2021 PA Turnpike Accomplishments

- Southern Beltway - 13 New miles of roadway opened
- 104 Lane Miles of Mill and Pave Contracts
- Placed 405,000 Tons of Asphalt
- Average Pavement Density was 95%
- The average IRI for 2021 was 51 inches per mile

2022 PA Turnpike Contracts

BID 4TH QUARTER 2021 - STARTING 2022:

TOTAL RECONSTRUCTION CONTRACT: A-037 (MP A38 to A43)

ASPHALT RESURFACING: T-144 (MP 144.95 to MP 149.23)

A-104 (MP A107 to MP A115)

T-345 (MP 345 to MP 354)

FOR 2022 - WE HAVE SCHEDULED:

11 MILES OF TOTAL RECONSTRUCTION (A-037 and T 126)

3 MILES OF NEW CONSTRUCTION (Mon-Fayette Extension)

WE HAVE SCHEDULED ROUGHLY 300 LANE MILES TO MILL AND PAVE

WE WILL BE BIDDING APPROXIMATLEY 795,000 TONS OF ASPHALT PAVING IN 2022

New PA Turnpike Contracts 2022

THE NEW PROJECTS FOR 2022 ARE AT MILEPOSTS:

Asphalt Resurfacing:

T 47 - T 56
T 94 - T 99
T 235 - T 242
T 306 - T 312
T 246 - T 255
T 197 – T 202
A 54 – A 61
T 75 New Stanton Interchange
T 333 Norristown Interchange

A 105
T 161 Breezewood Connector
T 263 – T 268
T 114 – T 121
T 142 – T 144
T 180 – T 184
T 31 – T 39

Total Reconstructions:

T 126 – T 131

Roadway Failures

Before the appropriate repair strategy can be applied to a distressed asphalt pavement, the type and extent of the deterioration must be understood, and the cause of the distress must be identified.

6 Common causes of roadway failure.

- Rutting
- Cracking
- Flushing
- Raveling
- Aggregate Breakdown and Loss of Aggregate
- Subbase and drainage issues

Rutting of Roadway Surface

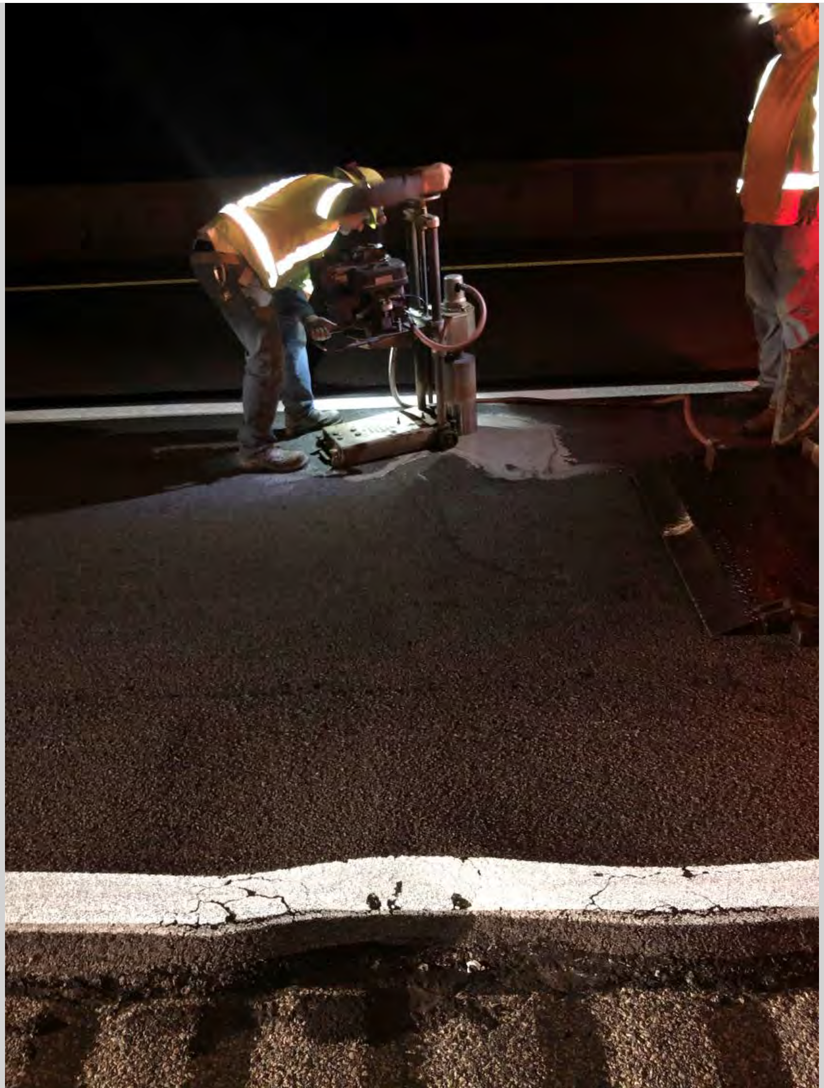
Rutting of Roadway Surface

Extensive Rutting

Cause of Rutting ?

