

PENNDOT PAPA 2022 BUS TOUR

IMPLEMENTATION OF MIX PERFORMANCE TESTING AND BALANCED MIX DESIGN IN PA



July 27, 2022

Gary L. Hoffman, P.E. Director of Technical Services

BALANCED MIX DESIGN (BMD)

Definition - BMD

“Asphalt mix design using performance tests on appropriately conditioned specimens that address multiple modes of distress (i.e., rutting & cracking) taking into consideration mix aging, traffic, climate and location within the pavement structure.”



[FHWA VIDEO](#) - Asphalt Pavement Principles: Long-Life Pavements - Bing video

STRATEGIC HIGHWAY RESEARCH Program (SHRP)



- **SUPERPAVE**
 - ✓ **SUPERPAVE GYRATORY COMPACTOR**



SUPERPAVE

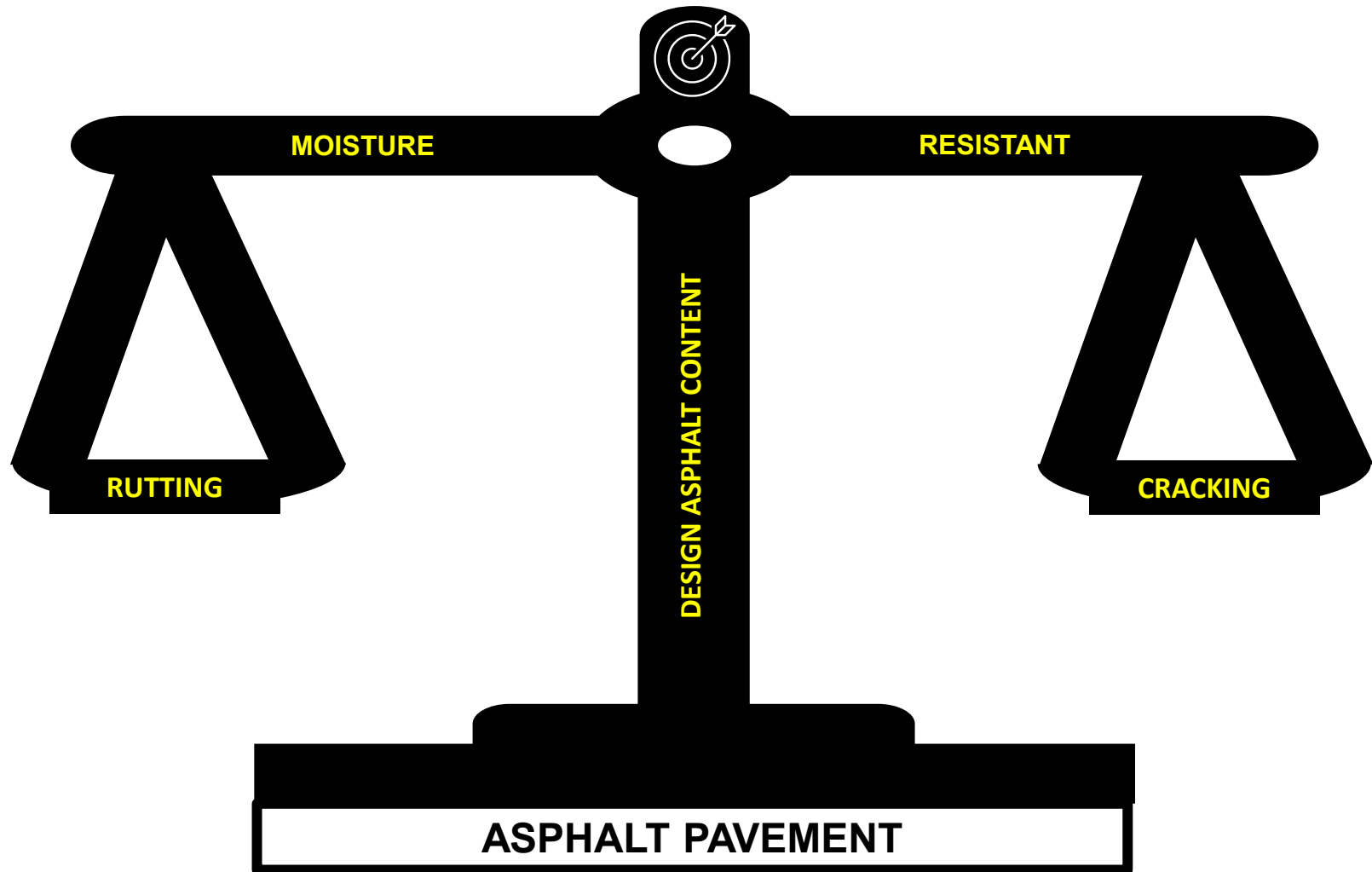
- In **1993**, SHRP developed Superpave mix design commenced (replacing Marshal Mix Design) Level 1 implementation. Mix performance tests were to be developed to ensure mix would not rut or crack.
- *Level 2 with performance tests was to follow* in due time once tests were developed and adopted.
- *Hamburg Wheel Track Test was imported from Germany to test for rutting.* That test has been adopted by many State DOT's including PennDOT.
- A short list of accepted tests for cracking resistance has been developed.



- **SUPERPAVE (Superior Performing Asphalt Pavement)**
 - ❖ **GYRATORY COMPACTOR**
 - ✓ Not a performance test
 - ✓ Mix mainly asphalt & aggregate
 - ✓ Now – RAP, RAS, WMA, Rejuvenators, Anti-Strip, Fibers, GTR, Recycled Waste Plastic, etc.

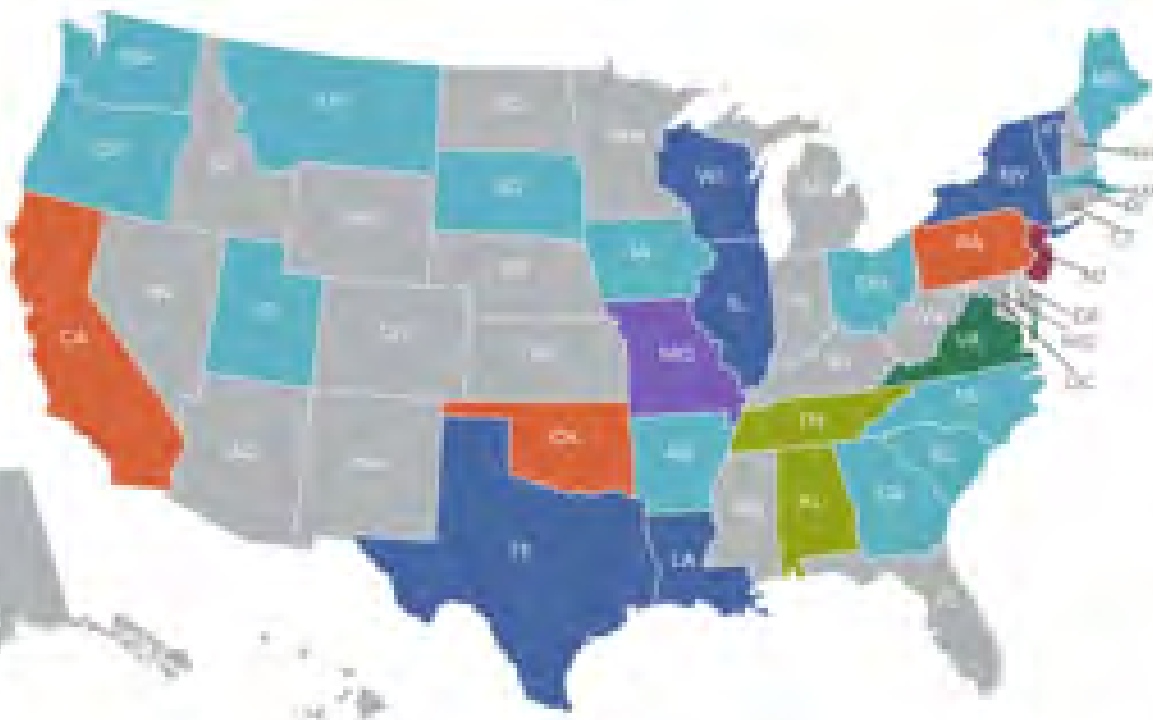


BALANCED MIX DESIGN (BMD)



