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## Near Surface Aggregate Reactivity (NSAR): What We Know

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 MN Concrete Forum  
 November 29, 2018  
 Gerard Moulzolf, PG

**Trust *Delivered.***

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### What is petrography?

Geologic term applied to the microscopic analysis of concrete, mortar, CMU's, grout, stucco, plaster, and other cementitious materials

ASTM Committee C9  
Sub-Committee C9.65

- ASTM:C856
- ASTM:C457
- ASTM:C295
- ASTM:C1324 (C12.02)




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### Why use petrography?

- Trouble Shooting Hardened Concrete and Masonry Problems
- QA or QC
- Condition Survey/Restoration
- Reverse Engineer




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## Outline

- Petrography Primer
- Define ASR
- Examples
- Define NSAR
- Our local NSAR enigma
- Surface prep
- The new age of NSAR
- Moisture sensitive flooring and NSAR
- Brief Case studies



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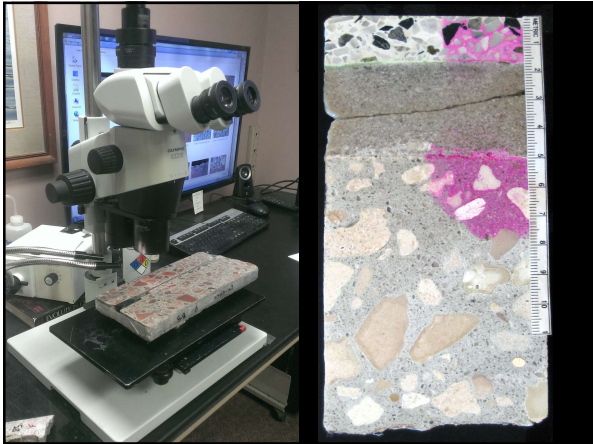
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**Alkali-Silica Reaction (ASR)**

A reaction between water in capillaries and pores in concrete paste, alkalis and hydroxyl ions (OH-) in solution, and unstable silicon dioxide in aggregates.

ASR produces a hygroscopic gel product.

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**Ramps and  
Bridges**

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**Water Control  
Structures**

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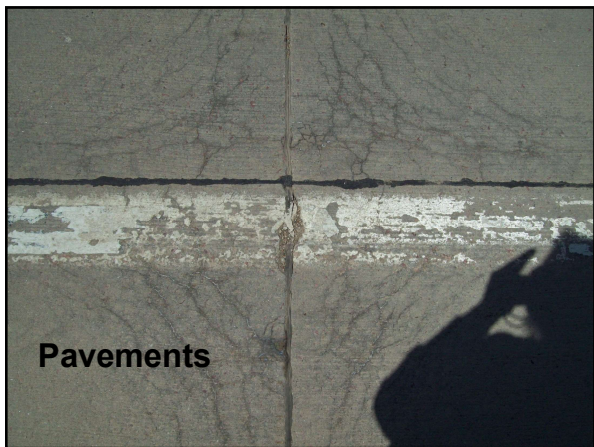
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**Pavements**

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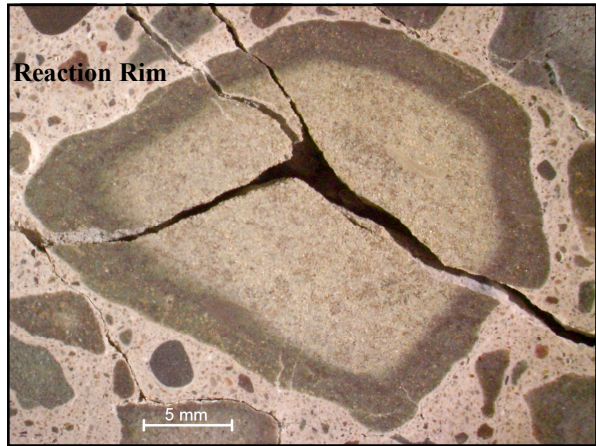
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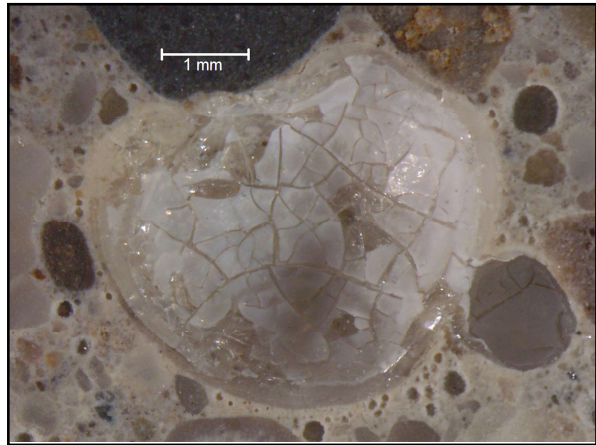
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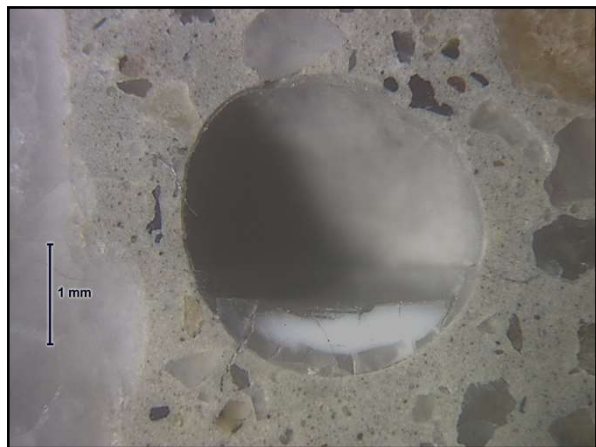
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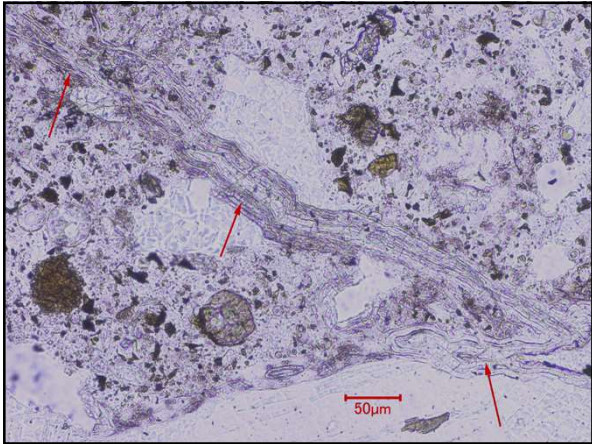
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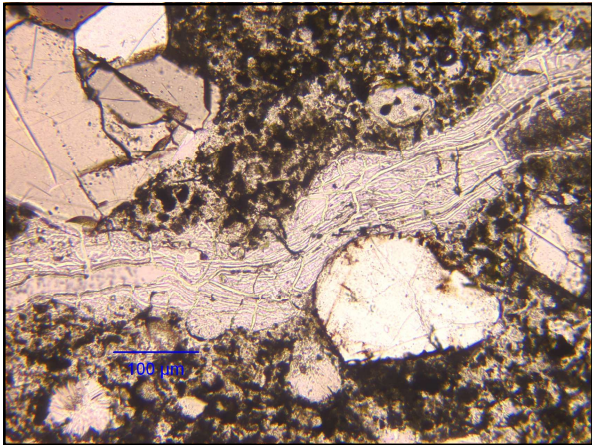
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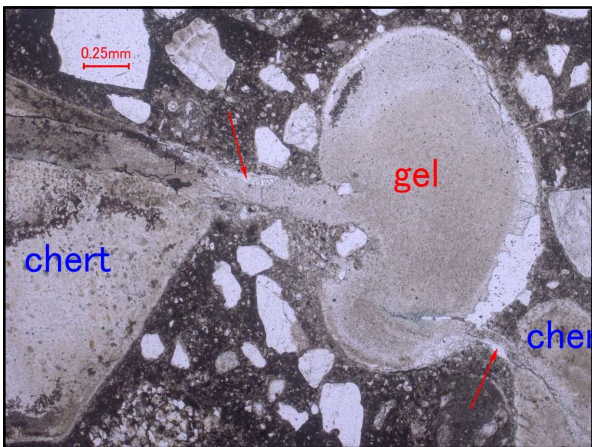
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**Alkali-Silica Reaction (ASR)**

