Innovation in Materials

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34th Annual DBE Workshop

January 20, 2020

Topics

- Concrete Innovations
  - Performance Engineered Mixes
  - Materials
  - Non-Destructive Testing
- Asphalt Innovations
  - Balanced Mix Designs

WHRP
Wisconsin Highway Research Program

Evaluation of Current Wisconsin Mixes Using Performance Engineered Mixture (PEM) Testing Protocols

Project 0092-17-07

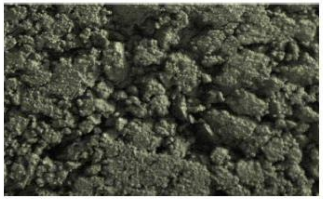
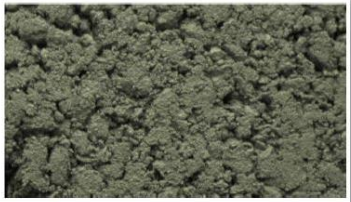
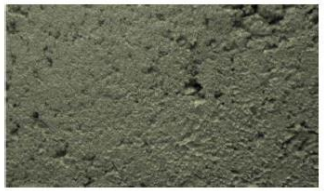
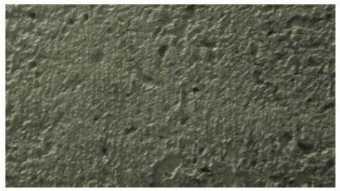
Close Out Presentation
October 28, 2019

PEM Research Project Testing

Sampled at batch plant, before & after paver

- Strength
  - Compressive
  - Flexural
- Tarantula Curve Analysis
- Workability Properties
  - Box Test
  - V-Kelly Ball
- Durability Properties
  - Super Air Meter (SAM)
  - Hardened Air Voids
  - Surface Resistivity
  - Bulk Resistivity
  - Formation Factor
  - Coefficient of Thermal Expansion (CTE)

