

# ALKALI-SILICA REACTION AT SEABROOK STATION

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## UPDATE ON TESTING PROGRAMS



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# STRUCTURAL TEST FACILITY



# CAPABILITIES

FABRICATION



LARGE SCALE



IN-HOUSE  
MACHINING

IN-HOUSE  
WELDING

TESTING



MULTI-AXIAL

HIGH  
TEMPERATURE



CLOSED LOOP CONTROL

INSTRUMENTATION

HIGH SPEED



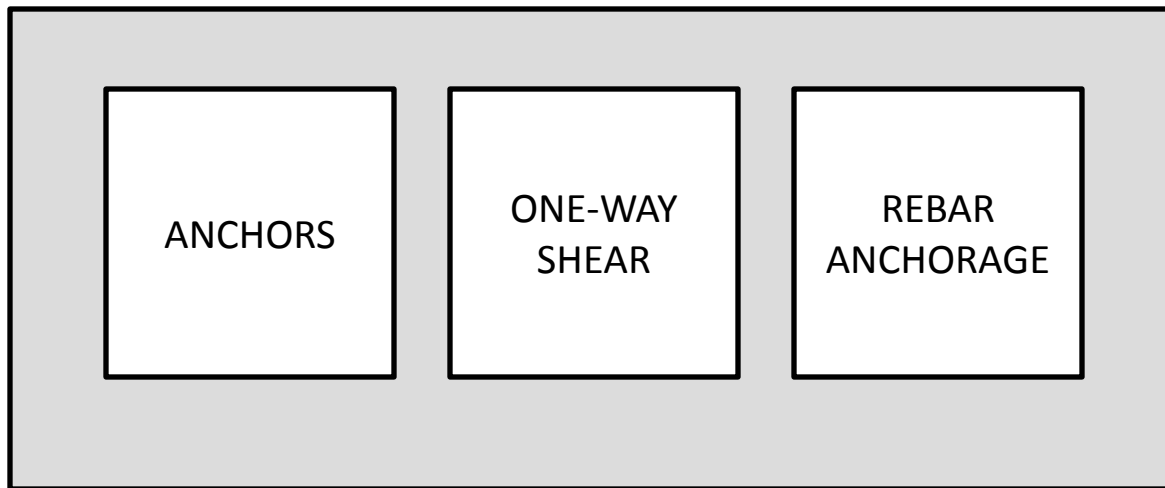
NON-CONTACT



HIGH PRECISION

# AGENDA

## SEABROOK TESTING PROGRAMS



# ANCHOR PROGRAM

# ANCHOR PROGRAM

## Wedge Anchors



Large size anchors, deep embedment



Medium size anchors , medium embedment



Small size anchors , shallow embedment

## Undercut Anchors



Medium size anchors, deep embedment



Medium size anchors, medium embedment

Half of all ASR-affected anchors installed before development of ASR.

# ANCHOR PROGRAM



Deep Anchor Test Setup



Shallow Anchor Test Setup

# PROGRESS TO DATE

Specimen fabrication completed October 2012.

Control tests completed in November 2012.

Post-installed anchors tested at low level of ASR in  
November 2013.

