RUTGERS Infrastructure Monitoring & Evaluation (RIME) Group

28th Annual NJDOT Research Showcase

Bureau of Research, Innovation & Information Transfer

Development of Non-Proprietary Ultra-High-Performance Concrete (UHPC) for Bridge Overlays

Presented by **Michael Ruszala**, RIME Group, Rutgers University

Authors: Hani Nassif · Reid Holland · Michael Ruszala · Chaekuk Na

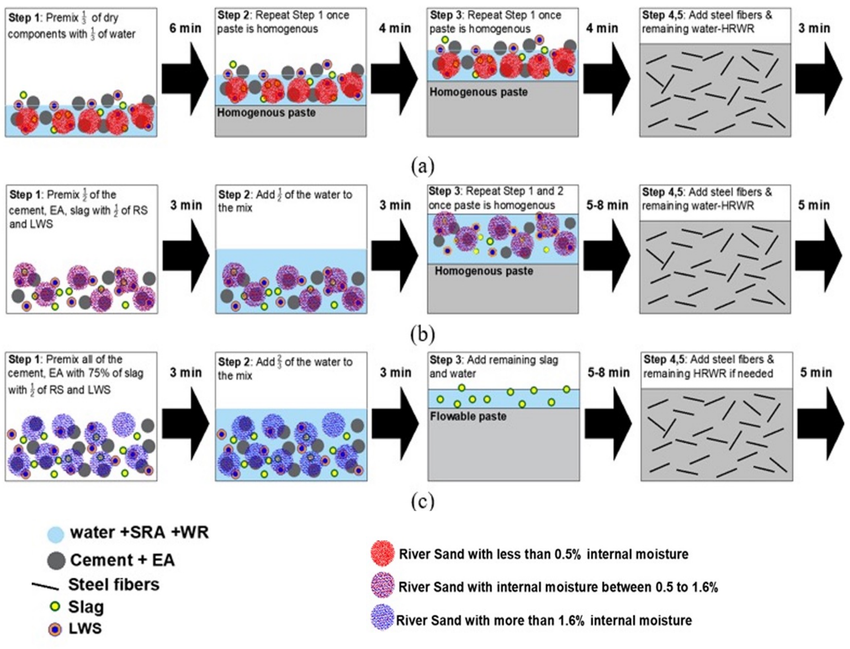
01 BACKGROUND & OBJECTIVES

Ultra-high-performance concrete (UHPC) offers exceptional strength and durability for bridge overlays, but wider use is often limited by large-volume workability and high autogenous shrinkage that can lead to early-age cracking and delamination. To address these shortcomings, a non-proprietary UHPC overlay mix developed using pre-saturated lightweight sand (LWS), expansive agents (EA), and shrinkage-reducing admixtures (SRA), validated under restrained conditions (AASHTO T334). Practical mixing protocols tailored to aggregate moisture conditions and field demonstration results will also be discussed.