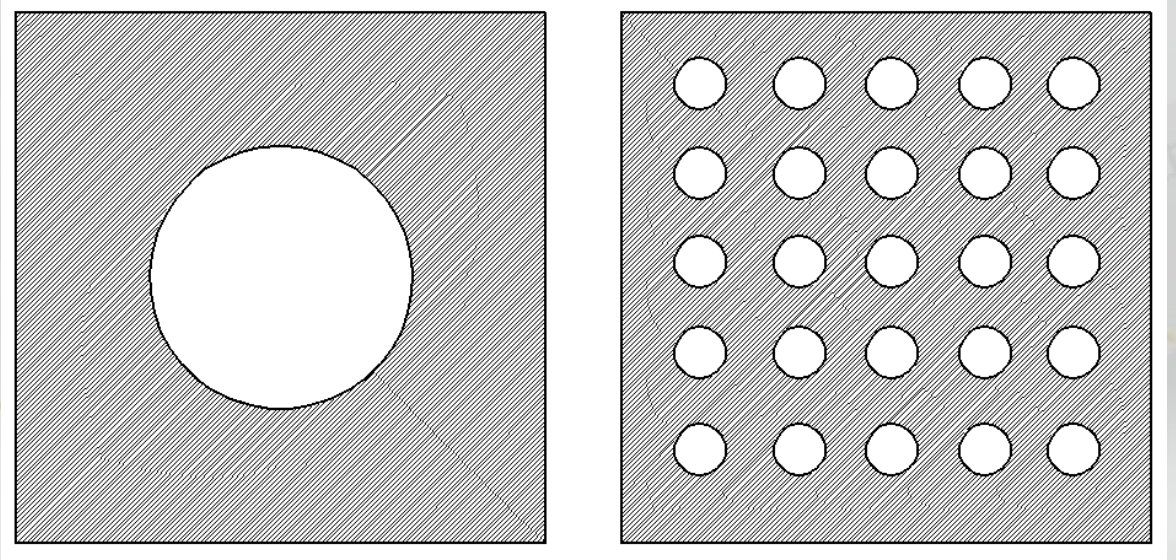
Box Test

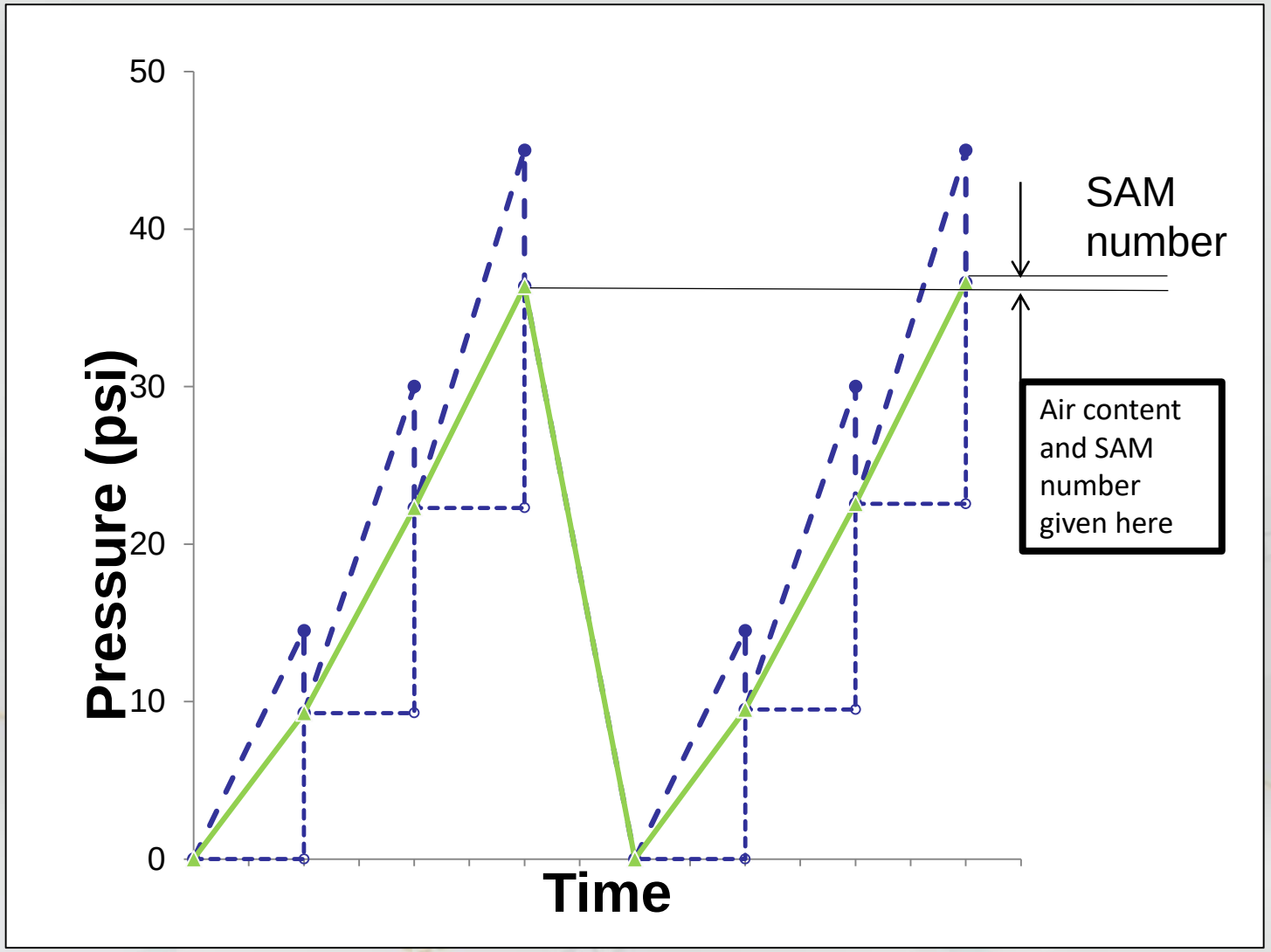
	
4	3
Over 50% overall surface voids.	30-50% overall surface voids.
	
