Asphalt Construction Program

Asphalt Plant Technician Certification
An Update/Refresher Course
for
Asphalt Plant Certification

January 2024

Presented by

Northeast Center of Excellence for Pavement Technology

1

NECEPT

Website: www.superpave.psu.edu

Email: superpave@psu.edu

Covers PENNDOT Certification Program

Click on Training to Access Course Information:

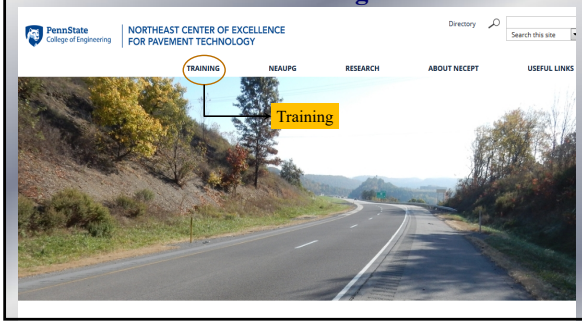
Courses, Registration, Schedule & Agenda, Pub 351, FAQ

Program Assistant

(814-863-1293)

2

On-Line Registration



3

Introductory Topics

- Housekeeping Items
- Certification Categories
- Certification Requirements
- On-Line Registration
- Course Objective
- Course Agenda
- Acronyms

4

Housekeeping

1. Attendance and Participation
2. Course Schedule and Breaks
3. Quiz at the end of each Module
4. Access to Course Material

5

1. Attendance and Participation

- Attendance in the course through Zoom is required.
- Zoom records must show at least 90% attendance.
- Participants' webcams will be off.
- Participants' microphones will be off.
- Have your speakers ON.
- Questions can be asked through Zoom.

6

2. Attendance and Participation

How to use Q/A and Chat Features on Zoom Webinar:

Remember these two rules:

1. Do you want to ask questions?
   Then USE Q/A

2. Do you want to answer the instructors' questions?
   Then USE CHAT

7

7

2. Course Schedule and Breaks

- Finish by 4:30 P.M.
- Short 5-to-10 Minute Breaks at the End of each Module (after quiz)

8

3. Quiz at the end of each module

- Short Quiz – Self Graded
- 5 to 10 Questions
- 3 to 7 minutes
- REQUIRED:
  - Must answer **85** percent of questions
  - Not graded for correct or wrong answers

NOTE: At the end of the module, take the quiz first before taking a break.
The quiz time is limited and will not be reopened.

9

4. Access to Course Material

Course Material:
is available at the NECEPT Website.
some of the modules will be added after the course.

Go to **www.superpave.psu.edu**
Look under "Training"

10

Certification Categories

- Asphalt Field Technician
- Asphalt Plant Technician Level I
- Asphalt Plant Technician Level II
- Concrete Field Testing Technician
- Aggregate Technician
- PG Asphalt Binder Technician
  - (Binder Course is through NETTCP)

11

Certification Publications

- Asphalt: PennDOT Pub 351
- Concrete: PennDOT Pub 536
- Aggregate: PennDOT Pub 725

12

Certification Requirements

Covered in Publication 351

BITUMINOUS OR ASPHALT TECHNICIAN CERTIFICATION PROGRAM

BITUMINOUS OR ASPHALT PLANT AND FIELD TECHNICIANS

Initial Certification Requirements
Certification Renewal Requirements
Registration Procedures
Performance Review and Code of Ethics
Course Administration

November 2018 Edition

pennsylvania DEPARTMENT OF TRANSPORTATION PUB 351 (11-18) www.penndot.gov PUB 351 (10-16)

13

PennDOT Publication 351

- Publication 351 Covers
  - Requirements for Initial Certification
  - Requirements for Recertification
  - Application Procedure
  - Exam Review & Retests
  - Code of Ethics
  - Covers both plant and field tech certification
- Certification Program developed to satisfy requirements of Code of Federal Regulations, 23 CFR, Part 637, QA Procedures for Construction

14

PennDOT Publication 351
Code of Ethics

- 1. **Beneficence/Autonomy: demonstrate concern for the welfare and dignity of the recipients of the services, including Department personnel.**
- 2. **Competence: maintain high standards of professional competence**
- 3. **Public Information: provide accurate information about Asphalt technician services**
- 4. **Professional Relationships: function with discretion and integrity in relation with colleagues and other professionals.**

15

Renewal/Recertification
Asphalt Level I Plant Technician

Pub 351: Section XII (**Option A**)

- Must have been Level I certified for previous 5 years
- Must have **500 documented hours experience** in asphalt lab or plant performing QC/QA testing or inspection since date of last certification
- Must have **sign-off from supervisor** or from a Level II Tech in company.
- Must have **sign-off from PennDOT** DME/DMM Within the previous 5 years, must have attended :
  - Two NECEPT Plant Technician Update/Refresher Courses, or….
  - One NECEPT Update/Refresher Course and six hours of asphalt related learning activities from workshops, seminars, conferences, etc.

16

Renewal/Recertification
Asphalt Level II Plant Technician

Pub 351: Section XIII (Option A)

- Must have been Level II certified for previous 5 years
- Must have **500 documented hours experience** in asphalt lab or plant performing QC/QA testing or inspection since date of last certification
- Must have **sign-off from supervisor** or from a Level II Tech in company.
- Must have **sign-off from PennDOT** DME/DMM Within the previous 5 years, must have attended :
  - Two NECEPT Plant Technician Update/Refresher Courses, or….
  - One NECEPT Update/Refresher Course and minimum of **six hours of asphalt related learning activities from workshops, seminars, conferences, etc.**

17

Examples of Accepted Asphalt-Related Annual Conferences, Seminars, and Workshops

- Annual APC Conferences
- Annual PAPA Conference
- Annual PAPA Regional Technical Meetings
- Annual Asphalt Pavement Conference from any MARTCP states
- Mid-Atlantic States QAW
- Nationally Recognized Conferences or Courses (NAPA, NCAT, NEAUPG, …)
- PennDOT pre-approved Department or Industry sponsored training

18

Accepted Asphalt-Related Annual Conferences, Seminars, and Workshops

Abbreviations for Terms

- APC: Associated Pennsylvania Contractors
- PAPA: Pennsylvania Asphalt Pavement Association
- MARTCP: Mid-Atlantic Reciprocity Certification Program states
- QAW: Quality Assurance Workshop
- NAPA: National Pavement Association
- NCAT: National Center for Asphalt Technology

19

Course Objectives

This is a course for renewal of certification as an Asphalt Plant Level I or Level II Technician.

The course objectives are

- To review the latest changes in PennDOT Specs
- To discuss latest issues and topics related to asphalt pavement materials, design, and construction

20

Plant Technician Certification Renewal
Course Agenda

- 1. Update on PennDOT Specifications
- 2. Update on PennDOT Bulletin 27
- 3. Balanced Mix Design & Data Variability: Virginia's Experience
- 4. Hot Topic 1 Related to Asphalt Construction
- 5. Hot Topic 2 Related to Asphalt Construction
- 6. Use of Rejuvenators in Asphalt Mixture

21

ACRONYMS

01. AASHTO: American Association of State Transportation Officials (www.transportation.org)
02. AET: Asphalt Emulsion Tack
03. AI: Asphalt Institute (www.asphaltinstitute.org)
04. ATPBC: Asphalt Treated Permeable Base Course
05. DME/DMM: District Materials Engineer/District Materials Manager
06. ESAL: Equivalent Single Axle Load
07. FHWA: Federal Highway Administration (www.fhwa.dot.gov)
08. HMA: Hot Mix Asphalt
09. JMF: Job Mix Formula
10. LTS: (PennDOT) Laboratory Testing Section

22

ACRONYMS

11. MTV: Materials Transfer Vehicle
12. NAPA: National Asphalt Paving Association (www.asphaltpavement.org)
13. NECEPT: Northeast Center of Excellence for Paving Technology (www.superpave.psu.edu)
14. NMAS: Nominal Maximum Aggregate Size
15. OSHA: Occupational Safety and Health Administration (www.osha.gov)
16. PAPA: Pennsylvania Asphalt Pavement Association (www.pahotmix.org)
17. PG: Performance Grade
18. PTM: Pennsylvania Test Method
    (ftp://ftp.dot.state.pa.us/public/pdf/BOCM_MTD_LAB/PUBLICATIONS/PUB_19/PTM_TOC.pdf)
19. QC/QA: Quality Control / Quality Assurance
20. RPS: Restricted Performance Specifications

23

ACRONYMS

21. PWL: Percent Within Limits
22. RAM: Reclaimed Aggregate Material
23. RAP: Reclaimed Asphalt Pavement
24. RAS: Recycled Asphalt Shingle
25. SGC: Superpave Gyratory Compactor
26. SRL: Skid Resistance Level
27. SMA: Stone Matrix Asphalt (Stone Mastic Asphalt)
28. TSR: Tensile Strength Ratio
29. VFA: Voids Field with Asphalt
30. VMA: Voids in the Mineral Aggregate
31. WMA: Warm Mix Asphalt

24

N E C E P T

Plant Technician Certification Program

An Update on

PennDOT Asphalt Specifications

2024

NECEPT

1

1

Your Role with PennDOT Specifications

- You must be
  - familiar with specifications that cover your project.
  - be aware of the effective change dates and your project let date.

NECEPT

2

2

Powers of Observation

- Do you think this is important for you as a certified plant technician?
- How would you rate yourself on a scale of 1 to 10, with 10 being the best!

3

FINISHED FILES ARE THE RESULT OF YEARS OF SCIENTIFIC STUDY COMBINED WITH THE EXPERIENCE OF MANY YEARS.

4

Can you read this?

I cdnuolt blveiee that I cluod aulaclty uesdnatnrd what I was rdanieg. The phaonmneal pweor of the hmuan mnid, aoccdrnig to a rscheearch at Cmabrigde Uinervtisy, it dseno't mtaetr in what oerdr the ltteres in a word are, the olny iproamtnt tihng is that the frsit and last ltteer be in the rghit pclae. The rset can be a taotl mses and you can still raed it whotuit a pboerlm. This is bcuseae the huamn mnid deos not raed ervey lteter by istlef, but the word as a wlohe. Azanmig huh? Yaeh and I awlyas tghuhot slpeling was ipmorantt! If you can raed this forwrad it

5

R34D 7H15

6

7H15 M3554G3 53RV35 70 PROV3 7H47 OUR M1ND5 C4N DO 1MPR3551V3 TH1NG5! 1N 7H3 B3G1NN1NG 17 WA5 H4RD. BU7 NOW, ON 7H15 LIN3 YOUR M1ND 15 R34D1NG 4UTOM471C4LLY W17HOU7 3V3N 7H1NK1NG 4BOU7 17. ONLY C3R741N P3OPL3 C4N R34D 7H15!

7

So,
Are you using your Powers of Observation?

Be observant to all aspects of the products you are working with.

Learn from you mistakes and mistakes of others.

Be knowledgeable of specifications and JMF.

8

PennDOT Specifications

Which Specifications Are Most Significant?

The specifications that cover your project and affect YOU are the most important. Be aware of the effective change dates and your project let date.

9

What you need to know...

- **PennDOT Specifications Publication 408**
- **Sections covering Asphalt & the important aspects of these specifications**

10

Publication 408/2020

- PennDOT Pub 408/2020 contains Construction Specifications
- Initial Edition, (Effective April 10, 2020)
- For PennDOT Projects Let after April 10, 2020
- PennDOT Website (Initial Edition): http://www.dot.state.pa.us/public/PubsForms/Publications/Pub_408/408_2020/408_2020_IE/408_2020_IE.pdf

11

PennDOT Specifications (Publication 408)

Version	Effective Date
Initial Edition	April 10, 2020
Change No. 1	October 2, 2020
Change No. 2	April 9, 2021
Change No. 3	October 8, 2021
Change No. 4	April 1, 2022
Change No. 5	October 7, 2022
Change No. 6	April 14, 2023
Change No. 7	**October 6, 2023**

2020

12

Sections of Publication 408

Question:

How Many Sections Are There in Spec 408?

Answer:

Twelve

13

13

Contents of Publication 408

- Sections 1 through 12
- Appendix A - Metric (SI) Information
- Appendix B – Standard Special Provisions (SSP)
  - as set forth in the Bid Proposals
  - need further tailoring for use on specific projects
  - includes seven indices (C, D, G, I, N, P, S)
  - SSP Contents accessible through ECMS Website
- Appendix C – Designated Special Provisions
  - Standard documents previously included in PennDOT Bid Proposals.
- General Index (indexing the Publication)
- Change Letters and Indices

14

14

Sections of Publication 408

- 100 - General Provisions
- 200 - Earthwork
- 300 - Base Courses
- 400 - Flexible Pavements
- 500 – Rigid Pavements
- 600 – Incidental Construction

15

15

Sections of Publication 408

- 700 - Materials
- 800 - Roadside Development
- 900 - Traffic Accommodation & Control
- 1000 - Structures
- 1100 - Manufactured Materials
- 1200 - Intelligent Transportation System Devices

16

16

Sections of Publication 408

- 100 - General Provisions
  - Abbreviations and definitions
  - Bidding requirements and conditions
  - Award and contract execution
  - Scope and control of work
  - **Control of materials (Section 106)**
  - Measurement of quantities
  - Payment
  - Several others

17

17

Sections of Publication 408

- 300 – Base Courses
  - SP Asphalt Mix Design & Construction, Base Course (**Section 313**)
  - Asphalt Rich Base Course (**Section 314**)
  - Cold Mixes (**Sections 341 and 342**)
  - Asphalt Treated Permeable Base (**Section 360**)

18

18

Sections of Publication 408

- 400 – Flexible Pavements
  - SP Asphalt Mix Design & Construction, Plant Mixed Courses with PWL and LTS Testing (Section 413)
  - SP Mixture Design & Construction of Plant Mixed 6.3 mm Thin Asphalt Overlay Courses (Section 412)
  - SMA (Section 419)

19

Sections of Publication 408

- 700 – Materials
  - Asphalt Materials (Section 702)
  - Aggregates (Section 703)

20

Are You Following Me?

- PA Rank in the Nation
  - Population: (5th)
  - Population Density: (9th)
  - Road Miles: (11th)

21

Discussion of Specification Changes

22

Publication 408/2016

Version	Effective Date
Initial Edition	**April 1, 2016**
Change No. 1	October 7, 2016
Change No. 2	April 7, 2017
Change No. 3	October 6, 2017
Change No. 4	April 6, 2018
Change No. 5	October 5, 2018
Change No. 6	April 5, 2019
Change No. 7	October 4, 2019

23

Relevant Sections Added in Pub 408 Since April 2019:

Date	Section	Description
April 2020	313	Plant Produced Asphalt Mixes (base course) – Merging 309 and 311
April 2020	413	Plant Produced Asphalt Mixes (wearing and binder courses) – Merging 409 and 411
April 2022	314	Rich Base Courses

24

Relevant Sections Removed from Pub 408 within the Last 5 Years:

Date	Section	Description
April 2020	309	SP Asphalt Mixtures, HMA Base Course – Merged into 313.
April 2020	311	SP Asphalt Mixture, Warm Base Course – Merged into 313.
April 2020	320	Aggregate-Bituminous Base Course.
April 2020	409	SP Asphalt Mixtures, HMA wearing and binder courses – Merged into 413.
April 2020	411	SP Asphalt Mixtures, WMA wearing and binder courses – Merged into 413.

25

Major Asphalt Related Changes in Pub 408 Since April 2019

Date	Section	Description
April 2019	413	Acceptance by Certification can be used for parking lots
April 2019	413	Change to Weather & Seasonal Limitations
October 2021	341 & 342	Allow foamed asphalt in cold recycling in addition to emulsified asphalt
October 2021	413	Once sublot size established, the sublot size will remain unchanged throughout the project
October 2022	413	Increase VMA by 0.5% in Table B

26

Major Asphalt Related Changes Since April 2019 (PennDOT Bulletin 27 and SSPs)

Effective Date	Publication #	Comments
1/21/2022	Bulletin 27	Minimum Effective Asphalt & Performance Related Testing
4/10/2020	SSP c0413	Superpave Asphalt Mixture Design, Binder Course (Leveling), High RAP
5/19/2020	SSP b04131	Superpave Mixture Design, Standard and RPS Construction of Plant Mixed Asphalt Courses With Percent within Limits and Hands-On Local Acceptance (HOLA)

27

Major Asphalt Related Changes Since April 2019 (Project Office & Design Manuals)

Effective Date	Publication #	Comments
October 2019	13M	Safety Edge
October 2020	72M: RC-25M	Safety Edge Drawings
12/21/2020	2 (POM)	Report delivered material using Electronic Ticketing System
4/1/2021	2 (POM)	Check temperature from truck bed holes
4/1/2022	2 (POM)	% Payment for Defective Asphalt Pavement

13M: Publication on Highway Design

28

Sections of Publication 408 Containing Asphalt Specifications (2020, Chg. 7)

Base Courses

106	Controls of Material Statistics
313	SP Asphalt Mixture Design & Construction of Base Courses
314	Rich Asphalt Base Courses
316	Flexible Base Replacement
341	Cold Recycled Asphalt Base Course (In-Place)
342	Cold Recycled Asphalt Base Course (Central Plant)
344	Full Depth Reclamation
360	Asphalt Treated Permeable Base

29

Sections of Publication 408 Removal of Some Sections related to Base Courses

320	Aggregate Bituminous Base Course – REMOVED from SPEC
321	Aggregate-Cement Base Course– REMOVED from SPEC
322	Aggregate-Line Pozzolan Base Course– REMOVED from SPEC

30

Sections of Publication 408 Containing Asphalt Specifications (2020, Chg. 7)

314	Rich Asphalt Base Courses
344	Full Depth Reclamation
360	Asphalt Treated Permeable Base

Section 314 **Q**: What is Design # of Gyrations? **50**

Section 314 **Q**: What is Design Air Voids? **2.5%**

Section 314 **Q**: What is minimum required VMA? **13%**

Section 344 **Q**: What stabilizing additives used in FDR?

