Development of High Early-Strength Concrete for ABC Closure Pour Connections

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Introduction and Objectives

- Use of accelerated bridge construction (ABC) in new construction and existing bridge deck replacements reduces construction time and increases safety
- ABC relies heavily on precasting components off-site and small volume closure pours on-site
- Rapid strength gain of closure pours is required for successful ABC implementation (target 4000 psi in 12 hrs)
- Ultra-high performance concrete is proprietary and can only be used in small closure pours for economic reasons

Objective: To develop a non-proprietary concrete mixture using constituents that can be obtained from several sources

Methodology

- Conducted a technical literature review and a survey of state DOTs and precasting plants to obtain typical high-strength concrete mixtures being used
- Developed mixture performance specification. Strength gain rate was the key performance parameter used to initially assess adequacy of the mixture
- Developed trial mixes to achieve performance targets of strength and workability
- Tested mixture following applicable ASTM and AASHTO specifications for set time, air content, slump (spread), compressive strength, bar pullout, confined shrinkage test, alkali-silica reactivity.
- Tested mixture in a realistic closure pour condition similar to those used to connect precast components. Test the joined specimen to failure in the structures laboratory.
- Two of the 18 trial mixes developed were identified for extensive testing and also to include slight variations in the proportioning to improve workability and strength gain rate

Results

Component	Material	Mix Number	
		MIX 6-HD	MIX 15-HD
Coarse Aggregate (lb)[1]	1/2" Crushed Stone	1252	1350
	3/8" Crushed Stone		
Fine Aggregate (lb)[1]	Concrete Sand	1043	1125
Cement (lb)	Type III Portland Cement	1190	1100
Fly Ash (lb)	Class F	210	194
	Class C		
Water (lb)[2]	N/A	396	366
Chemical Admixtures (fl. oz.)	Accelerator		
	Superplasticizer	224	207

1 - Weight of Aggregate Corresponds to Oven-Dried Weights
2 - Weight of Water Excludes Water Absorbed by Aggregates and was Adjusted for Water Content of Chemical Admixtures

