South Carolina
Department of Transportation

UNIVERSITY OF SOUTH CAROLINA

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Review of Class-E Concrete Bridge Decks in South Carolina-Phase II

SUMMARY REPORT

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South Carolina
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The objectives of this work include reviewing the specifications for high performance concrete (HPC) for states throughout the U.S. and evaluating the HPC used in South Carolina (Class E) for bridge deck concrete in accordance with the FHWA HPC Performance Grade criteria. A class comparison study is performed to compare South Carolina's Class D concrete, currently used for bridge construction, to the Class E concrete with respect to chloride permeability, compressive strength and modulus of elasticity. Finally, a time study of all concrete tested is presented with respect to chloride permeability, compressive strength and modulus of elasticity.

Standard specifications for HPC for states throughout the United States were reviewed. Most states reviewed require prepour conferences with participating parties and trial pours. Most states limit placement of concrete based on many factors including ambient air temperature, concrete temperature and maximum rate of evaporation. Fogging is required for most states immediately following finishing of the concrete deck to just prior to the placement of the curing material. Moist curing is required for HPC for a period of 7 days for most states although some states require up to 14 days. South Carolina's standard specifications for its HPC are consistent with other states' specifications. The rate of evaporation should be checked prior to concrete placement and the maximum rate of evaporation should be in the range of 0.5 $kg/m^2/hr$ (0.1 $lb/ft^2/hr$) to 1.0 $kg/m^2/hr$ (0.2 $lb/ft^2/hr$) based on the other maximum rates of evaporation used by other states across the United States.

Several tests were performed on Class E concrete to evaluate how the concrete compares to the FHWA HPC Performance Grade Criteria. Overall, the results from the tests performed on several properties of Class E concrete fit into FHWA HPC Performance Grades 1 or 2. The modulus of elasticity values were all low compared to ACI 318-02 equations, and all modulus values were too low to be considered in the FHWA HPC Performance Grade Criteria.

A class comparison study was conducted to evaluate the differences between the Class D and Class E concrete with respect to compressive strength, modulus of elasticity and rapid chloride permeability for 28, 56 and 100 day testing. The Class E and Class D concrete mixtures exhibited very

similar compressive strength and modulus of elasticity values. The main difference between the two mixes lays in the chloride permeability values. The Class D concrete permeability was about 70% and 140% higher than the Class E chloride permeability at 28 days and 56 days respectively.

A time study was conducted on each concrete batch tested. The time study consisted of compressive strength, modulus of elasticity, and rapid chloride permeability testing over time. The compressive strength increases over time and the value begins to level off at 56 days. The modulus of elasticity does increase with time although, the modulus of elasticity values are all low compared to ACI 318-02 equations.

The following recommendations can be made to the SCDOT from the research conducted:

1. A moist curing period of 14 days for HPC used for bridge decks in South Carolina should be implemented.

2. The maximum rate of evaporation for placement of HPC should be 0.5 $kg/m^2/hr$ (0.1 $lb/ft^2/hr$).

3. HPC requires strict curing procedures; therefore, it is imperative to make sure curing procedures included in the specifications are strictly applied.

4. 56 day testing results should be used to measure compressive strength and chloride permeability for acceptance and quality control of HPC.

5. Class E concrete can be used for bridge decks due to its decreased permeability compared to Class D concrete, which is currently used for bridge deck construction. If Class D is maintained, some modifications should be implemented in order to lower its permeability. A study should be conduced to develop an improved Class D mixture.

6. A further investigation of the low modulus of elasticity values should be conducted.

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