INTERNALLY CURED CONCRETE FOR PAVEMENT AND BRIDGE DECK

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OUTLINE

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2. Objectives
3. Methodology
4. Laboratory Results
5. Full-scaled Experimental Slabs
6. Conclusion & Implementation

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INTRODUCTION & BACKGROUND

- High-strength concretes used in rapid repairing, building, bridges, roads construction.
- Those concretes have one big problem which is high early-age shrinkage.
- High early-age shrinkage causes early-age cracking
- These cracks are primary causes of the structure's deficiencies and premature failures.

INTRODUCTION & BACKGROUND
(CONTINUED)

- Florida Department of Transportation (FDOT) spends billions $$ in infrastructure construction each year.
- And billions $$ more in repairing those structures.
- What to do??
- Internally cured concrete (ICC) is one way to tackle this problem.

OBJECTIVES

- FDOT-funded project to address the issue.
- ICC to mitigate and prevent early-age shrinkage in concretes.
- Laboratory setting.
- Full-scaled in-field setting.

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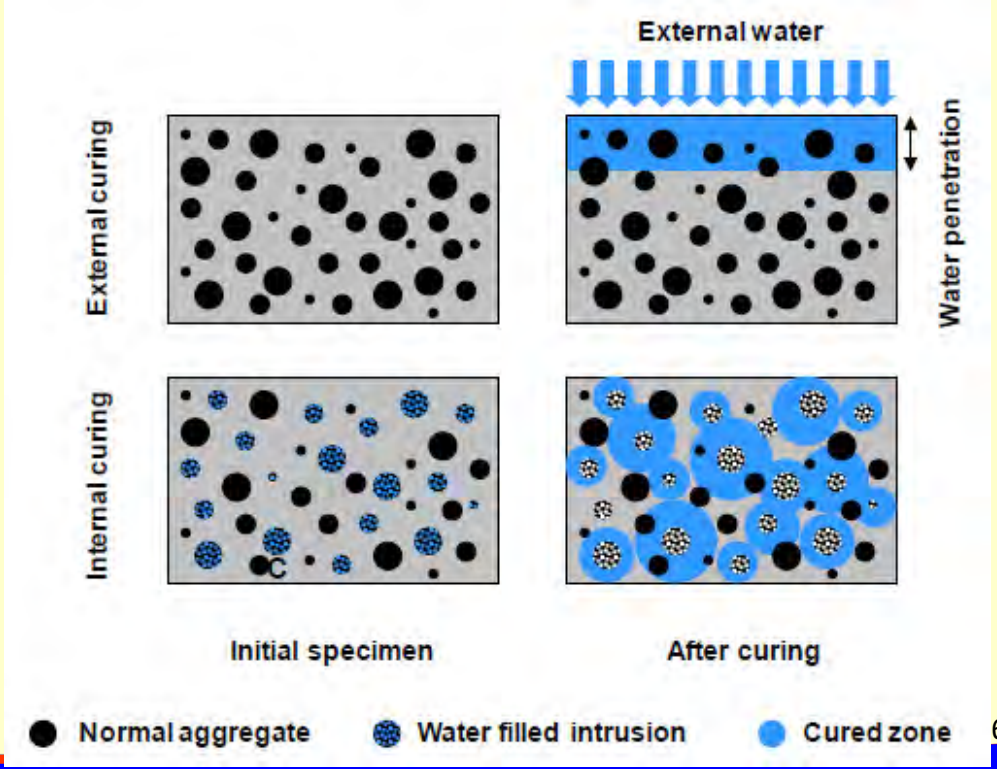
METHODOLOGY

- What is ICC? Internally cured concrete.
- Pre-wetted lightweight aggregate.
- Small reservoirs.



METHODOLOGY
(CONTINUED)

Benefits

- Reduce self-desiccation.
- Reduce autogenous shrinkage.
- Promote hydration.
- Reduce cracking tendency.