2	1
10-30% overall surface voids.	Less than 10% overall surface voids.

Super Air Meter (SAM)

Super Air Meter (SAM)

- Air-entrained bubbles are a key to freeze-thaw resistance in concrete
- Small air bubbles are more effective than large bubbles
- Has the ability to measure the air volume and distribution of the air




50
40
30
20
10
0
Pressure (psi)
Time
SAM number
Air content and SAM number given here

Surface Resistivity

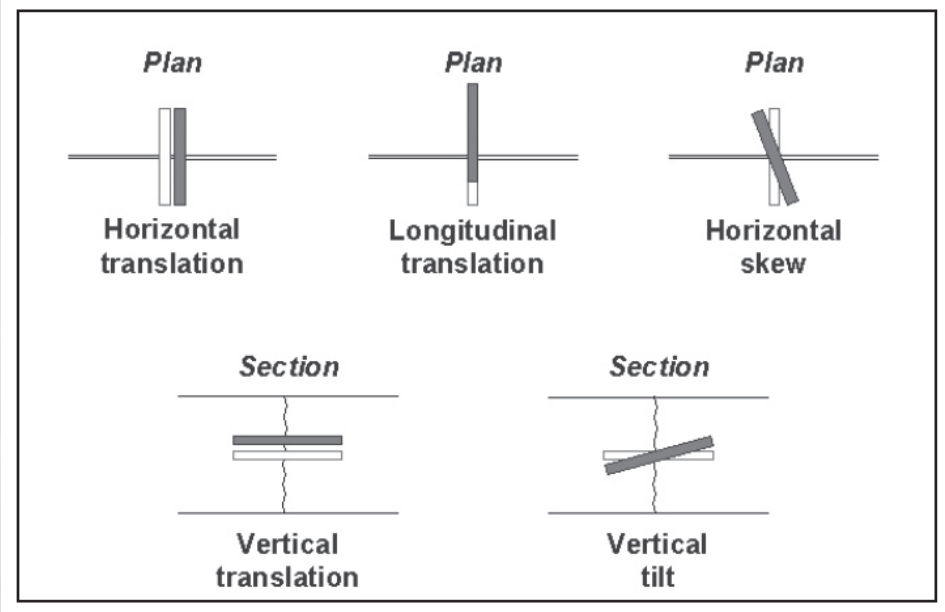
- ASTM C1556
  - Current acceptance testing
- AASHTO TP 119-15
  - Quicker and Better repeatability
  - Can be conducted on plastic concrete

Alternate Dowel Bar Technology

- Allow 7 different dowel bar types.
- Bars are evaluated on 10 million loading cycles before approval
  - Load transfer
  - Bar damage

