



2019 NETC Symposium

Grappone Conference Center

Concord, NH

June 19, 2019

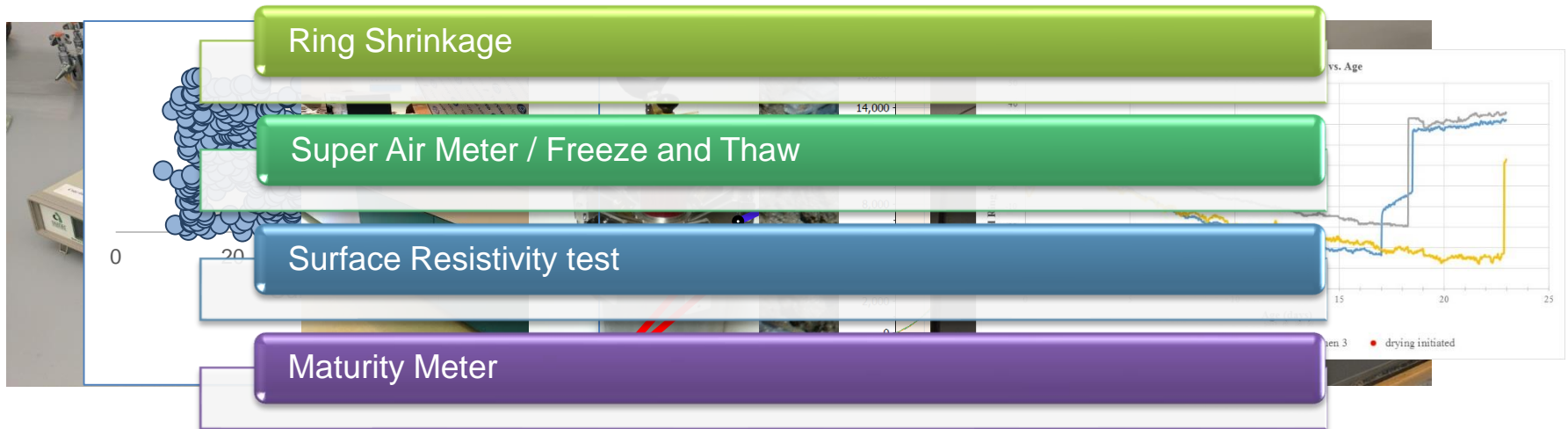
Advancements in Cement Concrete Research and Testing

John Grieco –Director of R&M



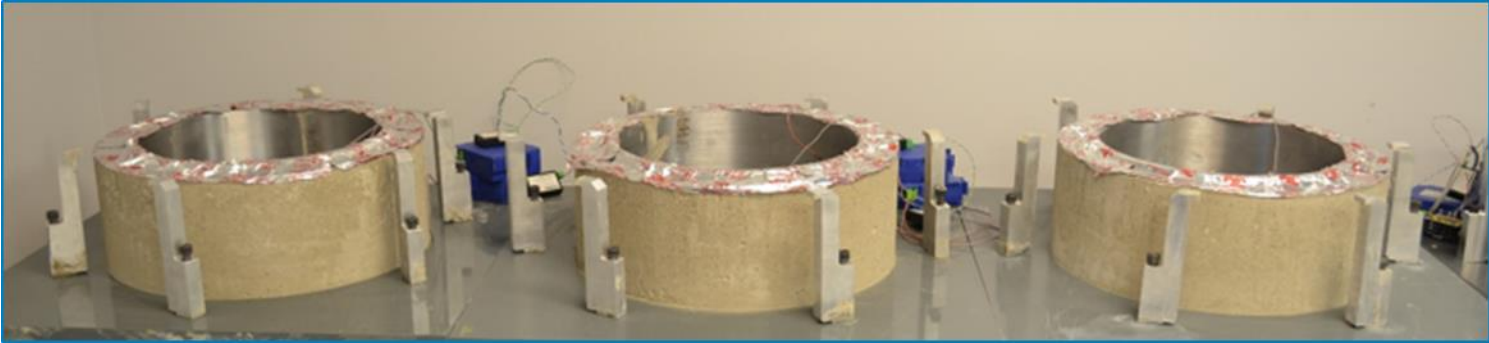
Summary

A need arises to incorporate
Different types of methods and technologies

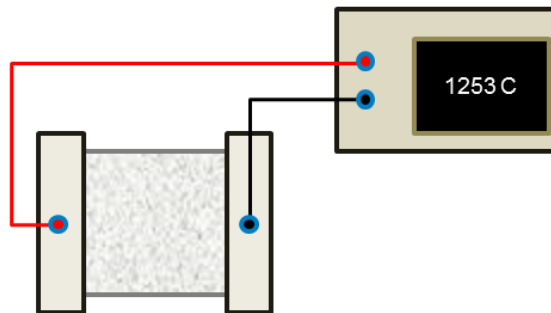


for the evaluation of **quality characteristics** and **mix properties of concrete** used for MassDOT construction projects