We decided to drill roadway cores at the tenth mile posts for the length of the distressed roadway area. Cores were drilled to the depth of the existing concrete slabs to determine the condition of the underlying asphalt layers.

Roadway Coring



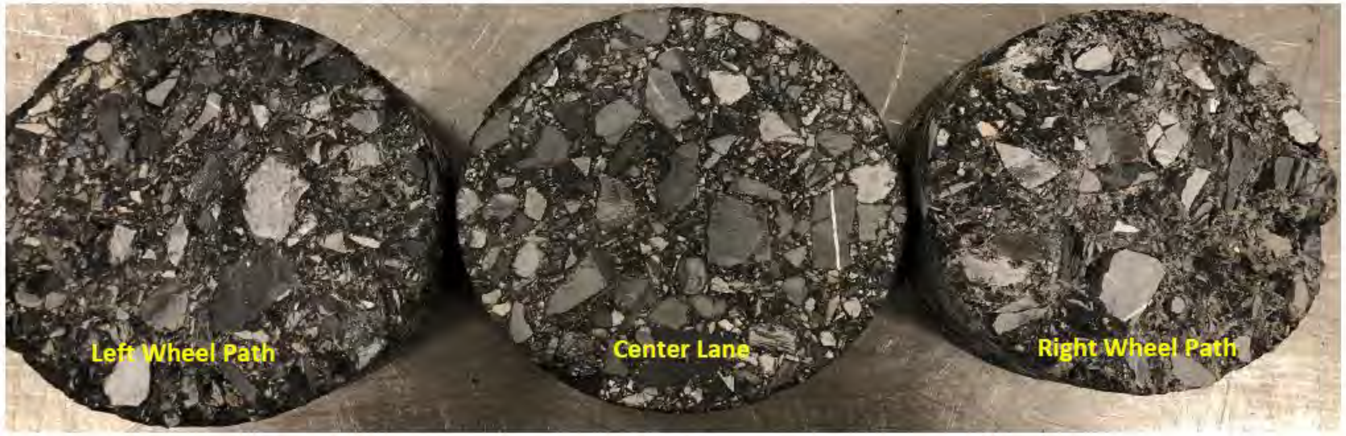
Roadway Core Review

Right Wheel Path Core — **Example of Differing Bituminous Layers** — **Center Lane Core**

Distinct lines were highly visible between the 1973 binder and the 1973 leveling coarse within cores taken from the wheel paths. However, Core specimens extracted from the center of the lane lacked this distinction. Observations of these two layers had provided a preliminary theory that the rutting may have been precipitated by the failure of these materials.

Aggregate Breakdown in the Binder/Leveling Coarse

Severe rutting had taken place at mile post 144.08. Specimens obtained from this area had exhibited great amounts of aggregate breakage within the wheel paths along with lower bulk gravities. The significant amounts of aggregate breakage had created additional air void volume within the specimens, therefore lowering the bulk gravity.



Crushed Aggregate in Binder Coarse

Crushed Aggregate in Binder Coarse

Asphalt Lift Conditions

Summary of Findings

5 Bituminous coarse were identified	Condition
1.) 9.5mm (2013) & 12.5mm (2020) Calcareous Sandstone	Good
2.) 19mm binder coarse (1973) Limestone	Poor
3.) Leveling coarse (1973) Limestone	Poor
4.) ID2 wearing coarse (1953) Blast Furnace Slag	Good
5.) ID3 binder coarse (1953) Limestone	Good

Summary

Failure of the existing binder / leveling coarse was the most probable cause of the rutting distresses. Documentation had estimated the age of the intermediate binder / leveling coarse to be nearly 50 years old. The area had also been resurfaced multiple times while the binder and leveling remained in place. Aggregate structure within the binder coarse had been severely damaged. A majority of the coarse aggregate within the material had been broken and structural integrity had been lost. Without having the load bearing capability, the binder coarse had succumbed to the continuous pressures of live traffic loads. Without the structural support beneath, the wearing coarse rutted significantly.

The repair required milling to remove the damaged binder/leveling coarse and repaving with 19mm Wearing PG 64E-22 asphalt mixture.

Forensic Testing of Existing Roadway Structure

To identify the underlying conditions of the existing roadway, the Roadway Unit has enlisted the assistance of the Geo Technical Unit in acquiring 6-inch full depth roadway cores of roadway sections prior to milling and overlaying.

These cores are being analyzed at the PTC Materials Lab. The results from the labs analysis are provided to Roadway Unit, so better-informed decisions can be made when determining the extent of milling and paving required to provide optimum results.

