Project Summary RES2013-39
Title: Development of Class P-SCC (Self-Consolidating Concrete) and Class A-SCC Concrete Mixtures
Author: Joseph O. Owino, Benjamin E. Byard, Mohamed Khalafalla Ahmed, Alex B. Rollins
Affiliation: The University of Tennessee at Chattanooga

Purpose of the Project:

Self-consolidating concrete (SCC) is a concrete technology that is growing in popularity with the precast/prestressed industry and contractors. SCC achieves the ability to flow and self-consolidate through modified aggregate gradations, increased cementing materials, and chemical admixtures; therefore, its hardened properties are similar to conventional concretes. Two Class P-SCC (precast) and two Class A-SCC (general use) were investigated to ensure they met the minimum strength and durability requirements for TDOT Class P and Class A mixtures respectively. The research program found that desired fresh properties are achievable with materials available in Tennessee. With the approval of TDOT management, Class P-SCC and Class A-SCC (with specified fresh and hardened properties) now appear as an option in TDOT specifications. Using SCC mixtures can potentially save TDOT money by allowing TDOT suppliers and contractors to utilize this cost and time-saving technology. Also, greater use of supplementary cementing materials (SCMs) will improve TDOT's environmental stewardship.

The primary objectives of this study were to:

- Investigate the fresh properties of SCC in comparison to conventional concrete.
- Investigate the relationship between Visual Stability Index (VSI) and fresh-segregation of SCC.
- Investigate the effect on fresh properties of Class F & C fly ash, and various gradations of coarse and fine aggregates.
- Investigate the effect of accelerated curing process on the hardened properties represented by compressive strength, tensile strength and Modulus of elasticity.
- Recommend a specification for fresh and hardened performance requirements for Class-P and Class-A SCC that TDOT could use.

Scope and Significance of the Project:

To achieve the above objectives the following scope of work was implemented: (1) reviewed other states specifications and relevant studies and literature; (2) developed a research approach; (3) investigated the fresh properties of general use SCC mixes; (4) investigated the effects of VSI on fresh and hardened segregation of SCC mixes; (5) investigated the effects of VSI on permeability of SCC mixtures; (6) compared the fresh and hardened properties of SCC mixtures with conventional concrete mixtures; (7) analyzed and studied the information obtained throughout the mixing and testing to develop findings, conclusions, and recommendations; and (8) prepared a report in order to document the information obtained during this investigation, and provided the TDOT with the specification of fresh performance requirements for SCC. Finally, training was provided to TDOT Materials & Tests staff at all four regional offices to help familiarize them with SCC and its testing procedures. This training took place near the conclusion of the research project.

Outcomes:

The project identified the limits of fresh concrete tests that indicated a reduction in hardened concrete performance. These limits were used to establish specification tolerances for fresh concrete testing to provide guidance in an attempt to ensure proper hardened concrete performance. The project concluded with the successful training of TDOT personnel in quality control/quality assurance performance of SCC in the fresh and hardened states, along with the writing of a specification for TDOT for SCC.

Time Periods and Status of the Project: 6/1/13 to 3/31/16, Complete

Contact Information:

Joseph O. Owino, P.E.
Professor, Department Head
Department of Civil and Chemical Engineering
College of Engineering and Computer Science
The University of Tennessee at Chattanooga
Email: joseph-owino@utc.edu
Phone: 423-425-4316

Alex Brent Rollins
Director, Civil Engineering Materials Research Laboratory
Department of Civil and Chemical Engineering
College of Engineering and Computer Science
The University of Tennessee at Chattanooga
Email: alex-rollins@utc.edu
Phone: 423-402-0658