What has R&M been Focused on



RCPT – 2 day process



Freeze Thaw Damage

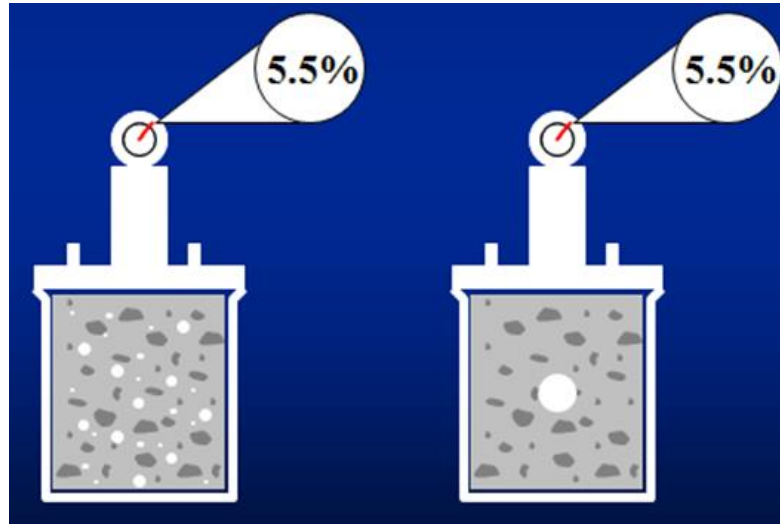


Freeze Thaw Testing



- Takes on average 100 days
- Cannot be reproduced in the field

Super Air Meter



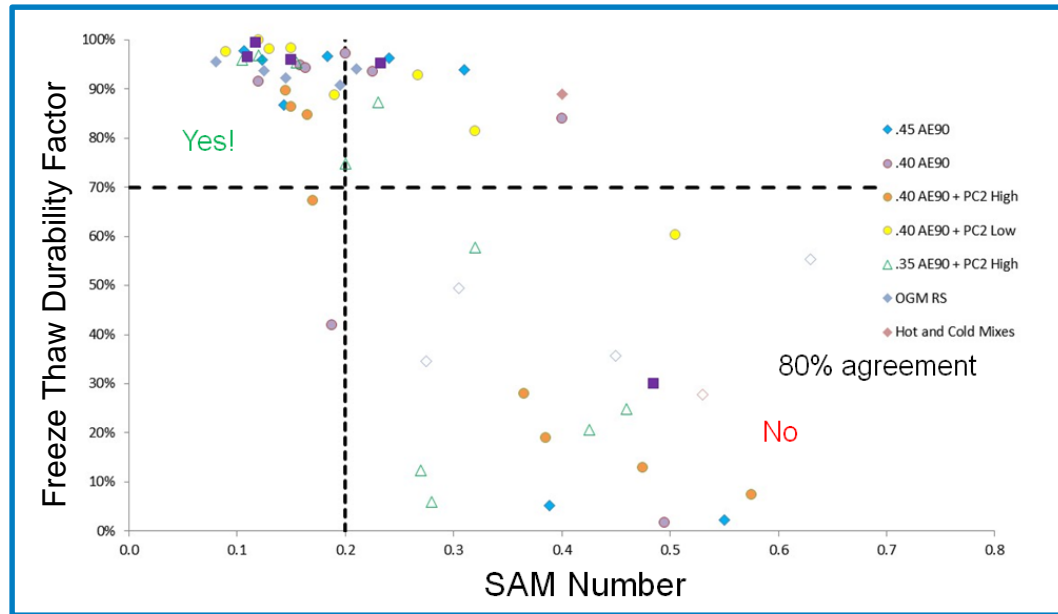
❑ Air Meter Type B

- Can only measure total air content

❑ Super Air Meter

- Provides air content
- SAM number

Super Air Meter / Freeze Thaw



□ Study by Dr. Tyler Ley, Oklahoma State University

Continuing the Research

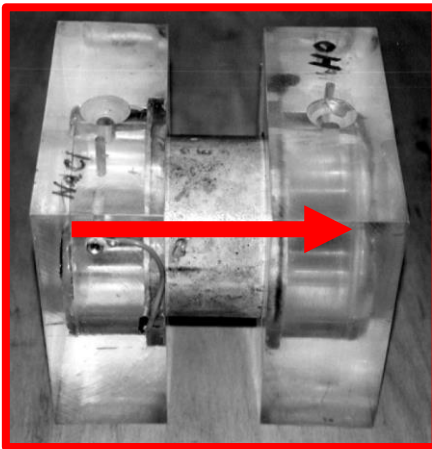


Surface Resistivity Test

Description of the methodologies to determine the permeability of concrete

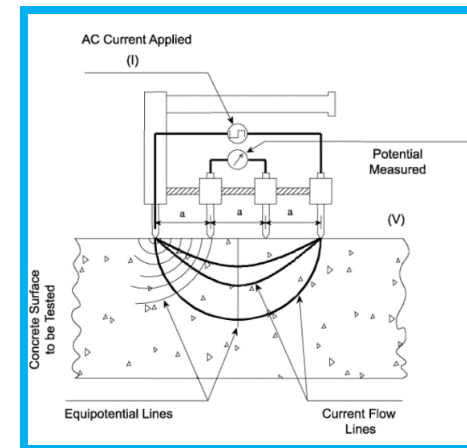
Rapid Chloride Penetrability Test AASHTO T 277

- ❖ Cumulative Current Passing
- ❖ Created in the 1970s
- ❖ Destructive
- ❖ Concrete Age: 90 days
- ❖ Aprox. 2 work days per set
- ❖ High cost



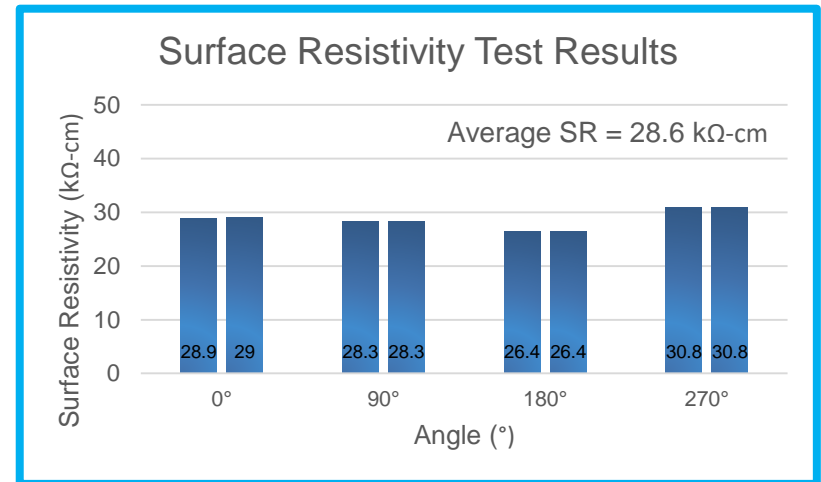
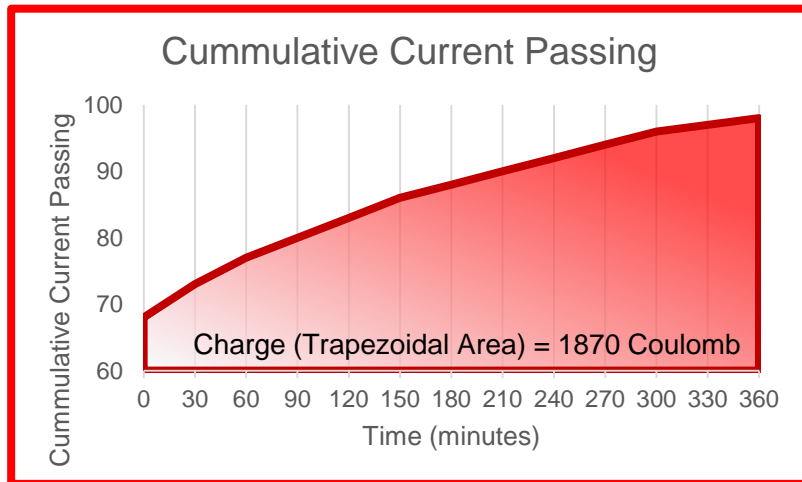
Surface Resistivity Test AASHTO T 358