US - BMD IMPLEMENTATION STATUS

- ✓ 14 DOTS IMPLMENTING
- ✓ 13 DOTS IN PROCESS OF IMPLEMENTING



- APPROACH A -
VOLUMETRIC DESIGN
WITH PERFORMANCE
VERIFICATION
- APPROACH A AND B
- APPROACH A AND D
- APPROACH B -
VOLUMETRIC DESIGN
WITH PERFORMANCE
OPTIMIZATION
- APPROACH C -
PERFORMANCE-
MODIFIED VOLUMETRIC
DESIGN
- APPROACH D -
PERFORMANCE DESIGN
- PRE-IMPLEMENTATION



[Implementation Efforts - National Asphalt Pavement Association](#)

NOTE: This link takes you to a Compilation of BMD Information



BMD IMPLEMENTATION APPROACHES

- A. Volumetric Design With Performance Verification.**
- B. Volumetric Design With Performance Optimization.**
- C. Performance Modified Volumetric Design.**
- D. Performance Design**

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✓ 14 DOTS IMPLMENTING

✓ 13 DOTS IN PROCESS OF IMPLEMENTING

[Implémentation Efforts - National Asphalt Pavement Association](#)

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BMD IMPLEMENTATION APPROACHES

- A. Volumetric Design With Performance Verification** - requires full compliance with the existing volumetric requirements and additional performance requirements and thus, is the most conservative approach and has the lowest innovation potential.
- B. Volumetric Design With Performance Optimization** - requires full compliance with the existing volumetric requirements at the preliminary OBC but allows moderate changes in asphalt binder content for performance optimization based on mixture performance test results. Although Approach B is slightly more flexible than Approach A, it is still considered a conservative approach with limited innovation potential.
- C. Performance Modified Volumetric Design** - allows some of the volumetric requirements to be relaxed or eliminated as long as the performance criteria are satisfied. The mix design modifications that can be used in performance optimization are not limited to changes in asphalt binder content. Therefore, it is less conservative than Approach A and Approach B and provides a medium degree of innovation potential.
- D. Performance Design** - has no requirement on volumetric properties and relies solely on mixture performance test results for mix design optimization, and thus, is considered the least conservative approach with the highest degree of innovation potential.



✓ **14 DOTS IMPLMENTING**

✓ **13 DOTS IN PROCESS OF IMPLEMENTING**

[Implementation Efforts - National Asphalt Pavement Association](#)

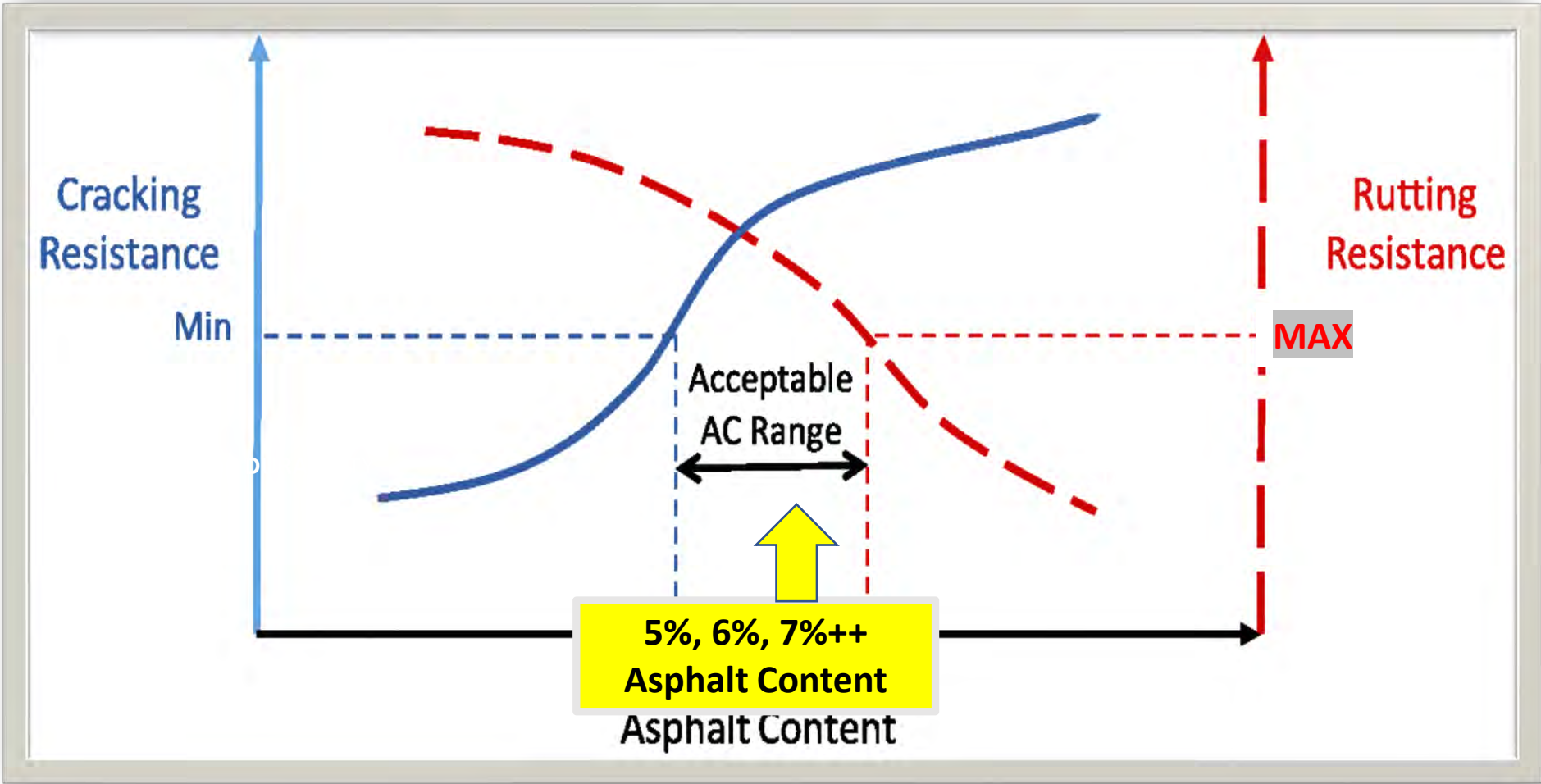
NOTE: This link takes you to a Compilation of BMD Information

BALANCED MIX DESIGN (BMD)

**“So where are we at with
implementing
PERFORMANCE
TESTING & BMD at
PennDOT?”**

BALANCED MIX DESIGN (BMD)

Asphalt Mix Design Performance Tests





BALANCED MIX DESIGN (**BMD**)

HWTT & CT-Index SSP 2021

- **Standard Special Provision approved by FHWA Jan. 25, 2021.**
- **HWTT & CT-Index testing results are for information only in 2021, 2022, 2023, & 2024.**

BALANCED MIX DESIGN (BMD)