Accuracy of Dowel Bar Placement

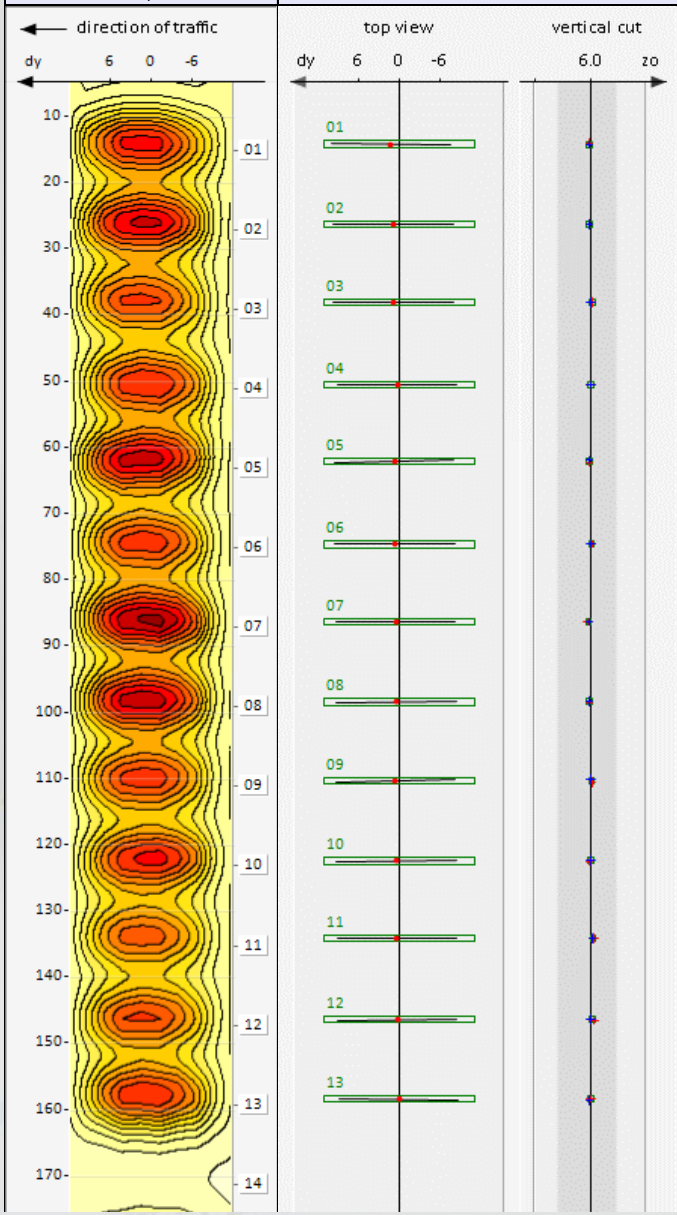
- Current WisDOT Specifications
  - 415.3.7.3
    - Within one inch of the planned transverse location and depth
    - Within 2 inches of the planned longitudinal location
    - Parallel to the pavement surface and centerline within a tolerance of 1/2 inch in 18 inches



Analyzed with MagnoProof 5.10.08

Location >> Highway: I 39 - Dir.: South - Station: 2323-50 Joint: 1 - First lane: Outer sh.

Measurement >> File Name: 1907310826 0.HDFX - Time: 31/07/2019 08:26 - Bar: 18 x 12/8



Color Map	Bar Visualization	Bar No.	X-Position	Depth	Depth Dev.	Side shift	Misal.	Hor. Misal.	Vert. Misal.	Comment
			in	in	in	in	in	in	in	
map	bar	no	xo	zo	dz	dy	m	mh	mv	cmt
		1	14.2	5.8	-0.2	1.3	0.2	0.2	0	
		2	26.3	5.8	-0.2	0.9	0	0	0	
		3	38.1	6.2	0.2	0.9	0.3	0.1	-0.3	
		4	50.6	6	0	0.3	0.1	0	-0.1	
		5	62.1	5.8	-0.2	0.8	0.6	-0.6	-0.2	
		6	74.6	6.1	0.1	0.6	0.1	-0.1	-0.1	
		7	86.4	5.6	-0.3	0.6	0.2	0.2	0.1	
		8	98.5	5.7	-0.3	0.5	0.3	-0.2	-0.2	
		9	110.4	6.1	0.1	0.6	0.3	-0.3	-0.1	
		10	122.5	5.9	0	0.5	0.4	-0.3	0.2	
		11	134.2	6.3	0.4	0.3	0.4	0	-0.3	
		12	146.4	6.2	0.2	0.3	0.4	-0.2	-0.4	
		13	158.4	6	0	0.1	0.3	0.2	-0.2	