- ❖ Electrical Resistivity
- ❖ Created in the 2000s
- ❖ Non-destructive
- ❖ Concrete Age: 28 days
- ❖ Aprox. 2 minutes per set
- ❖ Low cost



Surface Resistivity Test

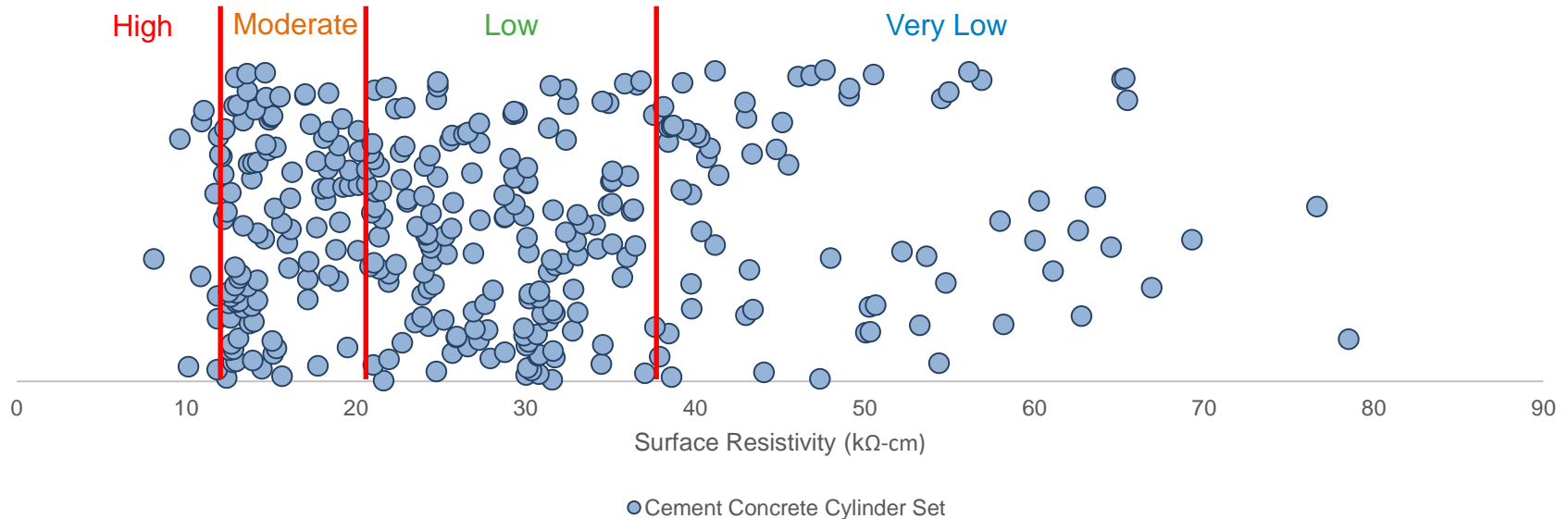
Description of the methodologies to determine the permeability of concrete



Chloride Permeability	Surface Resistivity (kΩ-cm) 100 by 200 mm (4 by 8 in.)	Charge Passed (C)
High	< 12	> 4000
Moderate	12-21	2000-4000
Low	21-37	1000-2000
Very Low	37-254	100-1000
Negligible	> 254	< 100

Surface Resistivity Test

28-day Concrete Cylinder Sets Surface Resistivity Results
Summer 2018

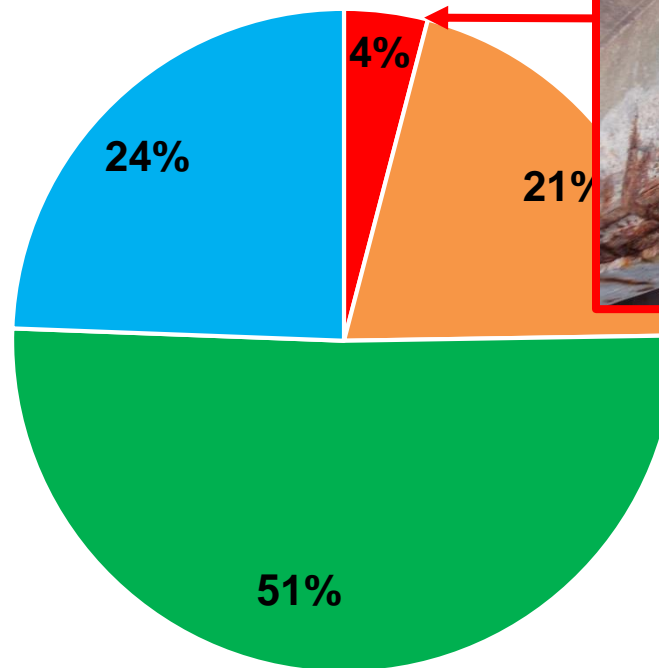


Chloride Permeability	Surface Resistivity Test 100 by 200 mm (4 by 8 in.)
High	< 12
Moderate	12-21
Low	21-37
Very Low	37-254
Negligible	> 254