This data is also being compiled to provide actual long term JMF performance data for BMD correlation.

PA Turnpike Preliminary Data

PTC Materials Lab Manager
Brian Paroda

Indirect Tensile Asphalt Cracking Test (IDEAL-CT)

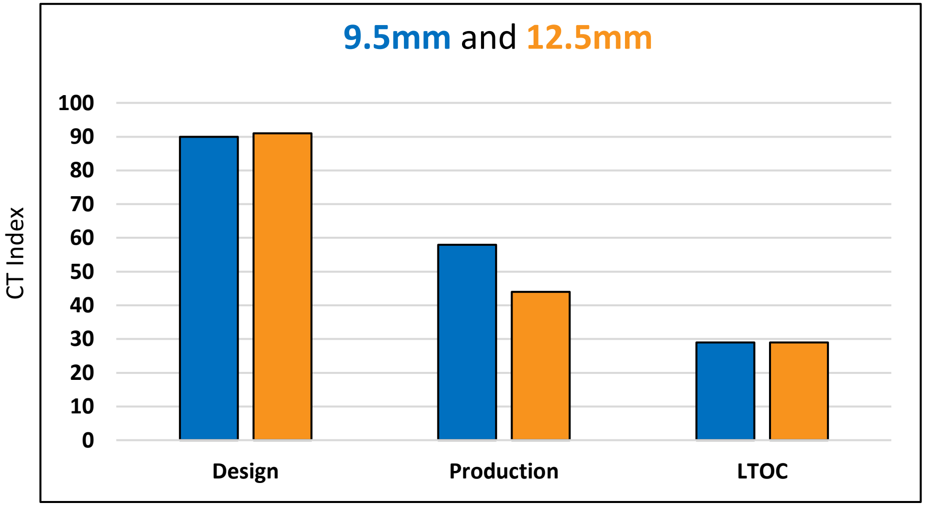
General Background

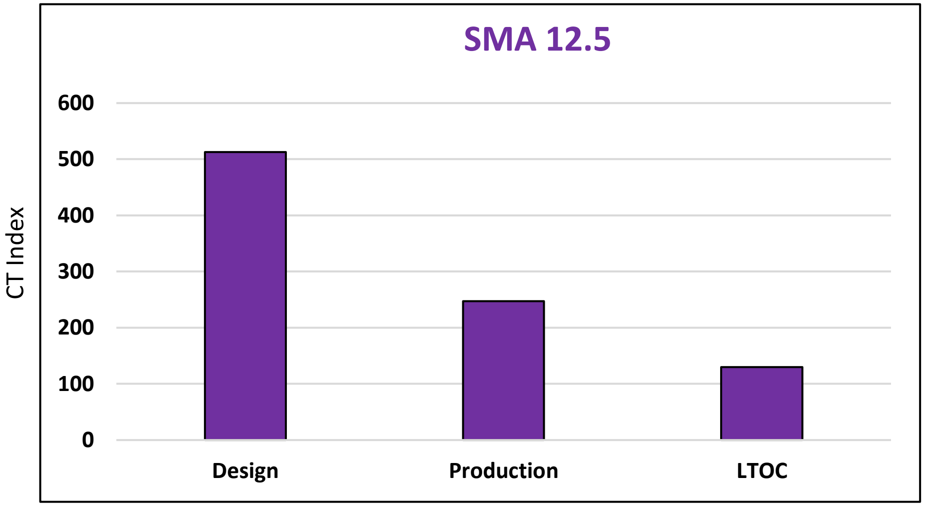
- Began collecting data in 2018
- Tested 2,700 + specimens
- 4 Material Classes (9.5, 12.5, SMA & 19)
- Multiple geological/rock compositions
- 5 material stages (Design, Production, Long Term Oven Conditioning (LTOC), Acceptance Field Cores and Exploratory Cores)
- Recently began looking at alternate conditioning methods / temperatures.

IDEAL-CT

Establish a Baseline (Lab Samples)

1. Establish a baseline of CT Index values at various material stages (2018)
2. Observed significant differences between the various stages