**“Fast” Reactors**

- Our shales
- Some cherts
- Glassy volcanics

**“Slow” Reactors**

- Metamorphic lithologies
- Argillites
- Silicified carbonates
- Quartzite

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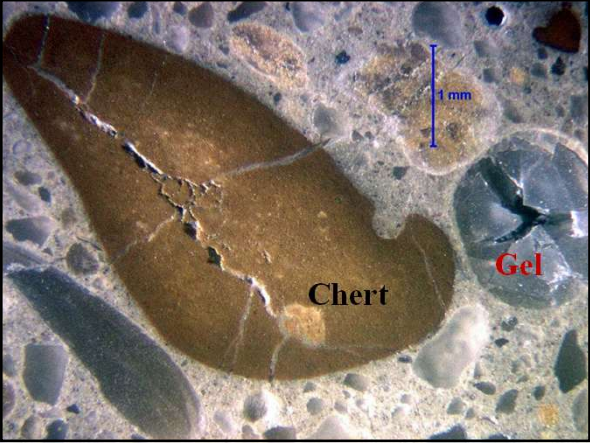
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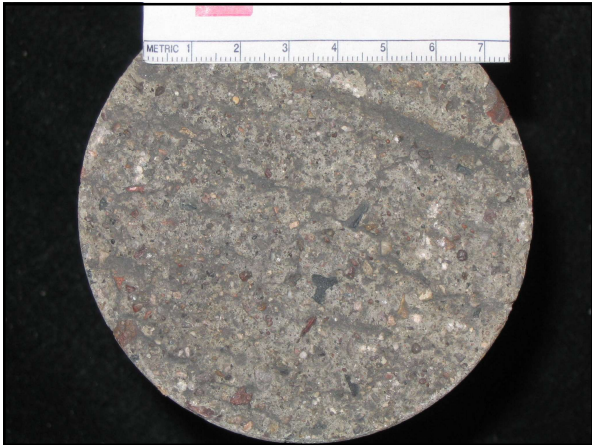
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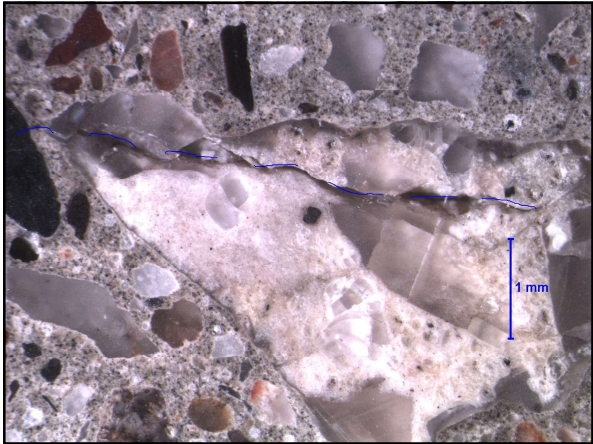
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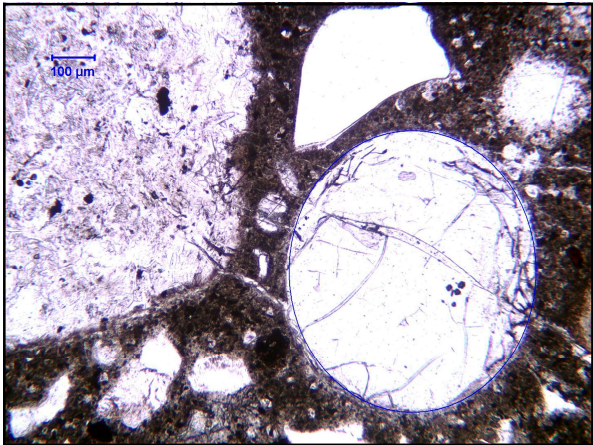
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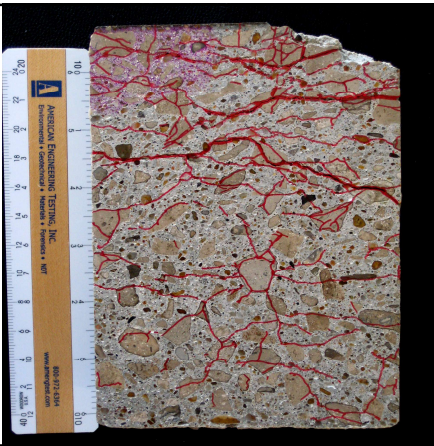
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**Silicified  
Carbonate**