RUTTING



PERFORMANCE TESTS



CRACKING

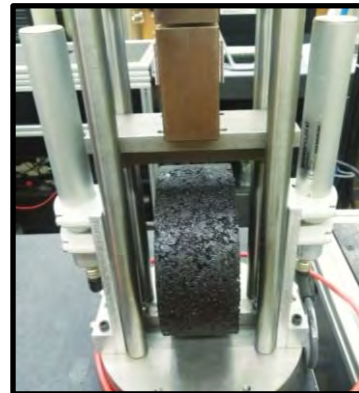
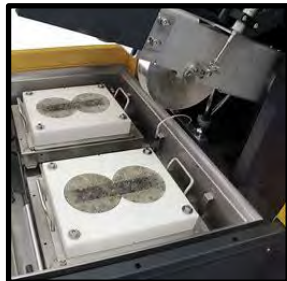
HWTT AASHTO T324

- Lab produced samples only for this pilot.
- Gyratory samples %7.0 (+/- 0.5%) air voids.
- Test run at 122° F (50° C).
- All samples tested to 20,000 cycles or 15mm rut depth, whichever comes first.
- May replace AASHTO T283 (TSR) eventually for moisture susceptibility.



IDEAL-CT ASTM D8225

- Gyratory samples %7.0 +/- %1.0 air voids (lab).
- Test run at 25° C (77°F).
- Applies load at 50mm / min.
- CT Index considers the Fracture energy, and post peak slope, and displacement at 75% peak load after failure.





BALANCED MIX DESIGN (BMD)



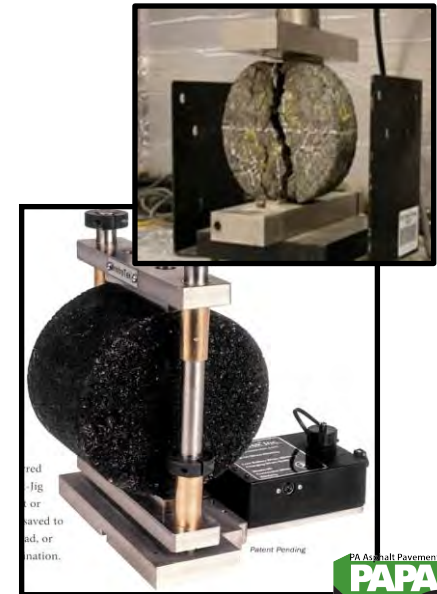
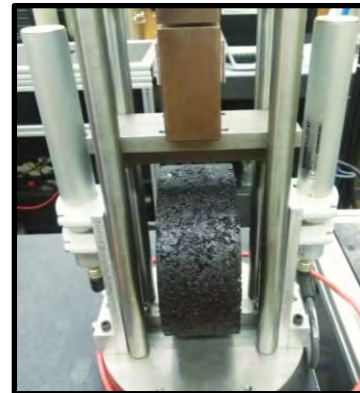
TO BE DETERMINED!

HWTT AASHTO T324

- **12.5 mm** @ 20,000 cycles
- **12.5 mm** @ 10,000 cycles
- Stripping inflection point TBD for moisture susceptibility. Replace or supplement TSR 283.

IDEAL-CT ASTM D8225

- **Minimum score of 70.**





BALANCED MIX DESIGN (**BMD**)

HWTT & CT-Index SSP 2021

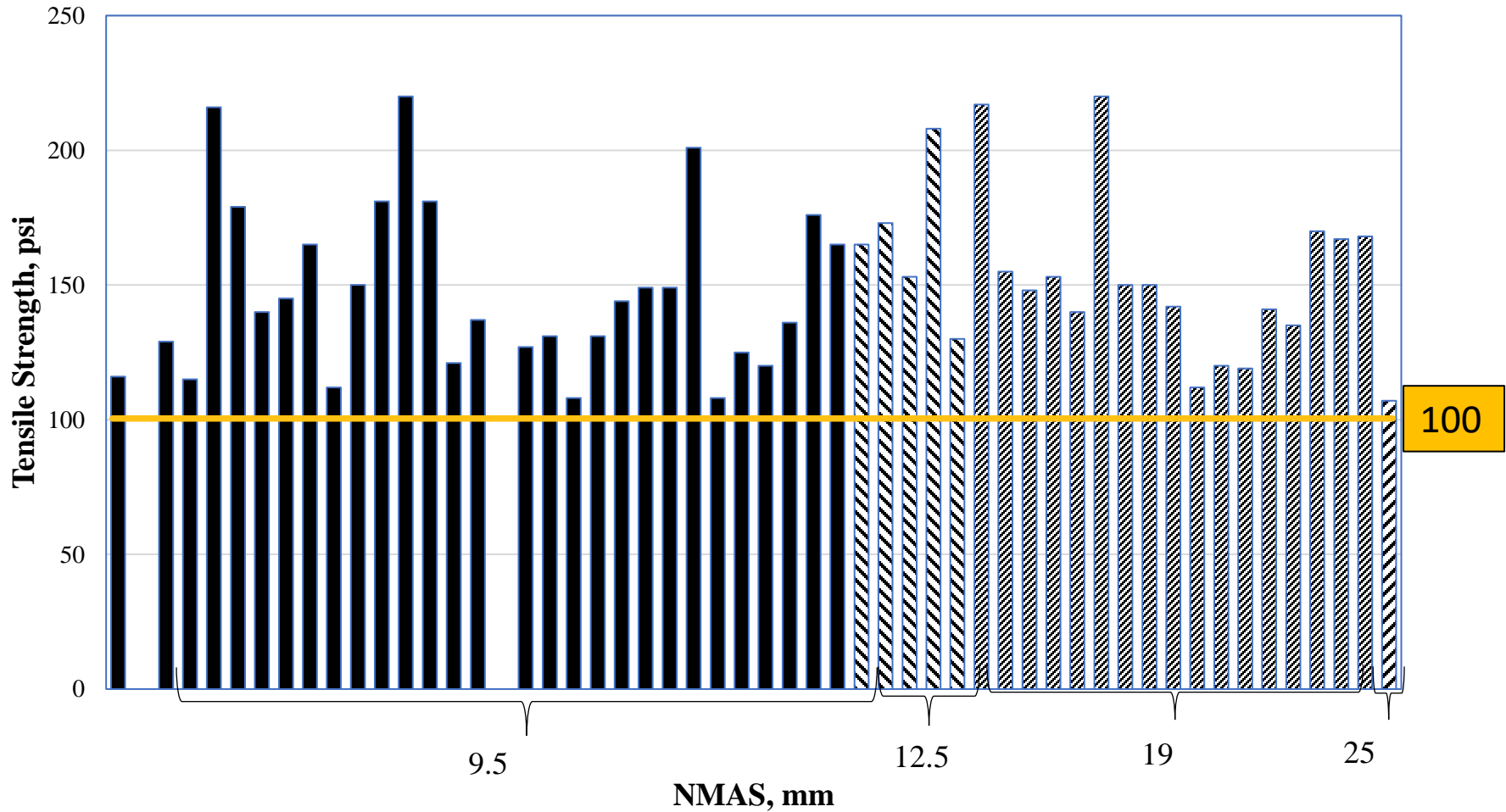
- Standard Special Provision approved by FHWA Jan. 25, 2021.
- HWTT & CT-Index testing results are for information only in 2021 - 2024.
- Solicitation letter sent to Districts asking that a minimum of 5 projects in the 2021 construction season with anticipated final inspection dates before October 31, 2022.
- A PDA shall be inserted into each project for payment of \$1,500 per JMF on the project.
 - This will probably be the last year for payments for testing.
- PennDOT wants to encourage producers to procure their own equipment
 - HWTT - \$55,000 TO \$75,000
 - IDEAL-CT - \$5,000 TO \$10,000