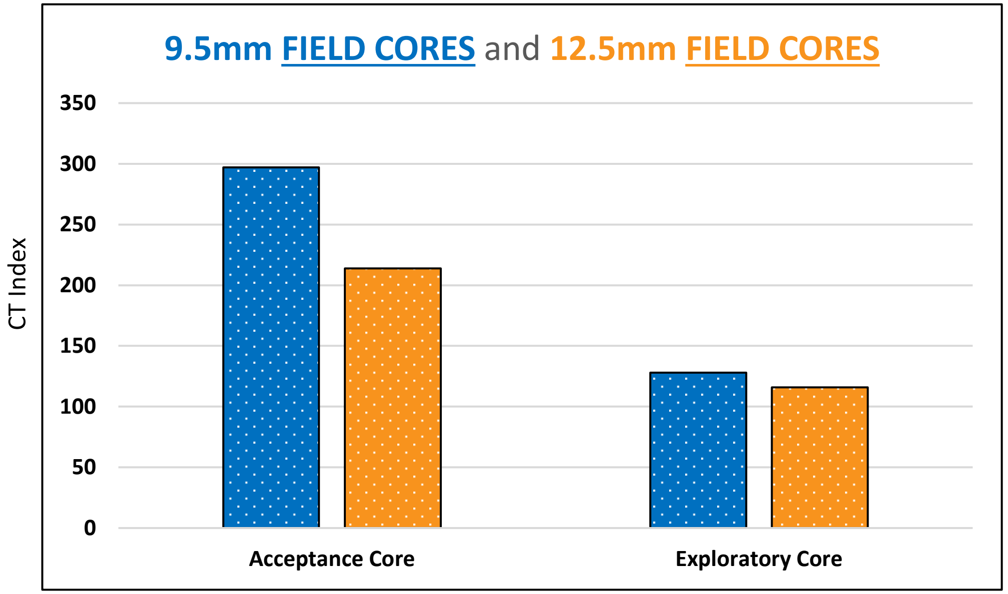


	Design		Prod.		LTOC	
	9.5	12.5	9.5	12.5	9.5	12.5
CT Index	**90**	**91**	**58**	**44**	**29**	**29**
St Dev	15.31	19.88	8.12	7.68	5.13	6.06
CoVar	16%	21%	14%	17%	19%	17%
Pbe	5.3	5.0	5.4	4.9	5.2	4.8

	Design	Prod.	LTOC
	SMA	SMA	SMA
CT Index	**513**	**247**	**130**
St Dev	76.20	54.73	19.2
CoVar	15%	21%	13%
Pbe	6.5	6.3	6.4

Establish a Baseline (Field Samples)

3. Observed similar differences between Field Cores taken for acceptance and those obtained with 3+ years of service.



	Acceptance		3+ yrs Service	
	9.5	12.5	9.5	12.5
CT Index	**297**	**214**	**139**	**115**
St Dev	86.64	47.24	37.97	45.67
CoVar	29%	24%	28%	40%

Challenges with testing field core samples:

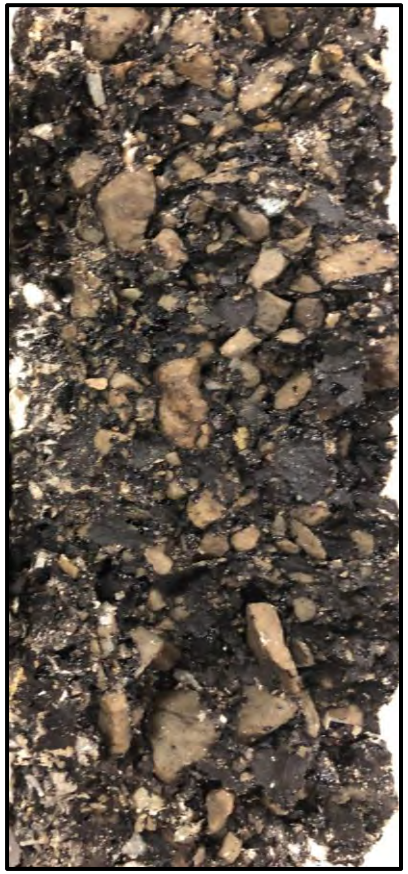
a. CT Index values for *Acceptance* field core specimens tend to be 60% GREATER than Lab compacted counterparts.

b. Considerable differences in specimen thickness. Pavement cross slope, Paver depth, etc.

c. Capturing when the material fails is difficult. Tend to obtain values once the material cracking is observed which may be considered too late.

d. Significant amount of severe stripping. 58% of exploratory field cores showed signs of extreme stripping!