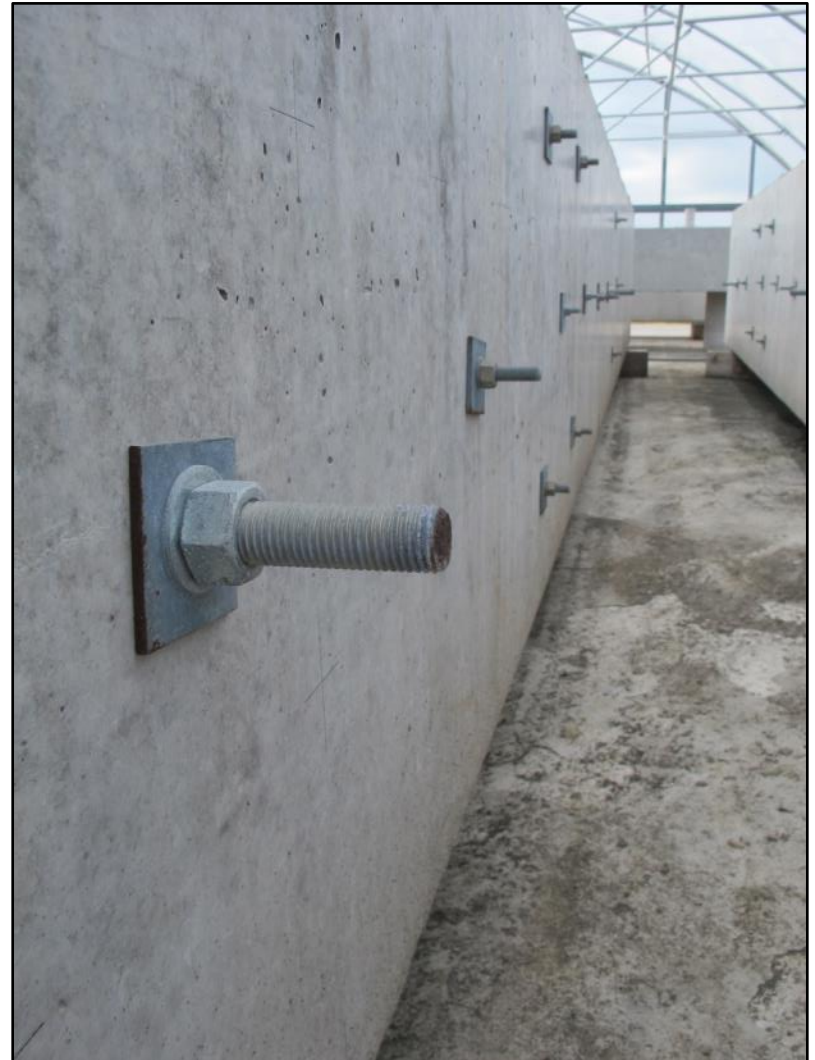
Deep Anchor Test Setup

Shallow Anchor Test Setup



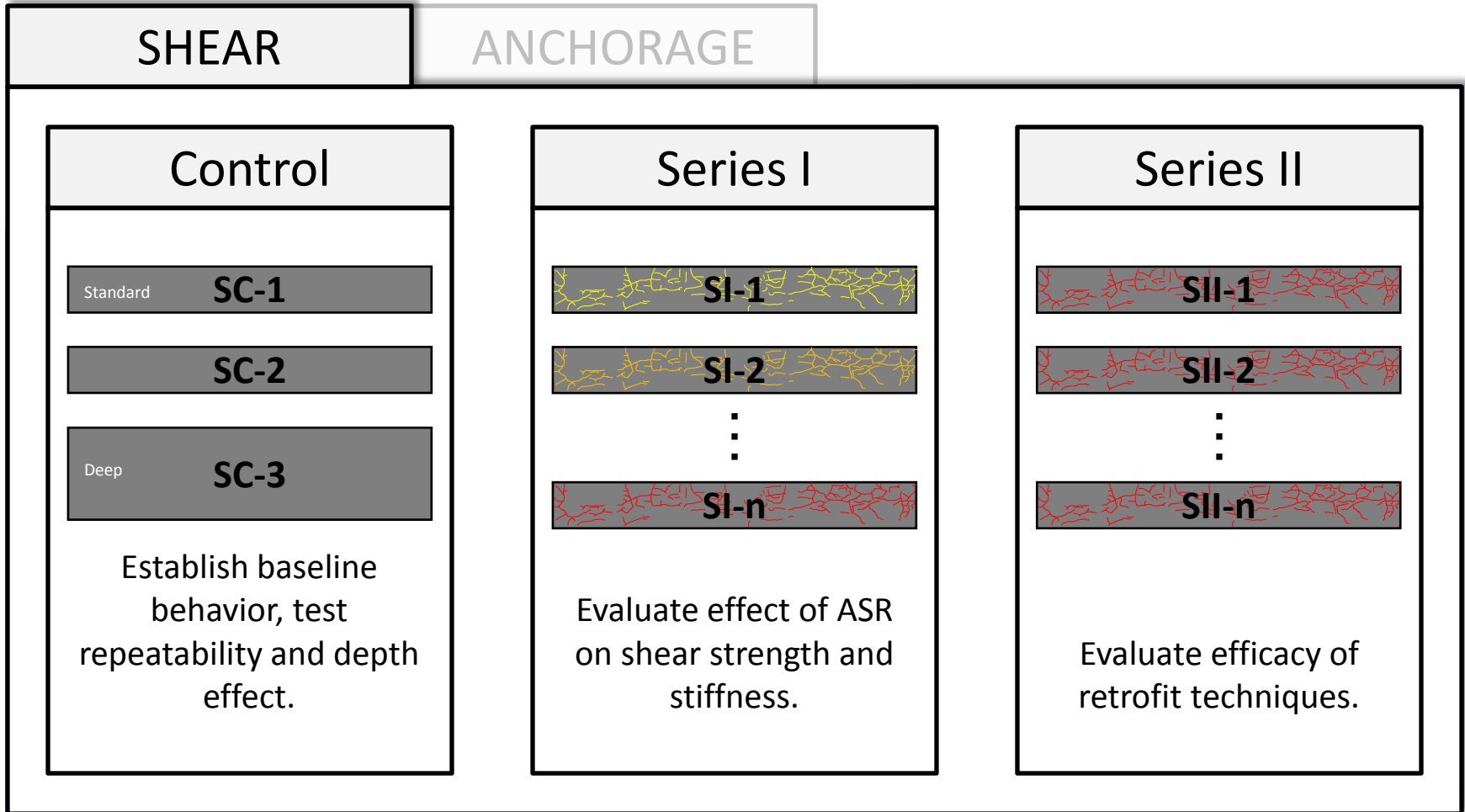
# OUTLOOK

- Environmental conditioning of blocks and beams is ongoing at FSEL