Asphalt, cement, hydrated lime, calcium chloride

Section 360 Q: What is the required mat density for ATPB?

No density requirement

31

31

Section 314: Rich Base Courses

- Asphalt Rich Base Course (ARBC)
- Max. RAP ≤ 20% by weight of mix
- No RAS Allowed
- Mix Design Requirements for ARBC for all Traffic Levels:

Volumetric Mix Design Property	25 mm NMAS
N_{design}	50
Design Air Void	2.5
VMA for all Production QC Samples	13.0
VFA	80-85

32

Sections of Publication 408 Containing Asphalt Specifications (2020, Chg. 7)

Surface & Binder Courses

404	Evaluation and Payment of Asphalt Pavement Ride Quality Incentive
405	Evaluation of Asphalt Pavement Longitudinal Joint Density, Payment of Incentive/Disincentive
410	SP. Mix Design, Stand. and RPS Construction of Plant-Mixed Asphalt Fine Graded Courses
412	6.3-mm thin asphalt overlays
413	Superpave Asphalt Mixture Design, Construction of Plant-Mixed Courses with PWL and LTS Testing

33

33

Sections of Publication 408 Containing Asphalt Specifications (2020, Chg. 7)

419	SMA Design & RPS Construction of Wearing Course
420	Pervious Asphalt Pavement System
460	Asphalt Tack Coat
470	Asphalt Seal Coat
471	Asphalt Seal Coat using Precoated Aggregate
480	Asphalt Surface Treatment

Section 420 Q: Is RAP allowed in Pervious Asphalt Pavement? **Yes, up to 10%**

Section 460 Q: What is asphalt residue range for tack coat? **0.03 to 0.07 gal/yd²**

Section 471 Q: How much asphalt residual for precoated agg.? **0.6 to 1.2% by weight of mix**

Section 480 Q: How is surface treatment different from seal coat? **It is 2 layers of seal coat.**

34

34

Sections of Publication Containing Asphalt Specifications (2020, Chg. 7)

481	Asphalt Surface Treatment using Precoated Aggregate
482	Slurry Seal
483	Polymer-Modified Emulsified Asphalt Paving System (Micro Surfacing)
489	Ultra-Thin Bonded Wearing Course
496	Asphalt Concrete Pavement, 60-month Warranty

35

35

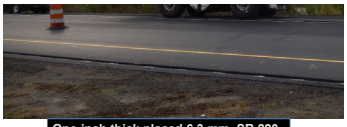
Change No. 4 (April 2018)

Section 412, Superpave Mixture Design, Construction of Plant Mixed Asphalt 6.3 mm Thin Overlay Courses

- Used in Thin Lifts (3/4" min, 1 ¼" max.)
- Useful Tool for Pavement Preservation
- An alternative to microsurfacing and seal coats.

36

Section 412
6.3 mm Thin Overlay Courses


One-inch thick placed 6.3 mm, SR 220

Mixture Details

- PG **64E-22** binder required
- Coarse aggregate: Type A
- Sand fine aggregate must be from the same source as coarse aggregate with SRL rating in Bulletin 14
- **Q:** RAP or RAS in mix? **NO**

37

Section 412
6.3 mm Thin Overlay Courses

Construction details:

- air and surface temperature > **50°F**
- MTV required, unless waived by Rep.
- Box samples from roadway, hopper, or screed
- Density acceptance by **Optimum rolling pattern or non-movement**

38

Section 412
6.3-mm Thin Overlay Courses

Critical points for success:

- Clean existing surface.
- Proper, uniform tack application
- Selection of compaction rollers
- Begin Rolling immediately.
- Time available for compaction is limited.
- Do not use pneumatic-tire rollers.

39

413–Superpave Asphalt Mixture Design and Construction of Plant Mixed Courses with PWL and LTS Testing

- 413.1 Description
- 413.2 Materials
- 413.3 Construction
- 413.4 Measurement & Payment

Where most changes have occurred in Specs.

.2 Deals with Materials
.3 Deals with Construction

40

Section 413.2: MATERIALS

TABLE A

JMF – Composition Tolerance Requirements

Gradation	Single Sample (n=1)	Multiple Sample (n≥3)
Passing 12.5 mm (1/2 inch) and Larger	± 8.0 %	± 6.0 %
Passing 9.5 mm (3/8 inch) to 150 µm (No 100) Sieves (Inclusive	± 6.0%	± 4.0 %
Passing 75 µm (No. 200) Sieve	± 3.0%	± 2.0%
Asphalt Content		
19.0 mm asphalt mixtures and smaller	± 0.7%	± 0.4%
25.0 mm asphalt mixtures and larger	± 0.8%	± 0.5%

41

Section 413.2: Materials
Table A

Temperature of Mixture (F)				
Class of Material	Type of Material	Chemical, Organic, Foaming Additives, Minimum	Mechanical Foaming Equip/Process Minimum*	Maximum*
PG 58S-28	Asphalt Binder	215	230	310
PG 64S-22	Asphalt Binder	220	240	320
PG 64E-22	Asphalt Binder	240	260	330
All other binders	Asphalt Binder	The higher of 215 or the minimum temp. specified in Bulletin 25 minus 45F	The higher of 230 or the minimum temp. specified in Bulletin 25 minus 30F	As specified in Bulletin 25

* Outline in the Producer QC Plan and follow more restrictive temperature requirements provided by the WMA technology manufacturer or Technical Representative(s) for production and placement of the mixture. Determine the SGC compaction temperature for the production QC which yields the same target air voids as the designed JMF. Include the SGC compaction temperature in the Producer QC Plan. Compact the completed mixture in the SGC for QC volumetric analysis at the SGC compaction temperature according to the guidelines provided by the Technical Representative.

42

Section 413.2:Materials
TABLE B

JMF – Volumetric Tolerance Requirements

Nominal Max Agg. Size (mm)	Each Specimen	Multiple Specimens
Air Voids at N_{des} (V_a)	±2%	±1.5%
Min. VMA% for 4.75 mm mixes	16.0	-
Min. VMA% for 9.5 mm mixes	15.0	-
Min. VMA% for 12.5 mm mixes	14.0	-
Min. VMA% for 19.0 mm mixes	13.0	-
Min. VMA% for 25.0 mm mixes	12.0	-
Min. VMA% for 37.0 mm mixes	11.0	-

43

43

Section 413.2: MATERIALS
TABLE C

Mixture Acceptance

Acceptance Level	Acceptance Method
Certification Acceptance	Producer Certification of Mixture Section 413.2 (i) 2
Lot Acceptance	Mixture Acceptance Sample Testing Section 413.3(h) 2

44

44

Section 413.3(h) 2: Mixture Lot Acceptance

- Normal Lot Size: 2,500 tons, 5 equal sublots
- Each sublot: 500 tons
- Special circumstances may change the size of a completed lot:
  - Minimum possible number of sublots: 3
  - Maximum possible number of sublots: 7

45

45

Section 413.3(h) 2: Sublot Size

(new as specified in Change 3 of Spec Edition 2020, (October 2021)

- Once the sublot size for each specific JMF has been established based on the project's plan quantity, the sublot size **will remain unchanged** throughout project completion.
- A completed sublot has a mixture acceptance box sample and either a core or other density acceptance measures

46

46

Section 413.3: Construction

- **TABLE D**. - Re-adjustment of Lot Size and Associated Number of Sublots
- **TABLE E**. - Density Limits for Partially Completed Lots
- **TABLE F**. - Density Acceptable Levels & Criteria
- **TABLE G**. - Minimum Mixture Compacted Depths

47

47

Section 413.2(h): Density Acceptance
TABLE E

Density Limits for Partially Completed Lots

Mixture NMAS	Density Limits
All RPS 9.5 mm, 12.5 mm, 19 mm, and 25 mm Wearing or Binder Course	≥ 92.0% and ≤ 98.0%
All Standard 9.5 mm, 12.5 mm, 19 mm, and 25 mm Wearing or Binder Course	≥ 91.0% and ≤ 98.0%
All 25 mm and 37.5 mm Base Course	≥ 90.0% and < 100.0%

- **PAYMENT:**
- If density meets Table E Criteria: **100% Pay**
- If density no more than **2%** below min. or no more than **2%** above max: **90% Pay**
- Other cases: Defective work. Remove & Replace unless directed otherwise by the District

48

48

Section 413.2(j): Density Acceptance

TABLE F

Density Acceptance

Density Acceptance Level	Acceptance Criteria
Non-movement	Table H
Optimum Rolling Pattern	Table H
Pavement Cores*	Table I
* Only when mixture is accepted by lots	

49

Section 413.2(j): Density Acceptance

Min. Thickness Requirement if Density Acceptance by Cores for Standard Construction

TABLE G

Mixture Minimum Compacted Depths

Mixture	Minimum Depth
9.5-mm Wearing Course	1 ½" (≈ 40 mm)
12.5-mm Wearing Course	2" (≈ 50 mm)
19-mm Wearing and Binder Course	2 ½" (≈ 60 mm)
25-mm Binder Course	3" (≈ 80 mm)

50

Section 413.4: Measurement & Payment

- TABLE H - **Mixture Acceptance by Certification**
  - **Asphalt Content**

NMAS	Criteria	Value		PF, %
All sizes	Printed Tickets	At least 90% is ± 0.2 of JMF		100
		Less than 90% is ± 0.2 of JMF		85
19 mm and smaller	QC Sample Testing	Single, n=1	n≥ 2	----------
		±0.7%	±0.5%	100
		±0.8% to 1.0%	±0.6%	85
		> ±1.0%	≥ ±0.7%	RR or 50%
25 mm and larger	QC Sample Testing	±0.8%	±0.6%	100
		±0.9% to 1.2%	±0.7%	85
		> ±1.2%	≥ ±0.8%	RR or 50%

51

Section 413.4: Measurement & Payment

- TABLE H - **Mixture Acceptance by Certification**
  - **Gradation**

NMAS	Criteria	Value		PF, %
		n=1	n≥ 2	
All sizes	QC Sample Testing for % Passing #200 Sieve	±3.0%	±2.1%	100
		±3.1% to ±4.0%	±2.2% to ±2.7%	85
		> ±4.0%	≥ ±2.8%	RR or 50%
All sizes	QC Sample Testing for % Passing #8 Sieve	±6%	±4%	100
		±7% to ±8%	±5%	85
		> ±8%	≥ ±6%	RR or 50%

52

Section 413.4: Measurement & Payment

- **Mixture Acceptance by Lots**

  TABLE I: Upper & Lower Spec Limits for Calculating Percent Within Tolerance

  TABLE J: : Dispute Resolution Retest Cost Table

53

Spec 408/2020 - Section 413

Weather and Seasonal Limitations

Place between **April 1 to October 15** for
- all PG 76-22 wearing courses, **(now PG 64E-22)**
- >10 million ESALs wearing courses,
- 4.75 mm wearing courses,
- wearing courses placed less than 1.5 inches (compacted)

Place between **April 1 to October 31** for other mixes

54

Spec 408/20206 - Section 413

Paving in extended season

- Submit requests in writing at least 14 days prior to work
- Group 1: **April 1 to November 15**
- Group 2: **March 1 to December 15**
- Density acceptance will be by pavement cores.
- Utilize a Material Transfer Vehicle (MTV) on any day when the paving length will exceed 1,500 linear feet.

55

Spec 408/2020 - Section 413

Paving in extended season

Paving work completed during the fall portion of the Extended-Season will be subject to a spring evaluation and manual survey by the Department to be conducted by May 1.

Manual surveys will be conducted in accordance with Publication **336.**

56

Spec 408/2020 - Section 413

Minimum Compacted Depth to Obtain Cores for Measuring and Accepting Density
For Standard Specification

Mixture	Minimum Depth
9.5-mm Wearing Course	1 ½" (≈ 40 mm)
12.5-mm Wearing Course	2" (≈ 50 mm)
19-mm Wearing and Binder Course	2 ½" (≈ 60 mm)
25-mm Binder Course	3" (≈ 80 mm)

57

Spec 408/2020 - Section 413

Materials for Painting
Existing Vertical Surfaces in Contact with an Asphalt Mix:

Paint existing vertical surfaces … in contact with asphalt mixtures with a uniform coating of either emulsified asphalt, consisting of PennDOT Material Class TACK or NTT/CNTT, applied in two or more applications, or hot asphalt material of the class and type designated for the bituminous course.

NTT: Non-Tracking Tack Coat (Anionic) & CNTT: Non-tracking Tack Coat (Cationic)

Removed the following materials for painting vertical surface:
Class E-6 (AASHTO SS-1 or CSS-1), E-8 (AASHTO SS-1h or CSS-1h), Class AET applied in two or more applications, or of the class and type designated for the asphalt course.

58

Spec 408/2020- Section 420
Pervious Asphalt Pavement System

Table B

Mixture Composition		
Gyrations	N_{design}	50
Air Voids	ASTM D6752	16.0% - 20.0%
	AASHTO T 275	18.0% - 22.0%
	AASHTO T 269	18.0% - 22.0%
Draindown	AASHTO T 305	≤0.3%

59

Are you ready for
Challenge Questions?

60

Spec 408/2020- Section 483 Microsurfacing

What emulsion is allowed for use in PennDOT micro surfacing?

CQS-1hPM (breaks and cures quickly)
(polymer modified cationic quick setting, with hard base asphalt)

What emulsion was previously used? CSS-1hPM (E-8CPM)

What is minimum percent of asphalt content in CQS-1h emulsion?

62%

61

Spec 408/2020- Section 412 and 413

Question: What methods are allowed for density acceptance of 6.3-mmand 4.75-mm mixes?

Non-movement (no movement of mixture under the roller)
Optimum Rolling Pattern using Nuclear Gauge (PTM 402)

Question: 4.75-mm mixes cannot be used if SRL is higher than?

L

62

Section 419: SMA

Question: Can WMA be used with SMA?