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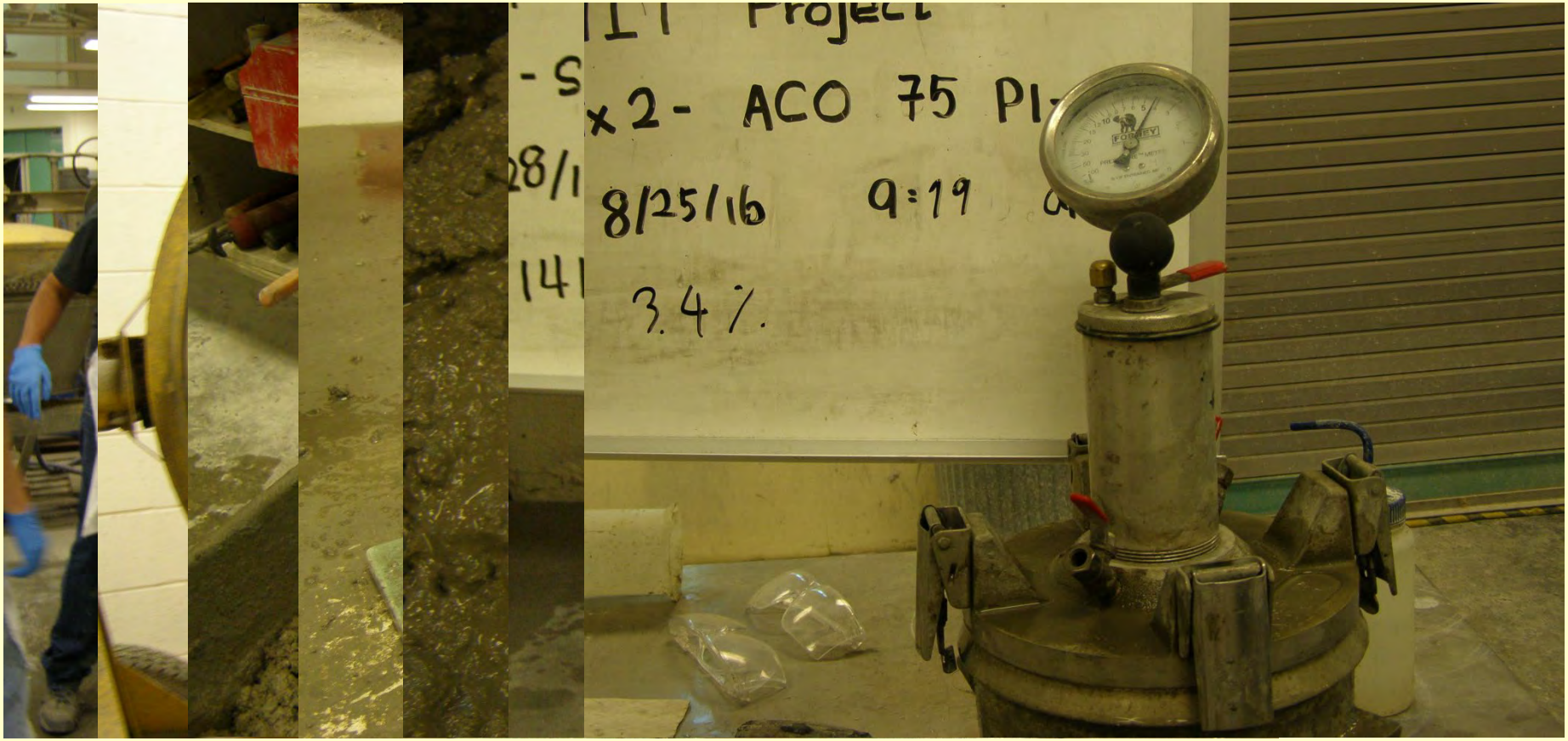
LABORATORY RESULTS



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LABORATORY RESULTS
(CONTINUED)

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(CONTINUED)

- Less water-reducing admixture needed to achieve the same workability as compared with the standard mixes.
- Average compressive strength was lower than the standard mixes by about 11%.
- Average flexural strength was lower than the standard mixes by about 6%.
- Average elastic modulus was lower than the standard mixes by about 18%.

LABORATORY RESULTS
(CONTINUED)

- Average splitting tensile strength was lower than the standard mixes by about 10%.
- Average coefficient of thermal expansion was lower than the standard mixes by about 10%.
- Average cracking age from the restrained shrinkage ring test was 3 times longer than the standard mixes.