Figure 1. Selected mixture proportions

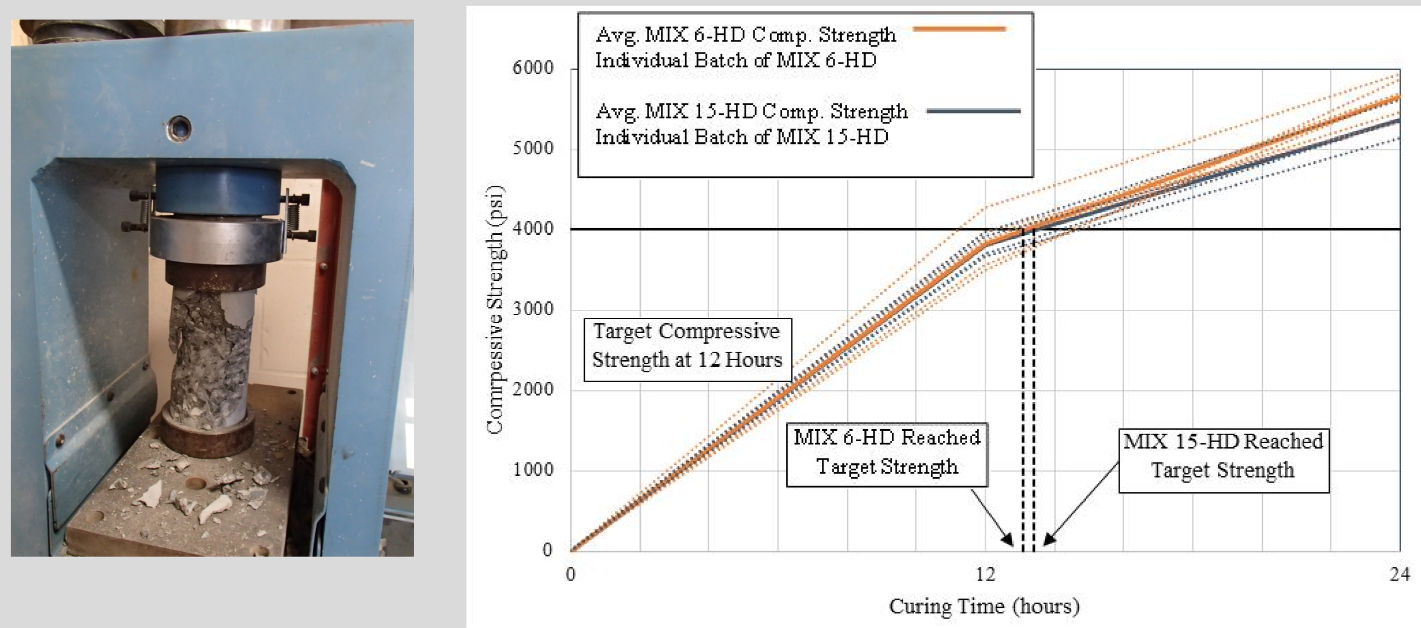

Figure 2. Compression testing

Figure 3. Spread test

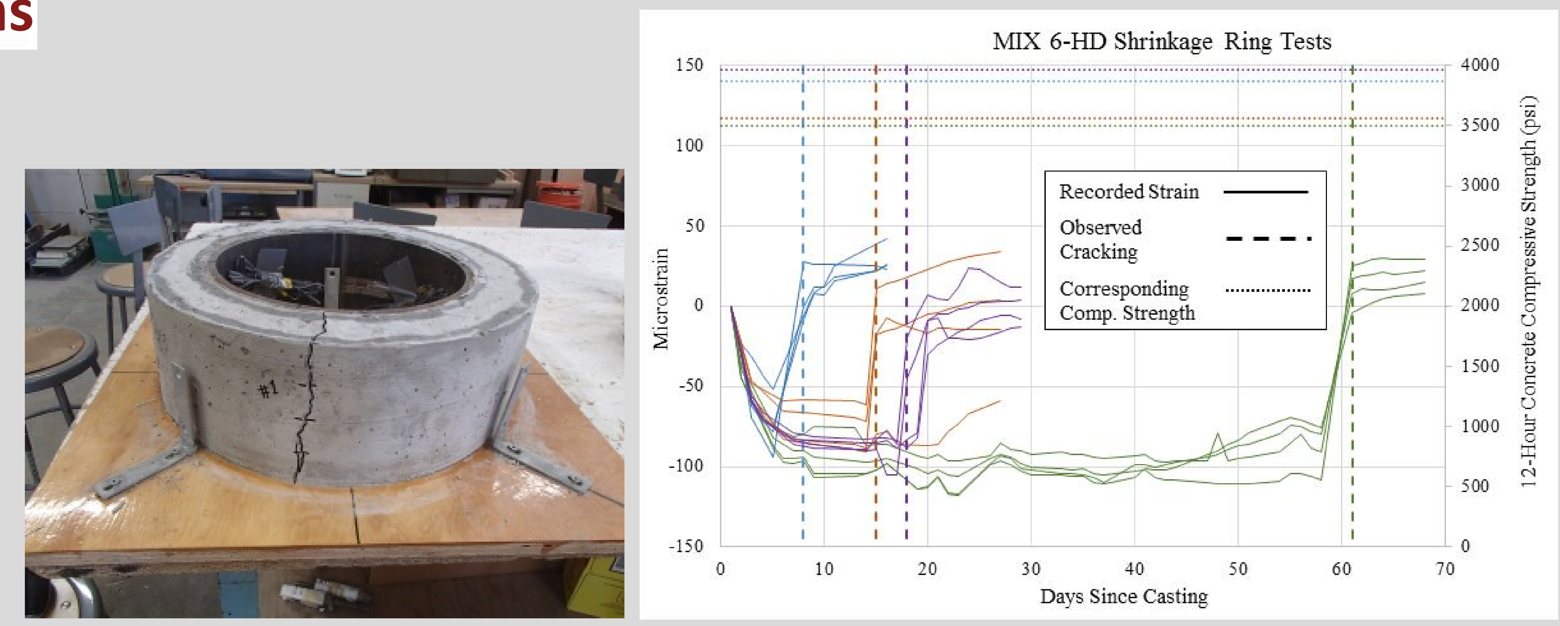

Figure 4. Confined shrinkage ring testing

Figure 5. Panel fabrication and testing

Conclusions

Two non-proprietary high early-strength concrete mixtures were successfully developed that satisfied the strength gain requirement while achieving adequate performance in terms of shrinkage, workability, bond strength and ASR low reactivity.

Acknowledgments

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