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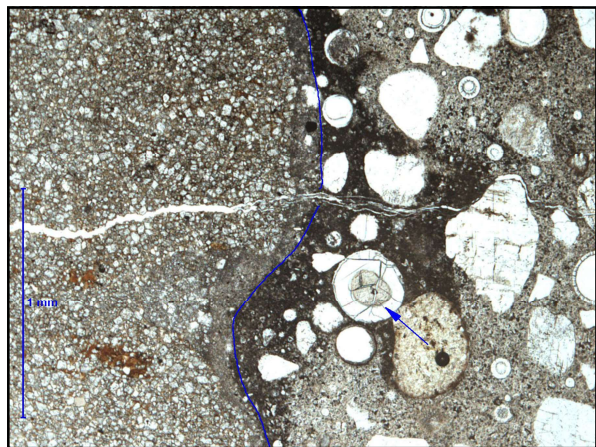
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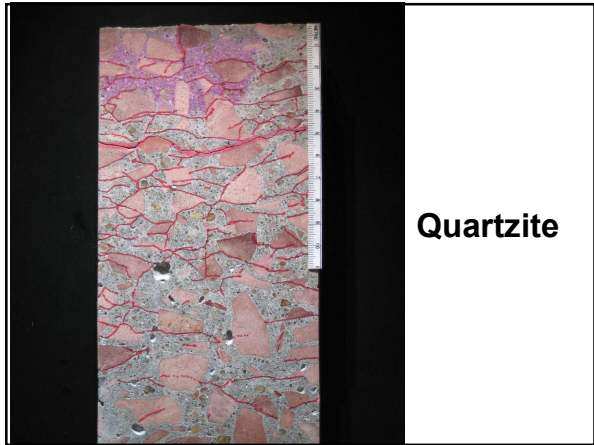
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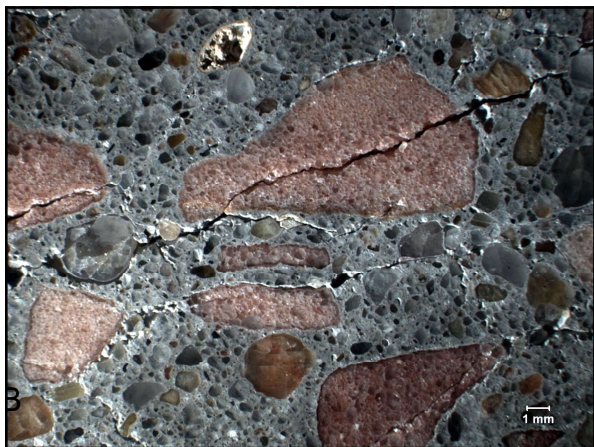
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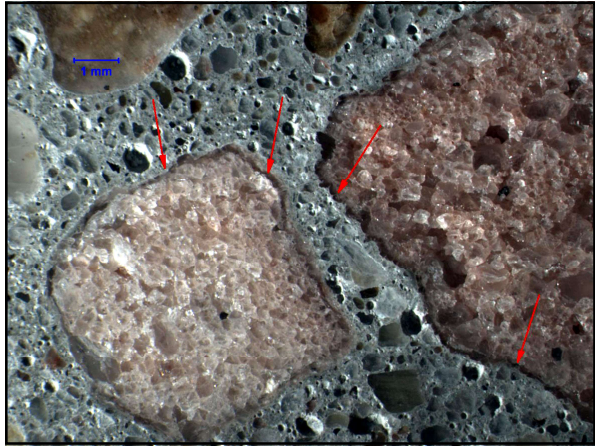
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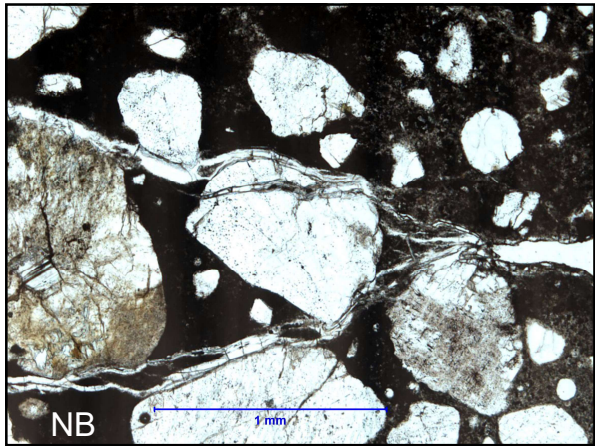
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### Near Surface Aggregate Reactivity

- ASR in the near surface concrete only
- Induced beneath M-S floorings by:
  - high RH
  - conc. of alkalis and OH-
- Produces a defect in flooring bond
- Allows osmotic pressure to produce a liquid-filled blister