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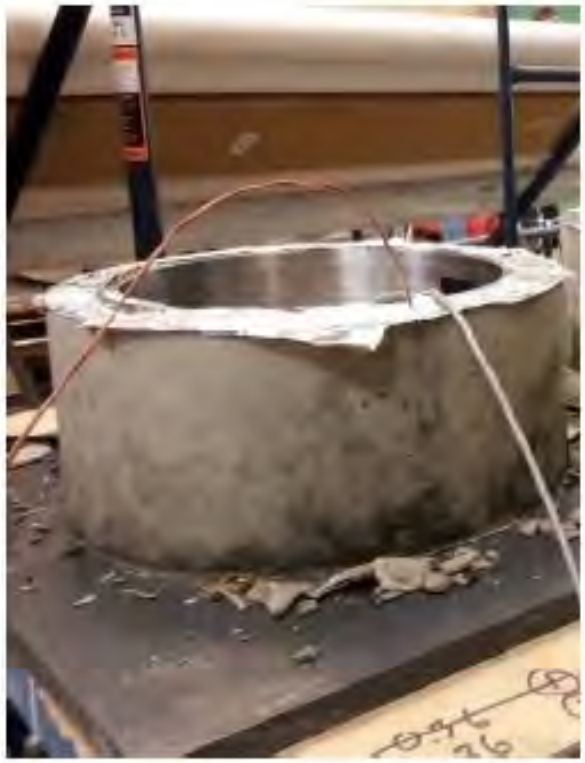
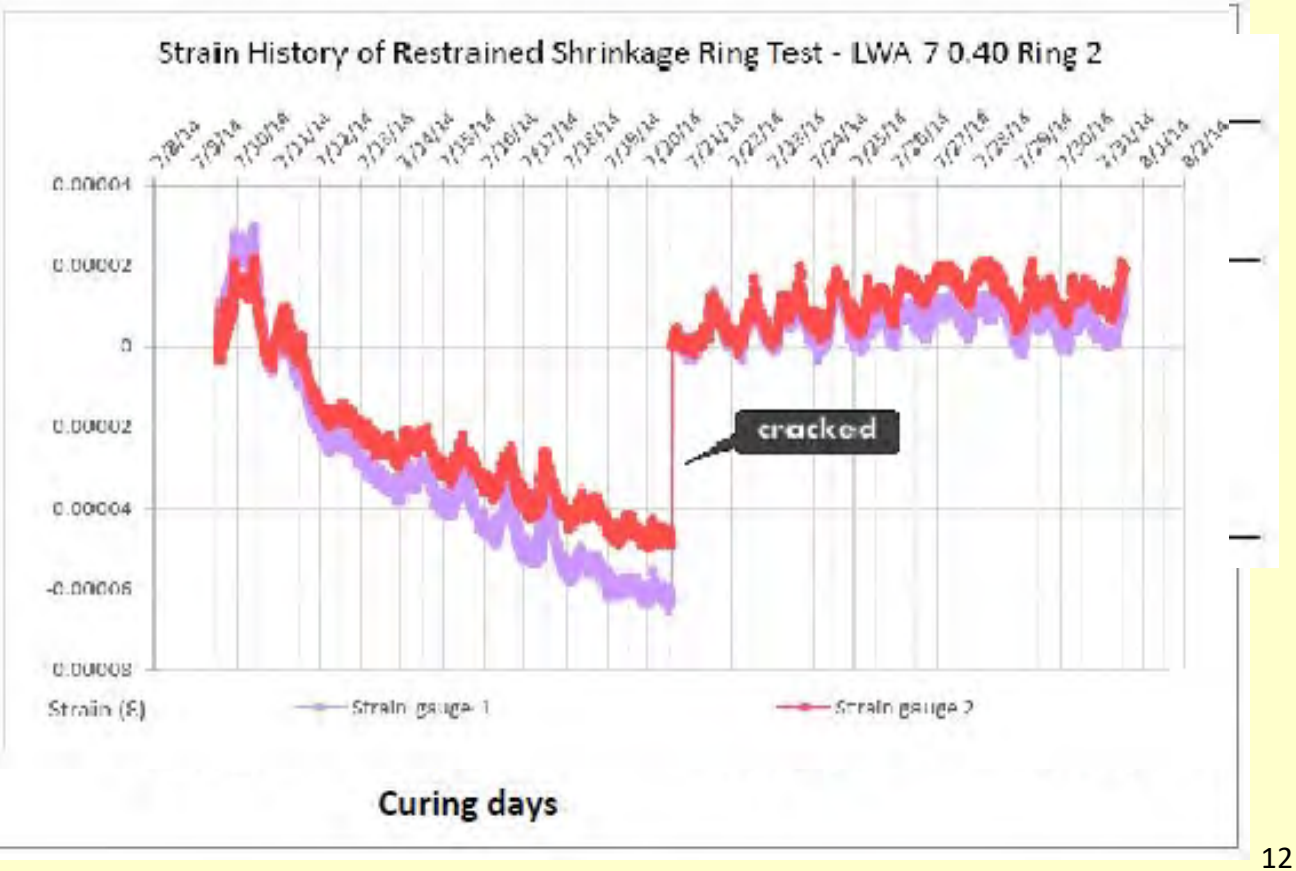
LABORATORY RESULTS
(CONTINUED)