2021 ASPHALT PERFORMANCE TEST RESULTS

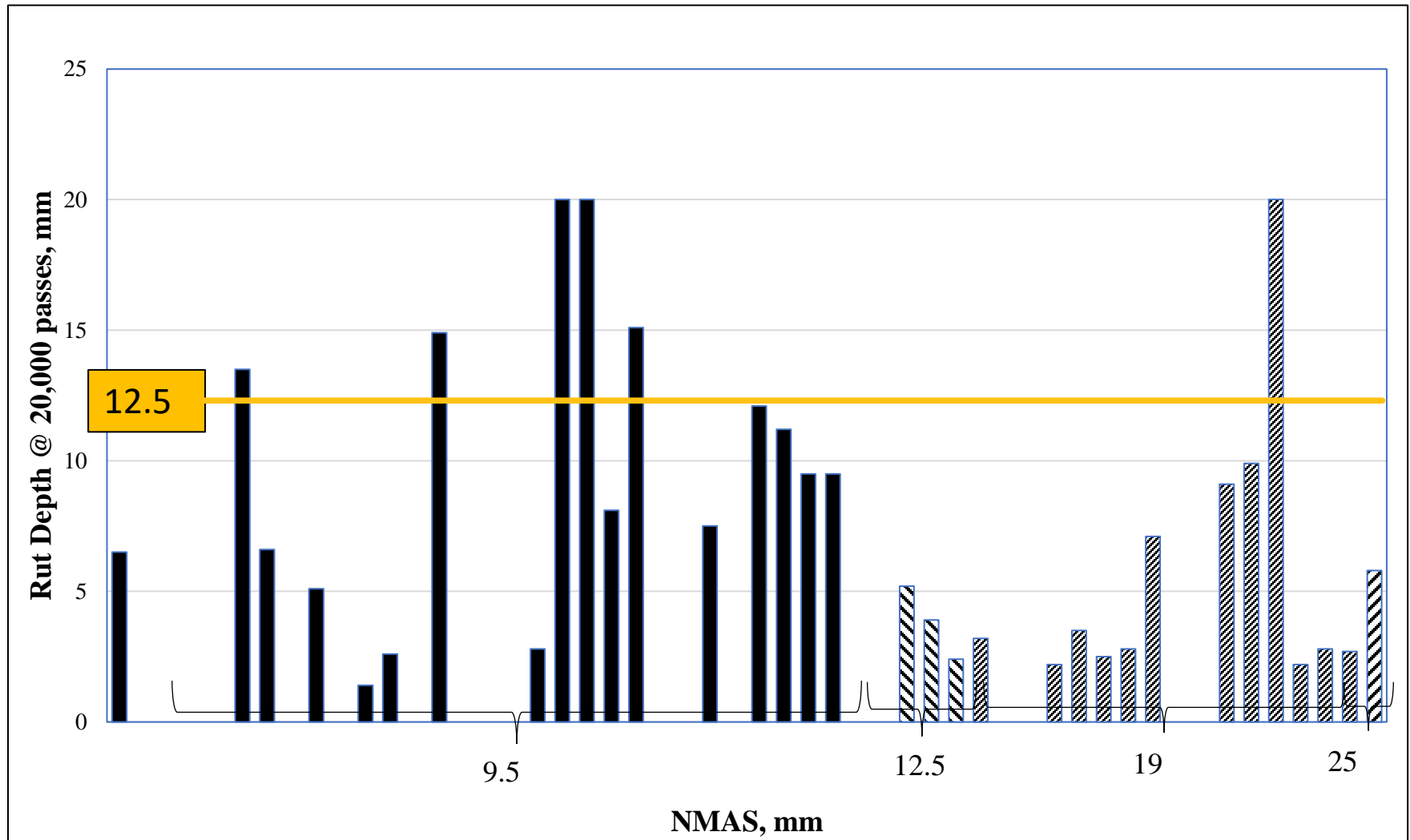
2021 Performance Test Results

ECMS#	Data	Depth @ 20,000	Depth @ 10,000	SIP Cycles	Tensile Strength	CT Index	NMAS	RAP %	AC%	PG	N des.
114715	#1		9.7	10,812	116	194	9.5	15	6.1	64S-22	75
	#2	3.2	2.6	None	155	37	19	30	4.5	64S-22	75
100503	#1		7.5	7,793		125	9.5	15	5.8	64S-22	50
109138	#1	5.8	4.7	None	107	132	25	25	4.2	64S-22	75
	#2	6.5	5.1	None	129	154	9.5	15	5.9	64S-22	75
108373	#1		>20	4,185	148	133	19	0	4.9	64S-22	75
	#2		>20	4,400	153	109	19	0	5.4	64S-22	50
Bakersville Plant Mix	#1	>12.5	7.5	8,453	115	298	9.5	15	6.0	64S-22	75
114594	#1	11@11,000	8.2	>20,000	216	108	9.5	30	5.4	64S-22	75
107678	#1	2.2	1.9	None	140	69	19	25	4.4	64S-22	75
115245	#1	15@12,800	8.4	7,972	179	86	9.5	15	5.8	64S-22	75
	#2	15@15,800	5.1	11,852	140	148	9.5	25	5.9	64S-22	75
	#3	3.5	2.5	None	220	43	19	25	4.4	64S-22	75
32326	#1	2.5	1.9	None	150	66	19	25	4.4	64S-22	75
	#2	2.8	2.3	None	150	110	19	15	4.4	64E-22	75
	#3	13.5	6.7	14,300	145	77	9.5	25	5.8	64S-22	75
	#4	6.6	2.7	None	165	230	9.5	15	5.8	64E-22	75
	#5	15@10,800	11.9	7,666	112	123	9.5	25	5.8	64S-22	75
	#6	5.1	2.5	19,000	150	232	9.5	15	5.8	64E-22	75