Severe Stripping Observed in Field Cores



Age	9 yrs.
Pbe	4.8%
TSR	83.2
CT Index	**65**

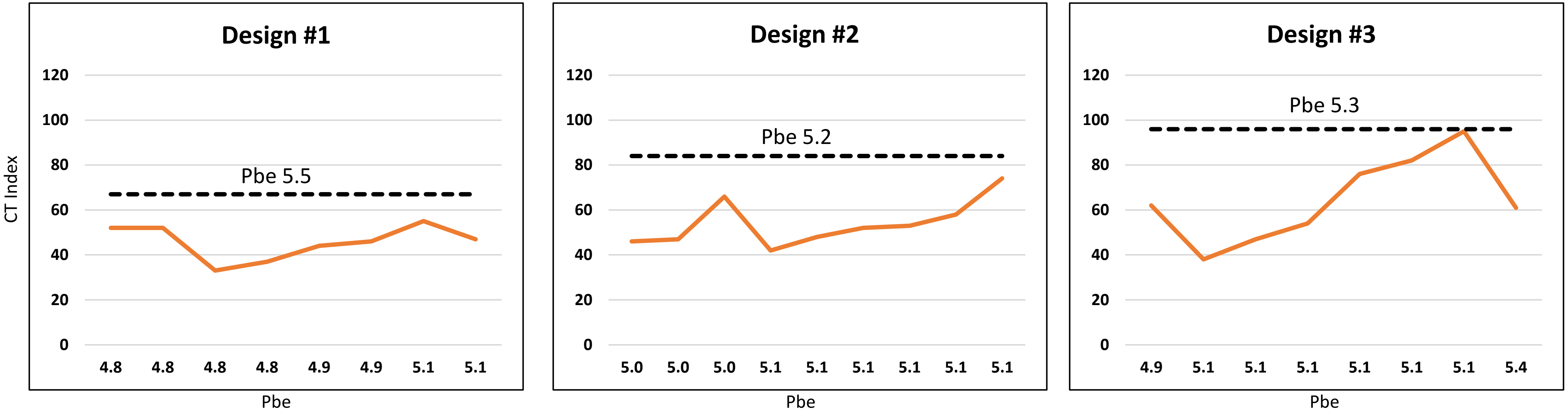
Age	5 yrs.
Pbe	5.2%
TSR	94.6
CT Index	**112**

Age	4 yrs.
Pbe	5.3%
TSR	100.5
CT Index	**79**

Age	3 yrs.
Pbe	6.5%
TSR	98.5
CT Index	**832**

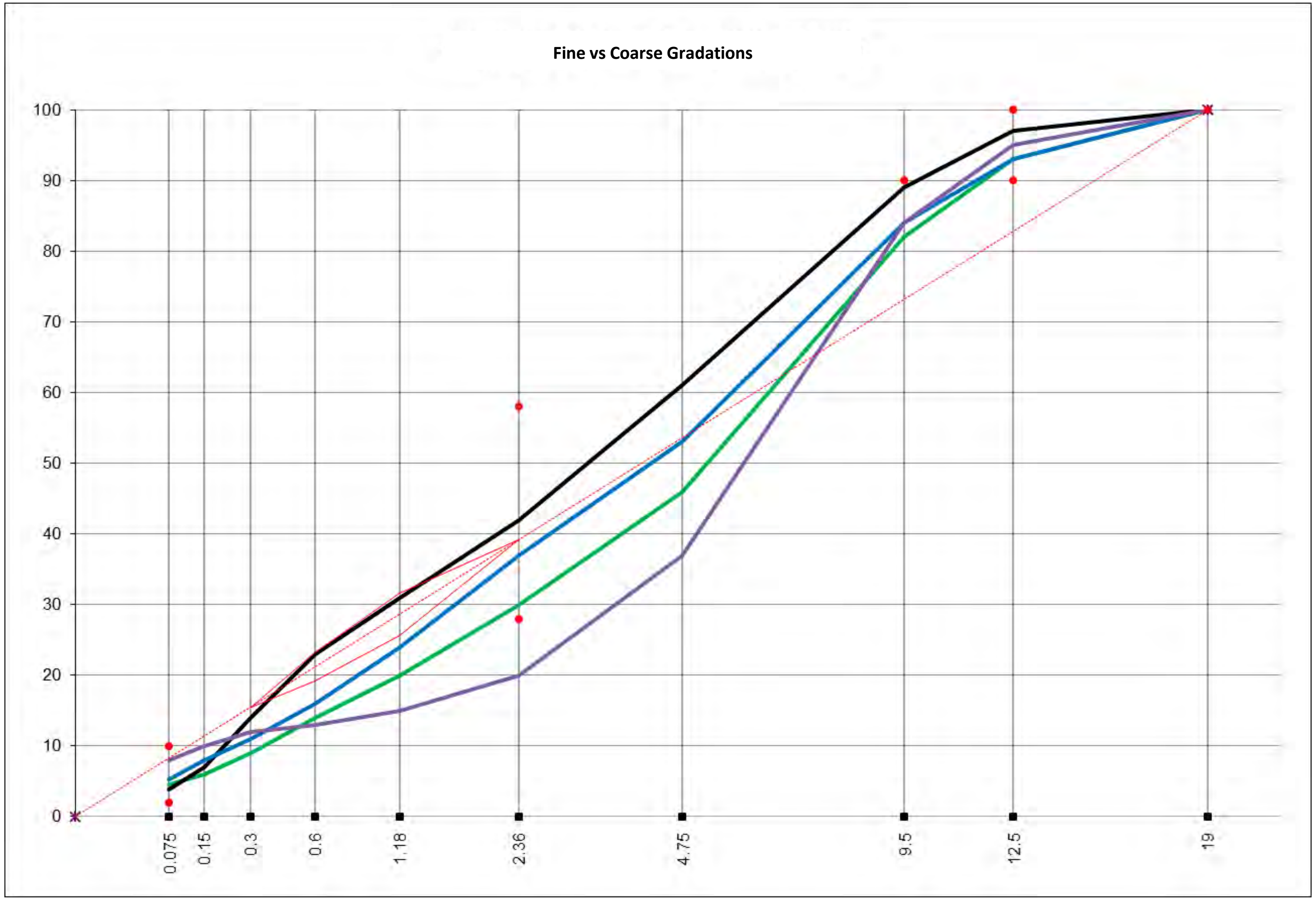
(Pbe) Design Samples vs Production Samples

Established a baseline of CT values with design samples; concentrating on Pbe.
Compared the design CT values with those obtained from production samples.