- Testing of pre-installed anchors at a low level of ASR is to be completed in December 2013.

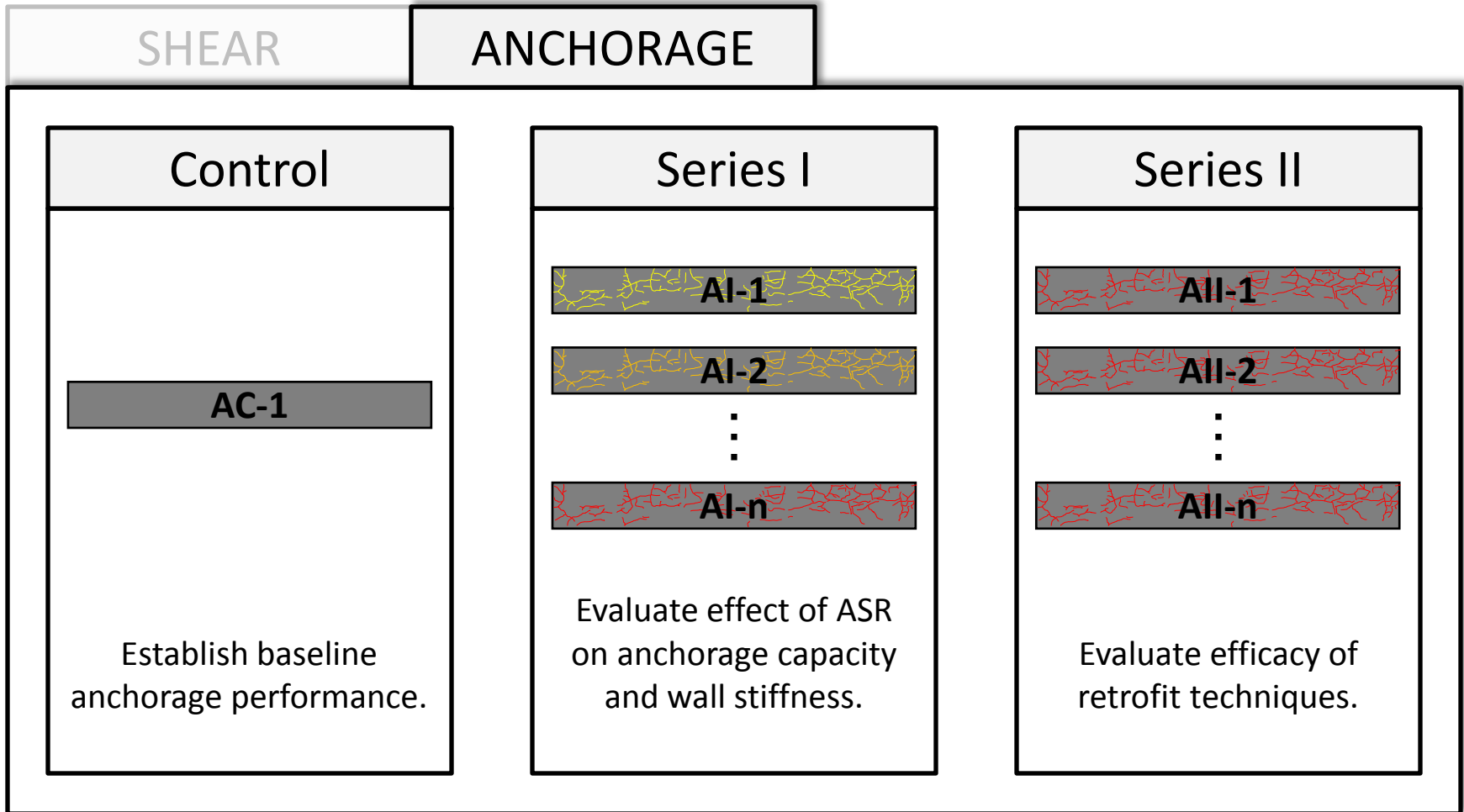


# BEAM PROGRAM

# BEAM PROGRAM



# BEAM PROGRAM



# REPLICATION OF SEABROOK DETAILS

The reinforcement detailing...