Answer: Yes

Question: Can crumb rubber be used in SMA as stabilizer? (How much)

Answer: Yes (0.3 to 1% by total mix weight)

63

63

Summary

- Discussed PennDOT Spec. 408
- Reviewed changes in Asphalt Specifications.
- Major additions within the last 5 years:
  - 6.3 mm Thin Lift (412)
  - SP Mixes with PWL-LTS (413)
  - SP Mixes for Base Course (313)
  - SP Asphalt Rich Base Course (314)

64

64

Summary

- Major Changes within the Last 5 years:
  - Addition of VMA Criterion for 4.75-mm mixes
  - Increase of Design VMA by 0.5%
  - Allowing WMA in SMA
  - Revised Tack Coat Spec
  - Revised Emulsion for Microsurfacing (Section 283)
  - Seasonal Limitations for Paving
  - Requirements for Extended Season Paving
  - Revised compacted depth for 12.5-mm mixes
  - Change of Density Limits for Partially Completed Lots

65

65

NECEPT

PennState

Thank You!

pennsylvania
DEPARTMENT OF TRANSPORTATION

66

66

UPDATE ON PENNDOT BULLETIN 27

2024 PennDOT/NECEPT Asphalt Plant Technician
Annual Update/Refresher Course

TIMOTHY L. RAMIREZ, P.E., ENGINEER OF TESTS, PENNDOT

pennsylvania
DEPARTMENT OF TRANSPORTATION

PENNDOT BY THE NUMBERS

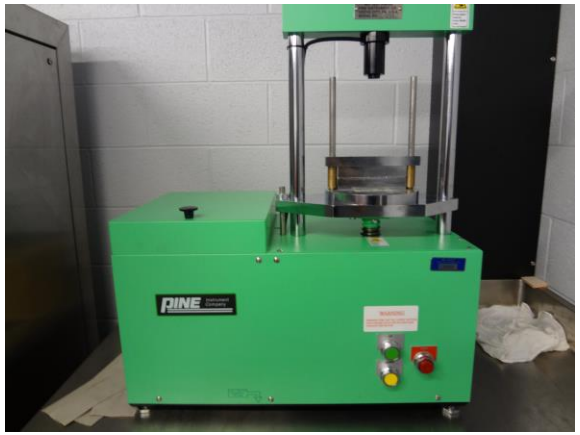
*Total miles on all PA roadways

LB (3-23)

OUTLINE

Bulletin 27, 2003 Edition, Changes

AASHTO Standards, Changes

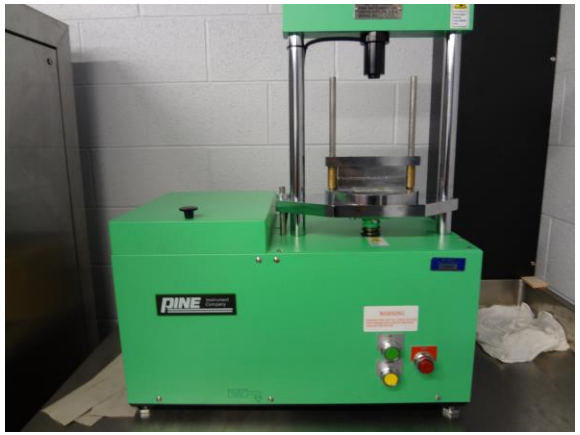


OUTLINE

Bulletin 27, 2003 Edition, Changes

AASHTO

AASHTO Standards, Changes

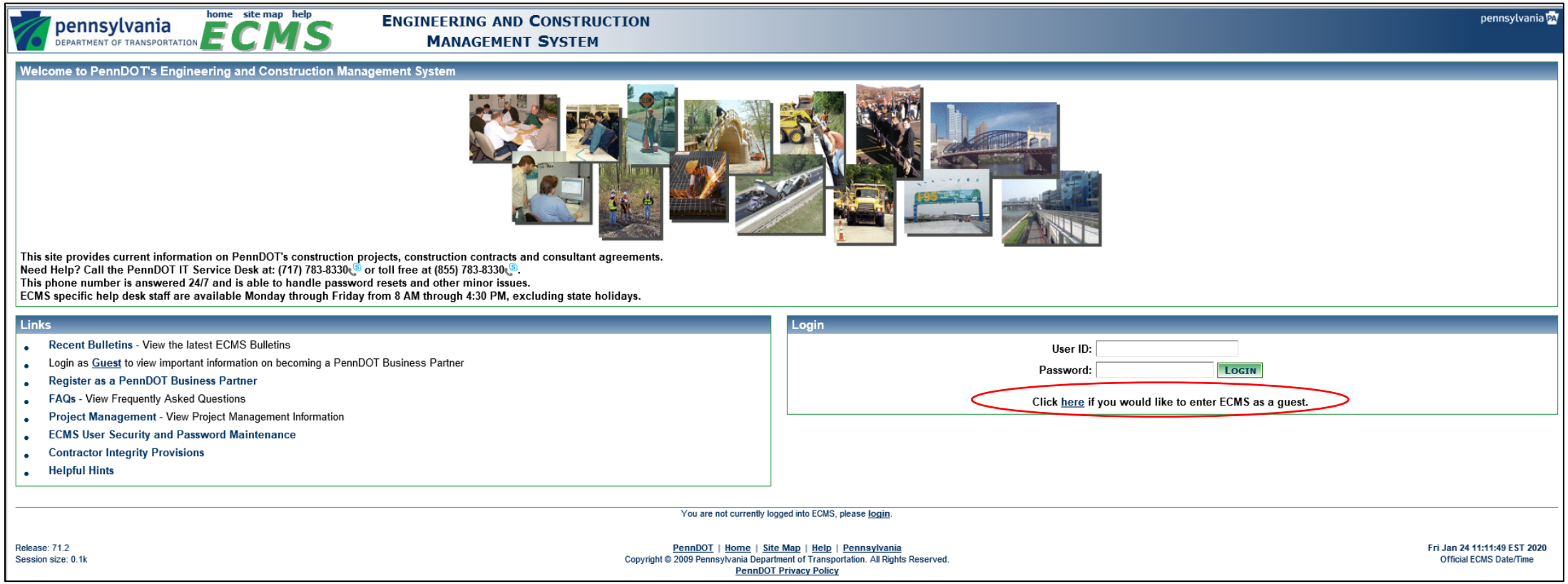


BULLETIN 27, 2003, CHANGES

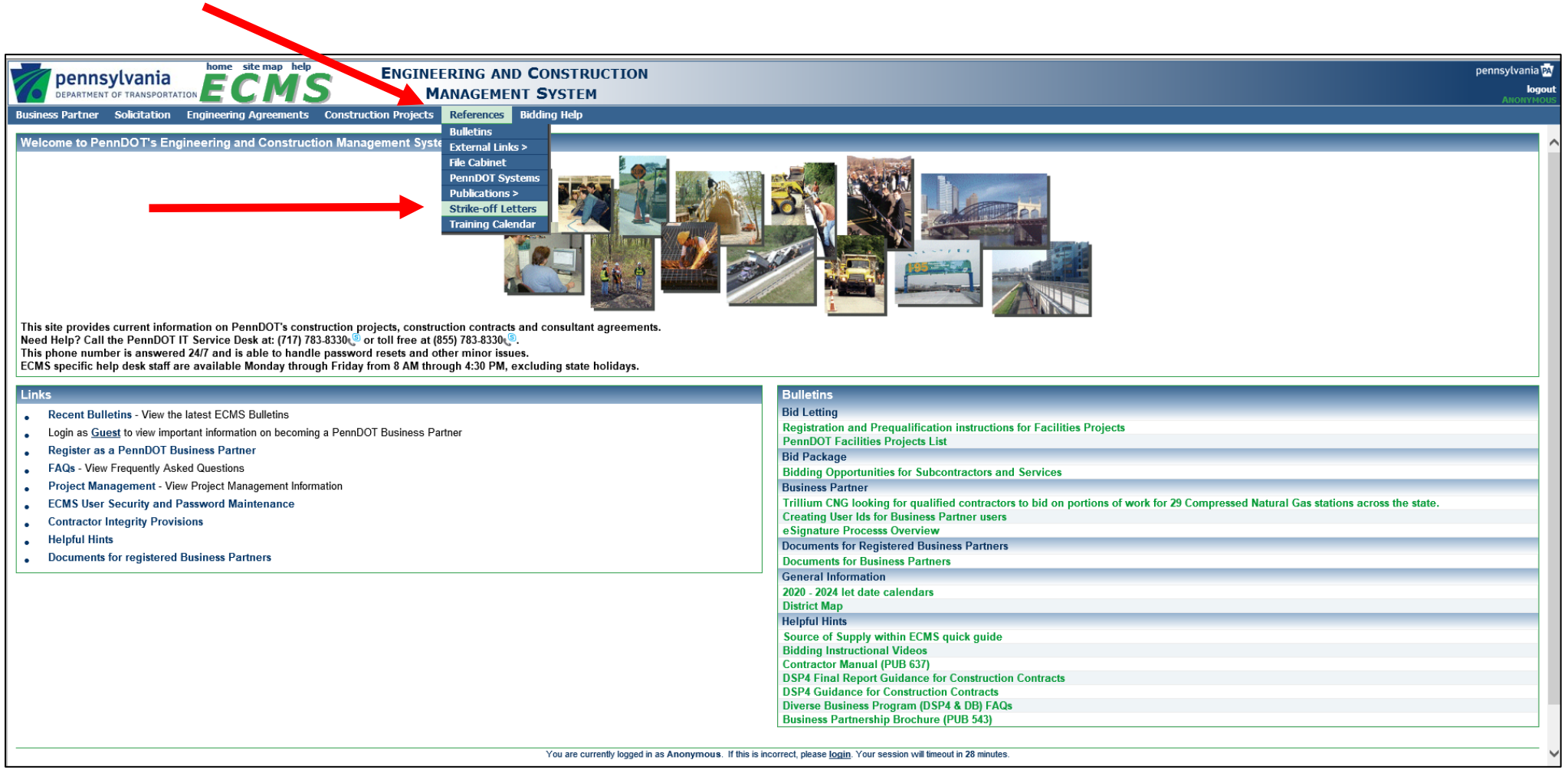
- Change 5 - issued on 01/19/2011
  - Active, except for Chapters 2A, 2B, and Appendix J
- SOL# 481-16-04 – issued on 04/13/2016
  - Active, for small portions of Chapters 2A and 2B, and all of Appendix J.
- SOL# 481-16-06 – issued on 10/28/2016
  - Active, for large portion of Chapter 2B (Chapter 2A in this SOL is no longer active, superseded by SOL# 481-22-01).
- SOL# 481-21-02 – issued on 11/30/2021
  - Not Active, superseded by SOL# 481-22-01.
- SOL# 481-22-01 – issued on 1/21/2022
  - Active, for large portion of Chapter 2A.
- Email from Timothy Ramirez to all DME/DMMs and copied to PAPA Representatives dated 02/14/2022
  - Active, for Appendix K.

ACCESSING PENNDOT STRIKE-OFF LETTERS (SOL)

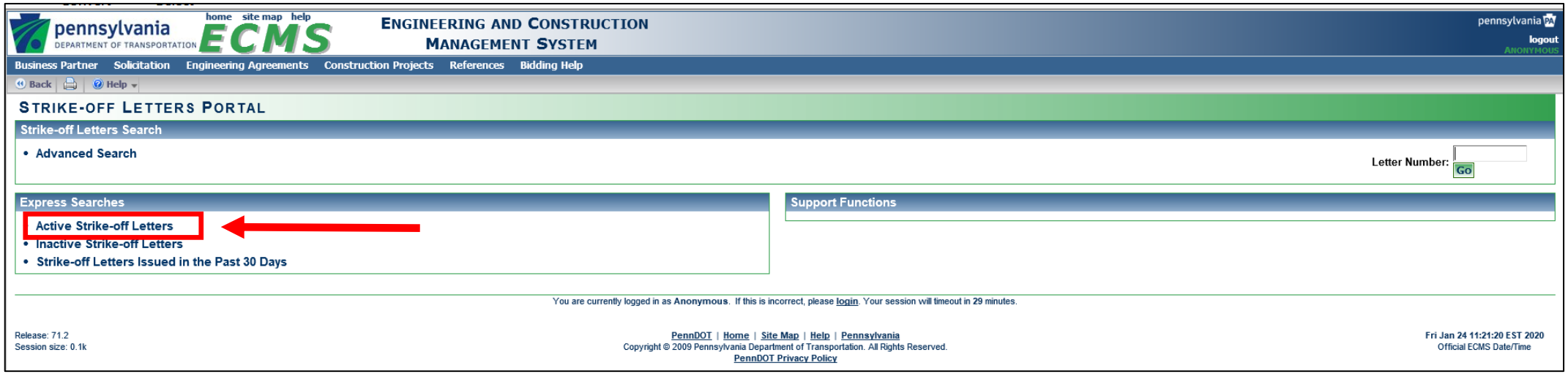
- ECMS - https://www.ecms.penndot.pa.gov/ECMS/



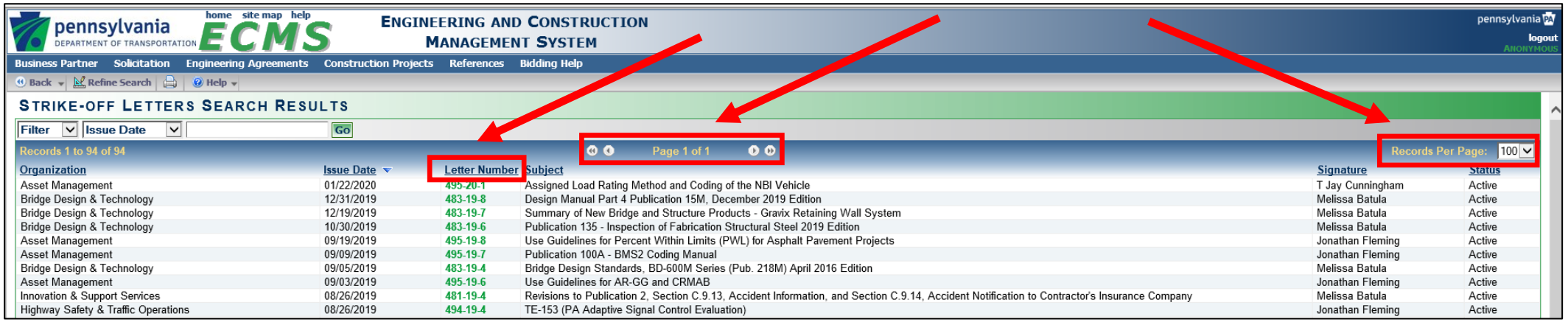
ACCESSING PENNDOT SOLS



ACCESSING PENNDOT SOL



ACCESSING PENNDOT SOL



Organization	Issue Date	Letter Number	Subject	Signature	Status
Asset Management	01/22/2020	495-20-1	Assigned Load Rating Method and Coding of the NBI Vehicle	T Jay Cunningham	Active
Bridge Design & Technology	12/31/2019	483-19-8	Design Manual Part 4 Publication 15M, December 2019 Edition	Melissa Batula	Active
Bridge Design & Technology	12/19/2019	483-19-7	Summary of New Bridge and Structure Products - Gravix Retaining Wall System	Melissa Batula	Active
Bridge Design & Technology	10/30/2019	483-19-6	Publication 135 - Inspection of Fabrication Structural Steel 2019 Edition	Melissa Batula	Active
Asset Management	09/19/2019	495-19-8	Use Guidelines for Percent Within Limits (PWL) for Asphalt Pavement Projects	Jonathan Fleming	Active
Asset Management	09/09/2019	495-19-7	Publication 100A - BMS2 Coding Manual	Jonathan Fleming	Active
Bridge Design & Technology	09/05/2019	483-19-4	Bridge Design Standards, BD-600M Series (Pub. 218M) April 2016 Edition	Melissa Batula	Active
Asset Management	09/03/2019	495-19-6	Use Guidelines for AR-GG and CRMAB	Jonathan Fleming	Active
Innovation & Support Services	08/26/2019	481-19-4	Revisions to Publication 2, Section C.9.13, Accident Information, and Section C.9.14, Accident Notification to Contractor's Insurance Company	Melissa Batula	Active
Highway Safety & Traffic Operations	08/26/2019	494-19-4	TE-153 (PA Adaptive Signal Control Evaluation)	Jonathan Fleming	Active

BULLETIN 27, 2003, CHANGES

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  - Active, for small portions of Chapters 2A and 2B, and all of Appendix J.

- SOL# 481-16-06 – issued on 10/28/2016
  - Active, for large portion of Chapter 2B (Chapter 2A in this SOL is no longer active, superseded by SOL# 481-22-01).

- SOL# 481-21-02 – issued on 11/30/2021
  - Not Active, superseded by SOL# 481-22-01.

- SOL# 481-22-01 – issued on 1/21/2022
  - Active, for large portion of Chapter 2A.

- Email from Timothy Ramirez to all DME/DMMs and copied to PAPA Representatives dated 02/14/2022
  - Active, for Appendix K.