MIT Thickness Scanning

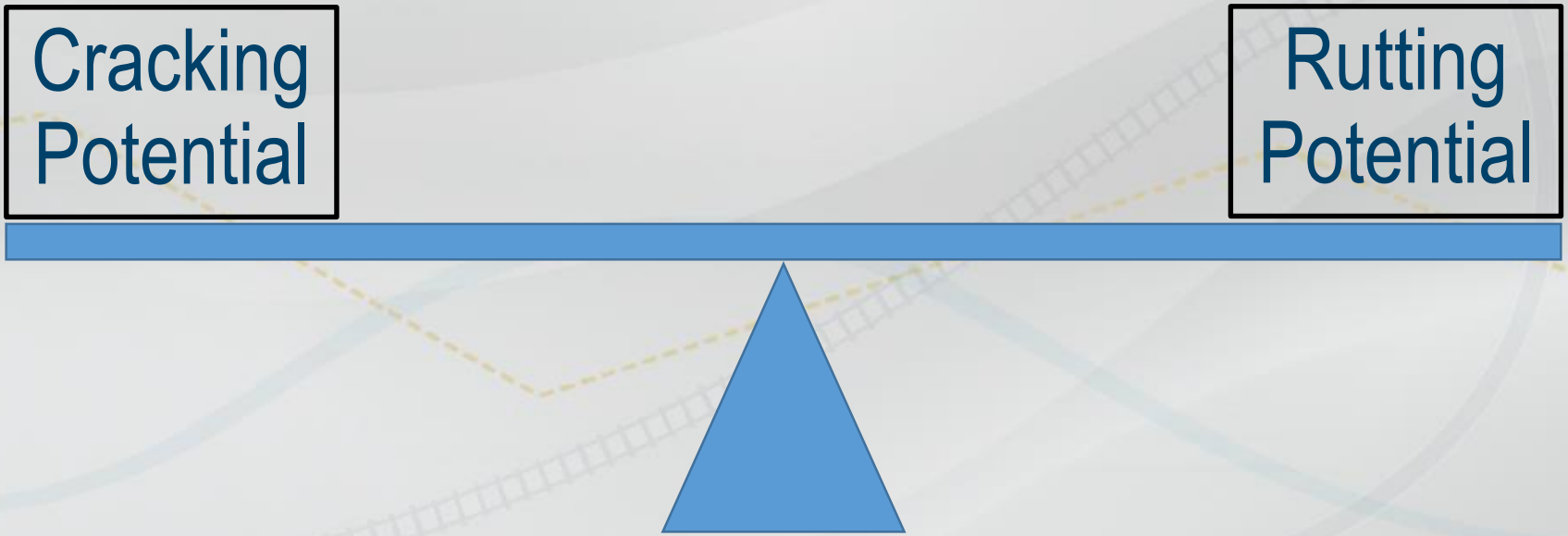
- Non destructive concrete thickness testing
- WisDOT has been using for several years with great success