... represents the lack of through-thickness reinforcement within structural walls

... will enable focused study of shear and anchorage behavior at current and future levels of ASR

# REPLICATION OF SEABROOK DETAILS

The concrete mixture...

... was developed through trial batching with representative coarse and fine aggregates

... is sufficiently reactive to obtain the necessary data in a timely manner

... yields mechanical properties that are representative of Seabrook structures

# CONCRETE MATERIALS



Santa Ana CA  
Lafarge Aggregates  
Bernalillo, NM



Jobe  
Cemex  
El Paso, TX



Type I/II  
Dragon Cement  
Thomaston, ME



Maine  
Pike Industries  
Westbrook, ME

# BEAM PROGRAM WORKFLOW





# AGGREGATE DELIVERY



# AGGREGATE STORAGE



# SIEVE ANALYSIS



# FABRICATION AREA



# CAGE FABRICATION



# FORMWORK



# READY MIX TRUCK



# AGGREGATE BATCHING EQUIPMENT





# AGGREGATE BATCHING



# AGGREGATE MOISTURE CORRECTION



# SODIUM HYDROXIDE ADDITION



# WATER ADDITION



# CEMENT BATCHING



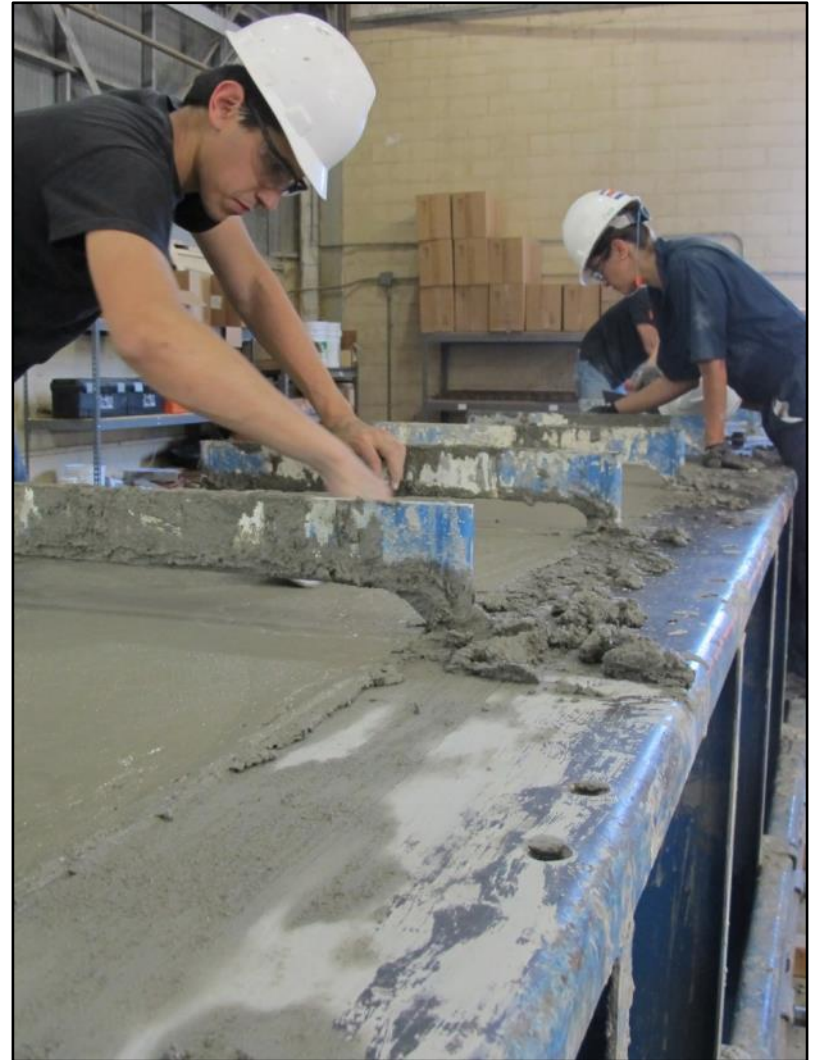
# CONCRETE SAMPLING EQUIPMENT



# SLUMP TESTING



# CONCRETE PLACEMENT





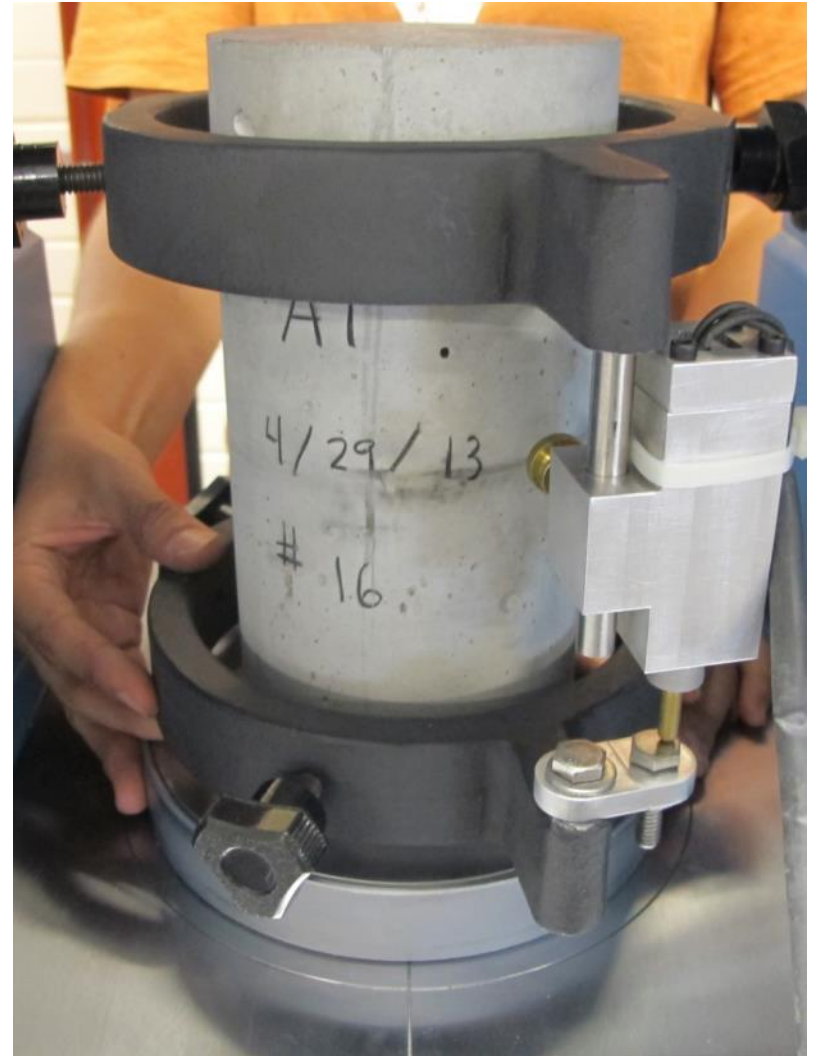
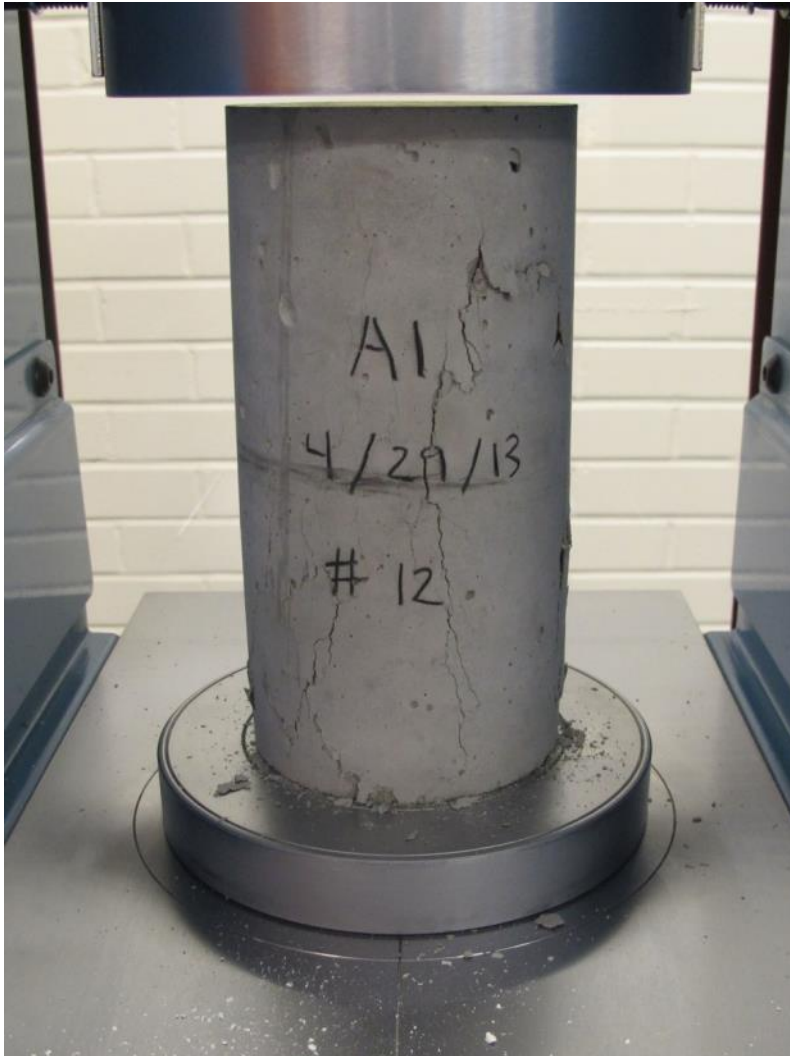
# BEAM IDENTIFICATION