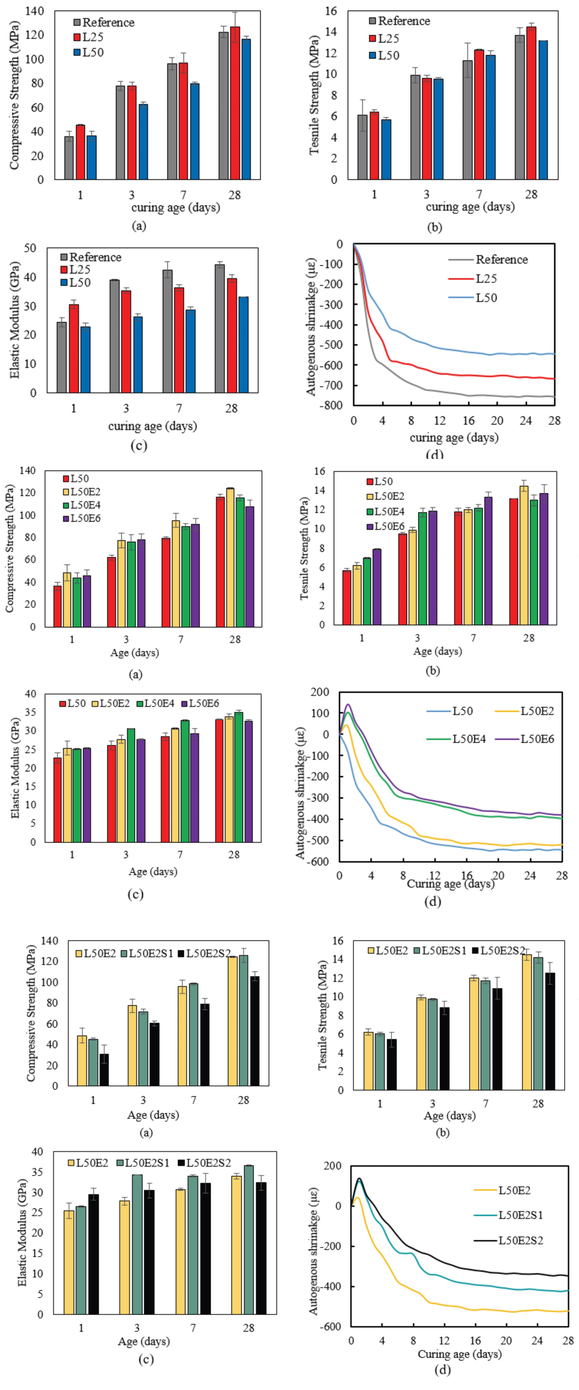
02 Mix Design and Procedure

Mixtures	Cement	Slag	EA	RS	LWS	HRWR	SRA	Water	SF
Reference	459.0	633.9	0	965.4	0	9.8	0	244.8	156
L25	459.0	633.9	0	721.4	163.9	7.8	0	245.9	156
L50	459.0	633.9	0	482.7	327.9	6.0	0	247.0	156
L50E2	447.5	623.2	22.9	482.7	327.9	6.0	0	247.6	156
L50E4	435.9	612.5	45.9	482.7	327.9	6.0	0	247.8	156
L50E6	423.3	601.8	68.8	482.7	327.9	6.0	0	247.8	156
L50E2S1	447.5	623.2	22.9	482.7	327.9	6.0	11	236.6	156
L50E2S2	447.5	623.2	22.9	486.7	327.9	6.0	22	225.4	156

Note: EA represents expansive agent; LWS represents pre-saturated lightweight sand; HRWR represents high-range water reducer; RS represents natural river sand/fine aggregates and SF represents steel fibers



04 Effects of Variables

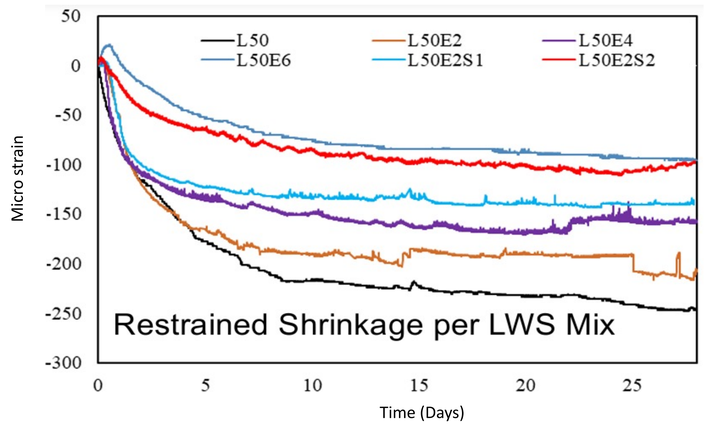


Effect of LWS

Effect of Expansive Agent

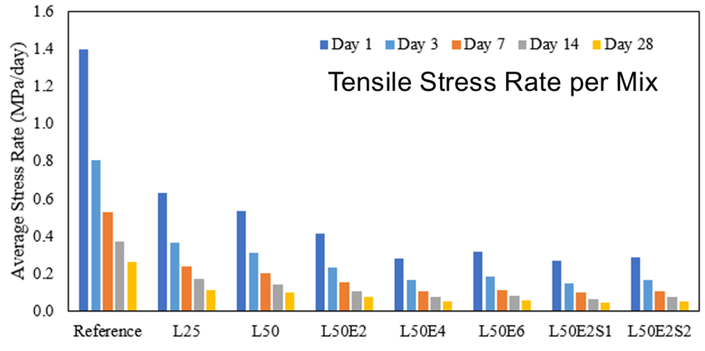
Effect of SRA

05 Results





Restrained Shrinkage Ring Test



06 Conclusions

1) Crack free UHPC under restrained conditions can be produced using LWS (50% by sand volume), EA (2%), and SRA (2%).

2) When combined, chemical shrinkage can be reduced by as much as 60% without compromising strength.

3) Mixing protocols are proposed based on mixture rheology and sand moisture. Mono-batching produces best results.

Acknowledgements: The authors gratefully acknowledge the New Jersey Department of Transportation (NJDOT) for its support and guidance throughout this work. The authors also acknowledge Xiaohua "Hannah" Cheng, Dipen Mehta, Habel Sabu, Hemant Padalia, and other SMEs in the Bureau of Structural Engineering Services. Additional thanks to all undergraduate student in RIME Group for the help on this project

For information please contact: Prof. Hani Nassif, Ph.D., P.E., Director nassif@soe.rutgers.edu
Please visit RIME Group Website at http://www.rime.rutgers.edu