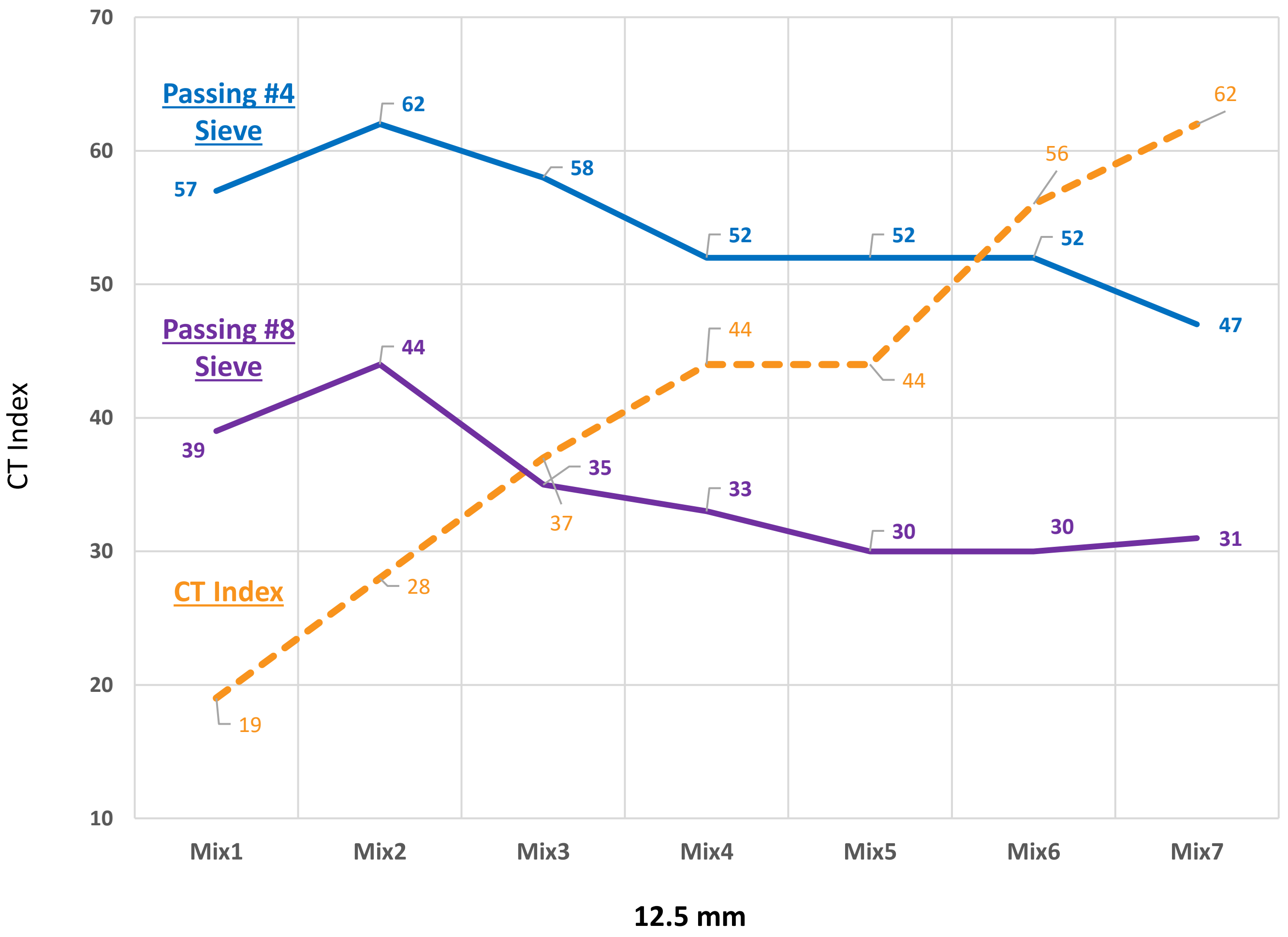
- Production CT values rarely achieved those of design. ?????
- Plant adjustments tended to increase the #200 (AC target can't be adjusted but production tended to run -0.1 from JMF)
  - ✓ 9.5mm 50% of producers had #200 PWL <90 (41% had #200 PWL <80)
  - ✓ 12.5mm 57% of producers had #200 PWL <90 (46% had #200 PWL <80)