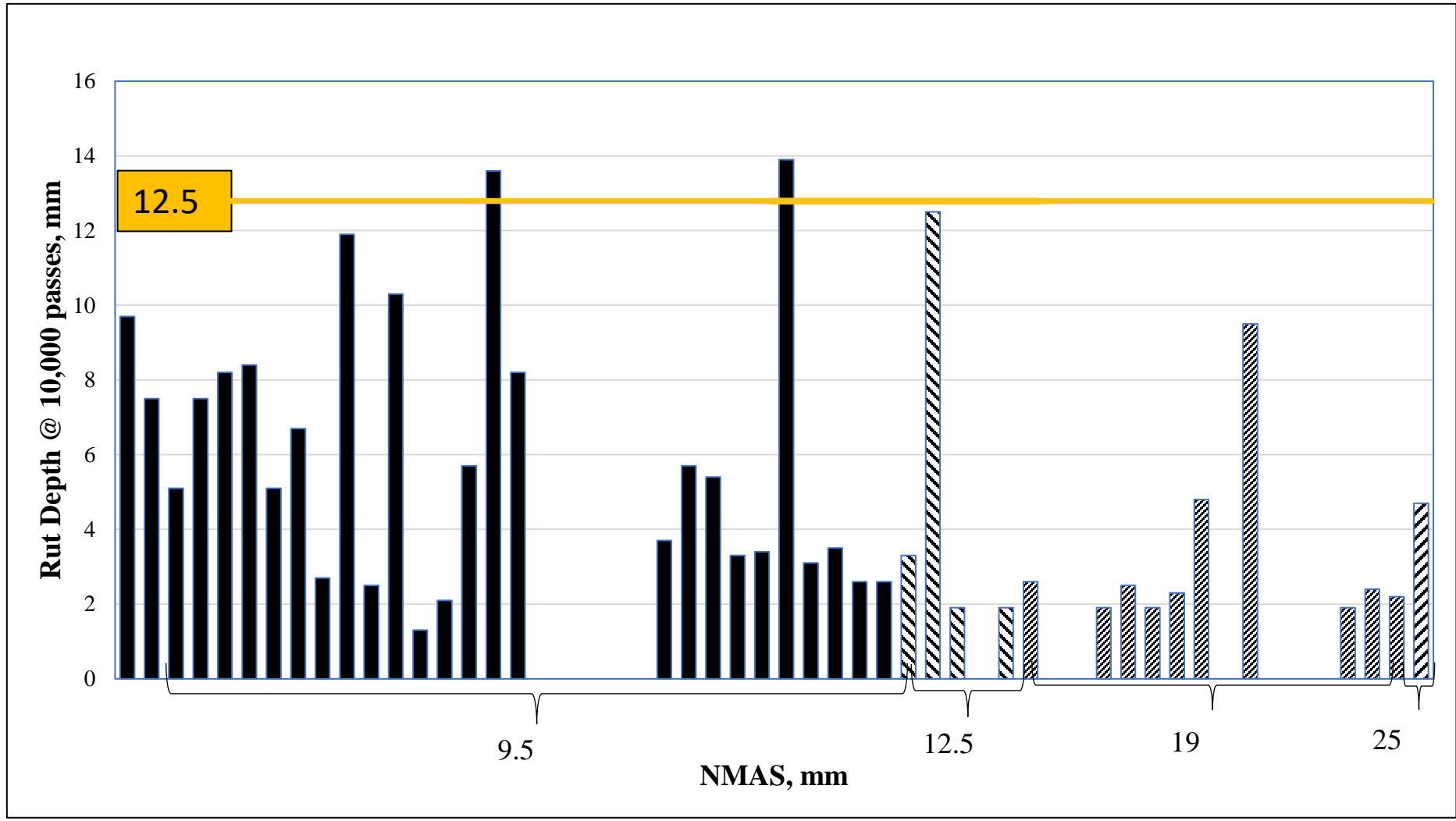
TENSILE STRENGTH vs NMA5



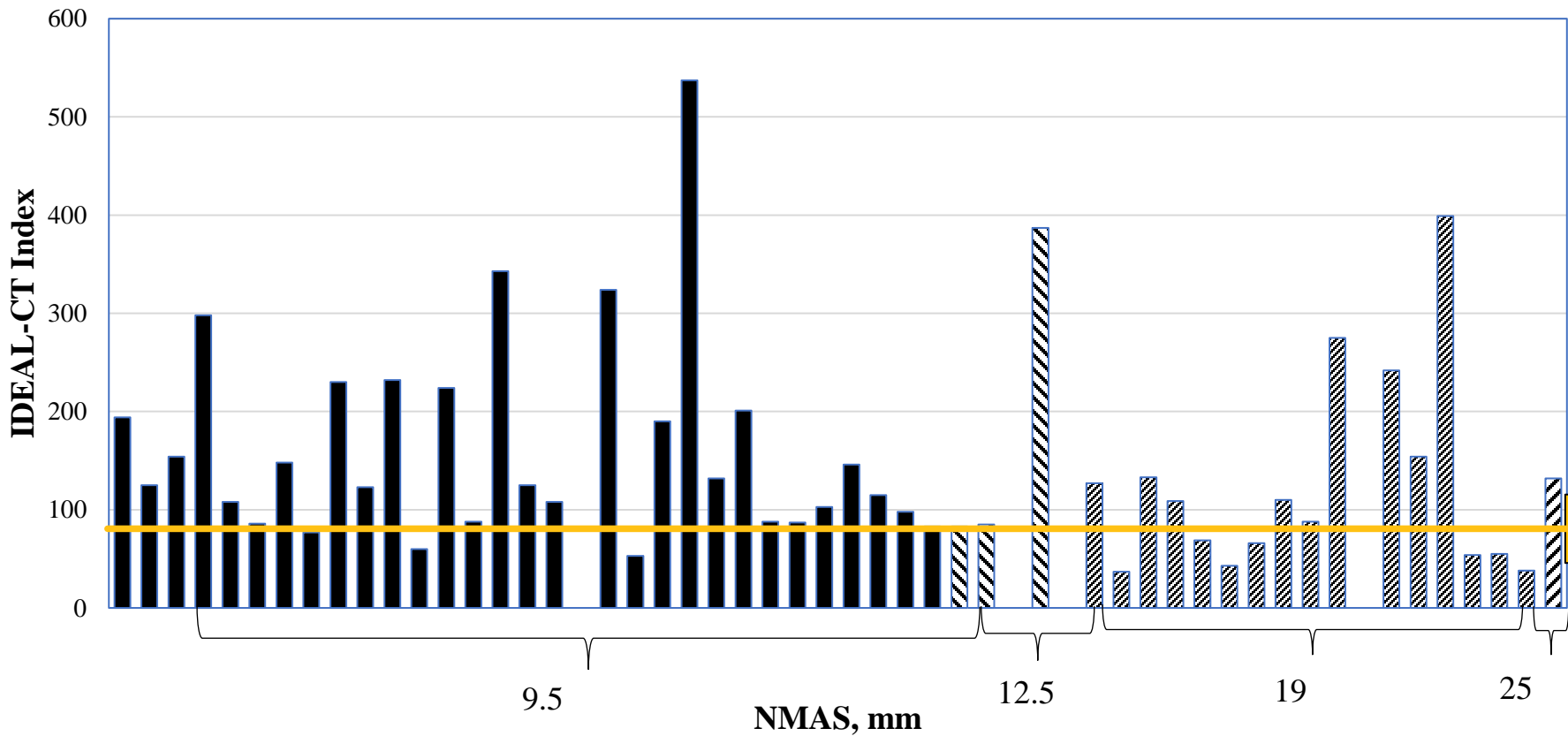
RUT DEPTH (20,000 CYCLES) vs NMAS



RUT DEPTH (10,000 CYCLES) vs NMAS

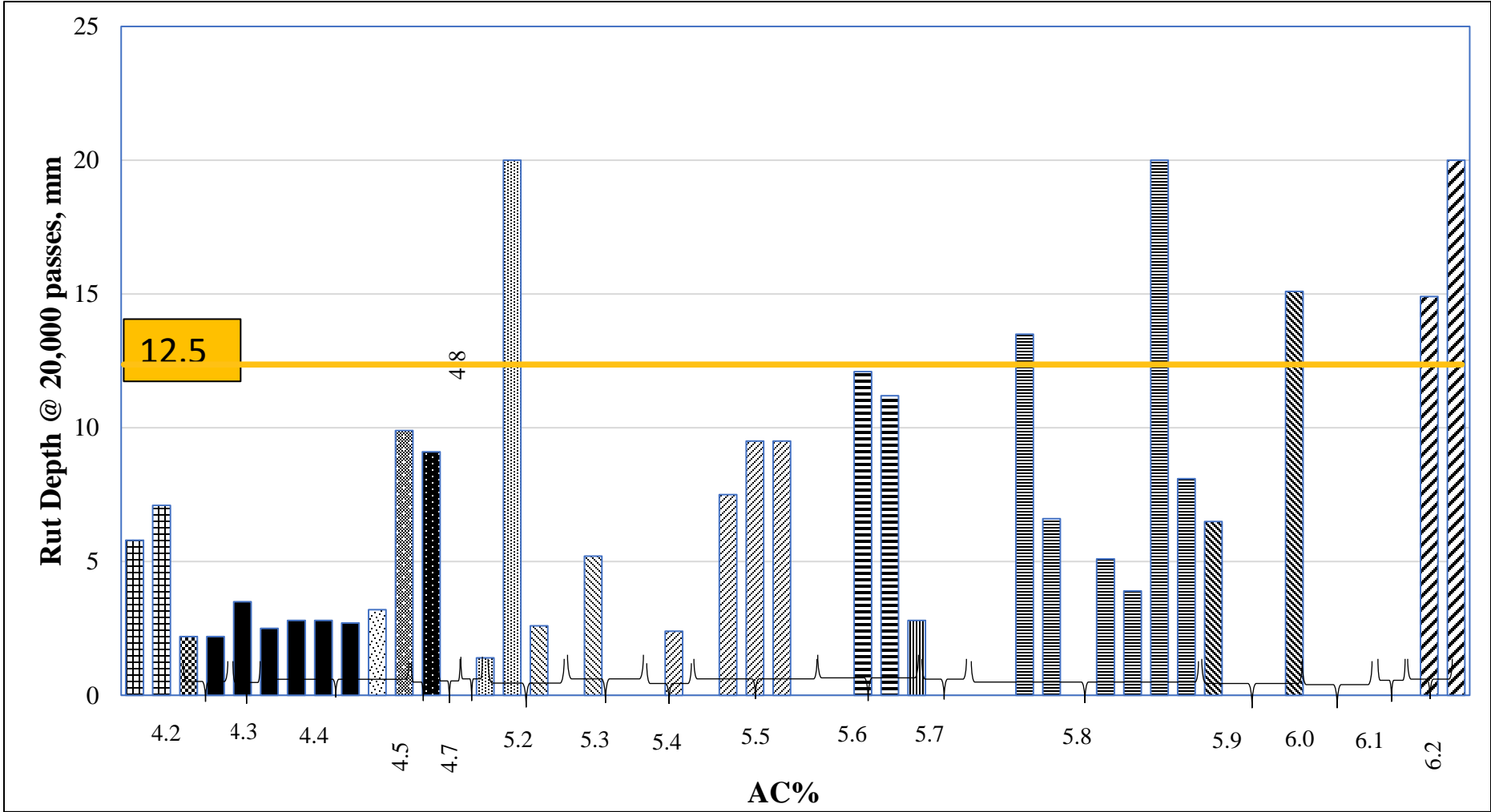


