BIOGRAPHICAL SKETCH

Alex Harold Kelley was born in Oak Ridge, Tennessee on August 3, 1994 to Harold and Debra Kelley. He graduated with honors from Oliver Springs High School in May of 2012. He attended Roane State Community College for two years and transferred to Tennessee Tech University in the fall 2014. He graduated from Tennessee Tech University with a Bachelor of Science Degree in Civil Engineering with a focus in Transportation Engineering in the fall of 2017. He entered the Graduate School of Tennessee Tech University in the spring of 2018 and graduated with a Master of Science Degree in Civil Engineering with a concentration in Transportation Materials in the spring of 2019 under Dr. L. K. Crouch.

EDUCATION

B.S., Civil Engineering

Tennessee Technological University

2014-2017

College of Engineering

TENNESSEE TECH

The Department of

Civil and Environmental Engineering

Announces the Dissertation Defense

Of

Alex Harold Kelley

In Partial Fulfillment of the Requirements

For the degree of

Masters of Civil Engineering

Wednesday, March 27, 2019

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Held at

PRESCOTT HALL ROOM 225

FIELD OF STUDY

Civil and Environmental Engineering

DISSERTATION TOPIC

THE EFFECT OF SUPPLEMENATRY CEMENTITIOUS MATERIAL SUBSTITUTION RATES ON TENNESSEE BRIDGE DECK PORTLAND CEMENT CONCRETE PERMEABILITY

EXAMINING COMMITTEE

Dr. L. K. Crouch – Chairperson

Dr. Daniel Badoe

Dr. Benjamin Mohr

ABSTRACT

The ability to lower concrete permeability by increasing the Tennessee Department of Transportation (TDOT) allowable supplementary cementing material (SCM) substitution rates for TDOT Class D (bridge deck) concrete has led to this investigation. Lowering the permeability of bridge deck concrete would slow the rate of water and chloride ion ingress that is corrosive to bridge deck steel. If higher allowable substitution rates were to be adopted as TDOT standards, bridge deck service lives could be prolonged due to the lowering of concrete permeability. A total of 60 batches were produced from 10 different mixtures: seven TDOT Class D mixes with different substitution rates of grade 100 ground granulated blast furnace slag (GGBFS), two TDOT class D mixes using ultrafine fly ash (UFFA), and one control TDOT Class D mix using 100% portland cement (PC). All of the GGBFS and UFFA mixtures were compared to the 100% PC concrete. The comparison tests included: surface resistivity (SR) and absorption after boiling. Compression testing was also performed to determine if all mixtures met TDOT 28-day compressive strength requirements. All mixes were designed to meet TDOT 604.03 plastic and hardened property specifications to avoid any subjective comparisons. The test results showed that the TDOT Class D grade 100 GGBFS concrete was superior to the 100% PC concrete for SR at all testing intervals. GGBFS concrete showed to have no significant difference or was inferior to the 100% PC in absorption after boiling, however, GGBFS was statistically superior to the 100% PC at the 65% substitution rate. The test results also showed that the TDOT Class D UFFA concrete SR results were superior to the TDOT Class D 100% PC concrete after 21-day testing for both substitution rates. The 25% UFFA substitution rate was statistically superior to the 100% PC concrete in absorption after boiling, however, the 35% substitution rate showed no significant difference to the 100% PC concrete.