Shrinkage Compensation Deck Concrete
(KY 1974 Bridge over Tates Creek Road)

David Q. Hunsucker
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Research Report
UKTRP-86-26

SHRINKAGE COMPENSATING DECK CONCRETE
(KY 1974 Bridge over Tates Creek Road)

by

David Q. Hunsucker
Research Engineer Associate

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Kentucky Transportation Research Program
College of Engineering
University of Kentucky
Lexington, Kentucky

in cooperation with
Kentucky Transportation Cabinet

and

Federal Highway Administration
US Department of Transportation

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(KY 1974 Bridge over Tates Creek Road)

David Q. Hunsucker

Kentucky Transportation Research Program
College of Engineering
University of Kentucky
Lexington, Kentucky 40506-0043

Prepared in cooperation with the U. S. Department of Transportation,
Federal Highway Administration

This report summarizes the construction activities on an experimental bridge deck utilizing shrinkage compensating concrete. The experimental concrete is characterized in terms of freeze/thaw durability, compressive strength, and elastic moduli.
PROJECT LOCATION

Shrinkage compensating concrete is made with an expansive cement in which the expansion, if restrained, induces compressive stresses that approximately offset tensile stresses induced by drying shrinkage. The objectives of this study were to evaluate the construction and performance of the Shrinkage Compensating Bridge Deck Concrete, Class S, and to compare the performance to conventional bridge deck concrete, Class AA.

The bridge under study is located on KY 1974 (Tates Creek Road) over West Hickman Creek in Lexington, Fayette County, Kentucky. The subcontractor for the bridge was R. R. Dawson Bridge Company. The experimental shrinkage compensating concrete was batched at the W. T. Congleton Company.

EXPERIMENTAL MATERIALS

A trial mix was batched at the W. T. Congleton Company ready-mix plant to determine the optimum amount of water to be used in the mix. The reason for this determination was the fact that the concrete had to be transported for approximately thirty minutes before reaching the job site, and loss of slump was of concern. Materials to produce 1 cubic yard were as follows:

Cement.................620.0 lbs
Water..................41.6 lbs
Fine Aggregate.....1095.0 lbs
Coarse Aggregate...1685.0 lbs
Air Entrainment
Admixture.............6.5 ozs

Immediately after mixing, the slump was 5-3/4 inches and the air content was 5.0 percent. After 30 minutes, the slump was 4-1/2 inches and the air content was 5.0 percent. The final concrete mix design obtained from the Division of Materials is reported in Appendix I.
CONSTRUCTION

Site investigations were made prior to placement of the experimental concrete (see Figure 1). Figures 2 and 3 show the tied reinforcing steel in the deck. Equipment observed at the site included a Bucyrus-Erie 30-B Series Crane with drop buckets to place the concrete. A Bidwell vibrating screed concrete finishing machine was used to finish the deck (see Figures 4 and 5).

The shrinkage compensating deck concrete was placed in the eastbound lanes on Wednesday, March 26, and in the westbound lanes on Friday, March 28, 1986. Interviews with Kentucky Department of Highways personnel revealed that the experimental concrete on the eastbound deck was difficult to finish. The stiff wind blowing that day evaporated much of the free water necessary for a good finish. The bridge also was on a skew and the tyning machine was not, and the experimental concrete was sticky. Results were much better on the westbound deck. The amount of free water necessary for a good finish was adequate and workers seemed to have gained experience from the previous pour.

The experimental shrinkage compensating concrete has been characterized in terms of freeze/thaw durability, compressive strength, and elastic modulus. Results of freeze/thaw testing are contained in Appendix II. The average durability factor (based on 350 cycles) for four prisms was 56. The average percent expansion was 0.071 for the set. The average durability factor and percent expansion fall below the requirements for Class AA concrete.

Compressive strength and elastic modulus tests were performed at 28 days. Results are contained in Appendix III. The average compressive strength for two cylinders was 3,080 psi and the average elastic modulus was 3.16 million psi. Section 601.05 of the Kentucky Standard Specifications for Road and Bridge Construction states that a Class AA concrete shall have a 28-day compressive strength of 4,000 psi.

Due to the fact that 28-day compressive strengths were low, a request was made by the District 7 Engineer for Construction for the Division of Materials to core the deck. Results of this activity are contained in Appendix IV. The
Figure 1: The Construction Site
Figure 2: The Reinforcing Steel

Figure 3: The Tied Reinforcing Steel
Figure 4: The Drop Buckets

Figure 5: Bid-Well Concrete Finisher
average compressive strength for westbound-lane cores at 52 days was 3,720 psi. The average for eastbound-lane cores at 54 days was 4,270 psi.