# CURING



# COMPRESSION TESTING



# HANDLING



# CONDITIONING



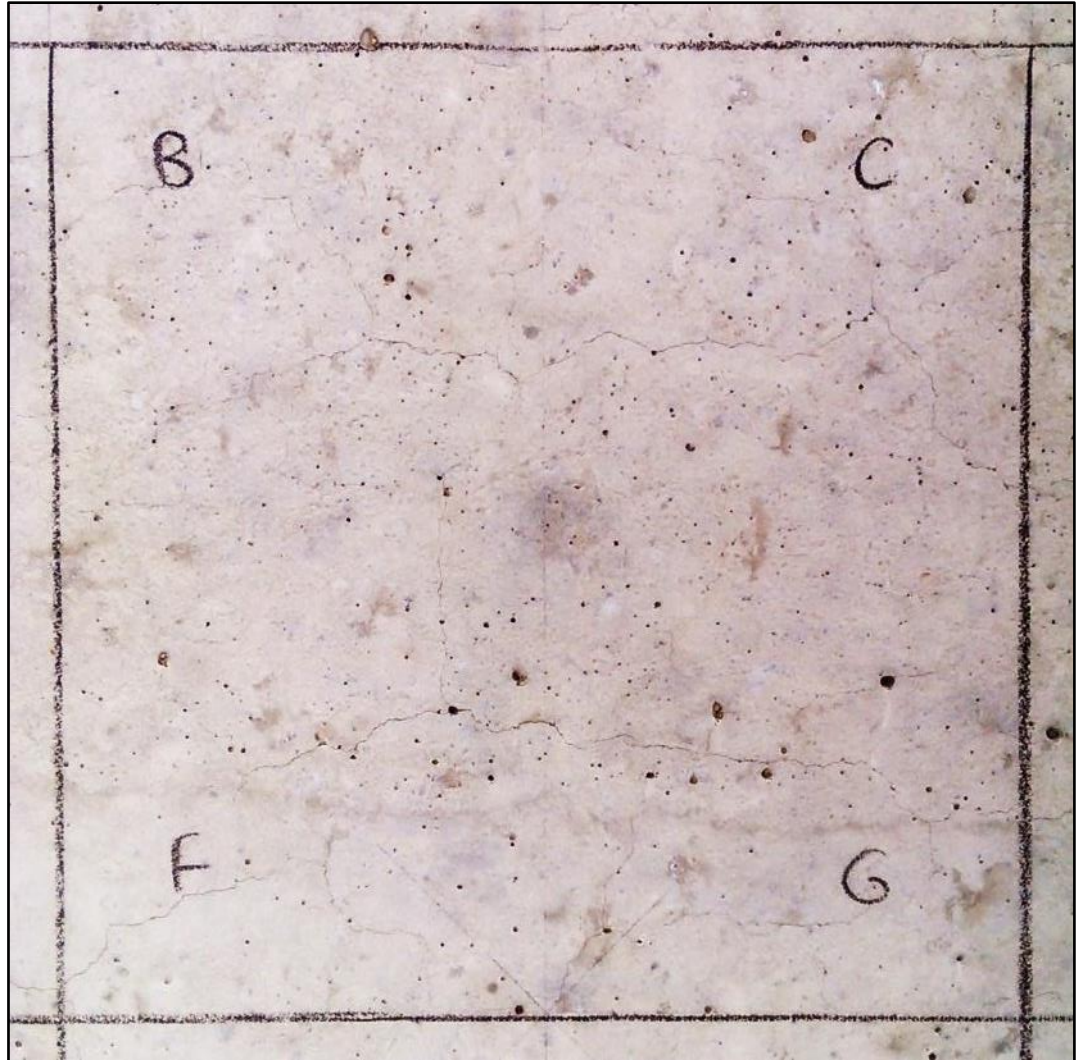
# EXPANSION MONITORING GRID



# EXPANSION MEASUREMENT

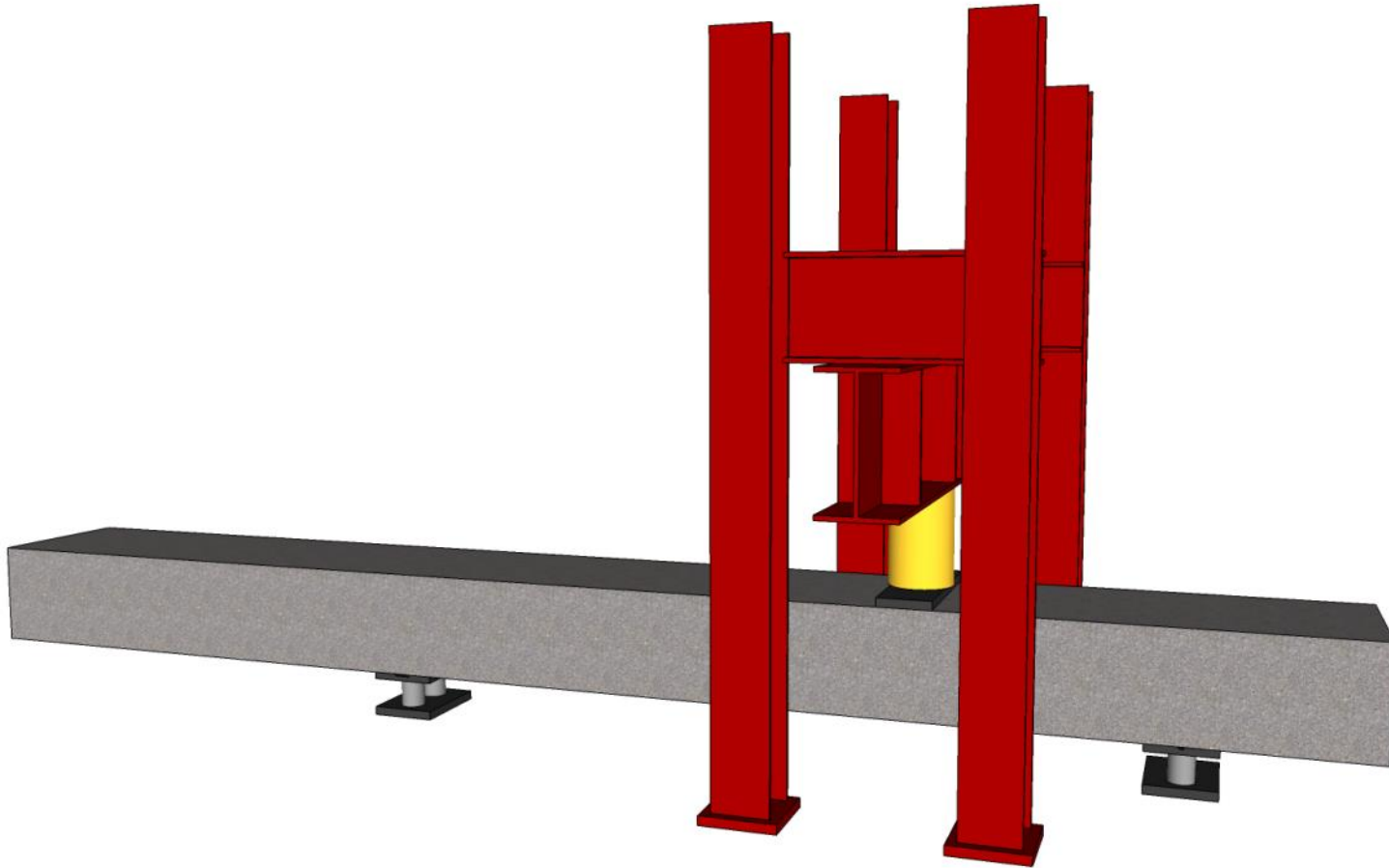


# CRACK MEASUREMENT

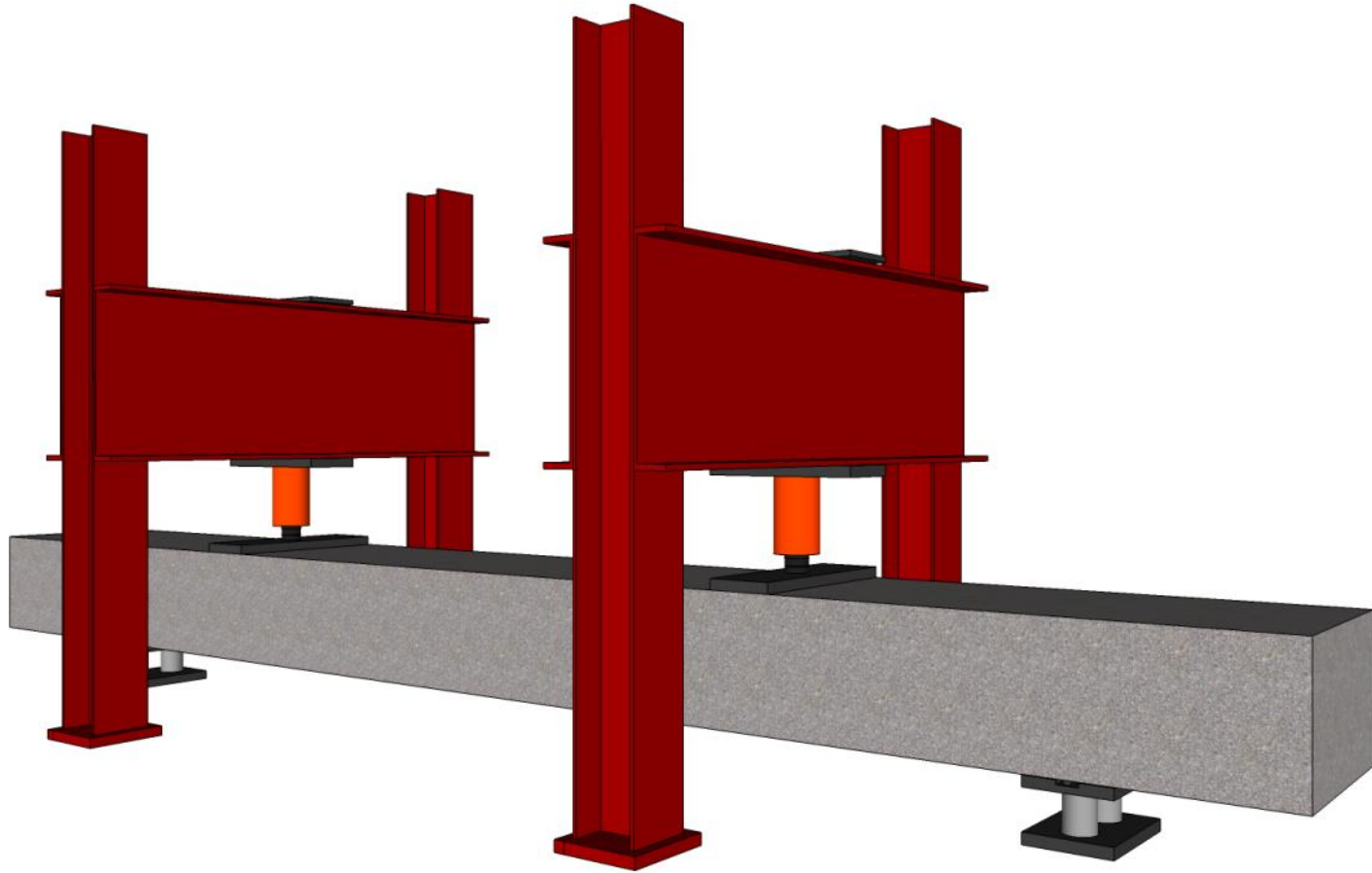




# SHEAR TESTING



# ANCHORAGE TESTING



# PROGRESS / OUTLOOK

SHEAR	ANCHORAGE	
<p>Control</p> <p>Standard SC-1</p> <p>1<sup>st</sup> control test currently scheduled for Q1 of 2014.</p> <p>Establish baseline behavior, test repeatability and depth effect.