Kessler Soils Engineering

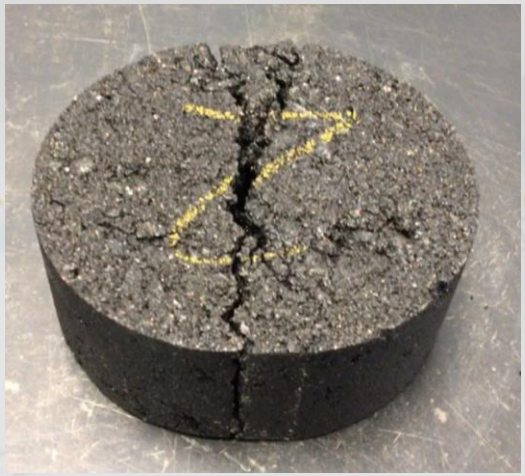
Concrete Cooling

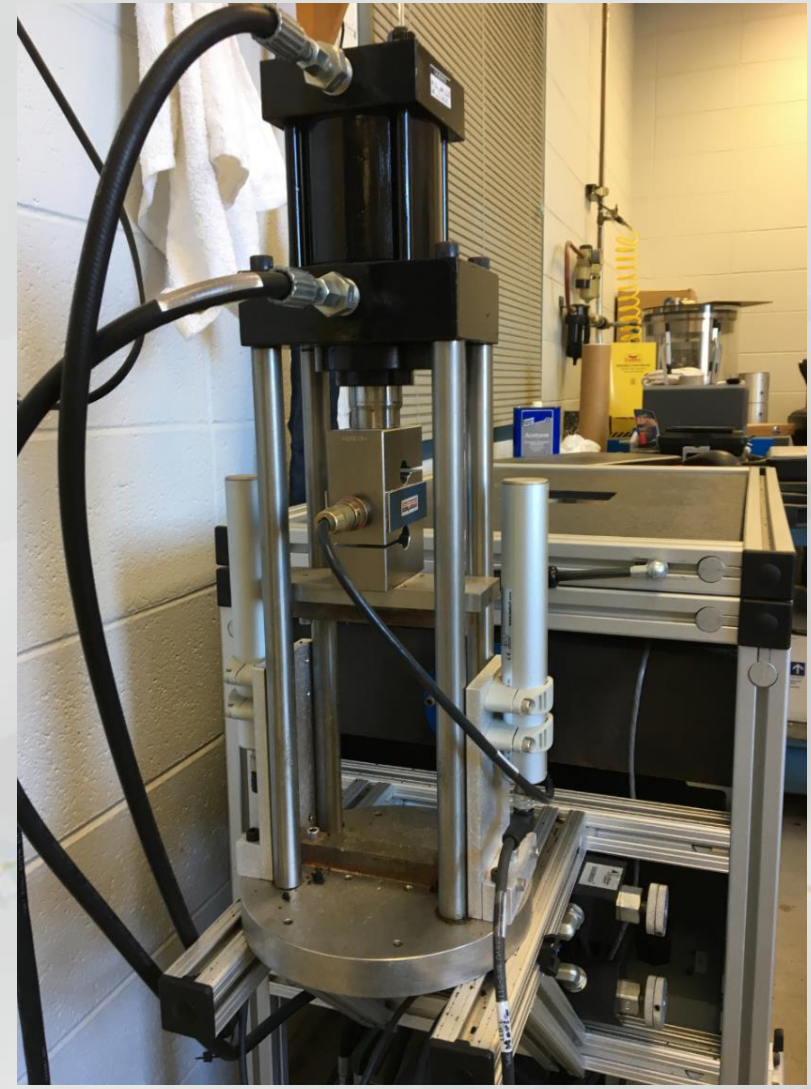
Hot Mix Asphalt

- Performance Testing
  - To quantify performance properties of HMA
- Balanced Mix Design
  - To optimize performance properties for best life