Surface Resistivity Test

While mixes are showing **low permeability**, some mixes have **excess of paste content**

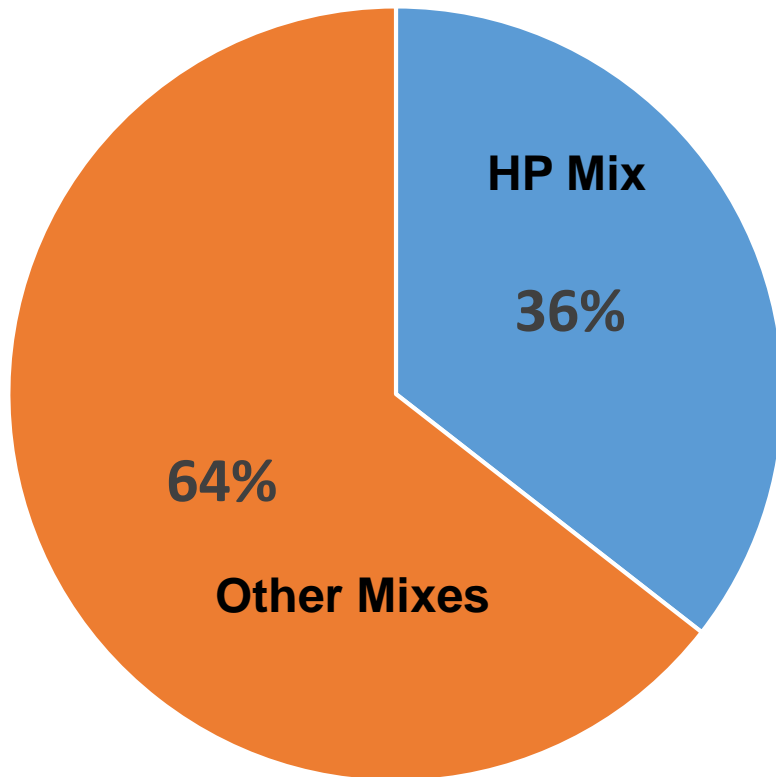
Overall 28-day Concrete Cylinder Sets Surface Resistivity Results Summer 2018



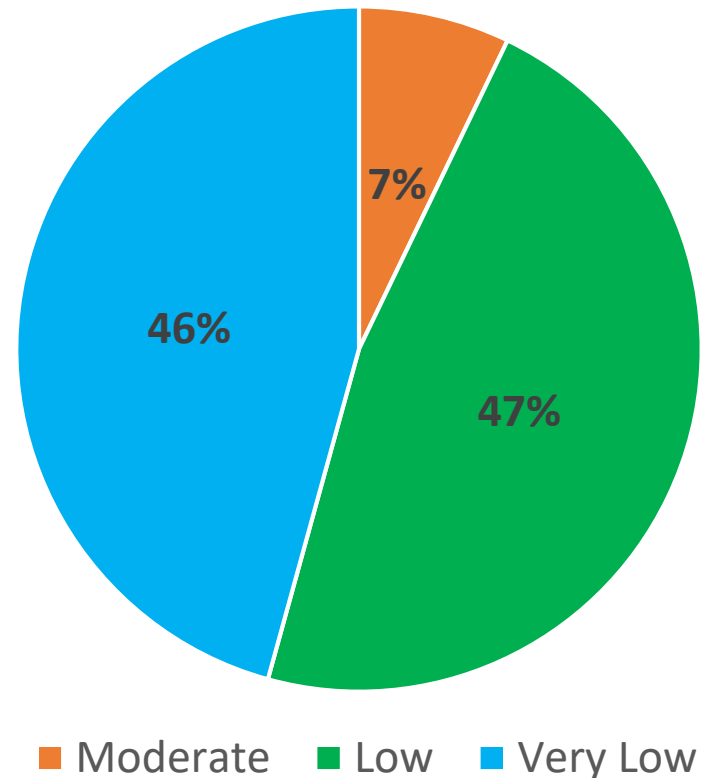
Permeability ■ High ■ Moderate ■ Low ■ Very Low

Surface Resistivity Test

SRT 28 Day Samples Concrete Mixes



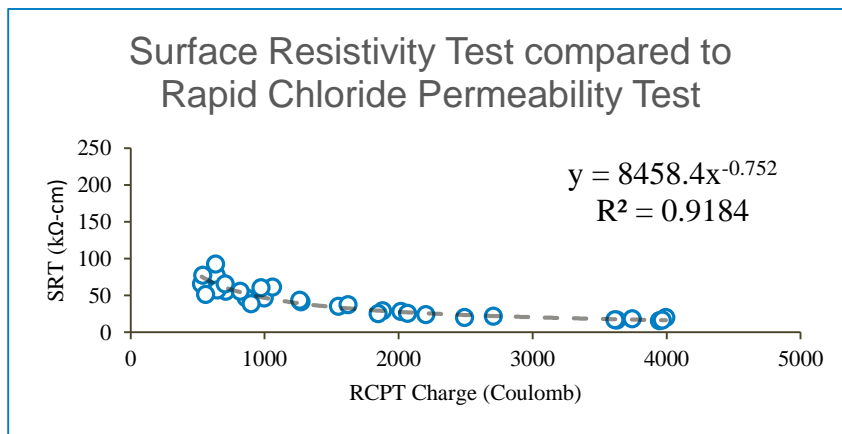
SRT Results for 28 Day HP Mixes



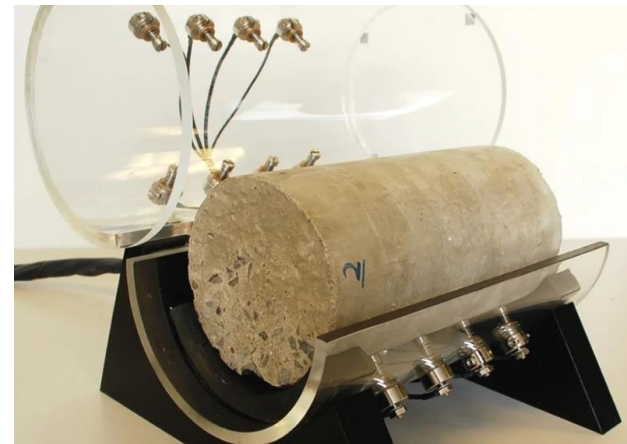
Surface Resistivity Test

Why is the Surface Resistivity Test an alternative to the Rapid Chloride Penetrability Test?

