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## SUMMARY REPORT

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# INVESTIGATION OF THE PERFORMANCE AND BENEFITS OF LIGHTWEIGHT SCC PRESTRESSED GIRDERS AND SCC MATERIALS

Self-Consolidating Concrete (SCC), also known as self-compacting concrete, is a highly flowable concrete that is capable of filling formwork without using conventional vibration techniques. SCC is widely used for commercial building applications and is being considered for use in precast prestressed bridge girders. SCC is advantageous for many reasons including: (i) the number of workers required and the noise produced by mechanical vibration are reduced significantly; (ii) the safety hazards of workers on top of the girders is eliminated; (iii) the surface finish of the concrete can be more smooth than that of conventional concrete; (iv) formwork damage from mechanical vibration is reduced, increasing the life of the forms; (v) reinforcing bar configurations are not damaged; (vi) improved bond of concrete to prestressed strands could reduce strand end-slip and the top bar effect; and (vii) SCC is able to fill complicated shapes and congested reinforcement areas better than vibrated concrete.

The use of lightweight concrete (115 – 130 pcf) for bridge girders likewise has several advantages. The most obvious is the reduction in shipping and erection costs when compared to girders fabricated with conventional weight concrete. This is becoming more important as girder designs are continually increasing in length to reduce construction costs. There may also be reason to believe that the durability of lightweight concrete girders may be equal to or in some cases superior to conventional concrete girders. This has been attributed to the similarity between the modulus of the lightweight aggregate and the cement paste, potentially leading to fewer micro-cracks between

these two components of the concrete mixture.

The use of lightweight concrete as a self-consolidating material for precast prestressed bridge girders is promising due to the reasons mentioned above. Because lightweight SCC (referred to as SCLC) is a novel material with many potential benefits research was carried out to assess performance for precast prestressed concrete bridge girder applications.

This research report addresses the design and resulting properties of normal weight SCC mix designs developed at the University of South Carolina and the experimental characterization of three full-scale AASHTO Type III bridge girders. Both aspects of the research project addressed material properties in the fresh and hardened states. Fresh properties included slump flow, filling ability, passing ability, and air content.



Hardened properties included compressive strength, modulus of elasticity, creep, shrinkage, split tensile strength, chloride permeability and freeze-thaw behavior. Characterization of the girders included transfer length, end-slip, internal curing temperature, camber, prestress losses, and load versus midspan deflection and strain.

The results of the studies were compared to the AASHTO LRFD, 4<sup>th</sup> Edition and other documents. Recommended guidelines are provided in relation to assessment of the fresh and hardened properties of trial batches and for production. Considerations for design are also addressed.

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