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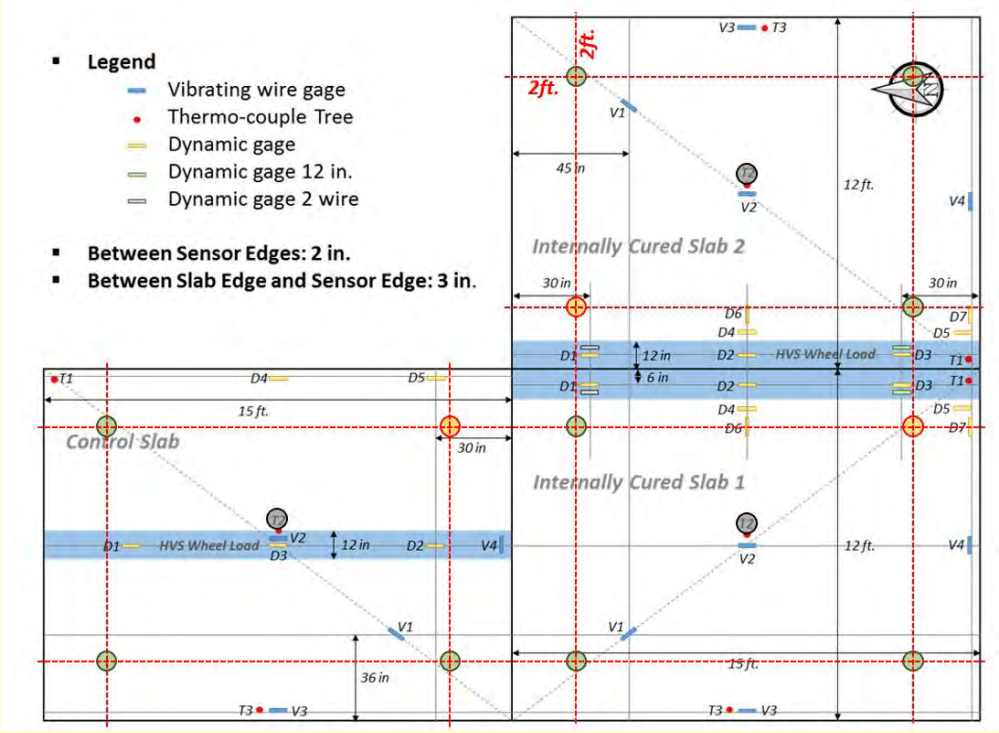
Full-scale Experimental Slabs

- Three test slabs with one standard control concrete and two ICC.
- At FDOT accelerated pavement testing area.
- Simulate traffic loading.
- Created 3D finite element models.