BULLETIN 27, 2003 EDITION, CHANGES
SOL# 481-16-04 – ISSUED ON 04/13/2016

- General:
  - Changes to reduce the number of annual JMFs submitted for review and approval
  - Bulletin 27, Appendix J – Revisions
  - Bulletin 27, Appendix K – New
    - Standardized JMF Naming (Numbering) System
  - Bulletin 27, Chapter 2A – Revisions
  - Bulletin 27, Chapter 2B – Revisions

- Submit JMFs meeting following conditions:
  - Existing JMFs produced and placed for a PennDOT or Municipal Project (Liquid Fuels Funds) during previous construction year
    - QC results must be in eCAMMS ESB
  - New JMFs that producer identifies will be used on an awarded PennDOT or Municipal Project (Liquid Fuels Funds)
  - In select cases, new JMFs the DME/DMM elects to review after receiving request in writing from Producer

- Archive all other existing JMFs
  - Submit archived JMFs on an as-needed basis where the JMF will be used on newly awarded PennDOT or Municipal Project (Liquid Fuel Funds)
  - Submit archived JMFs at least 3 weeks before start of mixture production

BULLETIN 27, 2003 EDITION, CHANGES
SOL# 481-16-04 – APPENDIX J REVISIONS

- Prior to Any JMF submittals and when the submitted aggregate Gsb values are not within the Table J-1 tolerances of the LTS Bulletin 14 aggregate Gsb values

  - Follow-up testing is required
    - Any testing determined by the DME/DMM
      - Aggregate Gsb and absorption testing
      - Asphalt mixture testing
      - Other

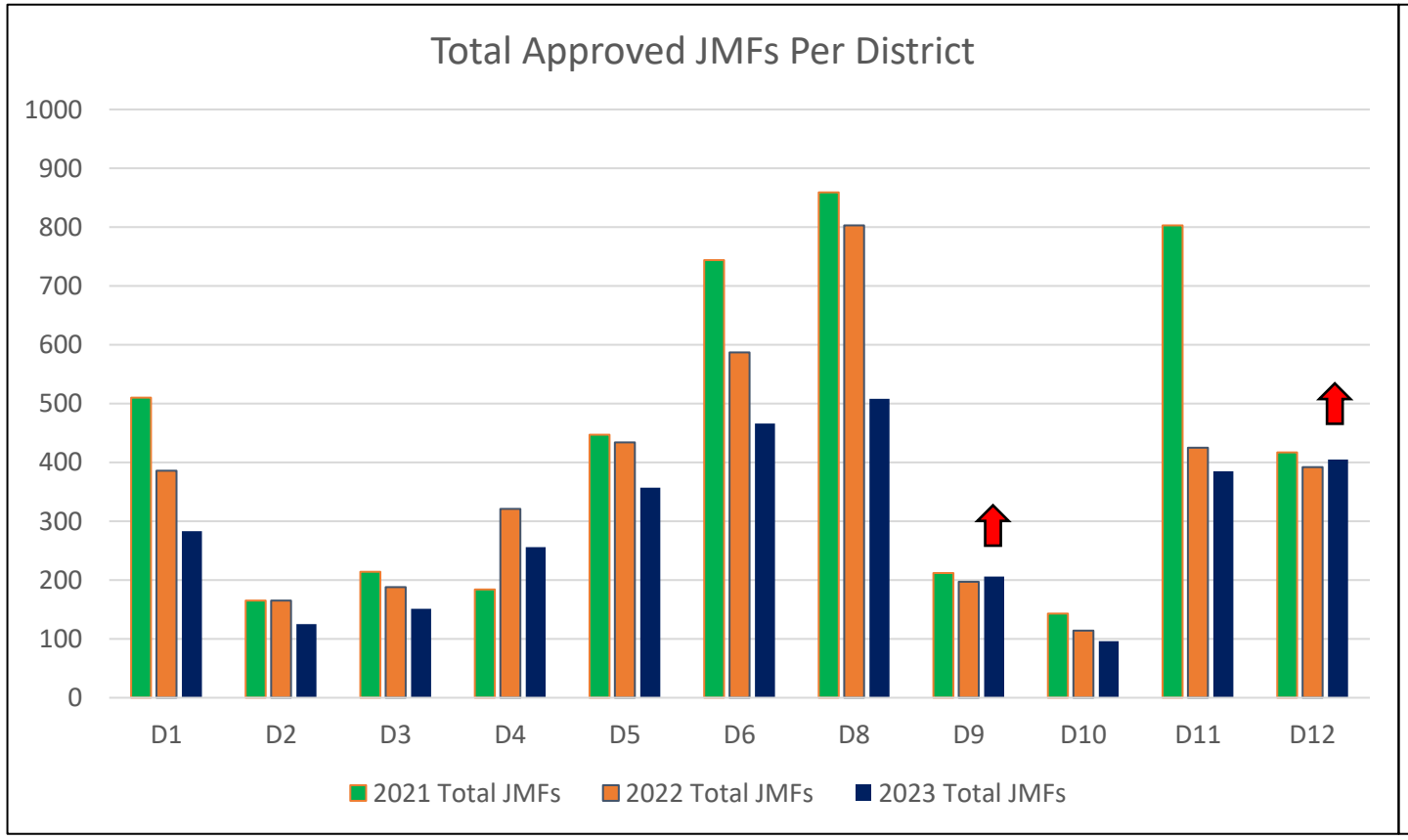
BULLETIN 27, 2003 EDITION, CHANGES
SOL# 481-16-04 – CHAPTER 2A REVISIONS

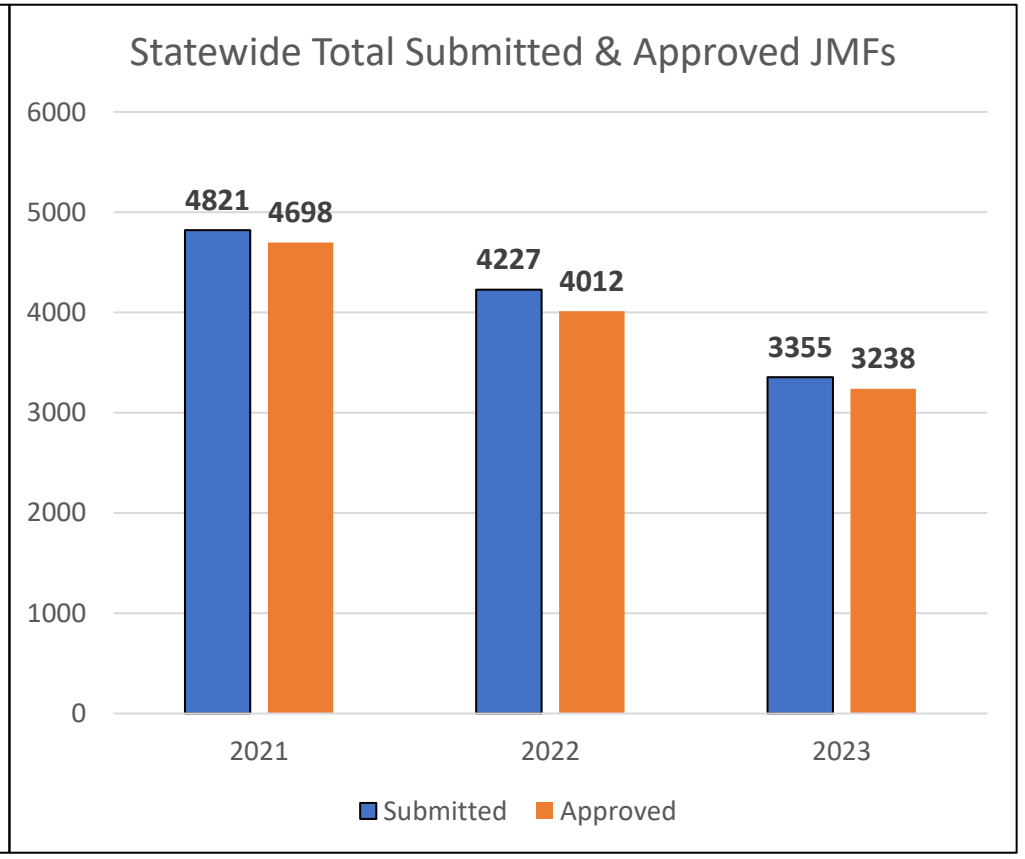
- Bulletin 27, Chapter 2A, Modifications to AASHTO R 35, Section 13. Report
  - Assign a JMF number by using the naming convention shown in Appendix K – Table 1
  - No other changes

BULLETIN 27, 2003 EDITION, CHANGES
SOL# 481-16-04 – CHAPTER 2B REVISIONS

- Bulletin 27, Chapter 2B, Modifications to AASHTO R 46, Section 4. Summary of the Practice
  - Subsection 4.6 Review of the Job Mix Formula (JMF)
  - Assign a JMF number by using the naming convention shown in Appendix K – Table 1
  - No other changes

BULLETIN 27, 2003 EDITION, CHANGES
SOL# 481-16-04 (4/13/16) – JMF REDUCTION





BULLETIN 27, 2003, CHANGES

- Change 5 - issued on 01/19/2011
  - Active, except for Chapters 2A, 2B, and Appendix J

- SOL# 481-16-04 – issued on 04/13/2016
  - Active, for small portions of Chapters 2A and 2B, and all of Appendix J.

- SOL# 481-16-06 – issued on 10/28/2016
  - Active, for large portion of Chapter 2B (Chapter 2A in this SOL is no longer active, superseded by SOL# 481-22-01).

- SOL# 481-21-02 – issued on 11/30/2021
  - Not Active, superseded by SOL# 481-22-01.

- SOL# 481-22-01 – issued on 1/21/2022
  - Active, for large portion of Chapter 2A.

- Email from Timothy Ramirez to all DME/DMMs and copied to PAPA Representatives dated 02/14/2022
  - Active, for Appendix K.

- General (Applies to Chapter 2A and Chapter 2B):
  - All JMFs (HMA and WMA) approved after December 30, 2016 required to contain a minimum amount of anti-strip (AS) additive
  - Existing AS requirements associated with WMA JMFs have been deleted from Pub. 408, Section 311 and Section 411
    - i.e., WMA Categorized as Mechanical Foaming requiring minimum 0.25 percent AS
  - JMFs containing both coarse and fine aggregate types that are highly moisture susceptible
    - required to be evaluated for moisture susceptibility or contain a higher dosage of AS

BULLETIN 27, 2003 EDITION, CHANGES
SOL# 481-16-06 – CHAPTER 2A AND CHAPTER 2B REVISIONS

- Chapter 2A:
  - Modifications to AASHTO R 35, Section 4.4 (Page 2A-7)
    - 1st paragraph – AASHTO T 283 mixture conditioning according to Bulletin 27, Appendix I
      - i.e., 2 hours or 6 hours at 140, 145, or 153°C (285, 293, or 308°F)
- Chapter 2B:
  - Modifications to AASHTO R 46, Section 4. Summary of the Practice
    - Revisions (New) to Subsection 4.4 *Evaluating Moisture Susceptibility* (Page 2B-2)
      - 1st paragraph – AASHTO T 283 mixture conditioning according to Bulletin 27, Appendix I
        - i.e., 2 hours or 6 hours at 153°C (308°F)

BULLETIN 27, 2003 EDITION, CHANGES
SOL# 481-16-06 – CHAPTER 2A AND CHAPTER 2B REVISIONS

- Chapter 2A:
  - Modifications to AASHTO R 35, Section 4.4 (Page 2A-7)
    - 1st paragraph – AASHTO T 283 mixture conditioning according to Bulletin 27, Appendix I
      - i.e., 2 hours or 6 hours at 140, 145, or 153°C (285, 293, or 308°F)

- Chapter 2B:
  - Modifications to AASHTO R 46, Section 4. Summary of the Practice
    - Revisions (New) to Subsection 4.4 *Evaluating Moisture Susceptibility* (Page 2B-2)
      - 1st paragraph – AASHTO T 283 mixture conditioning according to Bulletin 27, Appendix I
        - i.e., 2 hours or 6 hours at 153°C (308°F)

- **DO <u>NOT</u> DO!**

Note that the above Chapter 2A modification was removed in the SOL # 481-22-01 version and is now correct.

- Chapter 2A and Chapter 2B:
  - AASHTO T 283 Mixture Conditioning
    - AASHTO T 283, Section 6.4 (LMLC) - After mixing:
      - Mixture cooled at room temperature for 2 ± 0.5 h
      - Mixture placed in a 60 ± 3°C (140 ± 5°F) oven for 16 ± 1 h for curing
      - Place the mixture in an oven for 2 h ± 10 min at the compaction temperature ±3°C (5°F) prior to compaction
    - AASHTO T 283, Section 7.4 (FMLC):
      - No loose-mix curing as described in Section 6.4 shall be performed on the field-mixed samples
      - Next, place the mixture in an oven *for 2 h ± 10 min at the* compaction temperature ±3°C (5°F) prior to compaction

BULLETIN 27, 2003 EDITION, CHANGES
SOL# 481-16-06 – CHAPTER 2A AND CHAPTER 2B REVISIONS

- Chapter 2A:
  - AASHTO R 35, Section 4.4 (Page 2A-7)
- Chapter 2B:
  - AASHTO R 46, Section 4.4 (Page 2B-2)

  - Mixtures containing <u>both</u> CA and FA classified as a type of sandstone, siltstone, slag, quartz, shale, or gravel
    - Producer may elect to conduct AASHTO T 283 testing at minimum dosage rate (e.g., 0.25%) and at dosage one level higher (e.g., 0.50%)
    - If <u>all</u> true, set AS, hydrated lime, or alternate AS dosage rate at the higher dosage rate:
      - TSR of higher dosage mixture is higher than TSR of minimum dosage mixture
      - Conditioned and unconditioned tensile strengths of all AASHTO T 283 tests are above the minimum strengths in Bulletin 27, modifications to AASHTO R 35, Section 11.3 or AASHTO R 46, Section 11.3 as appropriate.

BULLETIN 27, 2003 EDITION, CHANGES
SOL# 481-16-06 – CHAPTER 2A AND CHAPTER 2B REVISIONS

- Chapter 2A:
  - AASHTO R 35, Section 4.4 (Page 2A-7)
- Chapter 2B:
  - AASHTO R 46, Section 4.4 (Page 2A-7)

  - All mixtures shall include either:
    - compatible, heat stable, amine-based liquid anti-strip (AS),
    - hydrated lime, or
    - another alternate compatible AS additive
  - Include AS additive at minimum dosage on manufacturer's tech data sheet (typ. 0.25% by mass AC)
  - Mixtures containing both CA and FA classified as a type of sandstone, siltstone, slag, quartz, shale, or gravel
    - Include AS, hydrated lime, alternate AS at dosage one level higher than minimum dosage rate (typ. 0.50% by mass AC)

BULLETIN 27, 2003 EDITION, CHANGES
SOL# 481-16-06 – CHAPTER 2A AND CHAPTER 2B REVISIONS

- Chapter 2A:
  - Modifications to AASHTO R 35, Section 4, Summary of the Practice
    - Subsection 4.5 Review of the Job-Mix Formula (JMF) (Page 2A-3)
- Chapter 2B:
  - Modifications to AASHTO R 46, Section 4. Summary of the Practice
    - Subsection 4.6 Review of the Job Mix Formula (JMF) (Page 2B-2)

- Does not include reference to Appendix K (JMF/Mix Design Numbering/Naming System)

- Must use SOL 481-16-04
  - Assign a JMF number by using the naming convention shown in Appendix K – Table 1
  - Note: Appendix K reference included for Chapter 2B, but not for Chapter 2A

BULLETIN 27, 2003 EDITION, CHANGES
SOL# 481-16-06 – CHAPTER 2A AND CHAPTER 2B REVISIONS

- Chapter 2A:
  - Modifications to AASHTO R 35, Section 4, Summary of the Practice
    - Subsection 4.5 Review of the Job-Mix Formula (JMF) (Page 2A-3)
- Chapter 2B:
  - Modifications to AASHTO R 46, Section 4. Summary of the Practice
    - Subsection 4.6 Review of the Job Mix Formula (JMF) (Page 2B-2)

- Does not include reference to Appendix K (JMF/Mix Design Numbering/Naming System)

- Must use SOL 481-16-04
  - Assign a JMF number by using the naming convention shown in Appendix K – Table 1
  - Note: Appendix K reference included for Chapter 2B, but not for Chapter 2A

BULLETIN 27, 2003 EDITION, CHANGES
SOL# 481-16-06 – CHAPTER 2A AND CHAPTER 2B REVISIONS

- Chapter 2A:
  - AASHTO R 35, Section 11.3 (Added Page 16)
- Chapter 2B:
  - AASHTO R 46, Section 11.3 (Page 2B-7)

  - Moisture susceptibility must be re-evaluated, at a minimum, once every 5 years (when JMF material sources, proportions, & targets remain same)

  - Moisture susceptibility must be re-evaluated when material sources change or, material proportions or JMF targets significantly change, as determined by the DME/DMM

BULLETIN 27, 2003 EDITION, CHANGES
SOL# 481-16-06 – CHAPTER 2A AND CHAPTER 2B REVISIONS

- Chapter 2A:
  - AASHTO R 35, Section 11.3 (Added Page 16)
    - For virgin mixtures or mixtures falling under Appendix H, Tier 1 design
      - Compute required minimum AS or alternate AS dosage rate based on virgin asphalt binder content
        - Note: Versions of Pub. 408 prior to 408/2016, Change 2 in Section 411.2(h) specify to add minimum AS dosage based on total bituminous content
    - For mixtures falling under Appendix H, Tier 2 design
      - Compute required minimum AS or alternate AS dosage rate based on the total asphalt in the mixture
- Chapter 2B:
  - AASHTO R 46, Section 11.3 (Page 2B-7)
    - Compute required minimum AS or alternate AS dosage rate based on total asphalt in the mixture

BULLETIN 27, 2003 EDITION, CHANGES
SOL# 481-16-06 – CHAPTER 2A AND CHAPTER 2B REVISIONS

- Chapter 2A:
  - AASHTO R 35, Section 11.3 (Added Page 16)
- Chapter 2B:
  - AASHTO R 46, Section 11.3 (Page 2B-7)

  - All WMA versions of same parent HMA JMF must have separate moisture susceptibility evaluations

  - If HMA JMF requires anti-strip (AS), the WMA version of that JMF, produced by WMA Technology categorized as foaming or foaming process, must contain the minimum dosage of AS required in the HMA JMF.