Fine Gradation vs Coarse Gradation



	Pbe	#200	#8	#4	CT Index
#1 SR12.5	4.8	5.3	37	53	*16*
#2 SR12.5	4.7	3.8	42	61	*23*
#3 SR12.5	4.9	4.5	30	46	*59*
SMA12.5	6.4	8.0	20	37	*181*

Effect of Gradation on CT Index (#8 & #4 Sieves)



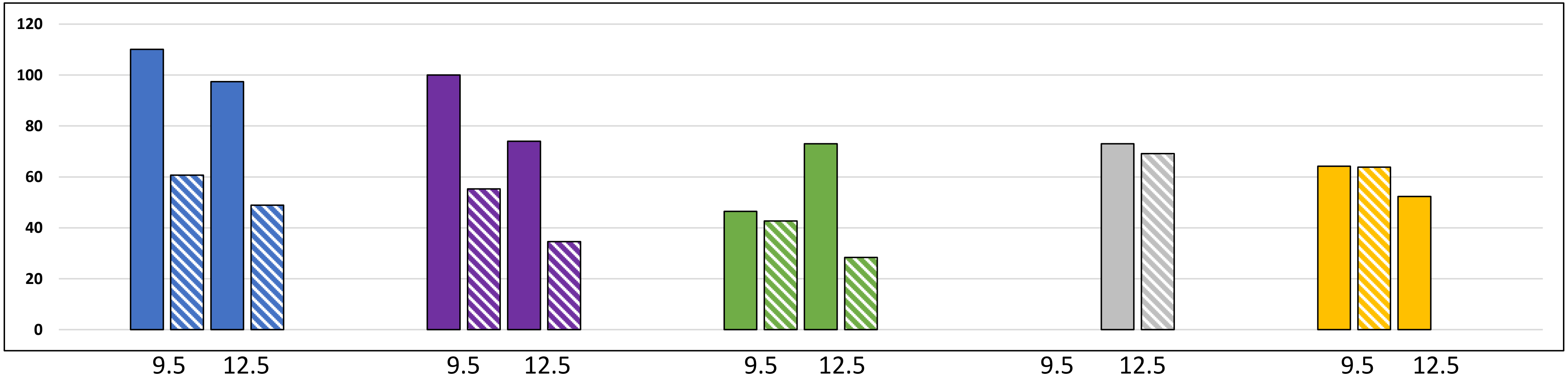
	CT Index	AC%	#8	#4
Mix 1	***19***	**5.6**	**39**	**57**
Mix 2	***28***	**5.6**	**44**	**62**
Mix 3	***37***	**5.4**	**35**	**58**
Mix 4	***44***	**5.6**	**33**	**52**
Mix 5	***44***	**5.3**	**30**	**52**
Mix 6	***56***	**5.4**	**30**	**52**
Mix 7	***62***	**5.4**	**31**	**47**

Geological Composition





		Calcareous Sandstone		Quartzite		Sandstone		Siltstone		Granodiorite	
		9.5mm	12.5mm	9.5mm	12.5mm	9.5mm	12.5mm	9.5mm	12.5mm	9.5mm	12.5mm
Design	CT Index	110	97	100	74	46	73		73	64	52
	StDev	19.03	21.66	11.22	20.59	7.30	25.24		25.24	7.05	8.53
	CoVar	17%	22%	11%	23%	14%	35%		35%	12%	18%
	Pbe	5.3	4.9	5.3	5.2	5.4	5.0		5.0	5.2	4.9
Production	CT Index	61	49	55	35	43	28		69	64	
	StDev	9.22	9.20	9.04	4.94	7.10	5.32		13.68	5.02	
	CoVar	15%	18%	16%	15%	18%	17%		21%	8%	
	Pbe	5.3	4.9	5.5	5.0	5.5	5.0		4.8	5.3	



DWT Hamburg Testing

- Data collection in progress (Limited samples)
- 3 material classes (9.5, 12.5 and SMA)
- No significant rutting or SIP observed

Average Rut Depth:

9.5mm = 3.42 mm

12.5mm = 2.82 mm

SMA 12.5 = 4.82 mm

* Tested specimens beyond T324 specifications. Wanted to observe SIP or complete failure. (>10,000 cycles)