</p>	<p>Series I</p> <p>SI-1</p> <p>SI-2</p> <p>2/3 of the shear beams fabricated.</p> <p><i>Fabrication, conditioning and monitoring efforts to continue until desired levels of ASR are achieved.</i></p> <p>Evaluate effect of ASR on shear strength and stiffness.</p>	<p>Series II</p> <p>SII-1</p> <p>SII-2</p> <p>Evaluate efficacy of retrofit techniques.</p>

# PROGRESS / OUTLOOK

SHEAR	ANCHORAGE	
<p>Control</p> <p>1<sup>st</sup> control test currently scheduled for Q1 of 2014.</p> <p>Establish baseline anchorage performance.</p>	<p>Series I</p> <p>2/3 of the anchorage beams fabricated.</p> <p>AI-2</p> <p>⋮</p> <p><i>Fabrication, conditioning and monitoring efforts to continue until desired levels of ASR are achieved.</i></p> <p>Evaluate efficacy of retrofit techniques on anchorage capacity and wall stiffness.</p>	<p>Series II</p> <p>AII-2</p> <p>⋮</p> <p><i>Fabrication, conditioning and monitoring efforts to continue until desired levels of ASR are achieved.</i></p> <p>Evaluate efficacy of retrofit techniques.</p>

Thank you!