Reliable



Non-Destructive



Reference: Giatec Scientific Inc.

Fast Paced



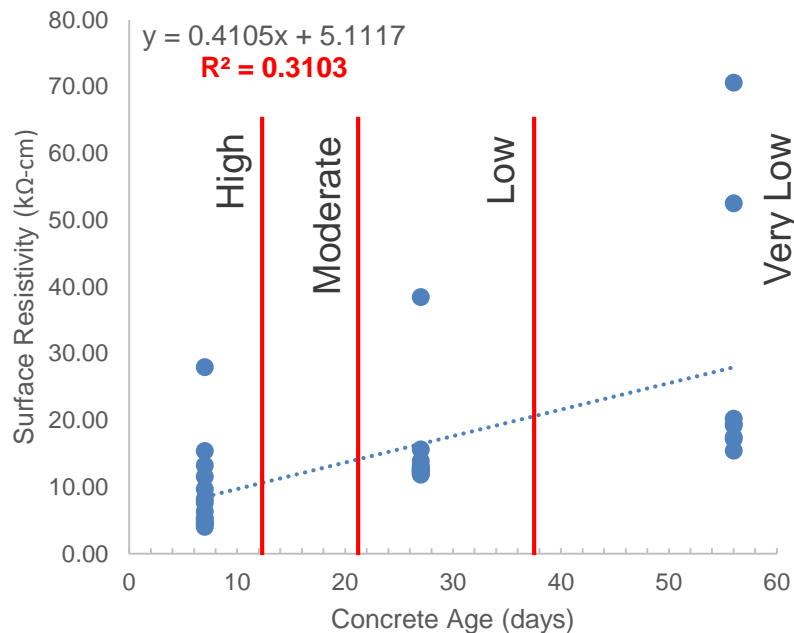
Cost Effective



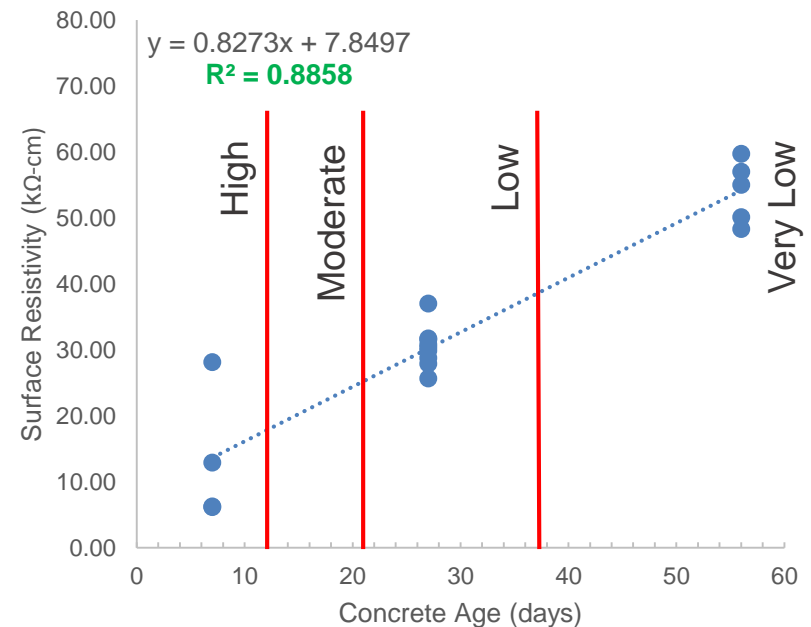
Surface Resistivity Test

How consistent are the SRT results when evaluating Concrete Mixes by Industry?

“Conventional” MassDOT Construction Mixes SRT Evaluation for a Single Industry



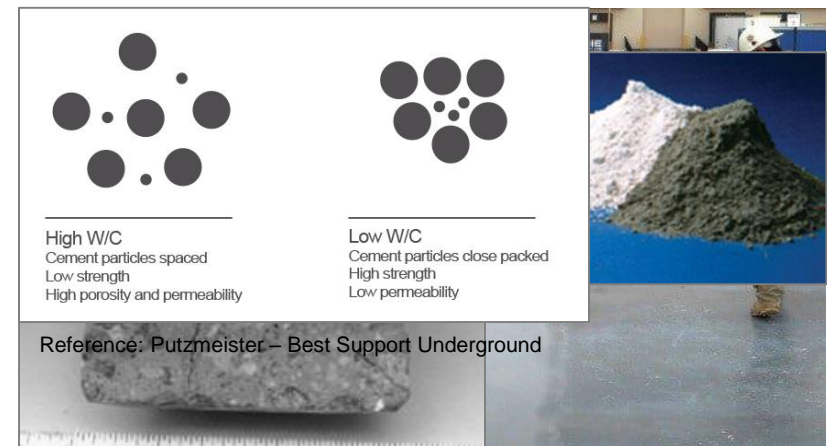
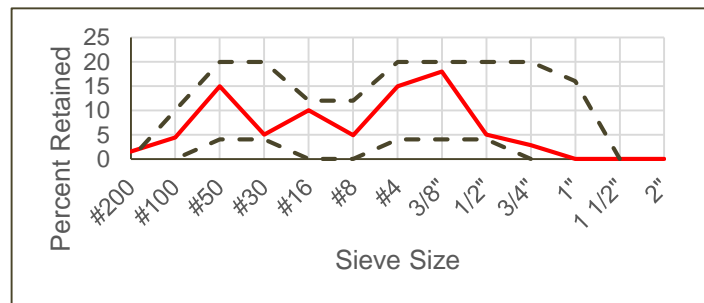
“HP” MassDOT Construction Mixes SRT Evaluation for a Single Industry