IDEAL CT INDEX vs NMAS

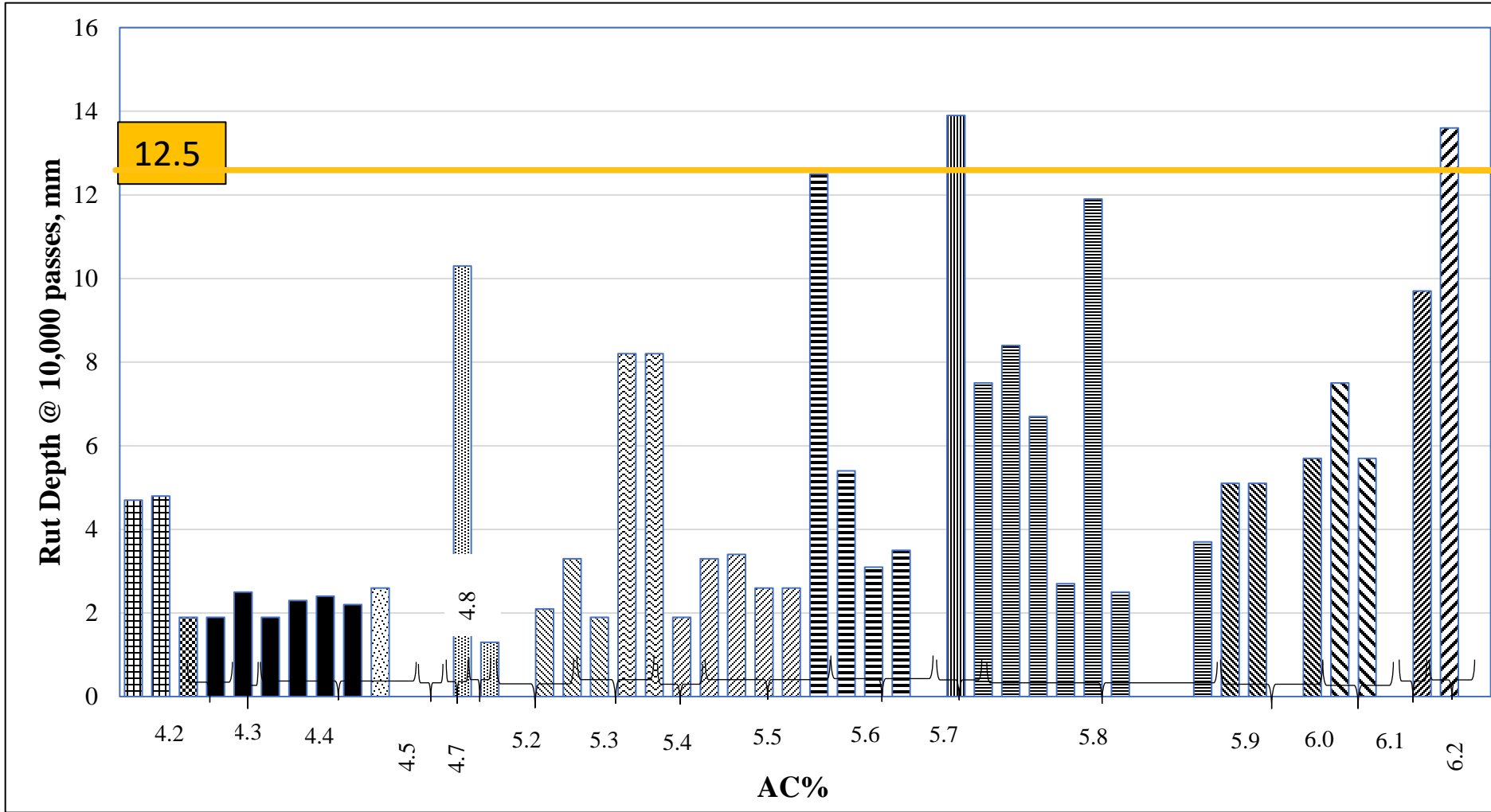


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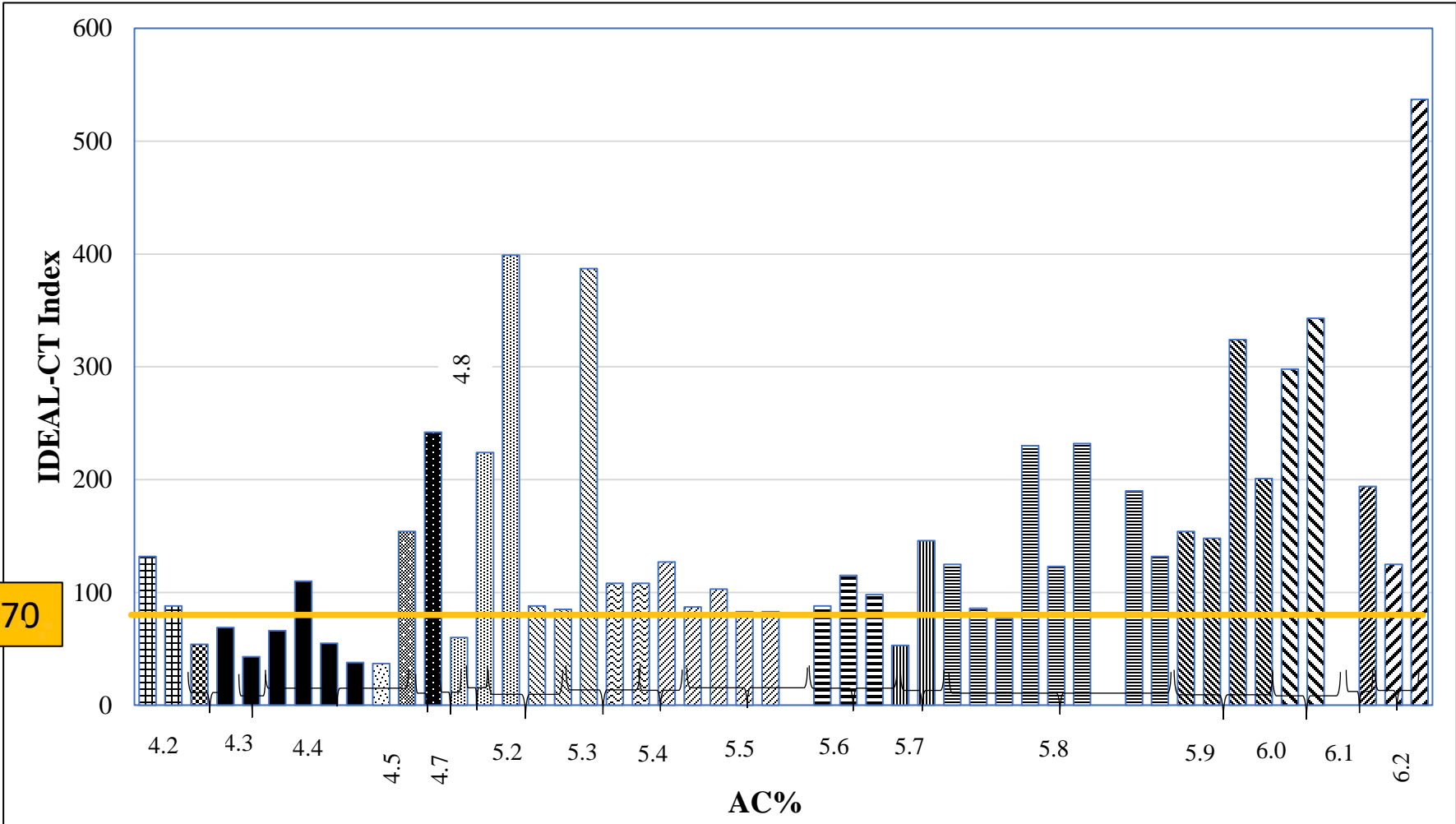
RUT DEPTH (20,000 CYCLES) vs AC%