BULLETIN 27, 2003 EDITION, CHANGES
SOL# 481-16-06 – CHAPTER 2A AND CHAPTER 2B REVISIONS

- Chapter 2A:
  - AASHTO R 35, Section 11.3 (Added Page 16)
- Chapter 2B:
  - AASHTO R 46, Section 11.3 (Page 2B-7)

    - If Producer elects to use an alternate AS (not typical amine-based AS), contact DME/DMM

      - If directed by DME/DMM, perform moisture testing using alternate AS at manufacturer’s recommended minimum dosage rate

      - If directed by DME/DMM, provide other documentation of successful use of alternate AS

BULLETIN 27, 2003 EDITION, CHANGES
SOL# 481-16-06 – CHAPTER 2A AND CHAPTER 2B REVISIONS

- Chapter 2A:
  - AASHTO R 35, Section 13, Report (Added Page 19)
- Chapter 2B:
  - AASHTO R 46, Section 13, Report (Page N/A)

    - Does not include reference to Appendix K [JMF/Mix Design Naming (Numbering) System]

    - Must use SOL 481-16-04
      - Assign a JMF number by using the naming convention shown in Appendix K – Table 1
      - Note: Appendix K reference included for Chapter 2A, but not for Chapter 2B

BULLETIN 27, 2003 EDITION, CHANGES
SOL# 481-16-06 – CHAPTER 2A AND CHAPTER 2B REVISIONS

- Chapter 2A:
  - AASHTO R 35, Section 13, Report (Added Page 19)
- Chapter 2B:
  - AASHTO R 46, Section 13, Report (Page N/A)

  - Does not include reference to Appendix K [JMF/Mix Design Naming (Numbering) System]

- Must use SOL 481-16-04
  - Assign a JMF number by using the naming convention shown in Appendix K – Table 1
  - Note: Appendix K reference included for Chapter 2A, but not for Chapter 2B

BULLETIN 27, 2003, CHANGES

- Change 5 - issued on 01/19/2011
  - Active, except for Chapters 2A, 2B, and Appendix J

- SOL# 481-16-04 – issued on 04/13/2016
  - Active, for small portions of Chapters 2A and 2B, and all of Appendix J.

- SOL# 481-16-06 – issued on 10/28/2016
  - Active, for large portion of Chapter 2B (Chapter 2A in this SOL is no longer active, superseded by SOL# 481-22-01).

- SOL# 481-21-02 – issued on 11/30/2021
  - Not Active, superseded by SOL# 481-22-01.

- SOL# 481-22-01 – issued on 1/21/2022
  - Active, for large portion of Chapter 2A.

- Email from Timothy Ramirez to all DME/DMMs and copied to PAPA Representatives dated 02/14/2022
  - Active, for Appendix K.

BULLETIN 27, 2003 EDITION, CHANGES
SOL# 481-21-02 – ISSUED ON 11/30/2021

- General (Applies to Chapter 2A Only):
  - Reduction in number of gyrations at N_{design}
    - AASHTO R 35, Section 8, Table 1 revisions
  - Increase in minimum design VMA for 9.5, 12.5, 19.0, 25.0 and 37.5 mm NMAS
    - AASHTO M 323, Section 7.2, Table 7 revisions
  - Revised VFA Ranges
    - AASHTO M 323, Section 7.2, Table 7 and Table 7 footnotes revisions
  - Other reference updates (e.g., Section 409 to Section 413)
  - Superseded by SOL# 481-22-01 dated January 21, 2022.

BULLETIN 27, 2003, CHANGES

- Change 5 - issued on 01/19/2011
  - Active, except for Chapters 2A, 2B, and Appendix J

- SOL# 481-16-04 – issued on 04/13/2016
  - Active, for small portions of Chapters 2A and 2B, and all of Appendix J.

- SOL# 481-16-06 – issued on 10/28/2016
  - Active, for large portion of Chapter 2B (Chapter 2A in this SOL is no longer active, superseded by SOL# 481-22-01).

- SOL# 481-21-02 – issued on 11/30/2021
  - Not Active, superseded by SOL# 481-22-01.

- SOL# 481-22-01 – issued on 1/21/2022
  - Active, for large portion of Chapter 2A.

- Email from Timothy Ramirez to all DME/DMMs and copied to PAPA Representatives dated 02/14/2022
  - Active, for Appendix K.

- Implementation of Performance Related Testing Results:
  - For eCAMMS JMF Year 2023:
    - All < 0.3 Million Design ESAL Range Asphalt Wearing Courses:
      - Require submission of performance related testing results as part of the JMF.
      - Performance related testing results for information only.
      - DME/DMM may approve 2023 Asphalt Wearing Course JMFs without performance related testing results entered in eCAMMS on a case-by-case basis.
  - For eCAMMS JMF Year 2024: **To Be Revised with Pending Strike-Off Letter**
    - All Asphalt Wearing Courses:
      - Require submission of performance related testing results as part of the JMF.
      - Performance related testing results for information only.
      - No Asphalt Wearing Courses will be approved without submission of performance related testing results entered in eCAMMS.

- General (Applies to Chapter 2A Only):
  - Includes SOL# 481-21-02
    - Reduction in number of gyrations at N_{design}
    - Increase in minimum design VMA for 9.5, 12.5, 19.0, 25.0 and 37.5 mm NMAS
    - Revised VFA Ranges
    - Other reference updates (e.g., Section 409 to Section 413 and AASHTO M 323 Table reference updates)
  - Includes previous Non-Pay Item Related Standard Special Provision, a10650 MINIMUM EFFECTIVE ASPHALT FOR 9.5 MM OR 12.5 MM SUPERPAVE MIXTURES
  - Includes Performance Testing Requirements, Performance Testing Limits, and Exceptions If Limits Are Met

BULLETIN 27, 2003 EDITION, CHANGES
SOL# 481-22-01 – ISSUED ON 1/21/2022

- Chapter 2A:
  - Title (Page 2A-1)
    - **Design and Control of Hot-Mix Asphalt (HMA) Mixtures Using the Superpave Asphalt Mixture Design and Analysis System with the Additional Requirement of Performance Testing**

- Chapter 2A:
  - Modifications to 1. General Scope (Page 2A-1)
    - "The Department has established procedures for the design and control of Hot-Mix Asphalt (HMA) based on the Superpave Asphalt Mixture Design and Analysis System, with the addition of performance related physical testing to help ensure that asphalt mixtures achieve optimum performance."

- Chapter 2A:
  - Modifications to AASHTO R 35, Section 4, Summary of the Practice
    - Subsection 4.4 Evaluating Moisture Susceptibility (Page 2A-4)

  - “The DME/DMM may allow JMFs that conform to the Performance Testing Limits in the Department's added AASHTO M 323, Section 7.4, Table 9 to use the exceptions in the Department's added AASHTO M 323, Section 7.4, Table 10.”

- Chapter 2A:
  - Modifications to AASHTO R 35, Section 4, Summary of the Practice
    - New Subsection 4.5 Evaluating Rutting Performance (Page 2A-4)

  - Perform rut testing according to AASHTO T 324 as modified in the Department's modifications to AASHTO M 323, Section 7.4.

- Chapter 2A:
  - Modifications to AASHTO R 35, Section 4, Summary of the Practice
    - New Subsection 4.6 Evaluating Cracking Performance (Page 2A-4)

  - Perform crack testing according to ASTM D8225 as modified in the Department's modifications to AASHTO M 323, Section 7.4.

- Chapter 2A:
  - Modifications to AASHTO R 35, Section 8. Compacting Specimens of Each Trial Gradation
    - Revisions to Table 1 - Superpave Gyratory Compaction Effort (Pages 2A-6 & 2A-7)

  - Binder & Wearing Courses:
    - < 0.3 Million Design ESALS – Ndesign = 50
    - ≥ 0.3 Million Design ESALS – Ndesign = 75

  - Base Courses:
    - All Design ESAL Ranges – Ndesign = 75

- Chapter 2A:
  - Modifications to AASHTO M 323, Section 7. Asphalt Mixture Design Requirements
    - Complete revision to Section 7.2 (Page 2A-20)

  - The asphalt mixture design, when compacted in accordance with AASHTO T 312, shall meet the relative density, VMA, VFA, and dust to binder ratio requirements specified in Table 7 and the minimum effective asphalt requirements in Table 8.

- Chapter 2A:
  - Modifications to AASHTO M 323, Section 7. Asphalt Mixture Design Requirements
    - Modification to Table 7 – Superpave Asphalt Mixture Design Requirements (Page 2A-20)

NMAS	Min. Design VMA	Min. Design VFA
4.75 mm	16.0	66
9.5 mm	16.0	74
12.5 mm	15.0	72
19.0 mm	14.0	70
25.0 mm	13.0	68
37.5 mm	12.0	65

- Chapter 2A:
  - Modifications to AASHTO M 323, Section 7. Asphalt Mixture Design Requirements
    - New Table 8 - Minimum Effective Asphalt (Pbe) for 9.5mm and 12.5mm Superpave Asphalt Mixtures (Pages 2A-20 & 2A-21)

  - Min. Pbe for each range of Combined Aggregate Bulk Specific Gravity (Gsb) from the Non-Pay Item Related Standard Special Provision, a10650 MINIMUM EFFECTIVE ASPHALT FOR 9.5 MM OR 12.5 MM SUPERPAVE MIXTURES

- Chapter 2A:
  - Modifications to AASHTO M 323, Section 7. Asphalt Mixture Design Requirements
    - New Subsection 7.4 Performance Testing (Page 2A-21)

- Mixture conditioning for preparation of test specimens for performance testing. Different conditioning temperatures by grade of PGAB.
- Air voids for test specimens for performance testing (7.0 ± 0.5%).
- Test temperature for AASHTO T 324 (50 ± 1°C)
- Test temperature for ASTM D8225 (25 ± 1°C)
- Submit results of AASHTO PP 78 Section 7 testing (ΔTc) of the JMF blended binder for all JMFs with a reclaimed binder ratio (RBR) ≥ 0.35.
- The DME/DMM may allow JMFs that conform to all of the testing criteria in Table 9 to apply the criteria exceptions in Table 10 to the JMF.

- Chapter 2A:
  - Modifications to AASHTO M 323, Section 7. Asphalt Mixture Design Requirements
    - New Table 9 – Performance Testing Limits (Pages 2A-21 & 2A-22)

- Performance Testing Limits by Design ESAL Range for:

Property	Criteria
Rutting & Moisture Susceptibility (AASHTO T 324)	Maximum Rut Depth at 20,000 Passes (mm) SIP (minimum passes) Minimum Passes at 12.5 mm Rut Depth
Cracking (ASTM D8225)	CT Index
High RAP / RAS (≥ 0.35 RBR) (AASHTO PP 78, Section 7)	ΔTc

- Chapter 2A:
  - Modifications to AASHTO M 323, Section 7. Asphalt Mixture Design Requirements
    - New Table 10 – Exceptions for JMFs that Meet All Table 9 Requirements (Page 2A-22)

- Exceptions for:

Property	Specification Requirement if Table 9 Limits are Met
Percent Air Voids at N_{Design}	3.0 to 4.1
Moisture Susceptibility	AASHTO T 283 and mandatory anti-strip waived
Asphalt PG Grade	PG grade bumping to meet all performance testing limits allowed

BULLETIN 27, 2003, CHANGES

- Change 5 - issued on 01/19/2011
  - Active, except for Chapters 2A, 2B, and Appendix J

- SOL# 481-16-04 – issued on 04/13/2016
  - Active, for small portions of Chapters 2A and 2B, and all of Appendix J.

- SOL# 481-16-06 – issued on 10/28/2016
  - Active, for large portion of Chapter 2B (Chapter 2A in this SOL is no longer active, superseded by SOL# 481-22-01).

- SOL# 481-21-02 – issued on 11/30/2021
  - Not Active, superseded by SOL# 481-22-01.

- SOL# 481-22-01 – issued on 1/21/2022
  - Active, for large portion of Chapter 2A.

- Email from Timothy Ramirez to all DME/DMMs and copied to PAPA Representatives dated 02/14/2022
  - Active, for Appendix K.

- Appendix K:
  - Addition of the New, Reduced Gyration, Design Life ESAL Ranges

a. < 0.3 Million(Nd=50)
b. 0.3 to < 3 Million(Nd=75)
c. 0.3 to < 10 Million(Nd=75)
d. 3 to < 10 Million(Nd=75)
e. 0.3 to < 30 Million(Nd=75)
f. 3 to < 30 Million(Nd=75)
g. 10 to < 30 Million(Nd=75)
h. >= 30 Million(Nd=75)
i. < 0.3 Million(Nd=75, BC) – Intended for 25.0 mm and 37.5 mm Base Courses (BC) Only.
j. < 10 Million(Nd=75, BC) – Intended for 25.0 mm and 37.5 mm Base Courses (BC) Only.
k. < 30 Million(Nd=75, BC) – Intended for 25.0 mm and 37.5 mm Base Courses (BC) Only.

BULLETIN 27, 2003 EDITION, CHANGES EMAIL TO DME/DMM DATED 02/14/2022

- Appendix K:
  - Cheat Sheet
    - Asphalt JMF Naming System ESAL # for new eCAMMS JMF Design ESAL Ranges.
    - ECMS Standard Item Number Description ESAL Ranges vs. the New, Reduced Gyration, eCAMMS Design ESAL Ranges.

New eCAMMS ESAL Ranges	eCAMMS Appendix K ESAL #
< 0.3 Million(Nd=50)	1
0.3 to < 3 Million(Nd=75)	2
0.3 to < 10 Million(Nd=75)	6
3 to < 10 Million(Nd=75)	6
0.3 to < 30 Million(Nd=75)	7
3 to < 30 Million(Nd=75)	7
10 to < 30 Million(Nd=75)	7
>= 30 Million(Nd=75)	8
< 0.3 Million(Nd=75, BC)	1
< 10 Million(Nd=75, BC)	6
< 30 Million(Nd=75, BC)	7

ECMS Standard Item Number Description ESAL Ranges	Equivalent eCAMMS JMF ESAL Ranges for projects let after December 30, 2021[a]
< 0.3 MILLION	< 0.3 Million(Nd=50)
	< 0.3 Million(Nd=75, BC)[b]
	< 10 Million(Nd=75, BC)[b]
	< 30 Million(Nd=75, BC)[b]
0.3 TO < 3 MILLION	0.3 to < 3 Million(Nd=75)
	0.3 to < 10 Million(Nd=75)
	0.3 to < 30 Million(Nd=75)
	< 10 Million(Nd=75, BC)[b]
	< 30 Million(Nd=75, BC)[b]
3 TO < 10 MILLION	3 to < 10 Million(Nd=75)
	0.3 to < 10 Million(Nd=75)
	3 to < 30 Million(Nd=75)
	0.3 to < 30 Million(Nd=75)
	< 10 Million(Nd=75, BC)[b]
	< 30 Million(Nd=75, BC)[b]
10 TO < 30 MILLION	10 to < 30 Million(Nd=75)
	3 to < 30 Million(Nd=75)
	0.3 to < 30 Million(Nd=75)
	< 30 Million(Nd=75, BC)[b]
>/= 30 MILLION	>= 30 Million(Nd=75)

[a] Colors indicate eCAMMS JMF ESAL Range Spans Multiple ECMS ESAL Ranges.

[b] 25.0 mm and 37.5 mm Base Courses Only.

Asphalt Concrete Mix Design Naming System

- Intended for **JMF/Mix Design Number** field in eCAMMS
- Up to 10 characters

- Gyratory Mix Example: **W95221G1**

  W = Type WMA
  95 = Size 9.5 mm
  2 = ESALS 0.3 to <3 (75 Ndes)
  2 = Asphalt Binder PG 64S-22
  1 = RAP/RAS Tier 1
  G = SRL-G
  1 = Version

- Non-Gyratory Mix Example: **ATPBC201**

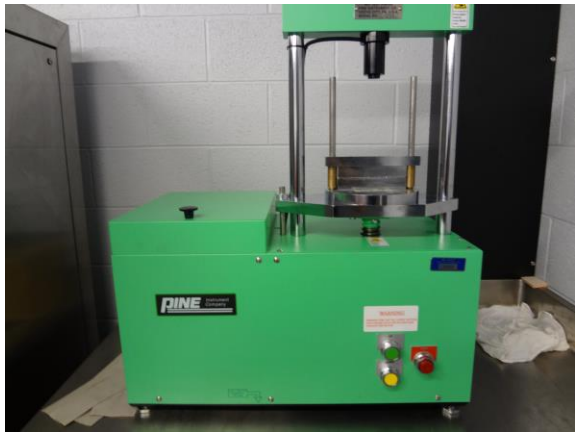
  ATPBC = Class ATPBC (Asphalt Treated Permeable Base Course)
  2 = Asphalt Material PG 64S-22
  0 = SRL-N/A
  1 = Version 1

OUTLINE

Bulletin 27, 2003 Edition, Changes

AASHTO

AASHTO Standards, Changes



2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS

- R 47-19, Reducing Samples of Asphalt Mixtures to Testing Size:
  - Revised “Hot Mix Asphalt (HMA)” to “asphalt mixture” throughout standard.
  - Revised heating equipment and tools “not to exceed the maximum mixing temperature of the asphalt mixture”

- R 79-19, Vacuum Drying Compacted Asphalt Specimens:
  - Removed definition for constant mass (not used).
  - Revised “handheld infrared temperature sensor” to “thermometric device”.
  - Added new Subsections to require two drying cycles.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- R 96-19, Installation, Operation, and Maintenance of Ignition Furnaces:
  - New Standard.