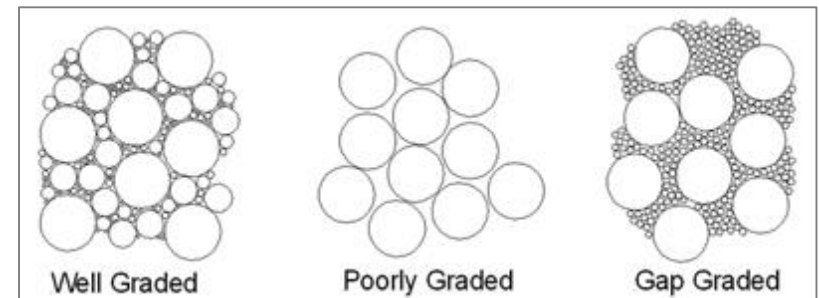
Surface Resistivity Test (SRT)

How can we lower permeability (increase durability)?

- ❑ Lower water/cement ratio
- ❑ Use Supplementary Cementitious Materials (SCMs)
- ❑ Control paste volume to minimize cracking
- ❑ Optimize the gradation of the coarse and fine aggregate (Tarantula Curve)
- ❑ Perform good curing practices



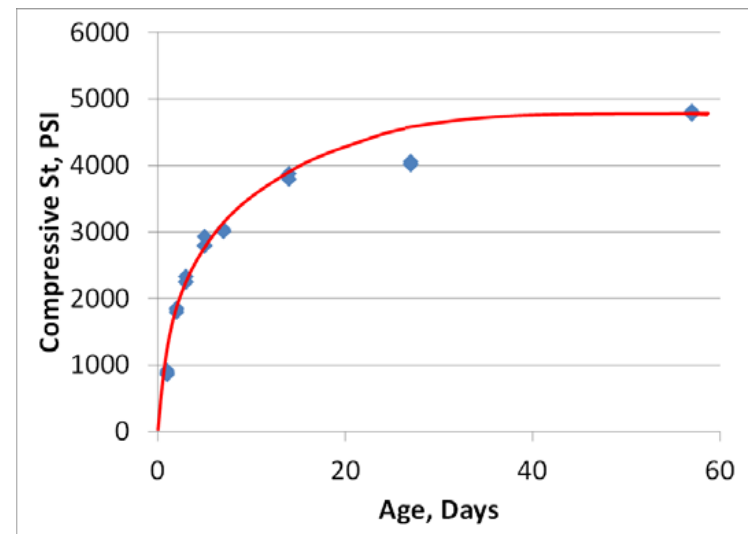
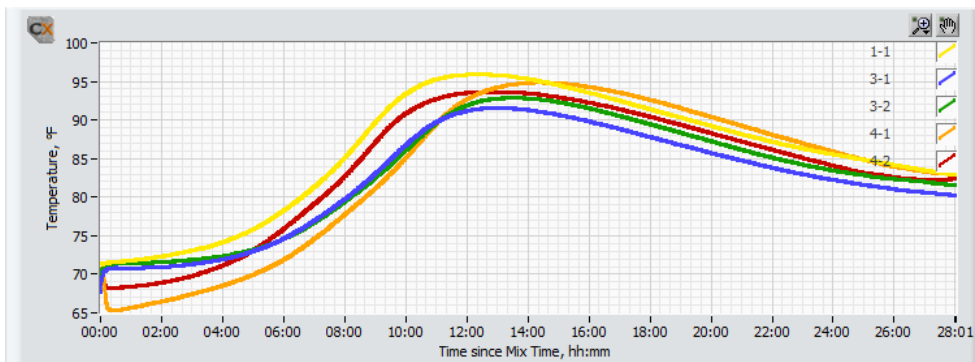
Reference: FHWA



Reference: The Concrete Countertop Institute

Maturity Meters

- ☐ Time Temperature Factor (TTF)
- ☐ Mixture specific relationship
 - Thermal history
 - Strength
- ☐ ASTM C1074



Maturity Meters



Strength Tests for Maturity Curve (optional)

If you have a pre-existing curve, click Next to enter that curve's parameters.

Control Sensor 1 Trial 1
Control Sensor 2 Trial 2

Guide

To develop a maturity curve, select 1 or 2 control sensors and add strength tests. Control sensors are the sensors in the test specimens that are cured with the specimens being broken.

+ Add - Remove

Timestamp	Age (hours)	Strength (psi)	TTF ("F-hr)
Oct 10, 2018 10:15 AM	24	5000	2114
Oct 12, 2018 10:15 AM	72	5410	5004
Oct 16, 2018 10:15 AM	168	6480	10707
Oct 23, 2018 10:15 AM	336	6980	20613
Nov 06, 2018 10:15 AM	672	8080	40444

