TECHSUMMARY *April 2015*

SIO No. 30000681 / LTRC Project No. 12-5C

Comparison of Conventional and Self-Consolidating Concrete for Drilled Shaft Construction

INTRODUCTION

Significant anomalies have been observed in many of the recent drilled shaft construction projects throughout Louisiana. The anomalies typically occur in the form of honeycombing within the zones of heavy reinforcement or sometimes at the shaft bottom. Self-Consolidating Concrete (SCC) has shown great potential to overcome the difficulties as noted in some pilot studies. For example, SCC was used in the drilled shafts for the Huey P. Long Bridge in New Orleans and performed satisfactorily. In contrast to the Huey P. Long Bridge, conventional concrete was used for the Audubon Bridge. Problems were noted in the construction as well as the shaft resistance. Both projects consist of large size shafts constructed in the Mississippi River in similar conditions.

This project was undertaken to determine the use of SCC and various test methods to assess the suitability of SCC in underwater placement conditions.

OBJECTIVE

The objectives of this research were to study the suitability of SCC in drilled shaft construction and to determine applicable test methods and acceptance criteria to show and limit washout potential.

SCOPE

To meet the objectives of this project, samples were produced in laboratory conditions from several mixtures of SCC targeting a 28- to 30-in. slump flow. Fresh properties of slump flow, J-ring, air content, and set time were measured for each mixture. Washout characteristics were determined using the L-box test and U.S. Army Corp. of Engineers (USACE) washout test. Compressive strength was measured at 7- and 28-days of age. Flexural strength, surface resistivity, and modulus of elasticity were measured at 28-days of age.

METHODOLOGY

Materials in the study include type I/II portland cement, class C fly ash, and grade 120 slag. Mixtures were produced with 564 lb. of total cementitious material per cubic yard while traditional SCC was produced with about 800 lb. of total cementitous material per cubic yard. Fresh properties were measured with ASTM C1611, ASTM C1621 and CRD 61-89A. L-box test results were also included.

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PRINCIPAL INVESTIGATOR:
Tyson Rupnow, Ph.D., P.E.

LTRC CONTACT:
Tyson Rupnow, P.E., Ph.D.
225.767.9148

FUNDING:
SPR: TT-Fed/TT-Reg

Louisiana Transportation Research Center

4101 Gourrier Ave
Baton Rouge, LA 70808-4443

www.ltrc.lsu.edu

CONCLUSIONS & RECOMMENDATIONS

The fresh concrete results of SCC showed that SCC produced with a No. 8 crushed stone or No. 8 gravel is adequate in terms of workability and strength with the use of a high range water reducer.

The L-box test results were varied across all mixtures and the method was abandoned in favor of the washout test. The washout test results showed that, for SCC mixtures being placed in an underwater condition, the addition of a viscosity modifying agent (VMA) greatly enhances the resistance of said concrete to washout.

Compressive and flexural strengths showed that SCC will be adequate for nearly all structural concrete and drilled shaft applications. The modulus of elasticity values for mixtures tested were slightly increased compared to traditional concrete values showing that the SCC mixtures are particularly suited for drilled shaft construction.

Surface resistivity values were slightly depressed for laboratory mixtures at 28-days of age, but field cast SCC mixtures will incorporate, not only additional supplementary cementitious materials (SCMs) but a greater proportion of SCMs, leading to increased resistivity values to meet the specification.

Figure 1
Washout test result for a No. 8 pea gravel mixture showing no cement paste

Figure 2
Washout test result for a No. 8 pea gravel mixture incorporating a VMA showing cement paste