Additional cores were obtained by the Division of Materials at 96 days and 98 days for the westbound and eastbound lanes, respectively. Results are contained in Appendix IV. The average compressive strength for the westbound-lane cores was 4,040 psi and the average for the eastbound-lane cores was 4,115 psi. The Division of Materials recommended the concrete be considered acceptable.

PERFORMANCE MONITORING

Visual inspections for cracks have been made. The initial inspection was made on April 2, 1986. Slick areas were observed in the eastbound deck. High wind during the placement operation may have caused moisture loss. During the finishing operation, slick spots developed in the drier areas (see Figures 6 and 7). There were no cracks observed during that inspection.

Visual inspections continued through the months of April, May, and June, and no cracking was observed. On July 11, 1986, cracking was observed in the eastbound deck near the northeast corner. The cracks were generally radial and extended from the west end of the bridge to the north barrier wall. Five cracks were observed (see Figures 8, 9, and 10).

The inspection of August 25, 1986, did not reveal additional deck cracking. However, cracking was observed on the western abutment and around the drain in the abutment wall (see Figures 11 and 12).

Two bridges of similar design and constructed using conventional Class AA concrete also have been inspected for crack patterns. One comparison bridge is located in Scott County, Kentucky, on KY 227 over Lecomptes Run. The bridge was let to contract in November 1981. The bridge was inspected in June 1985. Three small longitudinal cracks were observed. Each crack was about 3 feet in length.
Figure 6: Slick Spot in the Finish

Figure 7: A Good Finish
Figure 8: Cracks Observed

Figure 9: Deck Cracking
Figure 10: Corner Cracking
Figure 11: Crack in Abutment Wall

Figure 12: Cracking Around the Drain
The second comparison bridge is located in Jefferson County, Kentucky, on the Old Sheperdsville Road over Buechel Branch. The bridge was let to contract in December 1983. The bridge was inspected in June 1985. Corner cracking was observed on both ends of the northbound lanes. Cracking also was observed near drains in the northbound lanes.

Monitoring of the experimental and control bridge decks will continue. Interim reports will be issued detailing performance of the bridge decks. A final report will be issued at the end of the study period.
Appendix I
## Concrete Production Details

### Project Information
- **County:** E.L.
- **Project No.:** 134-1724-06-08-2.1-B
- **Date:** 3-28-86

### Concrete Producer
- **Plant Location:** EX

### Class of Concrete
- **Max. Water/Bag:** 6.30
- **Min. Cem. Factor/Bags/Cu.Yd.:** 6.6
- **Lbs. of Cement/Cu.Yd.:** 6.20
- **Cement Brand:** 217H

### Concrete Mix Details
- **Cement Sample No.:** 6 ozs./Cu. Yd.
- **Admix Brand & Amount Used:**
  - **Type:** "A" or "D" Admix
  - **Air Entraining Admix, Brand & Amount Used:**
    - **Brand:**
    - **Amount Used:** 6 ozs./Cu. Yd.

### Aggregate Data
- **Fine Aggregate Data:**
  - **Source:** IPSISON-SAND-CENTRAL
  - **Bulk Sp.Gr. (S.S.D.):** 2.65
- **Coarse Aggregate Data:**
  - **Source:** LEX, QUARRY
  - **Bulk Sp.Gr. (S.S.D.):** 2.71

### Design Weights
- **Design Dry Weights (S.S.D.):**
  - **Fine:** 18/3 lbs.
  - **Coarse:** 27/1 lbs.

### Time of Day
- **Time of Day:**
  - **Design Dry Weights (S.S.D.):**
    - (1) 12.08
    - (2) 5.4
  - **Percent by Volume:**
    - (1) 40
    - (2) 60

### Actual Weights
- **Actual Dry Weights (S.S.D.):**
  - (9) 111.0 lbs.
  - (10) 164.4 lbs.
  - (11) 64.6 lbs.
  - (12) 16.5 lbs.