< Back

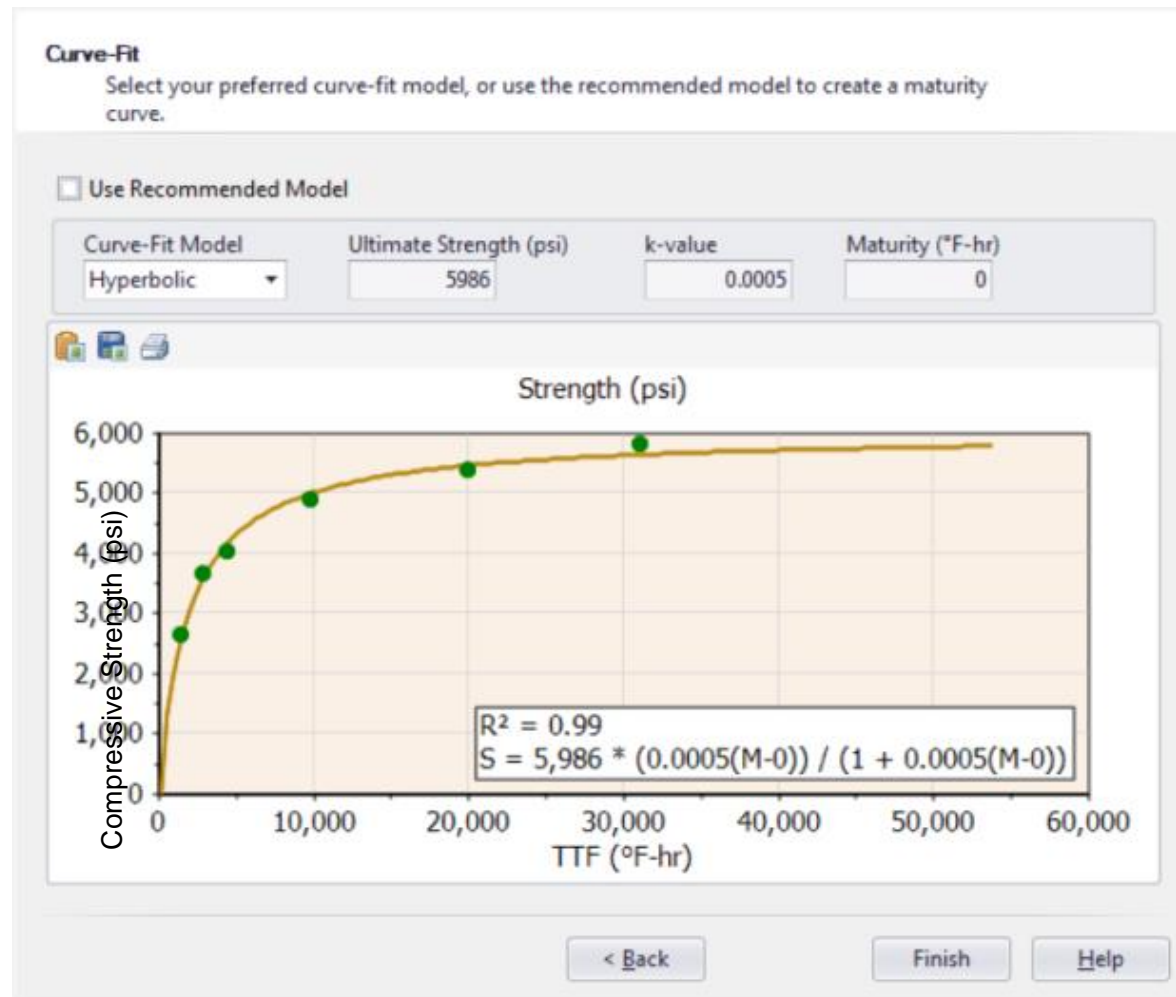
Next >

Cancel

Help




Maturity Meters



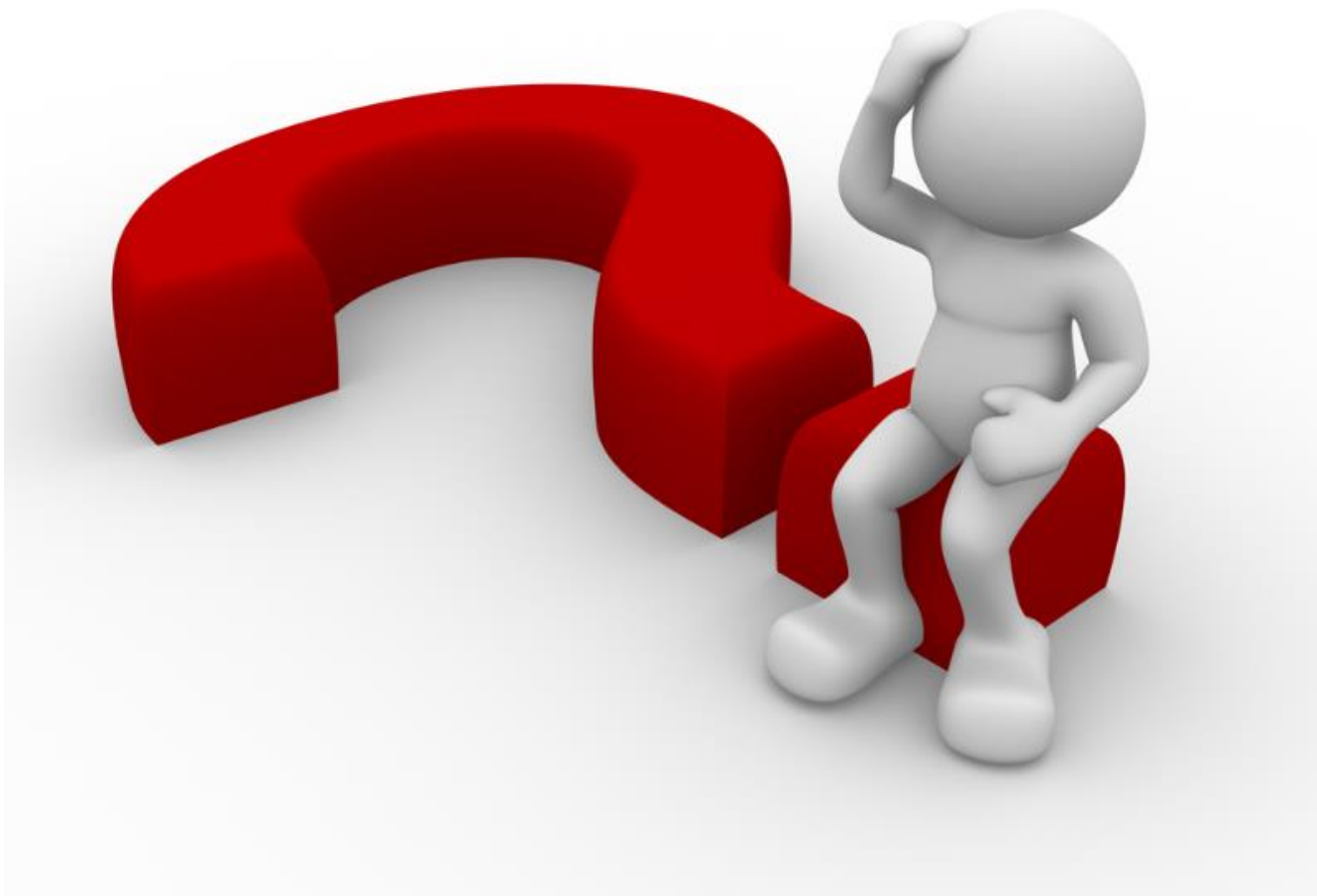
Maturity Meters



<input type="checkbox"/> B3-1.8 PME	Dec 18, 11:45 AM	11391 psi
<input type="checkbox"/> B3-1.7 OPME	Dec 18, 11:45 AM	11465 psi
<input type="checkbox"/> B3-1.7 PME	Dec 18, 11:45 AM	11420 psi
<input type="checkbox"/> B3-1.8 OPME	Dec 18, 11:45 AM	11453 psi
<input checked="" type="checkbox"/> B3-1.6 PME	Dec 17, 1:00 PM	11429 psi
<input checked="" type="checkbox"/> B3-1.5 PME	Dec 17, 1:00 PM	11455 psi
<input checked="" type="checkbox"/> B3-1.5 OPME	Dec 17, 1:00 PM	11510 psi
<input checked="" type="checkbox"/> B3-1.6 OPME	Dec 17, 1:00 PM	11476 psi
<input type="checkbox"/> B3-1.4 OPME	Dec 14, 1:00 PM	11444 psi
<input type="checkbox"/> B3-1.3 PME		

		SAMPLE TYPE: ACC		RMS 775 SAMPLE OF PRECAST CEMENT CONCRETE		DATE RECEIVED: NOV 26 2018 04379		LAB NUMBER:	
PROJECT INFORMATION									
Town/City, XX: Plymouth		Contract No.: 102199		Federal Aid No.: STP-003S(057)X		Cost Account No.: P605-038-C12		Dist. Mat'l's Engr.:	
Contractor: Lawrence Lynch		Report to District: 5		Resident Engineer:					
MATERIAL INFORMATION									
Bid Item:		Specification No.:							
Bid Item Description:									
Sub-Item Description:									
Bid Item Quantity:		Date to be Used: Today							
Manufactured by: Oldcastle Precast		Town/City, XX: Rehoboth, MA							
IA Project Quantity:		# of IA's Required:							
Proposed Use: Box beam / voided deck panel		Additional Information:							
Max. Agg. Size: 3/4"		Mix Strength: 8000 psi (6500 psi design)							
Min. Cem. Content: 840 lbs Cement + Fly Ash		Specialized Mix: Mix 87 MassDOT							
Additives:		Site Additives Added:							
Job Water Added: None		Ticket & Truck No.: Ticket# 84551, Bucket							
SAMPLING INFORMATION (R 60 / C172)									
Date Sampled: 11/19/2018		Sampled by: Edward Dusseau							
Sampling Location: Oldcastle QC Lab		Town/City, XX: Rehoboth, MA							
Random Sample: Y		Lot & Sub Lot No.: ADV6							
Quantity Represented: 3 Cubic yards		Weather & Temp. (°F): Indoors, 55F							