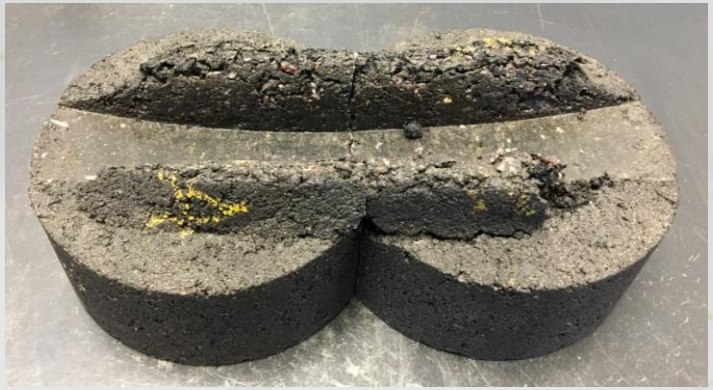


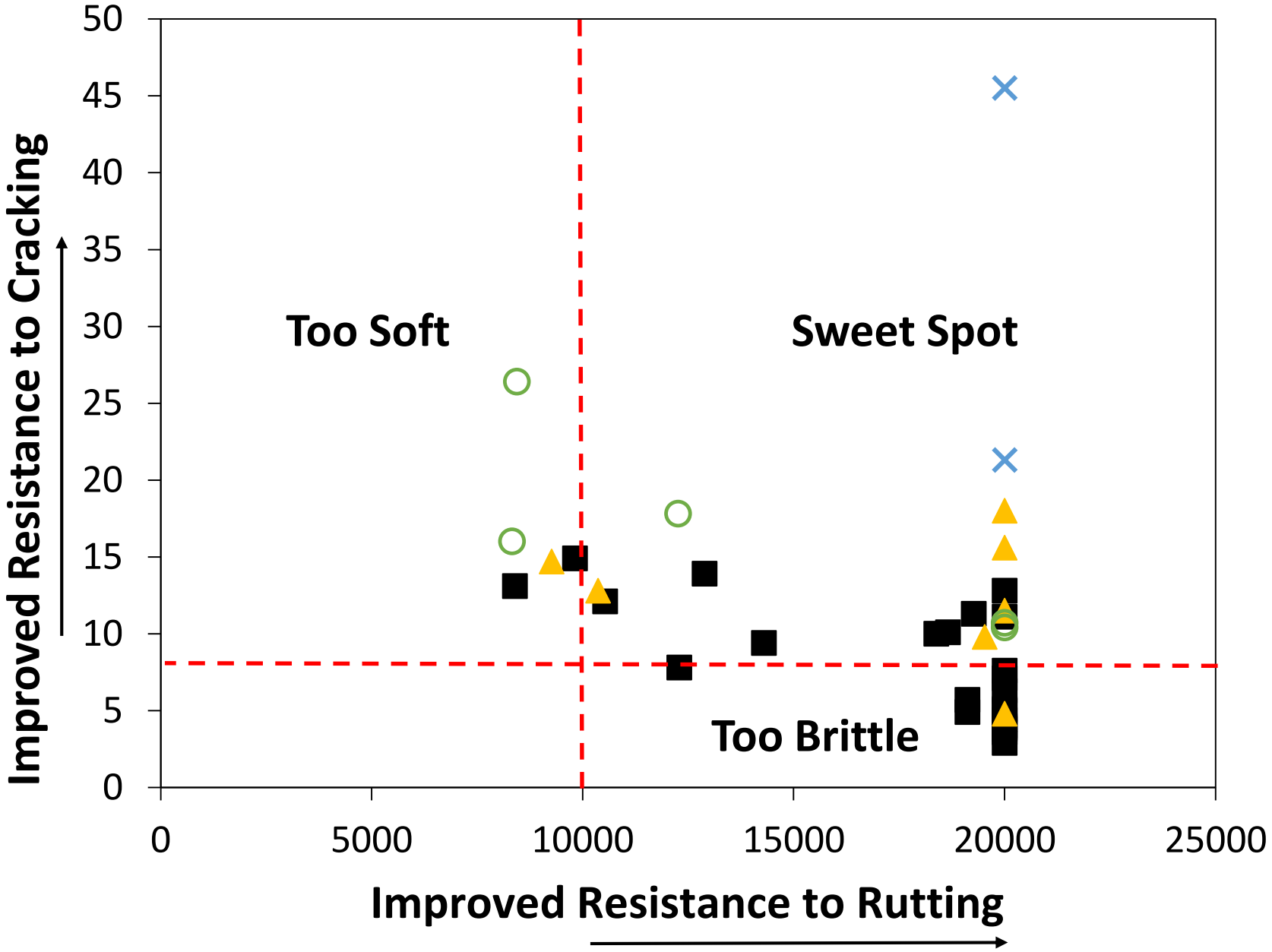
Cracking Potential





Rutting Potential




Too Soft
Sweet Spot
Too Brittle
Improved Resistance to Cracking
Improved Resistance to Rutting
0
5
10
15
20
25
30
35
40
45
50
0
5000
10000
15000
20000
25000

Stringless Paving

- Allowed in 2017 by SPV
- Increased to 11 projects in 2018
- In Standard Specifications in 2020
- Use has continued to increase

Intelligent Construction & Materials

- RFID Tags
- GPS Tracking of Materials
- E-tickets
- Intelligent Construction Technologies

Questions

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