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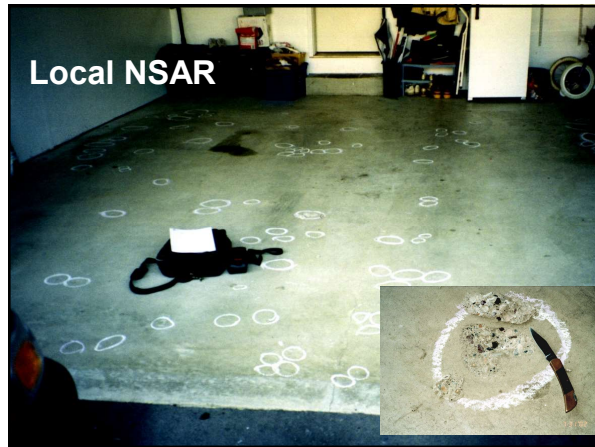
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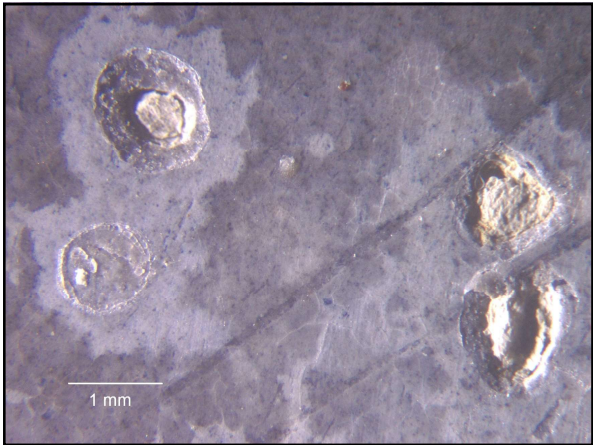
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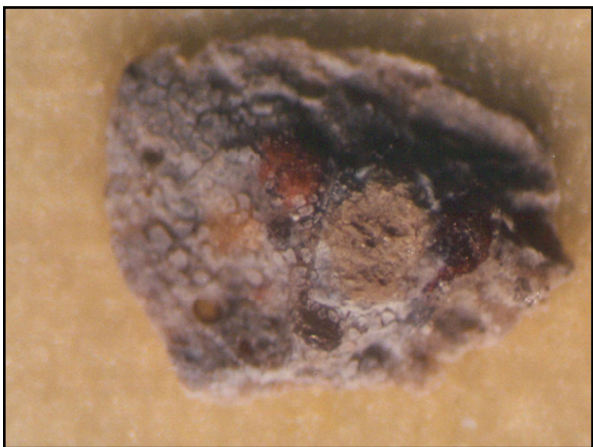
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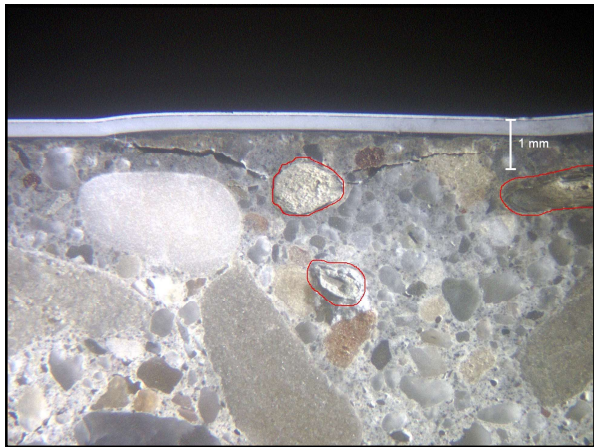
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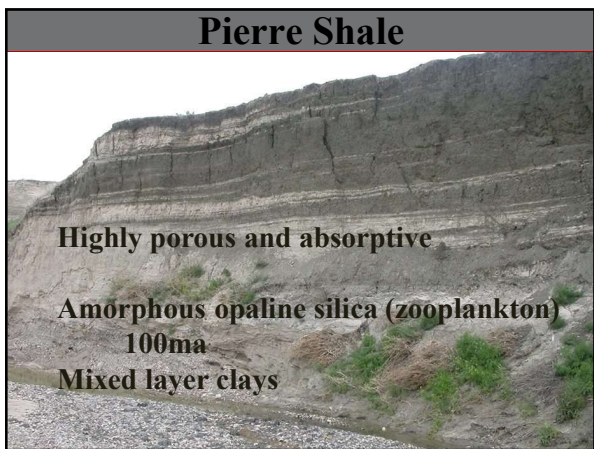
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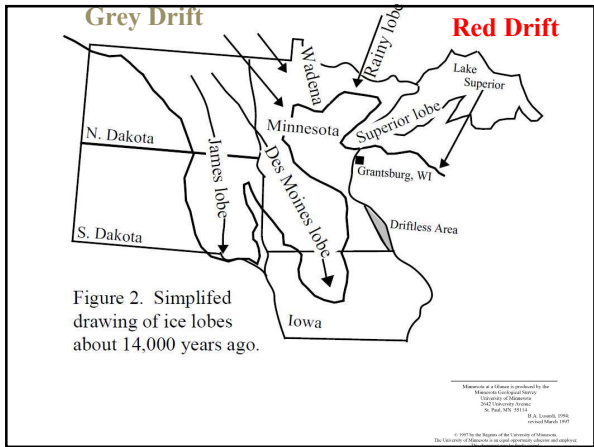