- R 97-19, Sampling Asphalt Mixtures:
  - New Standard. Formerly T 168.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- T 30-19, Mechanical Analysis of Extracted Aggregate:
  - Revised to move the specific sieve loading requirements including Table 1 to a new Annex A2.
    - Added language to body of standard “Do not overload sieves, see Annex A2.”
  - Revised from “Record the masses of each sieve…” to “Calculate percentages passing…”.
  - Added new Annex A1, Time Evaluation. New mandatory Annex on establishing minimum shaker time.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- T 209-19, Theoretical Maximum Specific Gravity (Gmm) and Density of Asphalt Mixtures:
  - Revised “Hot Mix Asphalt (HMA)” to “asphalt mixture” throughout standard.
  - Deleted Section 4, Summary of Test Method.
  - Apparatus
    - Revised “Vacuum bowl” to “Bowl”.
    - Added to flask “with a factory inscribed line”.
    - Added to pycnometer “with a volume defined by means of a machined lid or glass plate”.
    - Revised “Thermometric device” to “Thermometer”.
    - Revised water bath requirements [bath temperature must be 25 ± 1°C (77 ± 2°F)].
  - Added new subsections for “laboratory prepared” and “plant produced”.
  - Revised and moved language on Standardization of Flasks, Bowls & Pycnometer to an Annex. Note: Standardization now requires 3 readings within 0.3 g.
  - Simplified equation for mass determination in water.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- T 324-19, Hamburg Wheel Track Testing:
  - Apparatus:
    - Revised Note 1 to reference NCHRP report or available devices to verify the sinusoidal wave form.
    - Revised Linear Variable Differential Transducer (LVDT) to Linear Displacement Transducer (LDT).
    - Revised Note 2 to add that location of deformation readings should be verified accounting for the curvature of the verification device.
    - Added new text to “free circulating water on all sides of the mounting system”
    - For calculation of average rut depth at the five middle deformation locations, added the text “or other suitable method as specified by the agency”.
  - In Appendix X2, Calibration/Equipment Verification, added new subsection X2.6 requiring maximum limit from a sinusoidal wave and offset values of displacement values.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- R 67-20, Sampling Asphalt Mixtures after Compaction (Obtaining Cores):
  - PennDOT does not reference this standard. PennDOT references PTM No. 729.
  - Added language to brush off loose particles adhering to core and to remove any granular subbase material from bottom of core.
  - For Packaging and Transporting Samples, added text at end “to prevent breaking or deforming”
  - Appendix X2 (Non-Mandatory). Revised completely to make it a procedure for removing cut aggregates from a core before further testing of the core.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- T 209-20, Theoretical Maximum Specific Gravity (Gmm) and Density of Asphalt Mixtures:
  - Added reference to R 67, Sampling Asphalt Mixtures after Compaction (Obtaining Cores).
  - Include an equation and example for calculating the weighted average maximum theoretical specific gravity of large-size samples tested in portions.
  - In Sections 12.2 and 12.2.1, removed references to "(*Gmm)*" as these subsections are for Theoretical Maximum Density.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- TP 124-20, Determining the Fracture Potential of Asphalt Mixtures Using the Illinois Flexibility Index Test (I-FIT):
  - Changed title of standard to include “Illinois” and revised from “FIT” to “I-FIT” throughout standard.
  - Added reference to R 30 if testing to determine effects of long-term aging.
  - Revised notch width & tolerance requirements from 1.5 ± 0.5 mm to ≤ 2.25 mm.
  - Revised to allow SGC specimens compacted to 115 ± 1 mm height if laboratory does not have capability to compact SGC specimens to the recommended 160 ± 1 mm height.
  - Added precision estimates.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- M 332-21, Performance-Graded Asphalt Binder Using Multiple Stress Creep Recovery (MSCR) Test:
  - Revised “H” from “High” to “Heavy” throughout standard.
  - Revised PAV DSR G*sinδ from max 5000 kPa to 6000 kPa for “S” grade
    - If intermediate temperature stiffness, G*sinδ, is from 5000 to 6000 kPa, an intermediate phase angle minimum limit of min 42° is required.

- PP 113-21, Characterizing the Relaxation Behavior of Asphalt Binders Using the Delta Tc (ΔTc) Parameter:
  - New Standard.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- R 28-21, Accelerated Aging of Asphalt Binder Using a Pressurized Aging Vessel (PAV):
  - Corrected pressure gauge readings for SI and US Customary units for lab elevation.

- T 240-21, Effect of Heat and Air on a Moving Film of Asphalt Binder (Rolling Thin-Film Oven Test):
  - Added reference to NCHRP Project 20-07 / Task 400
    - Effect of Elevation on RTFO Aging of Asphalt Binders.
  - New Table 1, conditioning time with lab elevation.
    - Conditioning time increases 1 min. with each 1000 ft of elevation.
  - New equation for calculating mass change (mass change correction factor).
  - New Table 2, mass change correction factor vs. conditioning time.
    - Correction factor increases with increase in conditioning time.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- T 85-21, Specific Gravity and Absorption of Coarse Aggregate:
  - Added reference to T 255 (Total evaporable moisture content) for drying sample to constant mass.

- T 30-21, Mechanical Analysis of Extracted Aggregate:
  - In Table A1, removed sieves with opening sizes larger than 2 in.
    - Eliminates the sieving efficiency issue for larger sieves.
  - In Table A1, removed 350 by 350 mm and 372 by 580 mm sieve frame sizes.
  - In Table A1, added US customary units of measure equivalencies for sieve diameters and sieving area.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- T 331-21, Bulk Specific Gravity (Gmb) and Density of Compacted Asphalt Mixtures Using Automatic Vacuum Sealing Method:
  - Revised and clarified Procedure section regarding wet specimens and drying, bag mass, and check conditions.
  - Revised Equation *(1)* and definition of B (bag mass) to eliminate unnecessary steps.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- T 283-21, Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage:
  - Added reference to R 30 (Mixture Conditioning of HMA).
    - Prepare mixture according to R 30, Section 7.1 & determine Gmm according to T 209.
    - Determine compaction temperature according to R 30.
  - Added reference to R 67 (Sampling Asphalt Mixtures after Compaction).
    - Related to preparation of Field-Mixed, Field-Compacted specimens.
  - Deleted reference to T 269 (Percent Air Voids)
    - Added equation for calculating percentage of air voids.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- T 283-21 (Continued):
  - Deleted ASTM D3459 (Thickness/Height of Compacted Specimens).
    - Added “tape, rule or calipers for measuring specimen thickness”.
    - Added language to determine specimen thickness by measuring in four locations around the specimen and averaging, or if the specimen is compacted by T 312, use the final height from the SGC.
  - Revised pan depth from “approximately 25 mm (1 in.)” to “at least a depth of 25 mm (1 in.)”.
  - Added how to adjust compacted specimens to 7.0 ± 0.5 percent air voids.
    - Adjust by mass change or by level of compaction.
  - Added language for blotting each specimen with a damp towel and determining SSD as quickly as possible (not to exceed 15 s).

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- T 393-21, Determining the Fracture Potential of Asphalt Mixtures Using the Illinois Flexibility Index Test (I-FIT):
  - Formerly TP 124.
  - Adopted as a full standard.

- T 394-21, Determining the Fracture Energy of Asphalt Mixtures Using the Semicircular Bend Geometry (SCB):
  - Formerly TP 105.
  - Adopted as a full standard.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- In 2022, many AASHTO standards were revised to address proper selection of Temperature Measuring Devices (TMD) as a result of NCHRP Report 20-07, Task 427:
  - Added non-liquid in glass thermometer types, thermometer temperature ranges, and thermometer tolerance ranges based on temperature usage ranges and usage tolerance ranges specified in each standard.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- M 323-22, Superpave Volumetric Mix Design:
  - Various revisions from work done by the M 323/R 35 Task Force housed in the now defunct Mixture ETG that were never officially endorsed or forwarded to the AASHTO SOM/COMP including:
  - Added reference to M 332.
  - Added "binder content (P_b)" and "binder content RAP (P_{bRAP})" to terminology.
  - Added new Note 5 informing that a mixture performance test for cracking implemented by an agency is acceptable in lieu of the RAPBR binder selection criteria in Section 5.3.1.
  - Added PCS Control Point for 4.75 mm NMAS to Table 5 (1.18 mm sieve, 40%).
  - Removed VFA requirements and footnotes from Table 7 and added new Table 8 specifically for VFA requirements by NMAS.
  - Added references to Superpave5 and Annex A1 (mandatory) when agencies specify Superpave5 (agency discretion).

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- M 332-22, Performance-Graded Asphalt Binder Using Multiple Stress Creep Recovery (MSCR) Test:
  - Revisions from TFASH effort.
  - Added Note 3 to inform choice of which LTPPBind program version to use is up to the specifier.
  - Deleted references to M 323 regarding selection of asphalt binder grade.
  - Added new Section 4.2.5 explaining evaluation of J_{nrdiff} with max 75% limit except for when $J_{nr3.2}$ is less than 0.5 (“E” grades).
  - Deleted some Table 1 informational footnotes.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- M 350-22, Reclaimed Asphalt Shingles (RAS) for Use in Asphalt Mixtures:
  - Formerly MP 23.
  - Adopted as a full standard.

- MP 46-22, Balanced Mix Design:
  - Editorial updates to sequencing of notes and tables as well as updated State practices.

- R 114-22, Design Considerations When Using Reclaimed Asphalt Shingles (RAS) in Asphalt Mixtures:
  - Formerly PP 78.
  - Adopted as a full standard.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- R 30-22, Laboratory Conditioning of Asphalt Mixtures (title change – formerly “Mixture Conditioning of HMA”):
  - Revisions based on work completed in NCHRP 9-52, 9-52A, and 20-44 (19) relative to short-term aging.
  - Revised Section 1, Scope, to indicate long-term conditioning simulates 1-3 years of pavement service life.
  - Deleted Sections related to short-term conditioning for mixture mechanical property testing.
  - Added short-term conditioning for WMA, 2 h ± 5 min at 116 ± 3°C, and HMA, 2 h ± 5 min at 135 ± 3°C, in lieu of conditioning at compaction temperature.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- R 35-22, Superpave Volumetric Design for Asphalt Mixtures:
  - In Terminology Section, added *design air void content*, *reclaimed asphalt pavement binder ratio*, *VFA*, *VMA*, and *WMA* and removed *materials selection*, *design aggregate structure*, *design binder content selection*, and *evaluating moisture susceptibility* and associated Notes (Notes 3 and 4).
  - In Preparing Aggregate Trial Blends Section, added new subsection to oven dry RAP to constant mass and to avoid exposing RAP to extended oven conditioning to minimize further aging of RAP binder.
  - Added references to Superpave5 for use by agency discretion and added new Annex for Preparing Superpave5 Replicate Aggregate Specimens and alternate Table for Superpave5 Gyratory Compaction Effort.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- T 176-22, Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test:
  - Corrected and clarified dimensional discrepancies with the Sand Equivalency Apparatus described in Section 4.1 (Table and Figure 1).
  - Revised Section 6, Sampling, regarding reducing and splitting the sample.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- T 209-22, Theoretical Maximum Specific Gravity (Gmm) and Density of Asphalt Mixtures:
  - In Sections 5.4.5 and 5.5, revised 4.0 kPa (30 mmHg) to 3.3 kPa (25 mmHg) – bottom of range at which the test is performed instead of the middle of range.
  - In Section 7.2.1, revised to “Plant-produced samples may be short-term conditioned according to R 30 as specified by the agency. See Note 5.”
  - In Section 7.2.1, deleted requirement to dry the samples to constant mass.
  - In Sections 9.1 and 10.1, revised to require residual pressure for 15 ± 1 min. instead of 15 ± 2 min. to reduce variability.
  - In Section A1.1.1 (Standardization of Bowl for Mass Determination in Water), revised 2nd sentence to read “If the range of the three masses is less than or equal to 0.3 g, use the average as B in Equation 1.” and revised 3rd sentence from “variation” to “range”.
  - In Section A1.1.2 (Check of Bowl for Mass Determination in Water), added alternate check procedure for labs that standardize bowls frequently
  - In Sections A1.2.1 and A1.2.2 (Standardization of Flask and Pycnometer for Mass Determination in Air), revised similarly to revisions in A1.1.1 and A1.1.2, respectively.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- T 401-22, Cantabro Abrasion Loss of Asphalt Mixture Specimens (title change – added “Cantabro”):
  - Formerly TP 108.
  - Adopted as a full standard.
  - In Section 5 (Significance and Use), revised to include.
  - In Section 6.5, Chamber ambient temperature tolerance widened from ± 1°C to ± 2°C.
  - In Section 8.1 (Procedure), adjusted drying language not to exceed 52 ± 3°C.
  - Added Appendix A for conditioning protocols to simulate field aging.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- In 2023, a number of AASHTO standards will again be revised to address proper selection of Temperature Measuring Devices (TMD) as a result of NCHRP Report 20-07, Task 427 and further technical and practical review:
  - Includes revisions to thermometer types, thermometer temperature ranges, and thermometer tolerance ranges based on temperature usage ranges and usage tolerance ranges specified in each standard.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- M 332-23, Performance-Graded Asphalt Binder Using Multiple Stress Creep Recovery (MSCR) Test:
  - Revisions from Task Force for Asphalt Standards Harmonization (TFASH).
  - In Table 1, revised PAV conditioning temperatures to simplify as shown in table below.
  -

Performance Grade	PG 46	PG 52	PG 58	PG 64	PG 70	PG 76	PG 82
PAV conditioning temperature, °C	90	90	100	100	100 ~~(110)~~	100 ~~(110)~~	100 ~~(110)~~

f For climates with a LTPPBind high pavement temperature of 76 or above, the PAV conditioning temperature shall be 110 °C.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- T 209-23, Theoretical Maximum Specific Gravity (Gmm) and Density of Asphalt Mixtures:
  - Section 5. Apparatus:
    - In Section 5.5. (Vacuum Measurement Device), revised from “be accurate to 0.1 kPa (1mmHg)” to “be readable to at least 0.2 kPa (2 mmHg)”.
  - Section 9. Test Method A – Mechanical Agitation Procedure:
    - In Section 9.1., revised from “manometer reads 3.7 ± 0.3 kPa (27.5 ± 2.5 mmHg)” to “manometer reads 4.0 ± 0.6 kPa (30 ± 5 mmHg)”.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- T 240-23, Effect of Heat and Air on a Moving Film of Asphalt Binder (Rolling Thin-Film Oven Test):
  - New Section 6., Determination of Oven Preheat Time, added to include two preheat time options:
  - Section 6.1.1., determine time for fully loaded oven to thermally equilibrate at 163 ± 1.0°C (325 ± 1.8°F) as determined by two consecutive 15-min temperature recordings that do not vary by more than 0.5°C (1°F). Oven preheat time is the time oven takes to reach thermal equilibrium plus an additional 30 min.
  - Section 6.1.2., in lieu of using Section 6.1.1., a minimum oven preheat time of 4 h may be used.
  - In Section 7 (Preparation of Oven) and Section 7.5., revised from preheat oven from 2 h to the preheat time determined in Section 6.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- T 324-23, Hamburg Wheel-Track Testing of Compacted Mixtures:
  - Section 1. Scope:
    - New Section 1.5., indicating test method is standard; however, agencies may require deviations for test temperature, maximum rut depth calculation, equipment, or other.
  - Section 5. Apparatus:
    - In Section 5.3., (Impression Measurement System), added root-mean square error (RMSE) equation for determining the deviation from the 11 pre-set measurement locations.
    - In Section 5.7., (Balance), deleted this Section.
  - Section 6. Specimen Preparation:
    - In Section 6.3.1., (Field-Produced Asphalt Mixture), revised from T 168 to R 97 for obtaining sample of asphalt mixture.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- T 324-23, Hamburg Wheel-Track Testing of Compacted Mixtures (Continued):
  - Section 9. Calculations:
    - In Section 9.1., moved text from Note 10 to this Section. Note 10 text indicated that agency may define a test as a single slab specimen, a single 250-mm (10-in.) or 300-mm (12-in.) core specimen, or as two 150-mm (6-in.) diameter cylindrical or core specimens.
  - Annex A – Revised to “Evaluating Hamburg Wheel Tracking Device”.
    - Sections A1. to A7., now address inspection of the steel wheels and verification of water bath temperature, LDT calibration, wheel loading assembly, wheel travel and rut measurement.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- T 331-23, Bulk Specific Gravity (Gmb) and Density of Compacted Asphalt Mixtures Using Automatic Vacuum Sealing Method:
  - Section 5. Apparatus:
    - In Section 5.4., revised to include updates involving plastic bag size and thickness.

- T 340-23, Determining Rutting Susceptibility of Asphalt Mixtures Using the Asphalt Pavement Analyzer (APA):
  - Throughout standard, revised from hot mix asphalt (HMA) to asphalt mixtures.
  - Throughout standard as appropriate, revised to add testing details for testing four or six cylindrical specimens using a two-wheel or three-wheel APA, respectively.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- R 47-23, Reducing Samples of Asphalt Mixtures to Testing Size:
  - In Section 7.1., Mechanical Splitter Type A, revise for clarity.
  - In Section 8., Procedure for Mechanical Splitter Method:
    - In Section 8.1., deleted last sentence indicating the release agent shall not contain any solvents or petroleum based products. Previous sentence requires an approved asphalt release agent.
    - In Section 8.3.2., revise text to active voice.
  - In Section 9., Quartering Method Apparatus:
    - In Section 9.1., clarified text for the quartering template to require template to be formed in the shape of a 90-degree cross with equal length sides that exceed the diameter of the flattened cone of material to be quartered.
    - In Section 9.1., replaced Figure 5 and relabeled to Quartering Template.