### Moisture Correction
- **Total Moisture Correction (lbs. of water):** 3.4
- **Water Added at the Mixer (lbs.):** 2.93 (35.1)
- **Total Water Used (lbs.):** 34.7
- **Maximum Allowable Free Water (lbs.):** 34.7
- **Actual Water Underrun (lbs.):** 0
- **Total Water Per Bag of Cement (gals.):** 6.48

### Test Results
- **Test Results at Jobsite:**
  - **Slump:** 4.5
  - **Air Content:** 6.5
- **Test Results at Plant:**
  - **Slump:** 6.7
  - **Air Content:** 4.5

### Additional Information
- **Concrete Temp.:**
- **Cylinder Ident. Nos.:** 1-16-87
- **Central Lab, ADEC, DME, Project file

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*Concrete Plant Inspector*
## Concrete Producer

**Plant Location:**

### Class of Concrete

- **Max. Water (Gals./Bag):** 6.30
- **Min. Cem. Factor (Bags/Cu.Yd.):** 6.6

### Lbs. of Cement/Cu.Yd.

- 620

### Cement Brand

- *Cement Sample No.*

### Type "A" or "D" Admix. Brand & Amount Used

- **Czs./Cu.Yd.**

## Data For L. E

### Bag Batch

#### Design Dry Wts./Bag (S.S.D.)

- **Fine:** 18.3 lbs.
- **Coarse:** 27.1 lbs.

#### Time of Day

- **11:00**

#### Design Dry Weights (S.S.D.)

- (1) 130.8 lbs.
- (2) 5.5 lbs.
- (3) 6.12 lbs.
- (4) 11.10 lbs.
- (5) 4.1 lbs.

#### Percent Aggregate Deducted for Air

- (3) 16.2%

#### Free Moisture Content %

- (5) 6.0%

### Actual Damp Weights

- (10) 115.6 lbs.
- (11) 16.5 lbs.

### Moisture Correction (lbs. of water)

- (11) 4.6 lbs.

### Total Moisture Correction (lbs. of water)

- (12) 8.4 lbs.

### Water Added at the Mixer (lbs.)

- (7) 29.3 (lbs. 35.1)

### Total Water Used (lbs.)

- (13) 53.7 lbs.

### Maximum Allowable Free Water (lbs.)

- (6) 34.7 lbs.

### Actual Water Underrun (lbs.)

- (14) 0 lbs.

### Total Water Per Bag of Cement (gals.)

- (15) 630 gals.

### Adj. Water Underrun (lbs.)

- (9) 0 lbs.

### Sp. Gr. & Aggr. Ratio

- (F.A.) = 2.65
- (C.A.) = 2.71

### Test Results at Plant

#### Slump

- 6.75

#### Air Content

- 4.5 - 6.5

#### Concrete Temp.

#### Cylinder Ident. Nos.

- 1 - 16

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**Date:** 3-28-86

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**Concrete Plant Inspector:**

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**cc:** Central Lab, ADEC, DMS, Project File
KENTUCKY DEPARTMENT OF TRANSPORTATION  
BUREAU OF HIGHWAYS  
DIVISION OF MATERIALS

COUNTY: FAYETTE Cnty.  
PROJECT NO:  233-034-1974-02-08-020-C  
Date: 3-26-86

Concrete Producer: KENTUCKY (C) 
Plant Location: LEX

Class of Concrete: C6.51  
Max. Water-Gals./Bag: 6.5  
Min. Ce. Factor-Bags/Cu.Yd.: 6.5

Lbs. of Cement/Cu.Yd.: 620.  
Cement Brand: WESTERN  
Cement Sample No.: C-1

Type "A" or "D" Admix. Brand & Amount Used

Air Entraining Admix Brand & Amount Used

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<th>Data For:</th>
<th>Fine Aggregate Data</th>
<th>Coarse Aggregate Data</th>
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<td>Bulk Sp.Gr. (S.S.D.)</td>
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<tr>
<td>Coarse</td>
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<td>Absorption</td>
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<td>Percent by Volume</td>
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<th>Design Air Content % (2)</th>
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<th>Percent Aggregate Deducted for Air (3)</th>
<th>Dest. Dry Wts. Adj. for Air (S.S.D.) (4)</th>
<th>Tyne Moisture Content % (5)</th>
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<tr>
<th>Actual Dry Weights</th>
<th>Moisture Correction (lbs. of water) (11)</th>
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<tbody>
<tr>
<td>(9)</td>
<td>1110</td>
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</table>

| Total Moisture Correction (lbs. of water) (12) | 51 |
| Water Added at the Mixer (lbs.) (13) | 396 |
| Total Water Used (lbs.) (13) | 447 |
| Maximum Allowable Free Water (lbs.) (6) | 347 |

| Actual Water Underrun (lbs.) (14) | 6 |
| Total Water Per Bag of Cement (gals.) (15) | 6.300 |