PTC BMD Considerations

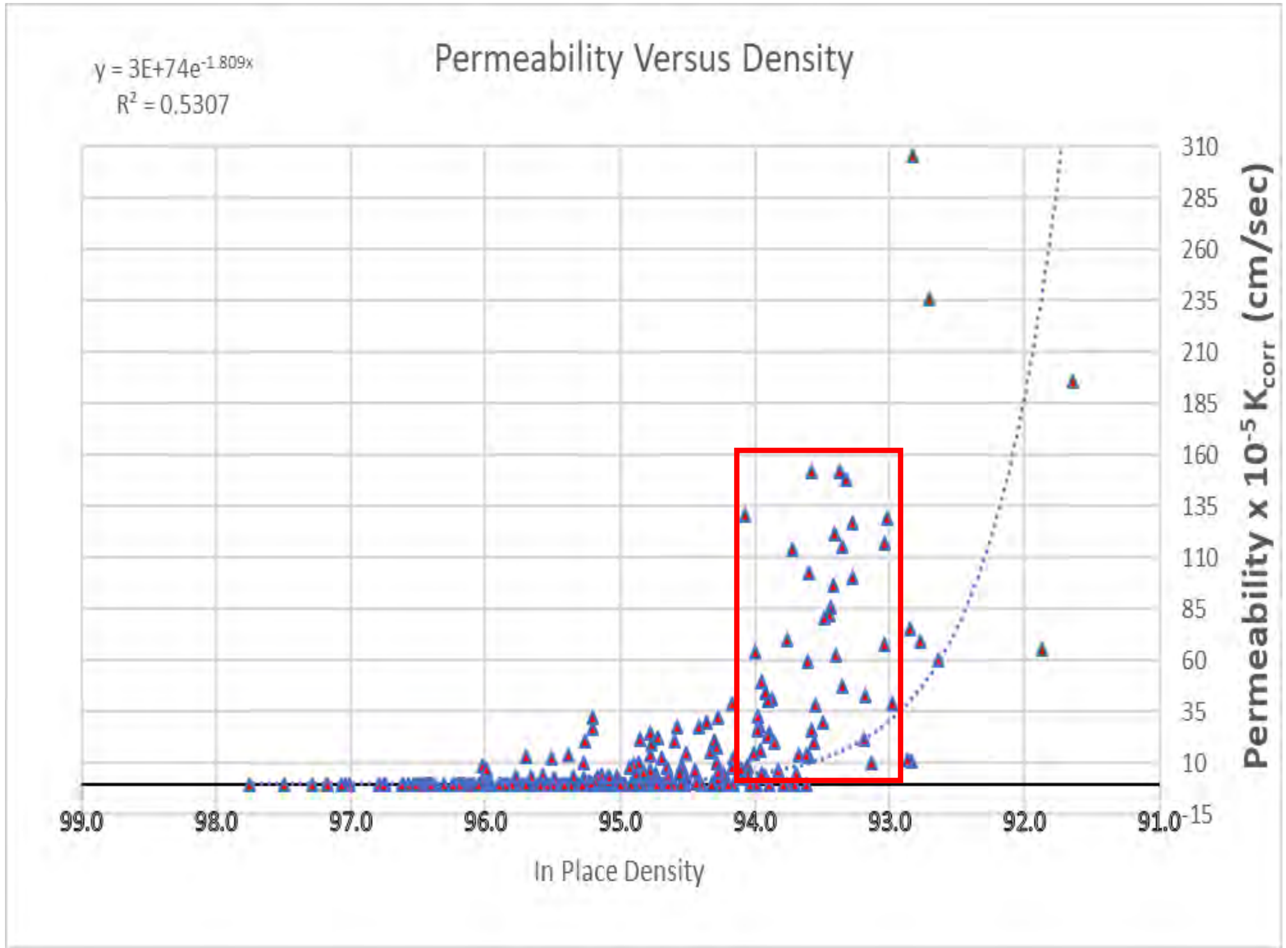
1. Hold design gyrations @ 100 (reduce air voids to 3.5% ???)
2. IDEAL-CT specimens gyrated to 5.5% +/- 0.5 air voids; Hamburg = 7.0% +/- 0.5
3. Volumetric Designs optimized utilizing performance testing
4. Perform IDEAL-CT samples with reduced AC -0.4% (total AC) and Hamburg samples with increased AC +0.4% (total AC)
5. Should IDEAL-CT / Hamburg values be required per liquid supplier ??????
6. Additional aggregate testing during production ???????
7. Thresholds for specifications ????????
8. Quality Control / Acceptance Testing ????????
9. Use only SMA for wearing course (Implemented in 2019 for all Total Reconstruct)

Why is 7.0% air voids for crack testing a concern?

1. Average density for PTC is 94.5% (5.5% air voids)
2. Our permeability study had revealed considerable water penetration when density falls below 94% density.
3. There is a misconception that the ASTM D8225 states air voids should be 7.0%.

8.2.3 Air Void Content – Prepare a minimum of three specimens at the target air void content +/- 0.5%.

Note:3 – The specimens air voids can be calculated using Test Method D3203/D3203M. The typical air void target for highway pavements is 7.0%. Other target air voids can be used, but specimens with significantly different air voids are not compatible.



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PA Turnpike Materials Unit

Thank You