. The water-to-cementitious material ratio for the girders is specified as less than 0.28. The cementitious material includesdportland 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 are 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 cannot exceed 71°C (160°F).

Substructure

The interior bents and the abutments were constructed using concrete with f'_c=21 MPa (3,000 psi).

Deck

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 hours. 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 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 has clusters of gauges at 12 locations. These gauges include vibrating wire gauges, electrical resistance strain gauges, and thermocouples. Diaphragms have points mounted on the surface to measure strains using mechanical gauges.

Construction

The bridge contract was let in April 1995. The girders were produced in the fall of 1995 and the deck was cast in the spring of 1996. The bridge was opened to traffic in 1996.

Benefits

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

For further information on High-Performance Concrete or this project, contact:

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