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<td>lbs. F.A. x 40</td>
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<td>lbs. C.A.</td>
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<td>lbs. C.A. x 60</td>
<td>% =</td>
<td>0</td>
<td>lbs. F.A.</td>
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Test Results at Jobsite

Slump: 6"  
Air Content: 5.8 %

Concrete Temp.:

Cylinder Ident. Nos.: 15 - A, B, C

cc: Central Lab, ADEC, DME, Project file

Test Results at Plant

Slump: 6.71"
Air Content: 5.8 - 6.12 %
Concrete Temp.:

(Concrete Plant Inspector)
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<tr>
<th>County: KY</th>
<th>Date: 3-26-86</th>
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<tr>
<td>Concrete Producer: C. Watson</td>
<td></td>
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<td>Plant Location: EX</td>
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<tr>
<td>Type of Concrete: C, S, M</td>
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<tr>
<td>Lbs. of Cement/Cu. Yd.: 6.0</td>
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</tr>
<tr>
<td>Lbs. of Aggregate/Cu. Yd.: 4.8</td>
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### Table: Concrete Compromise Data

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<tr>
<td></td>
<td>6</td>
<td>1</td>
<td>C-1</td>
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### Table: Air Entraining Admix Brand & Amount Used

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<th>Type</th>
<th>Brand &amp; Amount Used</th>
<th>6 OZS./Cu. Yd.</th>
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### Table: Design Dry Weights (S.S.D.)

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<tr>
<th>Time of Day</th>
<th>Design Dry Weights (S.S.D.)</th>
<th>Design Air Content %</th>
<th>Percent Aggregate Deduced for Air</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7.0</td>
<td>5.5</td>
<td>5.5</td>
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### Table: Free Moisture Content %

<table>
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<tr>
<th></th>
<th>3.9</th>
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### Table: Actual Damp Weights (S.S.D.)

<table>
<thead>
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<th>Actual Damp Weights</th>
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### Table: Actual Dry Weights (S.S.D.)

<table>
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<th>Actual Dry Weights (S.S.D.)</th>
<th>1.44</th>
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### Table: Moisture Correction (lbs. of water)

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<th>Moisture Correction (lbs. of water)</th>
<th>4.3</th>
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### Table: Total Moisture Correction (lbs. of water)

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<thead>
<tr>
<th>Total Moisture Correction (lbs. of water)</th>
<th>5.1</th>
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### Table: Water Added at the Mixer (lbs.)

<table>
<thead>
<tr>
<th>Water Added at the Mixer (lbs.)</th>
<th>3.96</th>
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### Table: Total Water Used (lbs.)

<table>
<thead>
<tr>
<th>Total Water Used (lbs.)</th>
<th>3.47</th>
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### Table: Maximum Allowable Free Water (lbs.)

<table>
<thead>
<tr>
<th>Maximum Allowable Free Water (lbs.)</th>
<th>3.47</th>
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### Table: Actual Water Underrun (lbs.)

<table>
<thead>
<tr>
<th>Actual Water Underrun (lbs.)</th>
<th>0.00</th>
</tr>
</thead>
</table>

### Calculations

- **F.A.** = lbs. F.A. x %
- **C.A.** = lbs. C.A. x %

### Test Results at Job Site

- **Slump:** 6.0
- **Air Content:** 5.5
- **Concrete Temp.:**

### Test Results at Plant

- **Slump:** 6.0
- **Air Content:** 5.8
- **Concrete Temp.:**

**cc:** Central Lab, ADEC, DME, Project file

**Concrete Plant Inspector:**  

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**Rev. 1/78**
Appendix II
June 23, 1986

Mr. Jim Stone, PE
Division of Materials
Kentucky Department of Highways
Frankfort, Kentucky 40622

Dear Mr. Stone,

Enclosed for your review and information are results of recent freeze/thaw testing of Type S Concrete prisms. Specifics regarding these activities are presented in Mr. Hunsucker's memorandum. If you need additional information, please contact this office.

