Development of Cost-Effective Rapid-Setting Concrete for Improved Bridge Joint Performance

Spencer McKinnon, Eshan V. Dave, Jo E. Sias, Yashar Azam
University of New Hampshire

Introduction

VTrans has adopted use of the accelerated bridge construction (ABC) approach which enjoy high material quality due to a large fraction of precast and prefabricated elements, connections between these elements must be placed in-situ. These are often treated as a “weak-link” in the ABC approach due to potential risk for inferior performance. This research study aims to assess the durability and structural performance of RSC used in current VTrans ABC projects through laboratory experimental evaluations and provide tools for implementation in the field and quantification of the benefits.

Figure 1. VTrans ABC Connections (in red boxes) ready for RSC placement

Experimental Plan

A partial factorial experimental design is being used for this research, with three approved VTrans mix designs serving as baselines. The primary variations considered in this design are cementitious material content, air content, workability, and aggregate sources.

ID	Cementitious Content (lbs./CY)	Target Air Content (%)	Target Workability (Slump/Spread)	Coarse Aggregate Source	Fine Aggregate Source
SCC-1 (RS-070)	900 (P,S,F)	6	27 (Spread)	Original	Original
SCC-1a	800 (P,S,F)	6	23 (Spread)	Original	Original
SCC-1b	1000 (P,S,F)	6	27 (Spread)	Original	Alter-1
SCC-1c	900 (P,S,F)	6	18 (Spread)	Alter-1	Original
PCC-2 (RS-231)	900 (B)	6	8 (Slump)	Original	Original
PCC-2a	750 (B)	6	6 (Slump)	Original	Alter-1
PCC-2b	825 (B)	4.5	8 (Slump)	Alter-1	Original
PCC-2c	1050 (B)	7.5	6 (Slump)	Original	Original
PCC-2d	900 (B)	4.5	9 (Slump)	Alter-2	Alter-2
PCC-2e	1200 (B)	6	8 (Slump)	Original	Original
PCC-3 (RS-010)	730 (P, FA)	6	6 (Slump)	Original	Original
PCC-3a	900 (P, FA)	6	6 (Slump)	Alter-1	Alter-1

Figure 2. Experimental design for Task-2 laboratory evaluations. P: Portland cement; S: Slag; F: Silica fume; FA: Fly Ash; B: Blended cement

Results

Materials in excess of 5 ton have been sampled by the research team to sup[port the experimental plan. Laboratory testing is currently underway. Strength evolution comparisons between lab manufactured RSC (UNH Control Mixes) and data for same mix proportion materials from VTrans is shown in Figure 3.

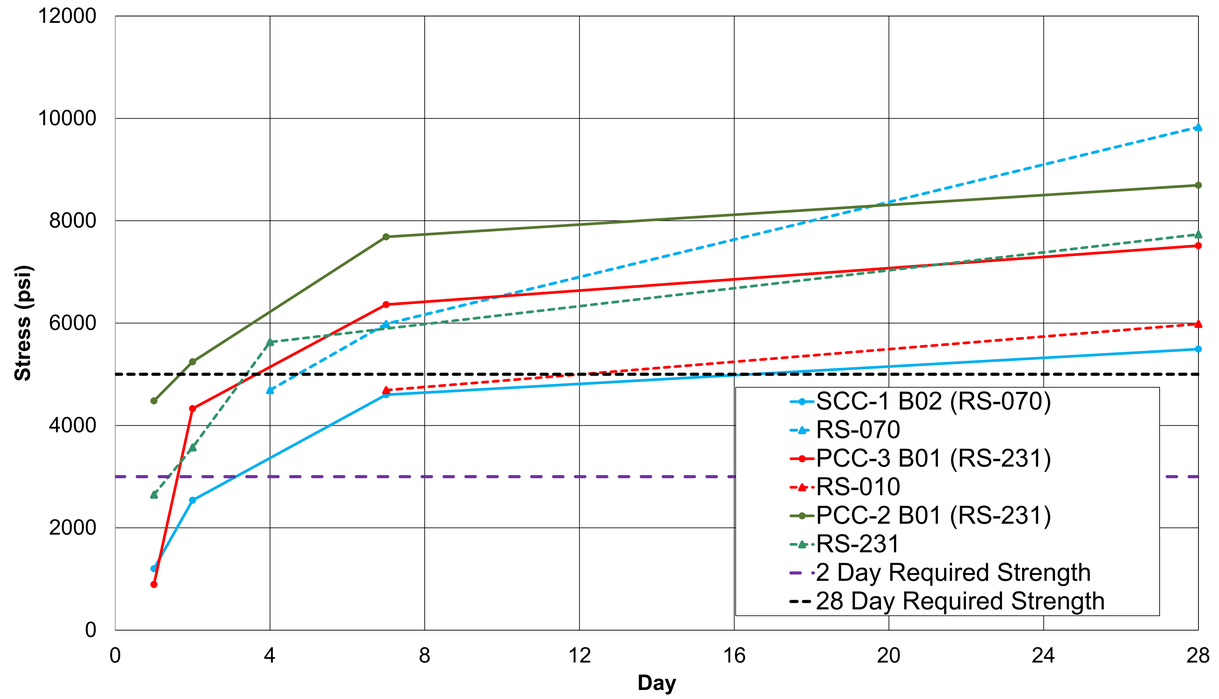

Figure 3. Compressive Strength Evolution (UNH Control Mixes: SCC-1, PCC2 and PCC3; VTrans Data: RS-070, RS-010, RS-231)

Conclusions & Potential Impacts

Early laboratory evaluation of workability, fresh properties and compressive strength of the three baseline VTrans mix designs have been completed. This effort has shown that there is need for increased workability in lab, however strength has been mostly on target. Durability testing is currently underway.

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