
FEASIBILITY OF NON-PROPRIETARY UHPC FOR USE IN HIGHWAY BRIDGES IN MONTANA PHASE II – FIELD APPLICATION

KICKOFF MEETING

APRIL 12 , 2018

Mike Berry

berry@montana.edu

994-1566

Camylle Wood

camyllekimberly@hotmail.com

Background Information

- UHPC - Ultra High Performance Concrete
- $f'_c > 20$ ksi, $f_r > 0.72$ ksi, often self consolidating
- Longer service life, decreased maintenance, thinner/lighter sections, tighter spacing on closure pours
- Commercially available since 2000 @ \$2000-\$3000 /cubic yard
- FHWA demonstrated nonproprietary UHPC could be made for \$500-\$1000/cubic yard

Phase I Mix

- Use locally available materials
- Strengths of $f'_c = 19.2$ ksi, $f_r = 1.98$ ksi
- Excellent durability properties
- MDT UHPC mix can be made for \$350-\$560/cubic yard

Material	Manufacturer	Cost (per ton)
Fine Aggregate	QUIKRETE	\$26
Portland Cement, Type I/II	CRH	\$145
Silica Fume	BASF	\$840
Fly Ash, Type F	Coal Creek	\$135
HRWR (per gallon)	CHRYSO, Inc.	\$14
Steel Fibers	Nycon	\$1,600

Mix Constituents & Costs

Age (days)	f'_c (ksi)
7	16.4
28	19.2
56	20.1

Unconfined Compressive Strength

Objective – Phase II

The objective of this research is to further characterize the non-proprietary UHPC mixes developed in the Phase I research, and ensure its successful application in field-cast joints.

Research Methodology

- Task 1- Literature Review
- Task 2- Material Sensitivity
- Task 3- Field Batching
- Task 4- Bond & Development Length Characterization
- Task 5- Analysis of Results & Reporting

Task 1: Literature Review

- Investigate UHPC application in field cast joints
- Material Sensitivity
 - Aggregate moisture content, gradation, & source
 - Variation in fly ash effect
 - Steel fiber type and amount
- Field Batching
 - Mixer type & batch size
 - Field demonstration projects
- Bond & Development Length Tests
 - Direct tension pullout tests

Task 2: Material Sensitivity

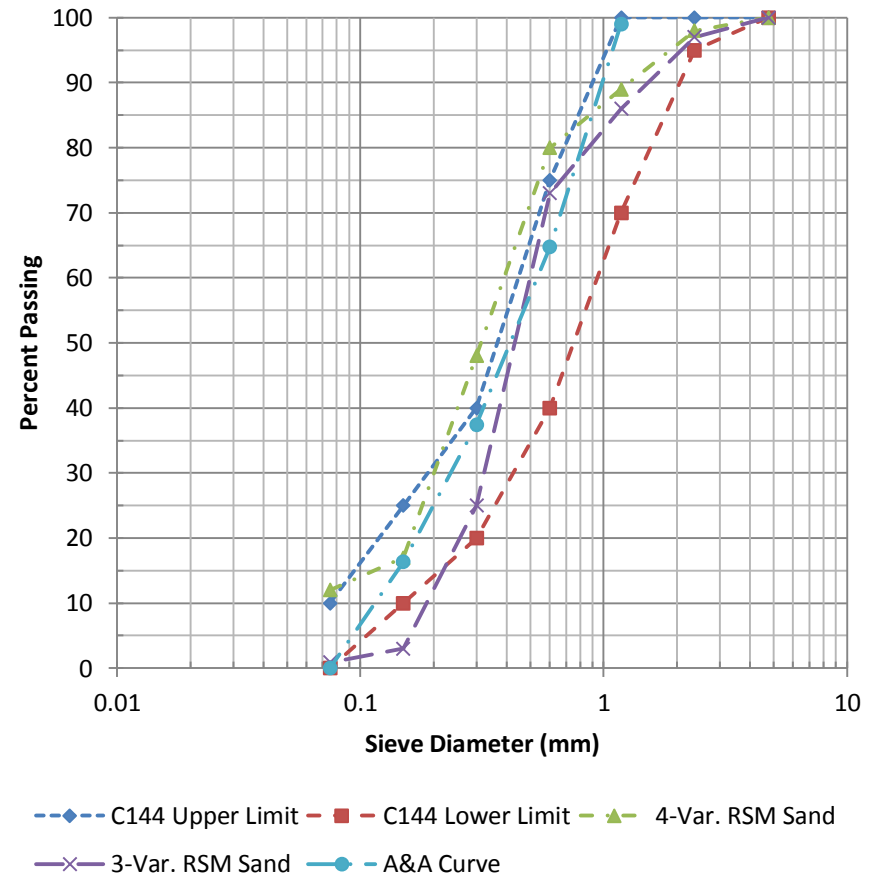
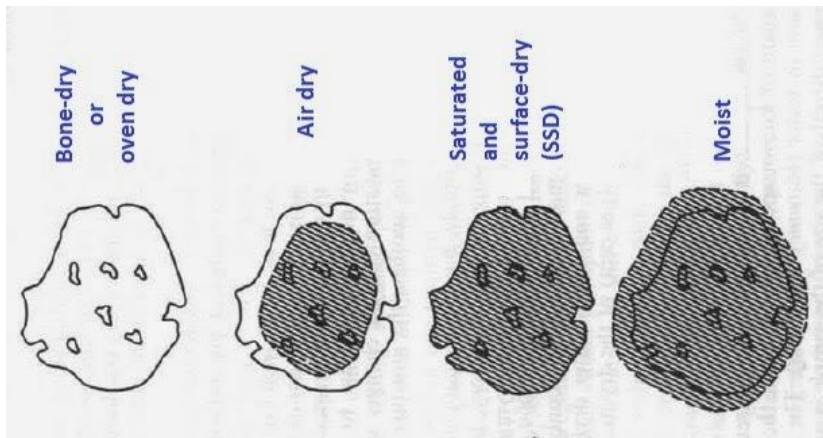
- Class F Fly Ash
 - Coal Creek vs Trident
 - Variations within source
 - Effects due to differences in:
 - Chemical composition & LOI
 - Fineness
 - Similarity of Particle Size Distribution (PSD) curve to cement PSD curve