Sincerely,

Robert C. Deen
Director

RCD:dh
Enclosure

cc. G.W. Sharpe
D.L. Allen

AN EQUAL OPPORTUNITY INSTITUTION
MEMORANDUM

TO: Robert C. Deen
Director

FROM: David Hunsucker
Research Engineer Associate

DATE: June 23, 1986

SUBJECT: Test Results -- Expansion Data for Type S Concrete Prisms Exposed to Freezing and Thawing

Four concrete length change prisms were delivered to this facility on April 23rd, 1986, for exposure to 350 cycles of rapid freezing and thawing. Freeze/thaw testing was in accordance with ASTM C-666, Procedure B, Freezing in Air and Thawing in Water. One freeze/thaw cycle is approximately three hours in duration with temperature variations of 0±30°F to 40±30°F (-17.80°C to 4.40°C). Periodic readings were made to determine changes in the relative dynamic modulus of elasticity (sonic modulus) and changes in the length and weight of each prism.

ASTM C-666 states that specimens be soaked in saturated lime water from the time of their removal from the molds until the time freezing and thawing begins. Upon receiving the concrete prisms, they were introduced into saturated lime water at 70°F. On Thursday, April 24th, the prisms were placed in the freeze/thaw unit and allowed to soak at 40°F for 4 hours. Initial readings were then taken for length, weight and sonic modulus of each prism.

ASTM C-666 states that a concrete prism should withstand 300 cycles of rapid freezing and thawing before the relative dynamic modulus (sonic modulus) of elasticity reaches 60 percent of the initial modulus. Specimen TPS-4 failed to meet this specification.
Kentucky Specifications require that a prism withstand 350 cycles of rapid freezing and thawing before the relative dynamic modulus (sonic modulus) of elasticity reaches 60 percent of the initial modulus. Specimen TPS-1 failed to meet this specification.

A value of 0.035 percent expansion for the concrete prisms has been recommended by the Division of Materials. The percent expansion is the ratio of the change in length to the initial length expressed as a percentage. All Type S specimens exceeded the 0.035 percent expansion limit.

All expansions were positive and freeze/thaw testing was continuous.

If there are any questions regarding the data, please contact our office at your convenience.
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<tr>
<th>DATE</th>
<th>CYCLE NUMBER</th>
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<td>WEIGHT (kg)</td>
<td>READING (n)</td>
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60% at 330 cycles
Durability Factor = 56

Durability Factor = 61
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Durability Factor = 42

60% at 248 cycles

Durability Factor = 42
Appendix III
Mr. Jim Stone  
Division of Materials  
Kentucky Department of Highways  
Frankfort, Kentucky  40622

Dear Mr. Stone:

Subject:  Experimental Bridge Deck Using Shrinkage Compensating Bridge Deck Concrete  
Fayette County  
Tates Creek Pike (KY 1974)  
Bridge over West Hickman Creek  
Item No. 7-201.0

Enclosed for your review are results of the 28-day compressive strength test data for the concrete cylinders made from the March 28th, 1986, placement of the subject bridge deck. The cylinders were cured and broken in accordance with ASTM C-39 Standards. The average 28-day maximum compressive strength for the cylinders was 3083 psi with a unit weight of 140.4 pcf.

In the Special Note for Shrinkage Compensating Bridge Deck Concrete, Class S, issued 10-15-84, it is stated that the concrete mixture shall conform to all requirements for Class AA concrete. Table 1 in Section 601.05 of the Standard Specifications for Road and Bridge Construction states that a Class AA concrete shall have a 28-day compressive strength of 4000 psi.

How do our results compare to your results for the Class S concrete? Is there sufficient questions concerning the quality of the concrete to warrant coring of the bridge deck to verify strength of the mixture?

Please inform me of your decision and forward a copy of your compressive strength data at your convenience.

Sincerely,

Robert C. Deen
Director

Enclosure

cc. B. L. Wheat; S. J. Amato
D. Hunsucker; D. Allen; G. Sharpe

AN EQUAL OPPORTUNITY INSTITUTION
<table>
<thead>
<tr>
<th>SAMPLE I</th>
<th>SAMPLE II</th>
<th>AVERAGE VALUES</th>
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<tbody>
<tr>
<td>STRAIN</td>
<td>STRESS</td>
<td>STRAIN</td>
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<tr>
<td>(%)</td>
<td>(PSI)</td>
<td>(%)</td>
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<td>0.28</td>
<td>3036.36</td>
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TABULAR VALUES OF STRESS-STRAIN, INCLUDING AVERAGES
### SUMMARY OF RESULTS OF STRESS TESTS