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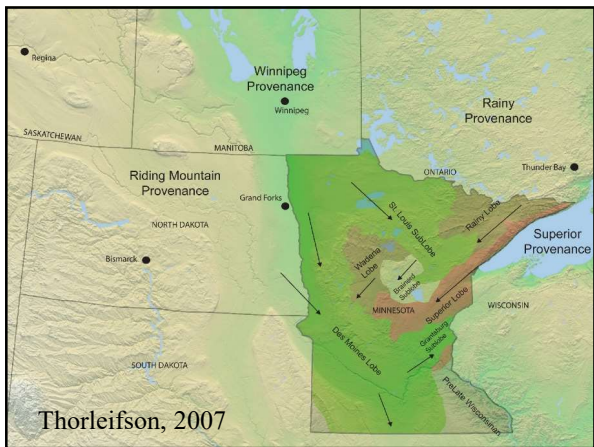
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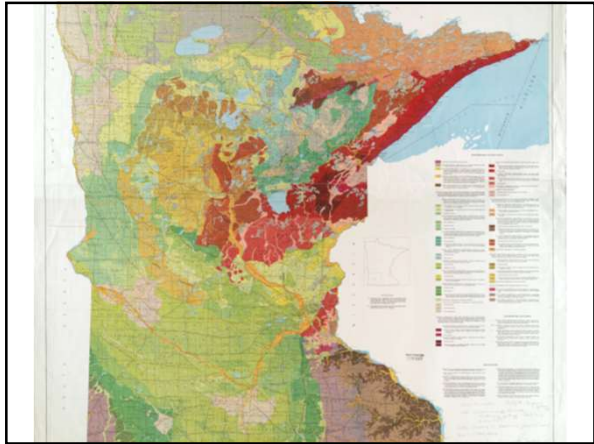
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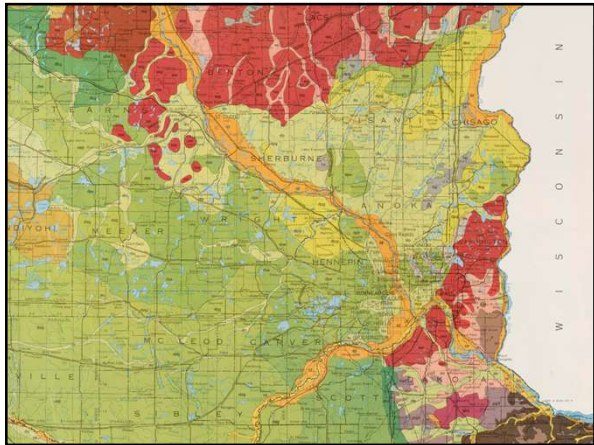
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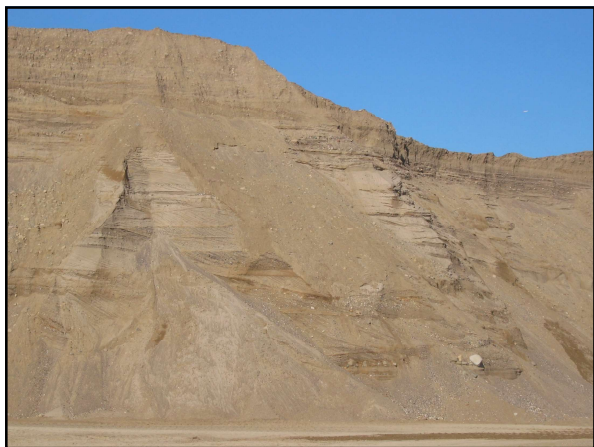
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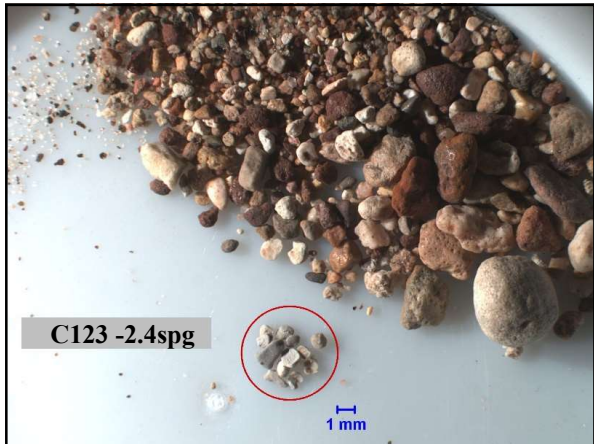
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### ASTM C33 Aggregate Quality