<http://www.caer.uky.edu/kyasheducation/flyash.shtml>

Task 2: Material Sensitivity

- Aggregate
 - Gradation
 - Source/Type
- Moisture Content



Task 2: Material Sensitivity

- Steel Fibers
 - Meet “Buy America” requirements
 - Fiber Shape
 - Straight vs Hooked vs Corrugated
 - Fiber Volume Fraction
 - Fiber Balling
 - Flowability



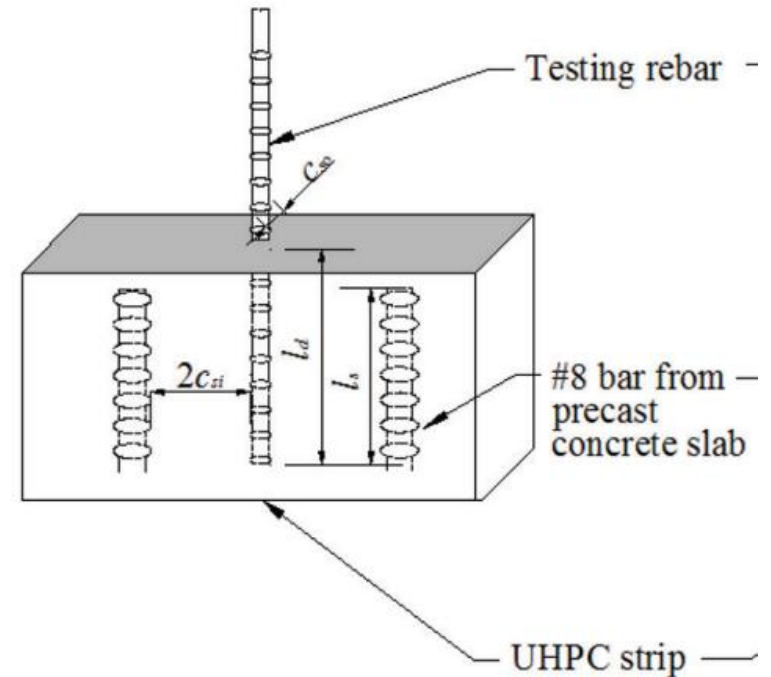
Task 3: Field Batching/Mixing

- Mixer Type
 - Imer Mortarman 350/750
- Mixing Conditions
 - Batch size
 - Temperature
 - Aggregate moisture content
- QC & Batch Consistency



Task 4: Bond/Development Length

- Direct Pullout Test
 - Embedment length, l_d
 - Concrete cover, c_{so}
 - Bar spacing, c_{zi}
 - Bar strength
 - Yield strength



Task 5: Reporting & Deliverables

- 7 Quarterly Progress Reports
- 3 Task Reports (Tasks 1-3)
- Final Report
- Project Summary Report
- Implementation report & meeting
- Material Specification
- Performance Measure

Schedule

Task/Milestone	Quarter (after start of work)							
	1	2	3	4	5	6	7	8
Task 0: Project Management	X	X	X	X	X	X	X	X
Task 1: Literature Review	X	X	X	X	X	X	X	X
Task 2: Material Sensitivity		X	X	X				
Task 3: Field Batching/Mixing				X	X	X		
Task 4: Bond/Development Length Characterization					X	X	X	
Task 5: Analysis of Results and Reporting							X	X

Questions/Concerns