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Full-scale Experimental Slabs
(continued)

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Full-scale Experimental Slabs

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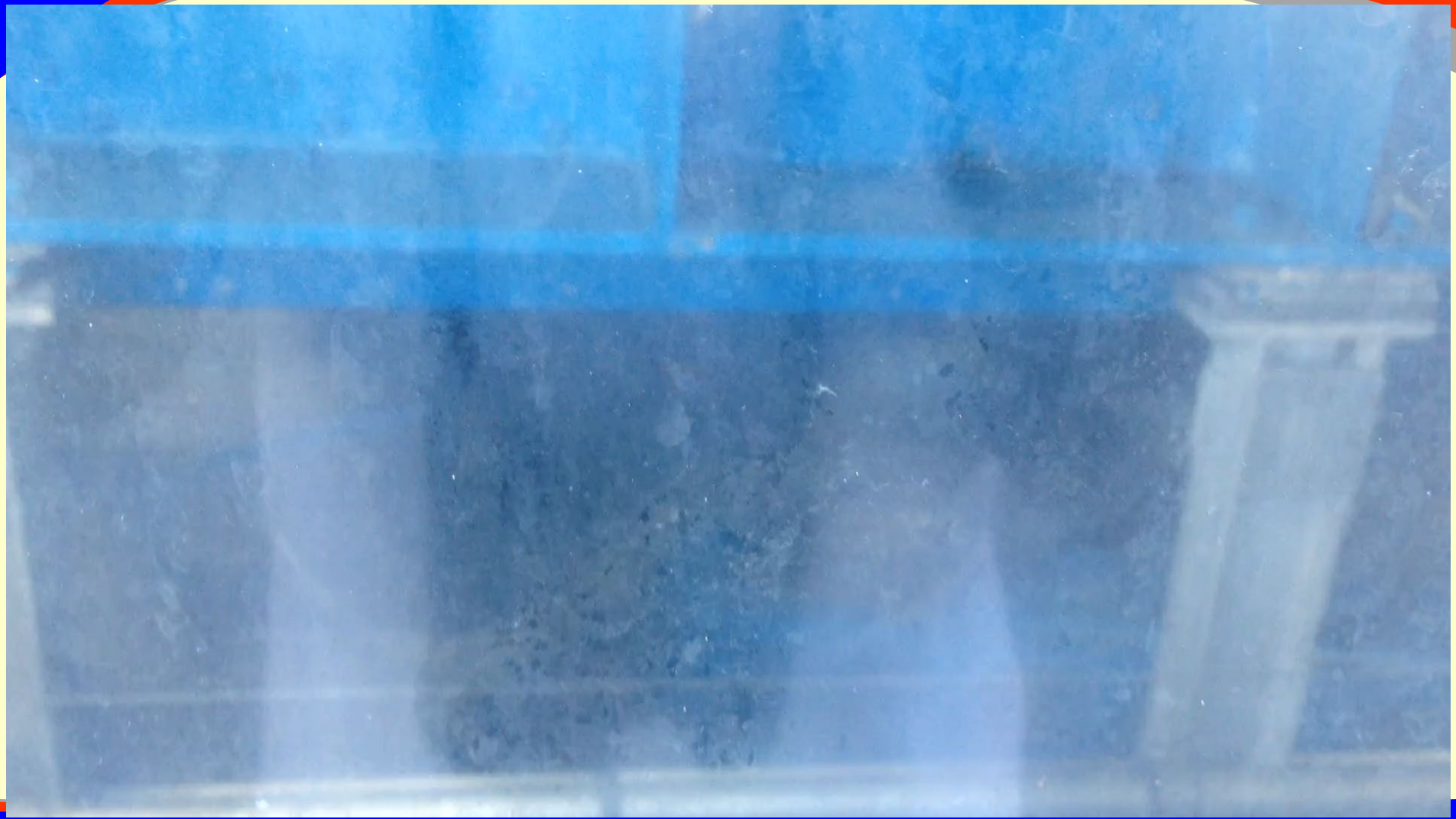