- R 47-23, Reducing Samples of Asphalt Mixtures to Testing Size (Continued):
  - In Section 10. Procedure of Quartering Method:
    - In Section 10.3., clarified text requiring flattening of conical pile to a diameter of four to eight times the thickness.
    - In Section 10.5., clarified text by adding new subsections for Quartering and Sectoring.
  - In Section 11., Incremental Method Apparatus:
    - In Section 11.1., deleted text about sampling as sampling is covered in Section 6.1.
  - In Section 12., Procedure for Incremental Method:
    - In Section 12.1., revised text to active voice and revised text to only include the requirements for a hard, non-stick, level surface to perform the incremental method.
    - Section 12.2 (new), added text from Section 12.1. regarding placing the sample on the level surface and requiring not to lose any material or introduce any foreign material.

2019 TO 2023 SIGNIFICANT UPDATES TO PUBLISHED AASHTO STANDARDS (CONTINUED)

- R 118-23, Characterizing the Relaxation Behavior of Asphalt Binders Using the Delta Tc (ΔTc) Parameter:
  - Formerly PP 113.
  - Adopted as a full standard.

SIGNIFICANT UPDATES TO AASHTO STANDARDS TO BE PUBLISHED IN 2024

- MP 46-24, Balanced Mix Design:
  - Section 5.5., add this new Section for High Temperature Indirect Tensile Test (HT-IDT) – ALDOT 458.
  - Appendix X1., Summary of Mixture Performance Test Criteria Used by State Highway Agencies, editorially and informationally revised and updated state specific requirements.

- PP 105-24, Balanced Design of Asphalt Mixtures:
  - Throughout, revised from “performance-based/related” to “mechanical” test results.
  - Section 4., Summary of the Practice, updated/clarified the four Approaches.
  - Section 10., Report, clarified the reporting requirements.

SIGNIFICANT UPDATES TO AASHTO STANDARDS TO BE PUBLISHED IN 2024

- R 30-24, Short-Term Laboratory Conditioning of Asphalt Mixtures:
  - Throughout, removed all procedures for Long-Term Laboratory Conditioning.

- R XXX-24, Long-Term Laboratory Conditioning of Asphalt Mixtures:
  - Proposed New Standard for Long-Term Laboratory Conditioning.
  - Section 7., Long-Term Mixture Conditioning Procedures, kept the existing LTOA conditioning from R 30 as Method A plus added four new LTOA conditioning options (Methods B to E) for specification by agencies:
    - Method A - Conditioning of Compacted Mixture Specimens at 85°C.
    - Method B - Conditioning of Uncompacted Loose Mixture at 85°C.
    - Method C - Conditioning of Uncompacted Loose Mixture at 95°C (NCHRP 09-54 – NCHRP Reports 870 and 973).
    - Method D - Conditioning of Uncompacted Loose Mixture at 100 to 125°C.
    - Method E - Conditioning of Uncompacted Loose Mixture at 135°C.

SIGNIFICANT UPDATES TO AASHTO STANDARDS TO BE PUBLISHED IN 2024

- T 11-24, Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing:
  - Section 2., Referenced Documents, and Section 8., Procedure A – Washing with Plain Water, added reference to AASHTO M 255, Total Evaporable Moisture Content of Aggregate by Drying, for procedure for drying the aggregate to constant mass.
  - Section 8., Procedure A – Washing with Plain Water, clarified language for agitating and washing the sample.

- T 27-24, Sieve Analysis of Fine and Coarse Aggregates:
  - Section 2., Referenced Documents, and Section 7., Procedure, added reference to AASHTO M 255, Total Evaporable Moisture Content of Aggregate by Drying, for procedure for drying the aggregate to constant mass.

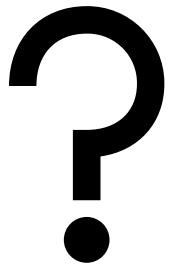
SIGNIFICANT UPDATES TO AASHTO STANDARDS TO BE PUBLISHED IN 2024

- T 30-24, Mechanical Analysis of Extracted Aggregate:
  - Section 2., Referenced Documents, added new references to AASHTO R 76, Reducing Sample of Aggregate to Testing Size, to AASHTO T 255, Total Evaporable Moisture Content of Aggregate by Drying, and to AASHTO T 319, Quantitative Extraction and Recovery of Asphalt Binder from Asphalt Mixtures.
  - Section 3., Summary of Method, added this new section.
  - Section 5., Apparatus, clarified requirements for balance, sieves, mechanical sieve shaker, oven, wetting agent, and mechanical washing apparatus (optional).
  - Section 8., Procedure, referenced AASHTO T 255 for procedure for drying sample to constant mass and clarified language for agitating and washing the sample for both manual washing and mechanical washing.
  - Annex A1., Time Evaluation, added new Note regarding recommendations when excessive time (more than 10 min.) is required to achieve adequate sieving.
  - Annex A2., Overload Determination, added alternate procedure for splitting the portion finer than the 4.75 mm (No. 4) sieve and equation for determining the mass of size increment on total sample basis.

SIGNIFICANT UPDATES TO AASHTO STANDARDS TO BE PUBLISHED IN 2024

- T 269-24, Percent Air Voids in Compacted Dense and Open Asphalt Mixtures:
  - Section 7., Calculations, added new informational Note that air voids may be reported to nearest 0.01%; however, test results should not be reported to a greater number of decimal places than the specified air void limits.

- T 315-24, Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR):
  - Revisions throughout the standard from the Task Force for Asphalt Standards Harmonization (TFASH).
    - Harmonization of ASTM and AASHTO asphalt binder standards.
  - Throughout standard, significant updates/revisions, including additional photographs, to clarify and update requirements and procedures of this test method.



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Handling Modified Binders

Contractor's View

Presented by: Michael Worden

Prepared for the Association of Modified Asphalt Producers Training Program

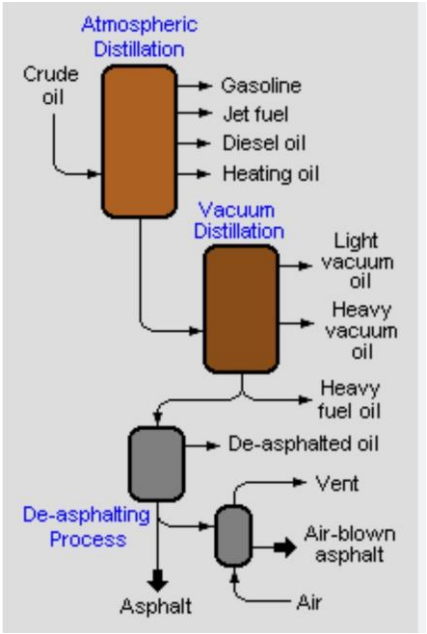
Association of Modified Asphalt Producers

Outline

- What is “Modified Binder”?
- Handling of Modified Binders at the Terminal
- Handling of Modified Binders at the Hot Mix Asphalt Plant
- Recommended Plant Operations
- Laydown of Modified Binder Mix
- Contractor’s Liquid Asphalt Binder QC Plan

What is asphalt binder?

It is a waterproof, thermoplastic adhesive. It acts as the “glue” that holds asphalt pavement mixes together. In its most simple definition, it is the “bottom of the barrel” when refining crude oil.



What is asphalt binder?

- It is a thermoplastic, viscoelastic material and behaves as a glass-like elastic solid at low temperatures or during high loading frequencies, and as a viscous fluid at high temperatures or low loading frequencies.
  - At high temperatures – fluid like
  - At low temperatures – a semi-solid

What is “Modified Binder”?

- Most typically, PMA (Polymer Modified Asphalt) is considered “Modified Binder”
  - Most agencies require SBS (Styrene-Butadiene-Styrene) for PMA
  - Can be used in HMA, WMA, and emulsion type applications

- Binders can also be modified with PPA (Polyphosphoric Acid), GTR(Ground Tire Rubber), and GTRH (“H” stands for “Hybrid”, and means GTR with SBS)

- A binder could also be considered “modified” anytime an ingredient/constituent has been added to “neat” (unmodified) asphalt binder, to change/enhance/improve it’s grade, properties, or performance

- Newer technologies include isocyanates and recycled plastics

PMA (Polymer Modified Asphalt)

Base asphalt modified with SBS (Styrene-Butadiene-Styrene)

GTR and GTRH modified binder

Base asphalt modified with GTR or GTRH

Chemically Modified Asphalt Binder

PPA (Polyphosphoric Acid), Isocyanates, WMA additives, rejuvenators, others…

+

Asphalt Binder modified with Recycled Plastic

New and evolving technology, considered “wet process” when added to binder

+

HANDLING MODIFIED ASPHALT BINDERS

HANDLING MODIFIED ASPHALTS

More and more asphalt binders are being modified

Most modified binders are in the PG 64-28 to 76-22 range

Be safe and follow manufacturer’s recommendations

HANDLING MODIFIED ASPHALT

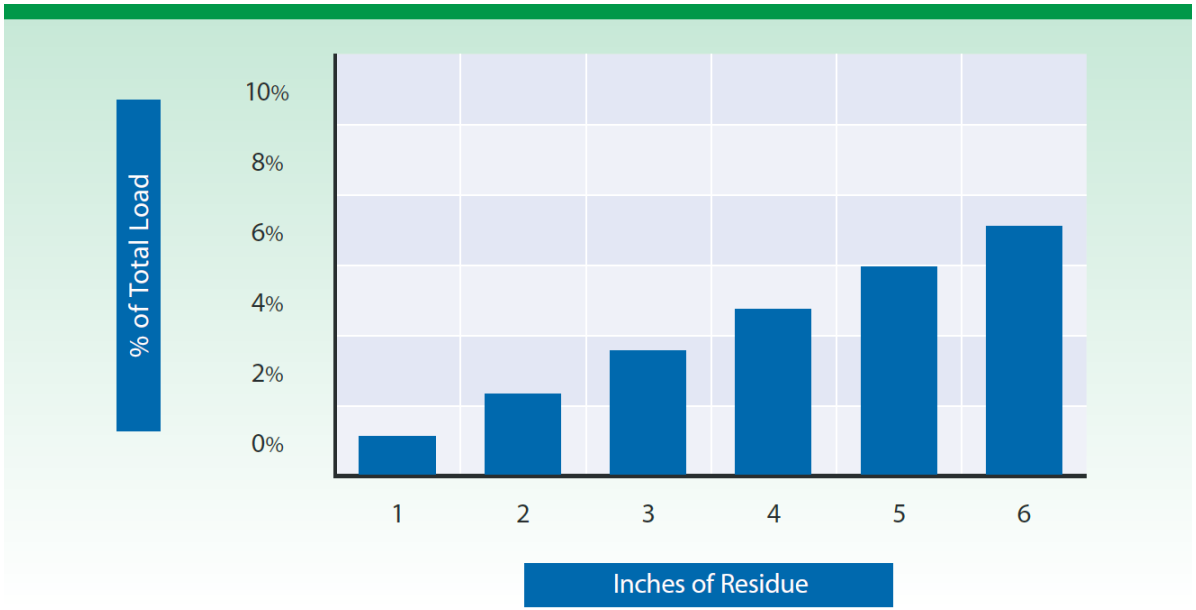
Mixing different asphalt binders (“neat” or modified) can cause the asphalt to fail

Reduce contamination at the terminal

Ensure tanker truck is empty before loading at terminal

Load from the correct loading arm at terminal

RESIDUE AS % OF LOAD



HANDLING Modified Binders AT THE PLANT

Reduce contamination at the HMA plant

- Pump into correct tank at HMA plant
- Use dedicated tanks, if possible
- If dedicated tank is not available
  - Empty tank as much as possible if previous material was different
  - Add 2 or 3 full loads of PMA before testing and/or using the material in the tank

Diluted Modified Binder may fail PG grade!!!

HANDLING Modified Binders AT THE PLANT

Vertical Tanks

- Vertical tanks provide more efficient agitation
- Very few PMAs require agitation to prevent separation
- Agitation is recommended for some GTR modified asphalt
- Not sure with new technologies
- Check with supplier

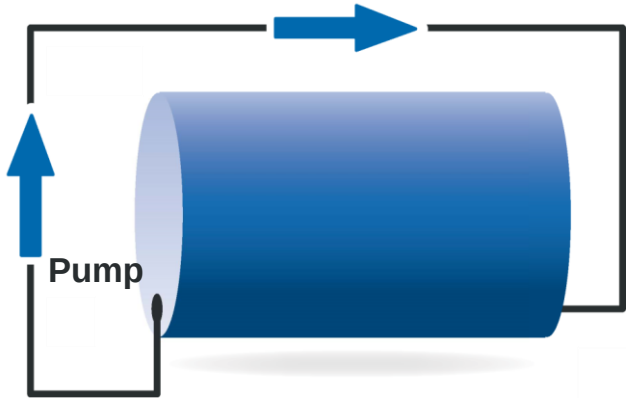
Check and Maintain Proper Temperatures!

HANDLING Modified Binders AT THE PLANT

Horizontal Tanks

- Horizontal tanks work fine for most PMAs
- Circulate to achieve uniform temperatures above and below heating coils

PROPER CIRCULATION IN HORIZONTAL TANKS



Suction and return lines at opposite ends of tank to completely circulate material

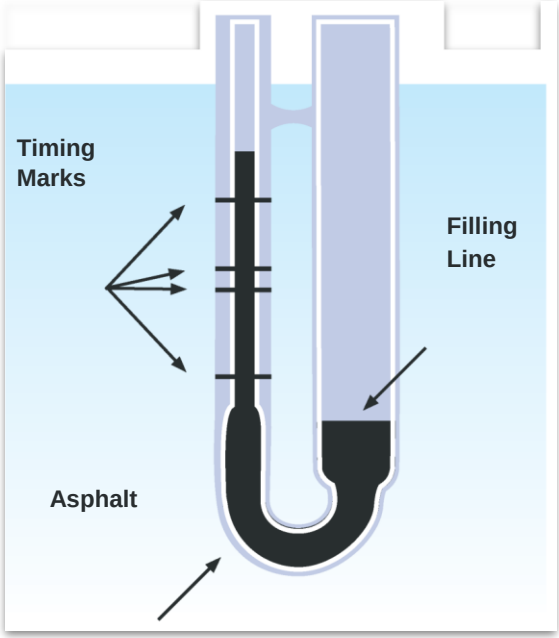
Return line near bottom of tank to prevent oxidation

HANDLING Modified Binders AT THE PLANT

BEWARE OF MIXING MODIFIED BINDERS FROM DIFFERENT SUPPLIERS!!!

- Different suppliers may use different technologies & chemistries
- Differing technologies & chemistries may not be compatible
- Mixing incompatible technologies & chemistries will cause failures!

MIXING & COMPACTION TEMPERATURE GUIDANCE



Asphalt Institute developed procedure in 1970's for determining laboratory mixing and compaction temperatures (MS-2)

Equiviscous laboratory mixing and compaction temperatures

- Viscosity at 135˚C and 165˚C
- Lab mixing range of 150-190 centistokes
- Lab compaction range of 250-310 centistokes

NOT FOR FIELD TEMPERATURES!!!

MIXING AND COMPACTION TEMPERATURE GUIDANCE

Superpave adopted AI procedure using rotational viscometer

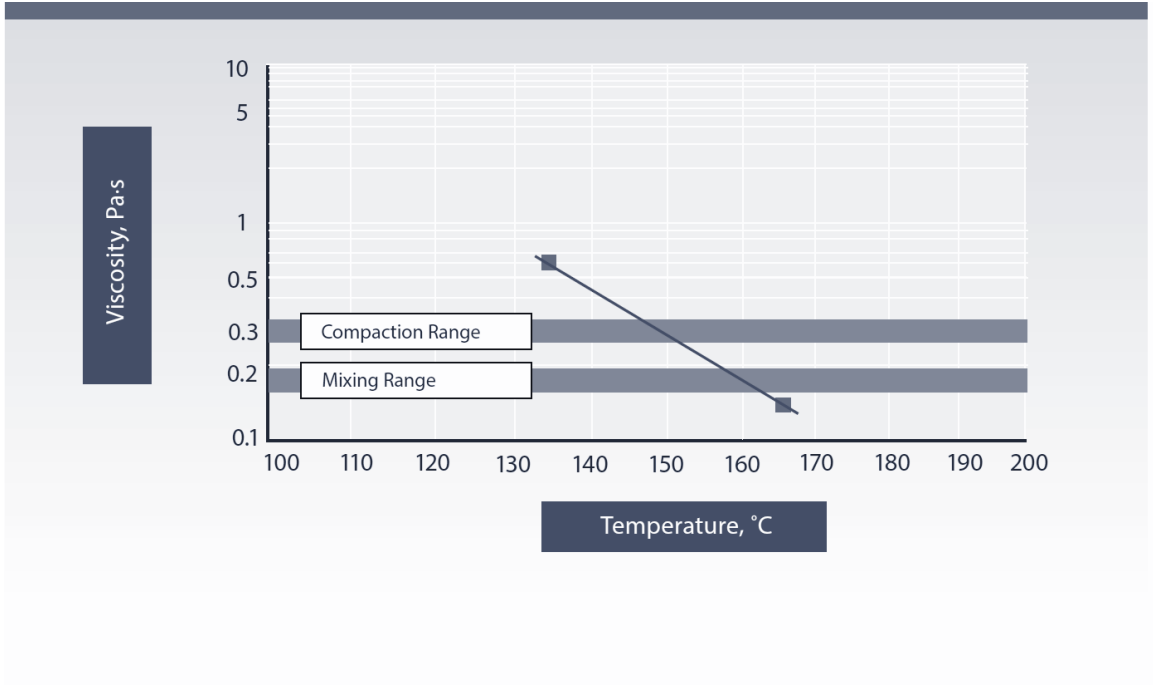
Equiviscous laboratory mixing and compaction temperatures

Does not work for PMA

- Yields extremely high temperatures
- Use suppliers' recommendations

Not For Field Temperatures for Unmodified or Modified Asphalts!!!