RUT DEPTH (10,000 CYCLES) vs AC%

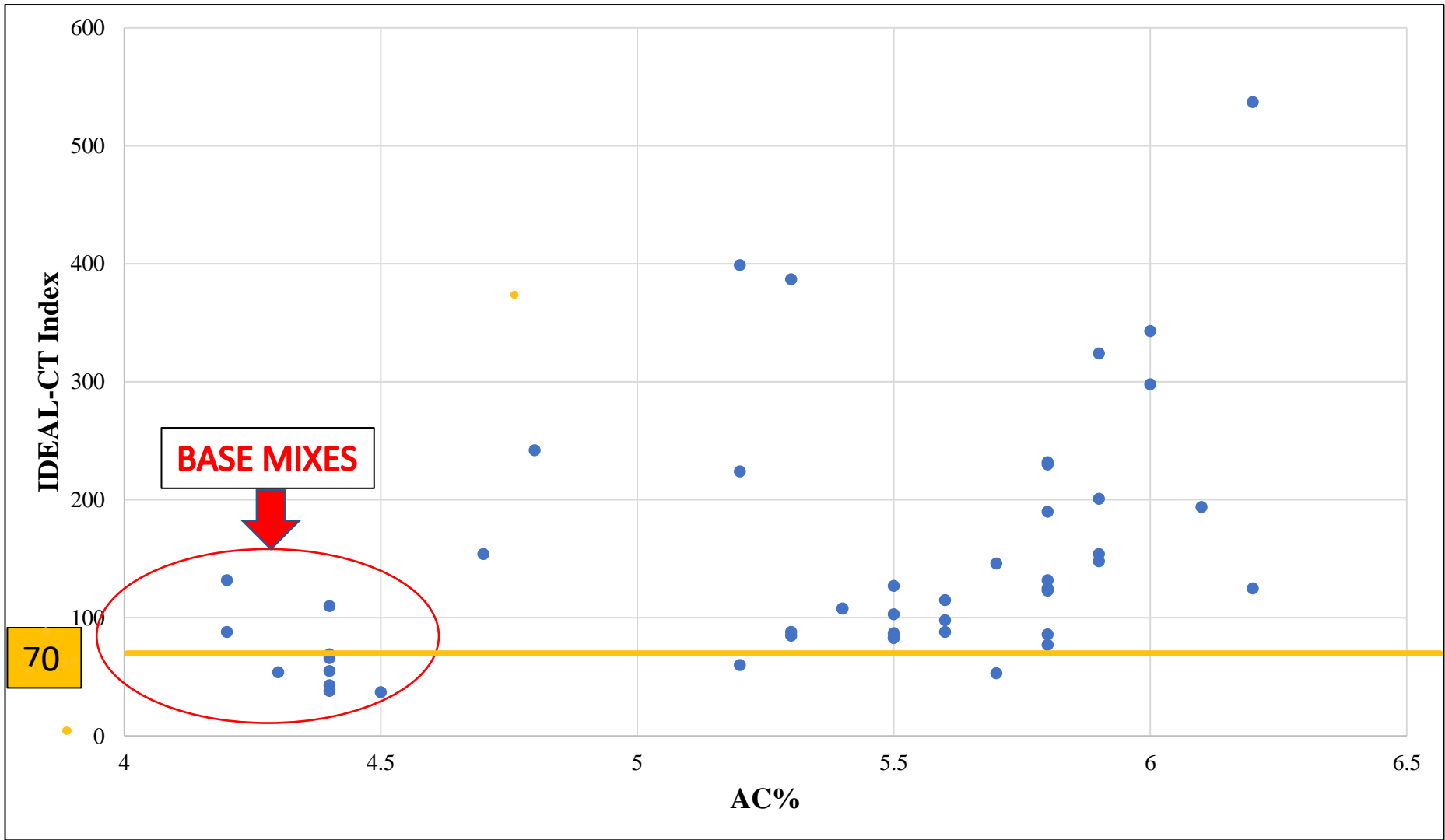


IDEAL CT INDEX vs AC%



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IDEAL CT INDEX vs AC%



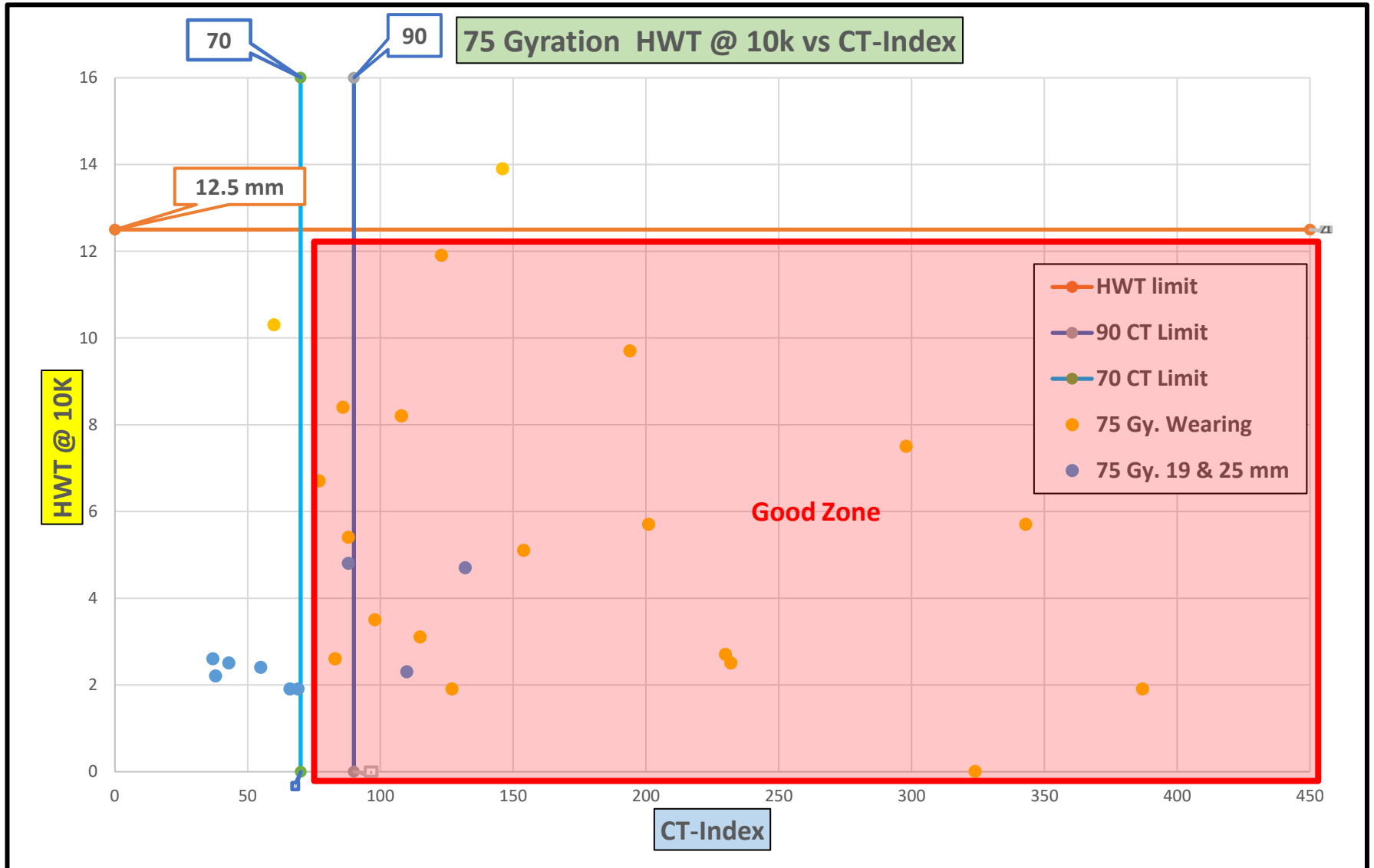
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BASE MIXES



2021 ASPHALT PERFORMANCE TEST RESULTS

75 Ndesign - 9.5 mm Wearing Mix



WHATS NEXT WITH BMD?



BALANCED MIX DESIGN (BMD) IMPLEMENTATION

- June 8, 2021, memo to Districts laying out **five-year implementation plan** for BMD with Performance Tests.

2021 Construction Season – Districts have/will include the attached standard special provision on selected projects in the 2021 construction season. Payments will be made for the HWTT and CT(Index) testing as outlined in the standard special provision. Information only test results will be reported in the Remarks section of the JMF input within the eCAMMS system.

2022 Construction Season – For JMFs approved for the 2022 calendar year, Asphalt producers are encouraged to complete for information only HWTT and CT(Index) testing results to be entered into the remarks section of the eCAMMS system for as many JMF wearing course submissions as possible. HWTT and CT(Index) testing costs will be considered incidental to JMF approval for all 50-gyraton wearing course JMFs approved after 12/1/2021.

BALANCED MIX DESIGN (BMD)

- June 8, 2021, memo to Districts laying out **five-year implementation plan** for BMD with Performance Tests.

2023 Construction Season – For JMFs approved after 12/1/2022, all 50 -gyration wearing course JMFs submitted for approval will require for information only HWTT and CT(Index) testing results entered into the remarks section of the eCAMMS system before JMF approval unless approved otherwise by the DME (refer to General Requirements Section). HWTT and CT(Index) testing costs will be considered incidental to the JMF approval for all 50-gyraton wearing course JMFs approved after 12/1/2022. **This is approximately 800 mix designs!**

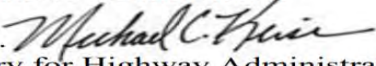
BALANCED MIX DESIGN (BMD)**LETTER TO DISTRICTS RE: IMPLEMENTATION OF PERFORMANCE TESTING**

481-22-01

DATE: January 21, 2022

SUBJECT: Implementation of Performance Related Testing into Pennsylvania's Asphalt Mix Design Approval Process

TO: District Executives
Assistant District Executives - Construction

FROM: Michael C. Keiser, P.E. 
Acting Deputy Secretary for Highway Administration