**TABLE 2 Limits for Deleterious Substances in Fine Aggregate for Concrete**

Item	Mass Percent of Total Sample, max
Clay lumps and friable particles	3.0
Coal and lignite:	
Where surface appearance of concrete is of importance	0.5
All other concrete	1.0

 C33/C33M - 18

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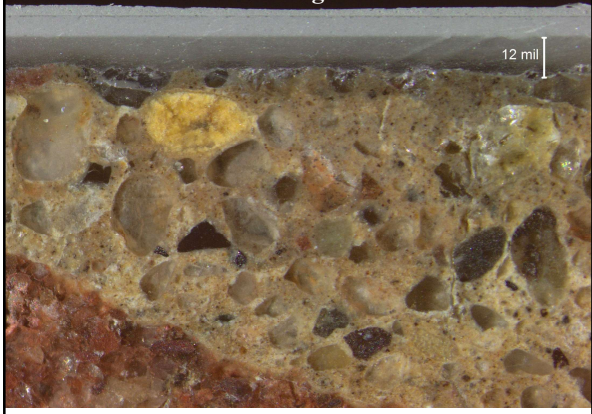


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**Moisture Sensitive Flooring**



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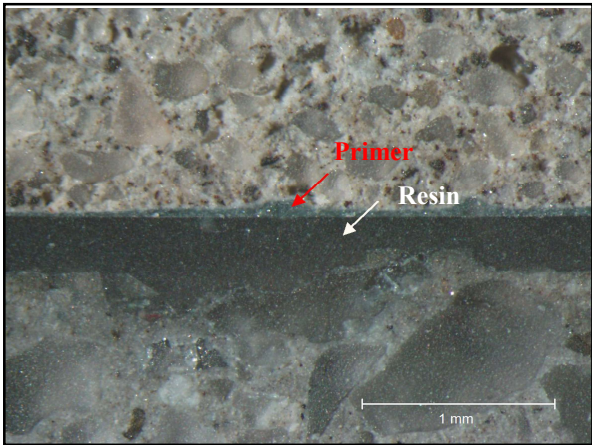
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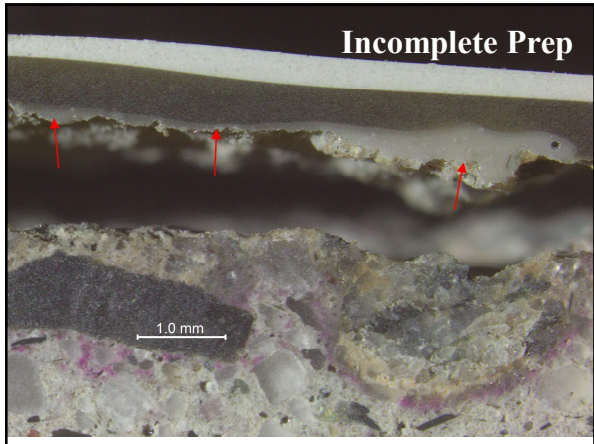
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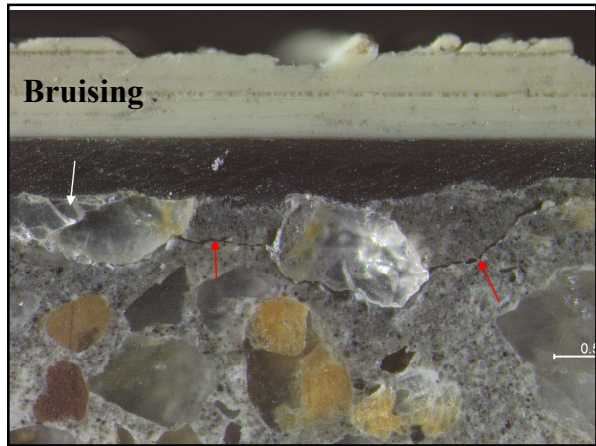
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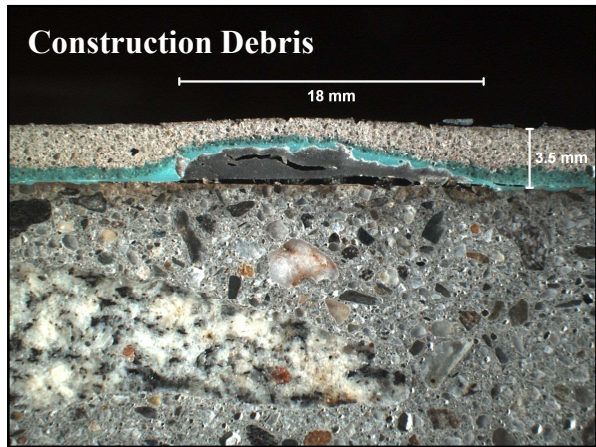
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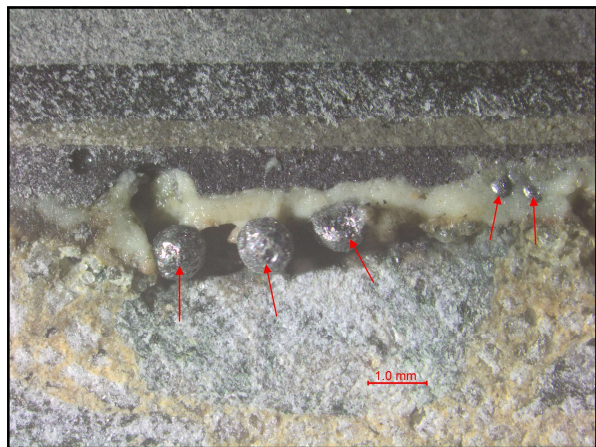
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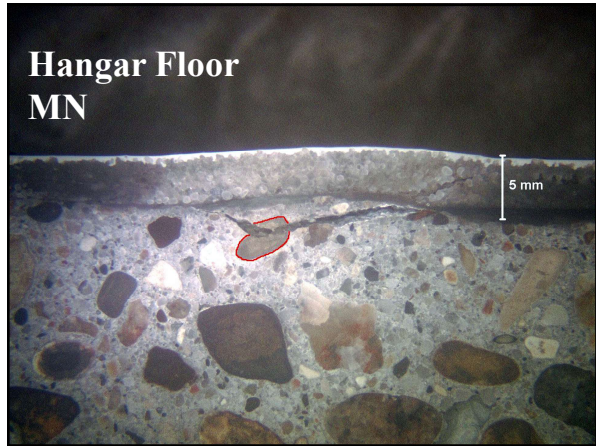
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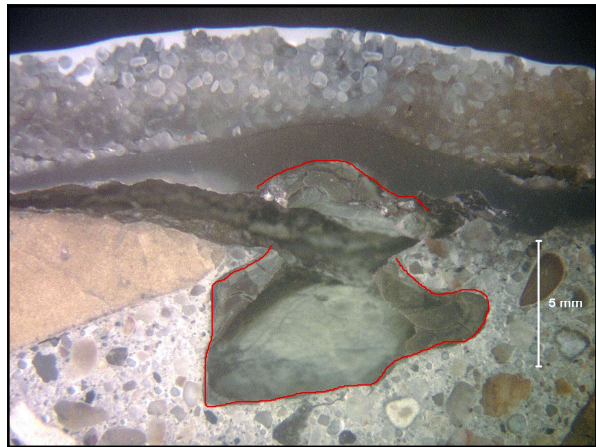
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**Local Commercial Floor – preexisting**

