High-Performance Concrete Bridges- Colorado Interstate 25 Over Yale Avenue, Denver

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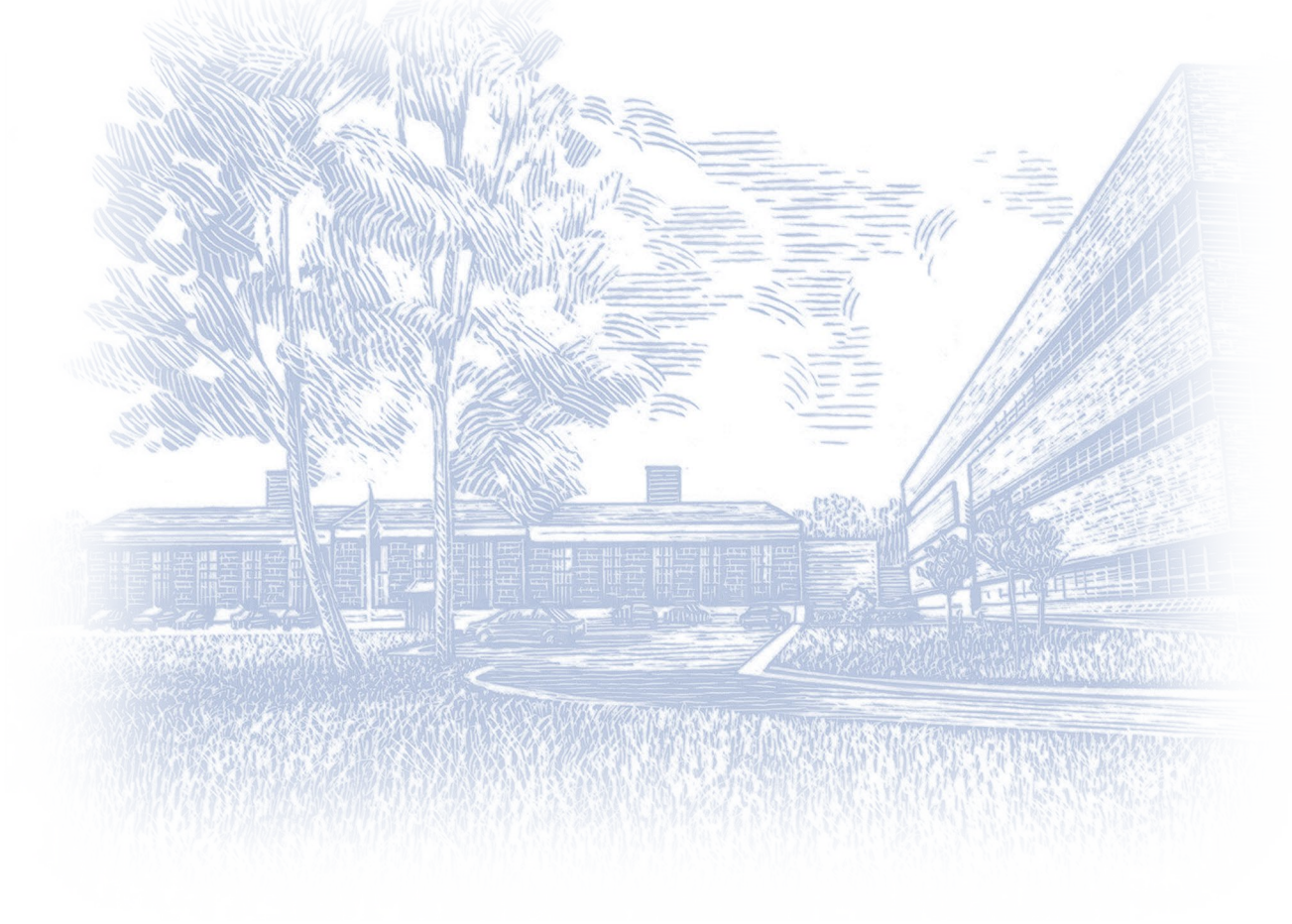

U.S. Department of Transportation
Federal Highway Administration

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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 existing structure is a four-span cast-in-place T-girder bridge. Column/pier lines are located in the median of Yale Avenue and at each side of the roadway. The HPC bridge solution is to construct a two-span structure using box beams made continuous over the center support. The two spans are 34.5 m and 30 m long, respectively. Because of the high traffic volume (151,000 average daily traffic), the replacement bridge must be quickly constructed. The 42-m-wide bridge will be built in phases to permit traffic flow in both directions during construction. The new bridge will need to maintain or improve clearances over Yale without a significant change in the grade of I-25. The Colorado Department of Transportation (CDOT) is conducting the project in cooperation with the University of Colorado at Boulder.

Outline of HPC Features

The HPC elements and compressive-strength requirements will be:

Element	Compressive Strength
Girders @ transfer	45 MPa (6,500 psi)
Girders @ 56 days	69 MPa (10,000 psi)
Deck & Substructure @ 28 days	34 MPa (5,000 psi)

Pretensioned Beams

The pretensioned concrete box beams are 1,700 mm (67 in)wide and 750 mm (30 in) deep. The beams will be made using 15.2 mm (0.6 in) diameter strands at 51 mm (2 in) center-to-center spacing. Testing will be done to measure strand pull-out strength, transfer length, and development length.

Substructure

The piers, columns, and abutments will be constructed with the deck concrete mix. This will permit some reduction of member sizes and increase durability of low-level elements exposed to spray and splash from Yale Avenue traffic.

Deck

The current C-DOT deck concrete specification calls for a 28-day strength of 31 MPa (4,500 psi) with mix approval based on a 28-day strength of 39 MPa (5,625 psi). In comparison, the deck and substructure concrete will require a 28-day strength of 40 MPa (5,800 psi) for mix approval. Air content will be 5 to 8 percent and silica fume may be used with the required fly ash admixture.

Concrete Tests

In addition to the tests indicated by the properties in the procedding table, the following concrete properties will be measured to establish a database:

Deck*	Girders*
Air Content	Air Content

56- & 90- day compressive strength	90-day compressive strength
Creep	Creep
Shrinkage	Shrinkage
Modulus of Elasticity	Modulus of Elasticity
Rapid Chloride Permeability	Modulus of Rupture
Freeze-Thaw	Splitting Tensile Strength

*Except for air current, these characteristics will be used in confirmation of design assumptions, and criteria and are not part of the project acceptance criteria for HPC.

Instrumentation

The completed bridge will instrumented to measure temperature and strain variations. This will be combined with deformation measurements to determine how the bridge behaves in response to creep, shrinkage, temperature changes, dead load, and live load. The first girder camber measurements occur at prestress transfer and then at each stage of girder loading until the bridge is completed.

Construction

The wind and low humidity in Colorado are a problem and can contribute to deck cracking. A new curing process has been developed to alleviate the cracking. A membrane-forming curing compound will be placed immediately upon finishing and a moist cure will be started when the deck concrete can be walked on without damage. The moist cure will be continued for 5 days.

Construction on this project began in November 1996 and is expected to continue into late 1998.

Benefits

The initial cost benefits are the elimination of two column/pier lines. It is expected that the more durable concrete will provide resistance to traffic wear, environmental factors, and the effects of de-icing chemicals.

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

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