This Strike-Off Letter (SOL) is time and cost neutral. The purpose of this SOL is to begin the implementation of performance related testing for asphalt wearing course mix designs. The full implementation of the new performance related testing for asphalt wearing courses will be phased in over the next 3 years. This SOL establishes the process needed to gather the data for the Department to establish effective, reasonable, and achievable performance related testing limits for asphalt wearing courses.

JANUARY 21, 2022 - SOL 481-22-01 "For eCAMMS JMF Year 2023, *District Materials Engineers/Managers (DME/DMM) may approve asphalt wearing course mix designs without performance related testing results entered into the eCAMMS system on a case-by-case basis.* However, for JMF Year 2024, no asphalt wearing course mix design will be approved without performance related testing results entered into the eCAMMS system. Procedures for entering JMF performance related data into the eCAMMS system is attached to this SOL".

BALANCED MIX DESIGN (**BMD**)

- June 8, 2021, memo to Districts laying out **five-year implementation plan** for BMD with Performance Tests.

2024 Construction Season – All wearing course JMFs submitted for approval after 12/1/2023 will require for information only HWTT and CT(Index) testing results entered into the remarks section of the eCAMMS system before JMF approval unless approved otherwise by the DME (refer to General Requirements Section). HWTT and CT(Index) testing costs will be considered incidental to the JMF approval for all wearing courses. JMFs approved for the 2024 calendar year.

2025 Construction Season – By 12/1/2024 the Department will establish HWTT testing limits and implement them for all wearing courses JMF approvals for JMFs approved for the 2025 calendar year.

BALANCED MIX DESIGN (BMD)**Implementation – Status - Need**

- Pick performance test(s) **75%**
- Decide on test protocols **75%**
- Sample aging protocols **50%**
- Field verification projects **20%**
- Who will be doing testing and how large of an investment is the equipment? **10%**
 - Contractors / Producers
 - Special Testing Labs
 - LTS
- Determination of acceptance limits **25%**
- Utilization of performance test results (design, QC, QA??)
- Trained technicians to run testing? **5%**
- **NECEPT CONTRACT** to assist with implementation NTP to **NECEPT July 26, 2022!**

QUESTIONS?

Thank you for your attention!



Please contact us for any assistance!

Gary L. Hoffman, P.E. – gary@pa-asphalt.org