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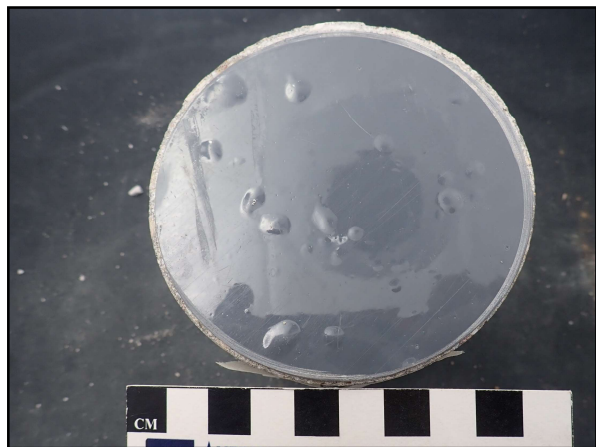
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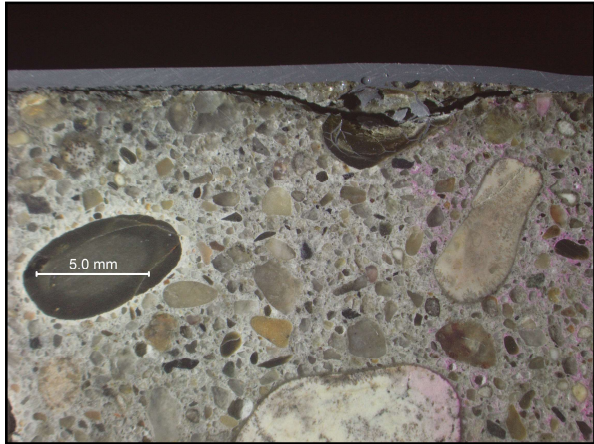
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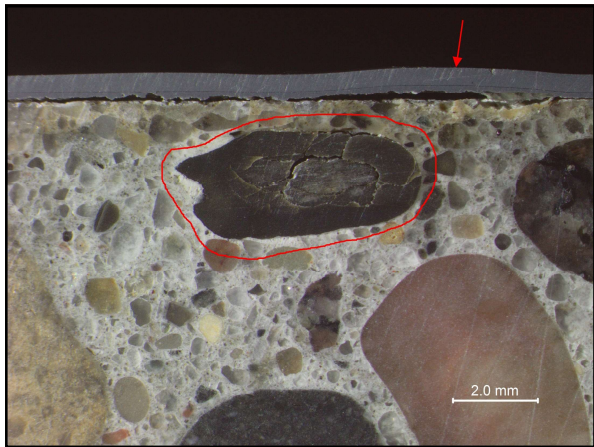
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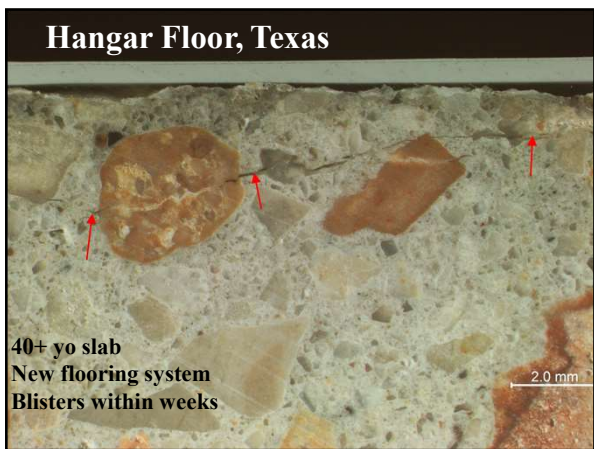
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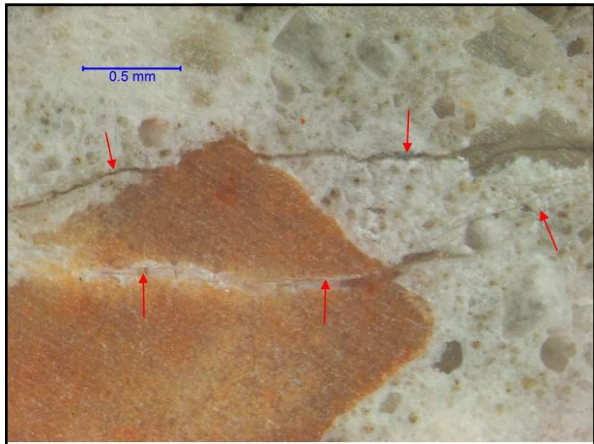
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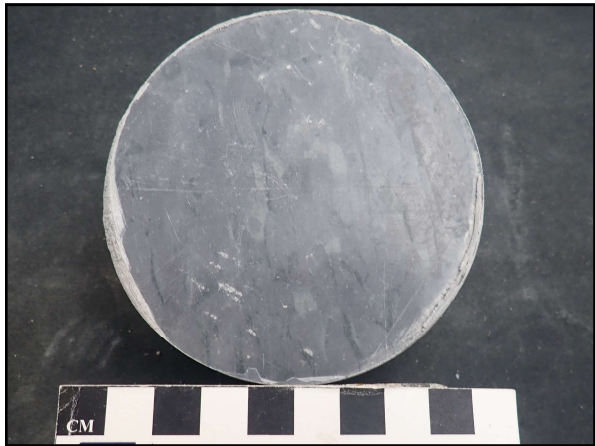
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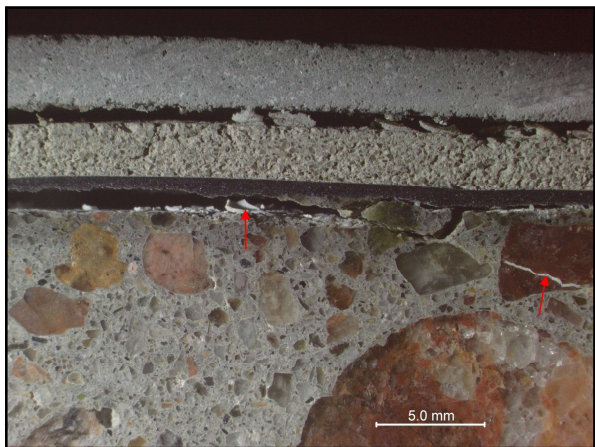
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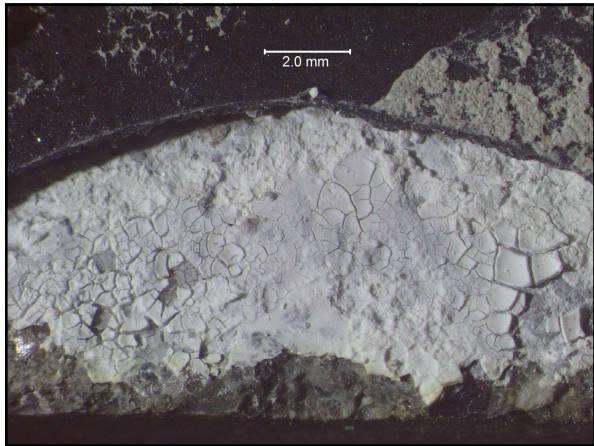