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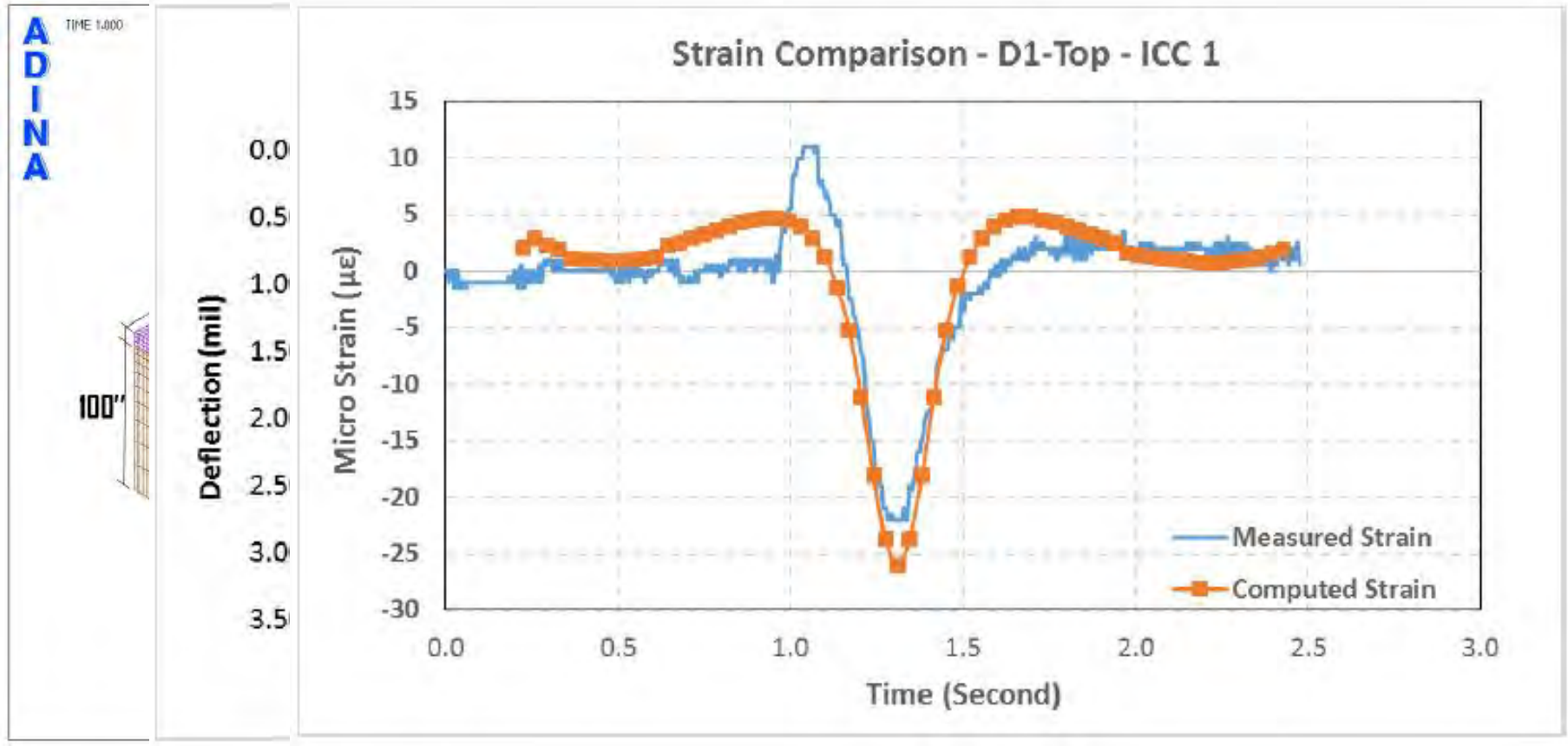
Full-scale Experimental Slabs (continued)

- 

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Full-scale Experimental Slabs (continued)

Table 5-13. Computed Maximum Stresses and Stress-to-Strength Ratios for the Test Slabs

Mix	W/C	CTE (in/in/°F)	Modulus of Elasticity (ksi)	Flexural Strength (psi)	Computed Stress (psi)		Stress-to-Strength Ratio	
					Corner	Mid-edge	Corner	Mid-edge
Temperature Differential of +20°F Between Top and Bottom								
SM	0.40	4.425	4,550	725	217.8	451.0	0.30	0.62
ICC-1	0.32	4.239	3,950	662 (820*)	194.3	397.4	0.29 (0.24#)	0.60 (0.48#)
ICC-2	0.40	4.239	3,800	705	190.6	389.7	0.27	0.55