PREPARATION OF CONCRETE SPECIMENS IN THE FIELD (T 23 / C31)									
Specimen Size: 4 x 8" <input checked="" type="checkbox"/> 6 x 12" <input type="checkbox"/>		Initial Curing Method: Curing Box <input type="checkbox"/> Field Cured <input checked="" type="checkbox"/>							
Specimens Covered: Yes: <input checked="" type="checkbox"/> No: <input type="checkbox"/>		Curing Temp. (°F): Low: 63 High: -							
SAMPLE PROPERTIES BY FIELD TESTS									
Slump or Spread (in.): 25		Air Content (%): 6.0		Concrete Temp (°F): 63.0					
T 119 (C143): <input type="checkbox"/> T 347 (C1611): <input checked="" type="checkbox"/> T 152 (C231): <input checked="" type="checkbox"/> T 196 (C173): <input type="checkbox"/> T 309 (C1064): <input type="checkbox"/>									
LABORATORY PREPARATION AND COMPRESSIVE STRENGTH (T 22 / C39)									
Lab Preparation: Sulfur T 231 (C617): <input type="checkbox"/> Neoprene (C1231): <input type="checkbox"/> Cutting T 22: <input type="checkbox"/> Grinding T 22: <input type="checkbox"/>									
Cylinder #	Age (Days)	Break Date	Weight (lbs)	Diameter (in)	Area (in²)	Load (lb)	Strength (psi)	Average Strength (T 22)	Break Type (T 22)
ADV6.1	7		8.6	3.98	12.4	135426	10930		2
ADV6.2	7	11-26	8.5	3.98	12.4	135535	10930	10720	2
ADV6.3	7		8.5	3.98	12.4	135522	10900		2
ADV6.4	28		8.5	3.98	12.4	141545	11320		1
ADV6.5	28	12-17	8.5	3.98	12.5	137557	11000	10940	1
ADV6.6	28		8.5	3.98	12.5	131223	10500		2
ADV6.7	56								
ADV6.8	56	01-14-19							
ADV6.9	56								
CONFORMS WITH SPECIFICATIONS									
Break Type T 22: <input checked="" type="checkbox"/> Cone <input type="checkbox"/> Cone & Split <input type="checkbox"/> Cone & Shear <input type="checkbox"/> Shear <input type="checkbox"/> Columnar <input type="checkbox"/> Unusual <input type="checkbox"/>									
SPECIFICATION LIMITS & SIGNATURE									
Results are within specification limits:					Results are outside specification limits:				
Performed by: PT		2nd Set		3rd Set		Review			
Signature:									
Date: 11-26-18		12-17-18							

Questions?



The State's Reptile Problem



SRT Compared to RCPT