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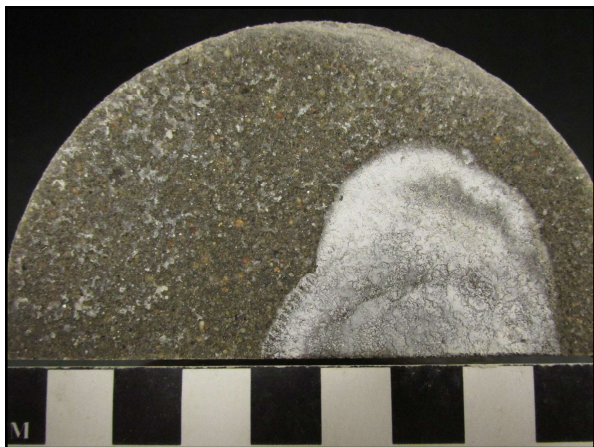
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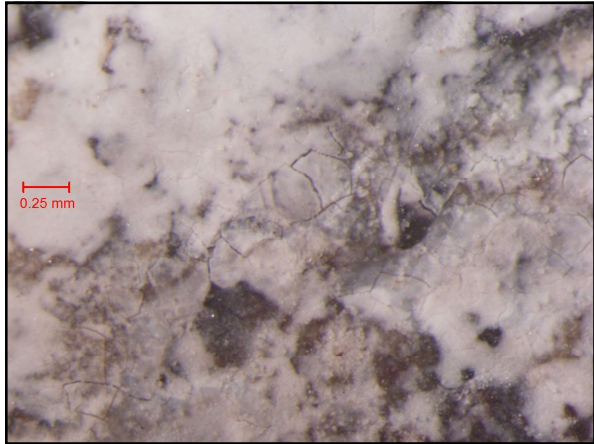
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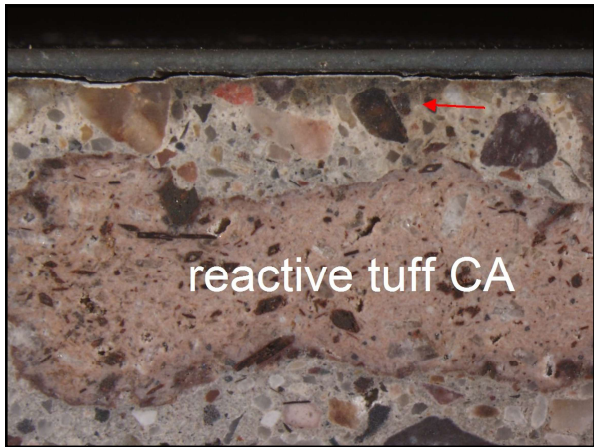
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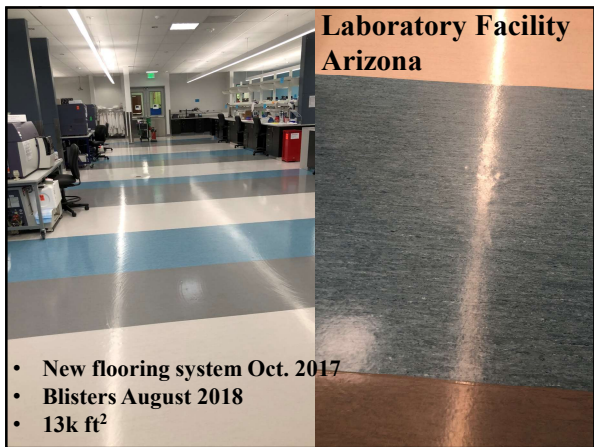
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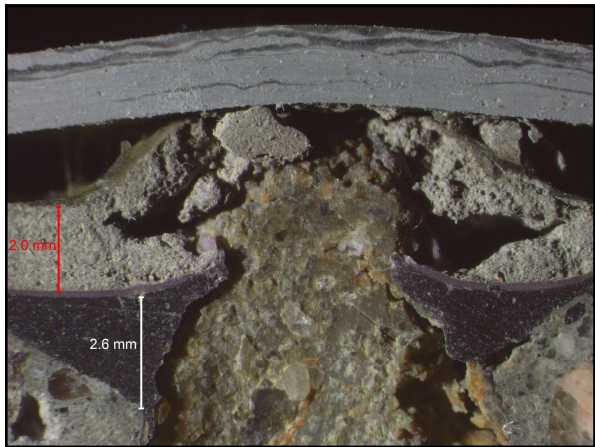
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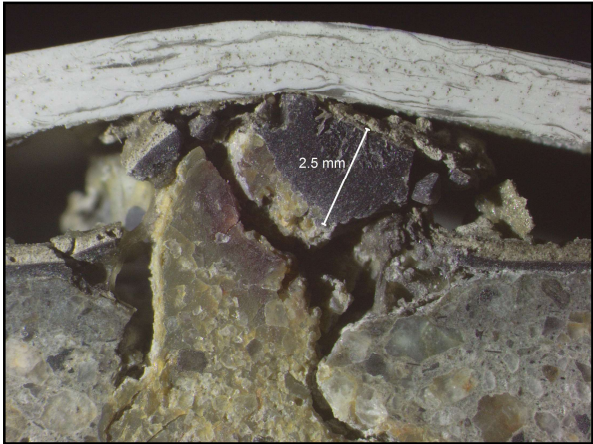
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AMERICA  
ENGINEERING  
TESTING, INC.

Thank You!



Trust *Delivered.*

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