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<thead>
<tr>
<th>SAMPLE NUMBER</th>
<th>MAXIMUM COMPRESSIVE STRESS (PSI)</th>
<th>MAXIMUM ELASTIC MODULUS (PSI)</th>
<th>UNIT WEIGHT (PCF)</th>
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<tr>
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<td>3218787.00</td>
<td>139.77</td>
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<td>II</td>
<td>3110.21</td>
<td>3101410.00</td>
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<td>AVERAGE</td>
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<td>3160098.00</td>
<td>140.37</td>
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SAMPLE # 1

MAXIMUM COMPRESSIVE STRENGTH

E = 3218787 PSI
SAMPLE # 11

AXIAL STRESS (PSI)

MAXIMUM COMPRESSIVE STRENGTH

E = 3101410 PSI

AXIAL STRAIN (%)
AVERAGE STRESS (PSI)

AVERAGE COMPRESSIVE STRENGTH

AVERAGE VALUES

AVERAGE E = 3100098 PSI
Appendix IV
MEMORANDUM

TO: Bill Mullins, District Engineer for Construction
    District 7, Lexington

FROM: John McChord, Director
      Division of Materials

BY: Jim Warfield
    Cement Section

DATE: May 19, 1986

SUBJECT: Fayette County M8615(3)
          FSP 034 1974 008.198 21 B 324

As requested, eight (8) cores were taken from the above mentioned project to determine the strength quality of in-place class "S" concrete. The results are as follows:

<table>
<thead>
<tr>
<th>Core</th>
<th>Location</th>
<th>Wt/Ft³</th>
<th>PSI</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>90+62.05, 22' RT</td>
<td>143.3</td>
<td>3435</td>
<td>52 Days</td>
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<td>2</td>
<td>90+35.05, 25' RT</td>
<td>143.7</td>
<td>4650</td>
<td>52 Days</td>
</tr>
<tr>
<td>3</td>
<td>90+7.05, 13' RT</td>
<td>142.2</td>
<td>3150</td>
<td>52 Days</td>
</tr>
<tr>
<td>4</td>
<td>90+26.05, 9' RT</td>
<td>141.0</td>
<td>3635</td>
<td>52 Days</td>
</tr>
<tr>
<td>5</td>
<td>90+49.05, 4' LT</td>
<td>142.0</td>
<td>3600</td>
<td>54 Days</td>
</tr>
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<td>6</td>
<td>90+30.05, 20' LT</td>
<td>145.7</td>
<td>4625</td>
<td>54 Days</td>
</tr>
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<td>7</td>
<td>89+93.05, 24' LT</td>
<td>144.2</td>
<td>4305</td>
<td>54 Days</td>
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<td>8</td>
<td>90+00.55, 2' LT</td>
<td>144.0</td>
<td>4545</td>
<td>54 Days</td>
</tr>
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</table>

If further information is desired, please advise.

JMc/JW/ad

cc: Construction
   David Hunsucker, Research
   David Treadway, R.E.
   L. Epley
   J. Stone
   File
MEMORANDUM

TO: Bill Mullins, District Engineer for Construction
   District 7 - Lexington

FROM: John McChord, Director
      Division of Materials

BY: Jim Warfield, Supervisor
     Cement Lab & Core Drill Units

DATE: July 7, 1986

SUBJECT: Fayette County M 8615 (3)
          FSP 034 1974 008.198 21 B 324

Additional cores were taken to further investigate the strength quality of in-place Class "S" concrete. See memo dated May 19, 1986. The results are as follows:

<table>
<thead>
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<th>CORE</th>
<th>LOCATION</th>
<th>WT./FT.³</th>
<th>PSI</th>
<th>AGE</th>
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<tbody>
<tr>
<td>1A</td>
<td>90+62, 21' Rt.</td>
<td>142.5</td>
<td>3640</td>
<td>96 Days</td>
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<td>1B</td>
<td>90+62, 23' Rt.</td>
<td>143.6</td>
<td>4350</td>
<td>96 Days</td>
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<tr>
<td>3A</td>
<td>90+07, 12' Rt.</td>
<td>140.6</td>
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<td>3B</td>
<td>90+07, 14' Rt.</td>
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<td>4A</td>
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<td>141.8</td>
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The average strength of cores 1A and 1B is 3995 PSI, and the average strength of cores 3A and 3B is 3970. Using the criteria of Section 105.04, we recommend that this concrete be considered acceptable on the basis of being in reasonably close conformity to the specification requirement of 4000 PSI.
If further information is desired, please advise.

JMc:JW:lw
cc: Construction
  David Hunsucker, Research
  David Treadway, R.E.
  L. Epley
  J. Stone
  file