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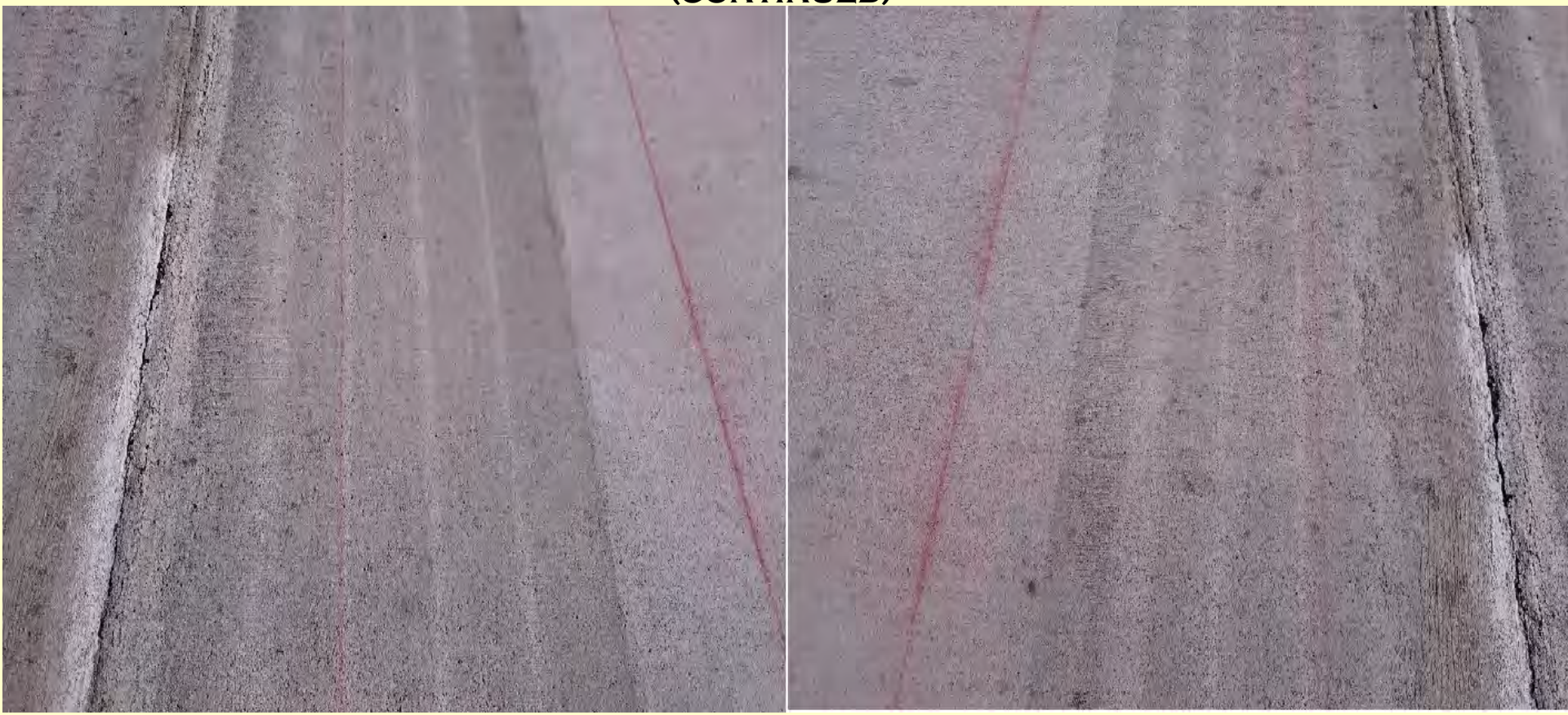
Full-scale Experimental Slabs (continued)



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Conclusion & Implementation

- Critical stress analysis:
  ICC slab has lower stress-to-strength ratio.
- Visual inspection:
  Standard control concrete showed hairline cracks – will lead to larger cracks.
  ICC showed no crack.
- Using of ICC for road pavement is recommended.

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Thank you.

Questions?

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