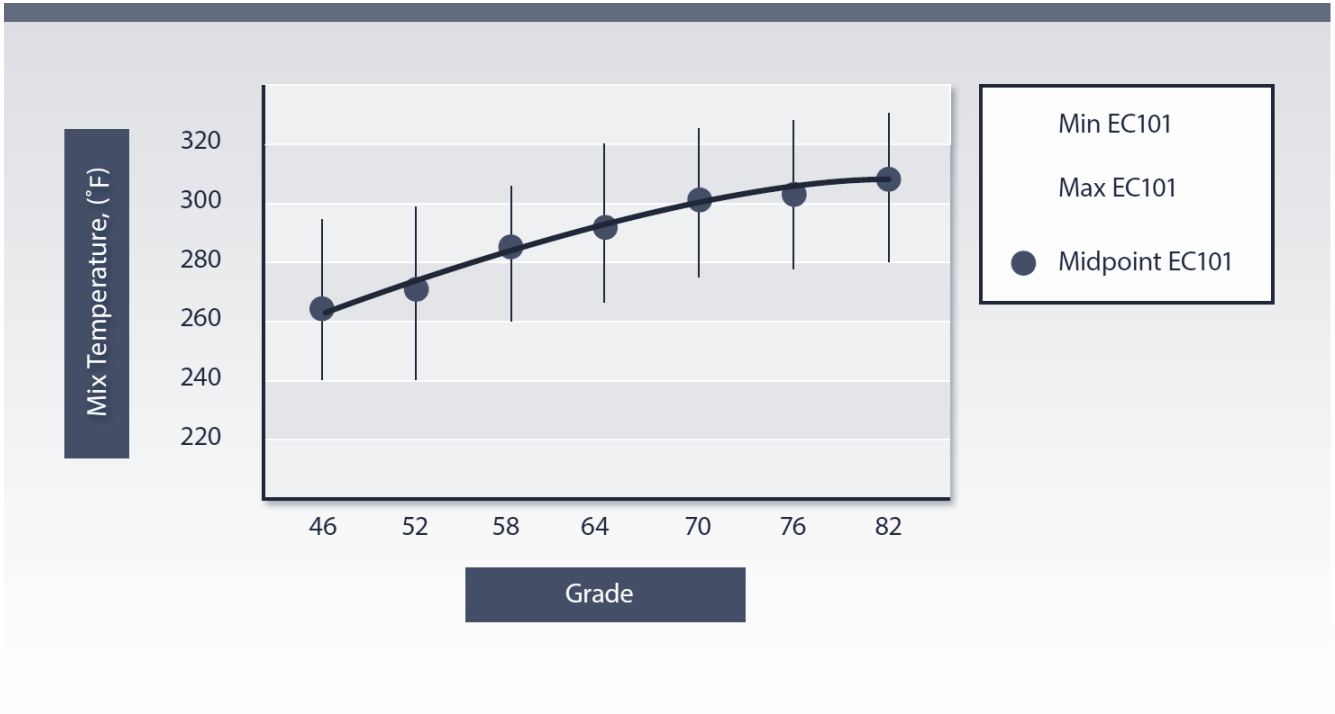
Method for “neat” (unmodified) **ONLY**!

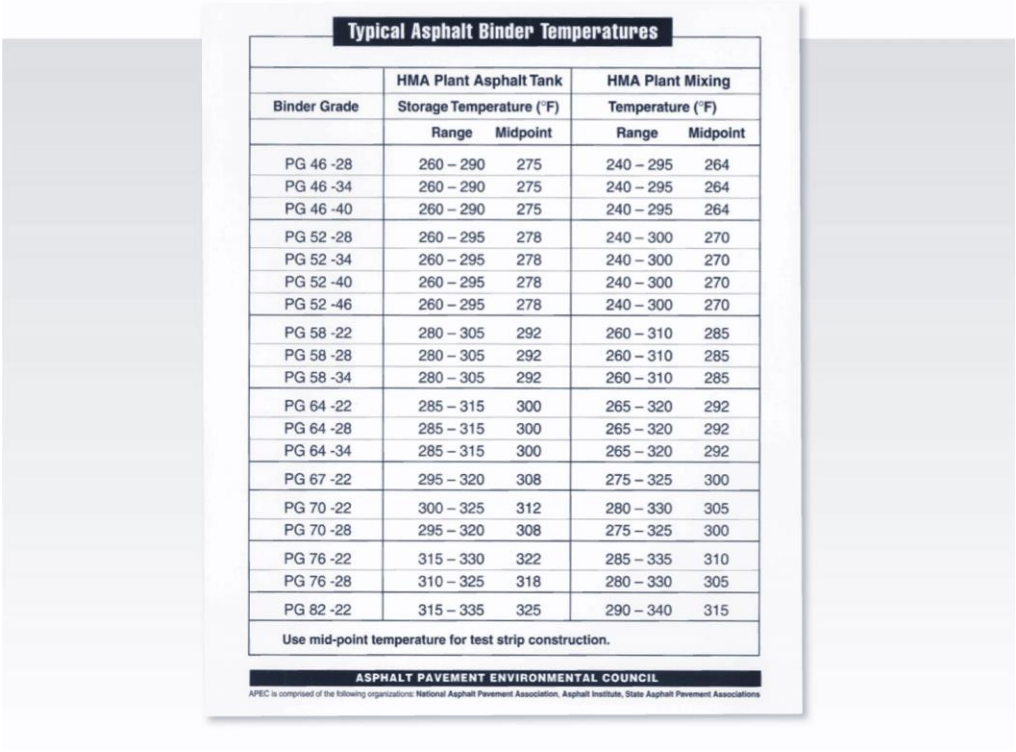


Lab Compaction 0.28 ± 0.03 Pa.s

Lab Mixing 0.17 ± 0.02 Pa.s

EC-101 GENERAL RECOMMENDATIONS





Typical Asphalt Binder Temperatures

Binder Grade	HMA Plant Asphalt Tank Storage Temperature (°F)		HMA Plant Mixing Temperature (°F)	
	Range	Midpoint	Range	Midpoint
PG 46 -28	260 – 290	275	240 – 295	264
PG 46 -34	260 – 290	275	240 – 295	264
PG 46 -40	260 – 290	275	240 – 295	264
PG 52 -28	260 – 295	278	240 – 300	270
PG 52 -34	260 – 295	278	240 – 300	270
PG 52 -40	260 – 295	278	240 – 300	270
PG 52 -46	260 – 295	278	240 – 300	270
PG 58 -22	280 – 305	292	260 – 310	285
PG 58 -28	280 – 305	292	260 – 310	285
PG 58 -34	280 – 305	292	260 – 310	285
PG 64 -22	285 – 315	300	265 – 320	292
PG 64 -28	285 – 315	300	265 – 320	292
PG 64 -34	285 – 315	300	265 – 320	292
PG 67 -22	295 – 320	308	275 – 325	300
PG 70 -22	300 – 325	312	280 – 330	305
PG 70 -28	295 – 320	308	275 – 325	300
PG 76 -22	315 – 330	322	285 – 335	310
PG 76 -28	310 – 325	318	280 – 330	305
PG 82 -22	315 – 335	325	290 – 340	315

Use mid-point temperature for test strip construction.

ASPHALT PAVEMENT ENVIRONMENTAL COUNCIL

APEC is comprised of the following organizations: National Asphalt Pavement Association, Asphalt Institute, State Asphalt Pavement Associations

EC-101

EC-101 General Storage and Plant Mixing Temperature GUIDANCE

GENERAL GUIDELINES FOR STORAGE AND MIXING TEMPERATURES

PG Binder	Storage Temperature (˚F)	Mixing Temperature (˚F)
64-22	285-315	265-320
70-22	300-325	280-330
76-22	325-340	285-335
Extended Storage <275˚F		

Source: EC-101

HMA PLANT ASPHALT PUMP

- Adequately sized AC pump
  - Modified Binders can cause higher amperage draw
- AC pump in good condition
- Calibrated
- Strainer
  - Larger than standard holes – 1/4”
  - Clean

Circulate “neat” (unmodified) binder first, before start-up	Switch to Modified Binder, and circulate before start-up	Switch back to unmodified asphalt and circulate through pump after shutdown at end of shift	Do NOT leave the Modified Binder in the plant’s AC pumps, meters & strainer until next shift

HMA PLANT ASPHALT PUMP OPERATION

HMA PLANT SLAT CONVEYOR

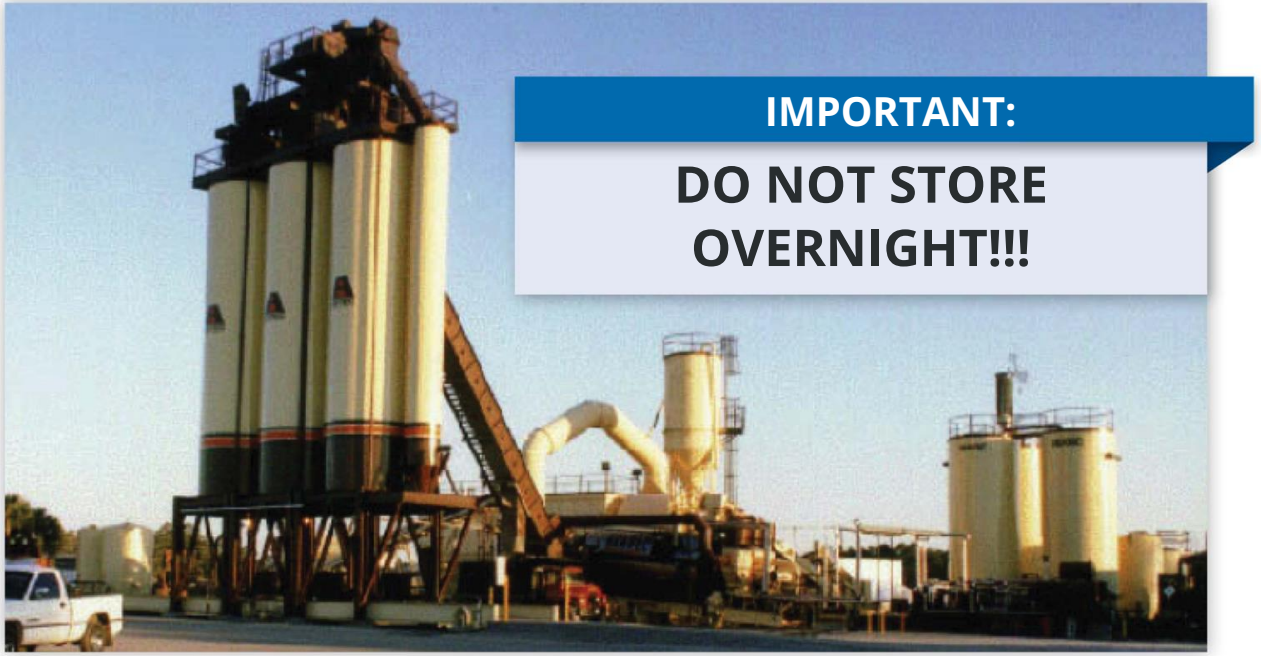
Properly Sized

Good Condition

Mix produced with Modified Binder can increase amperage draw on conveyor

- Start at reduced tonnage rate
- Start on unmodified mix to heat conveyor

MODIFIED HMA STORAGE



TRANSPORTING MODIFIED HMA TO PAVER

Clean, smooth truck beds

Release agent

- Type
- Amount
- “More” is not “Better”

Tarps, Tarps, Tarps

Typically, no modifications to equipment

Handwork can be more difficult

Attention to detail is KEY

Weather Conditions – 50°F minimum

PLACING MODIFIED HMA

COMPACTING MODIFIED HMA

Compaction Equipment

- Number–3 or 4
- Type–high frequency
- Size

Mix temperature

- Only high enough to allow proper compaction
- Follow manufacturer's recommendations

Roller pattern

- Front roller close to paver

Field monitoring

- Temp
- Density

COMPACTING MODIFIED HMA

Compacting mixes with PMA may actually be easier than un-modified asphalt mixes

- Compaction requires confinement
- PMA may eliminate tender zone

CONTRACTOR QC PLAN

Contractors need to establish QC plan to prevent PG asphalt contamination and failing test results

- Identify all hardware–label or number
  - Tanks
  - Pumps
  - Piping
  - Valves
  - Sample points
  - Heat system
- Establish standard procedures and hardware settings for asphalt flow into storage and into HMA plant

SUMMARY

Proper modification can improve the performance of HMA pavements

Understand the product you are using… Modified Binders and “Neat” (Unmodified) Binders are **NOT THE SAME**!

- Follow suppliers’ recommendations
- Use Best Practices
- Be Safe

Thank You!

Michael Worden

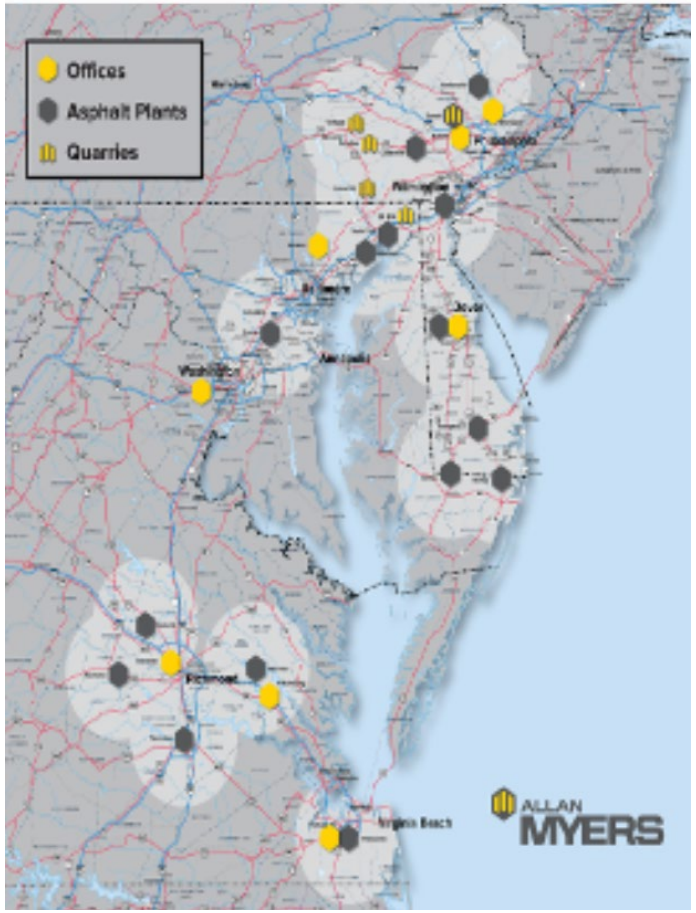
mworden@associatedasphalt.com

Modifiedasphalt.org

A Producer's Perspective of a successful Implementation of Balanced Mix Design.

ALLAN MYERS

Allan Myers is currently in 4 States with 4 different DOT approaches to BMD implementation.



ALLAN MYERS

2018 VDOT implemented a High RAP BMD option.

- Required testing of production mix.
- Daily APA Rut Testing 4 cores @ 7% voids less than 8.0 mm rut. Samples ran by VRTC – T340 except 120psi.
- Cantabro – every 500 tons volumetric cores - less than 7.5% loss.
- CTindex – every 500 tons 7% voids – At least 70 CT-index.
- Gradation AC – every 500 tons
- Volumetrics – every 500 tons – these cores can be used for Cantabro

- No Producers in Virginia volunteered

ALLAN MYERS

Allan Myers BMD Prep 2018

- Purchased APA Junior from PTI
- Purchased Smart Jig from Instrotek
- Serviced and Calibrated Pine Presses
- Got permission from Quarry QC to use LA Abrasion Machine for Cantabro Testing.
- Plan was to begin establishing baseline values for mixes.

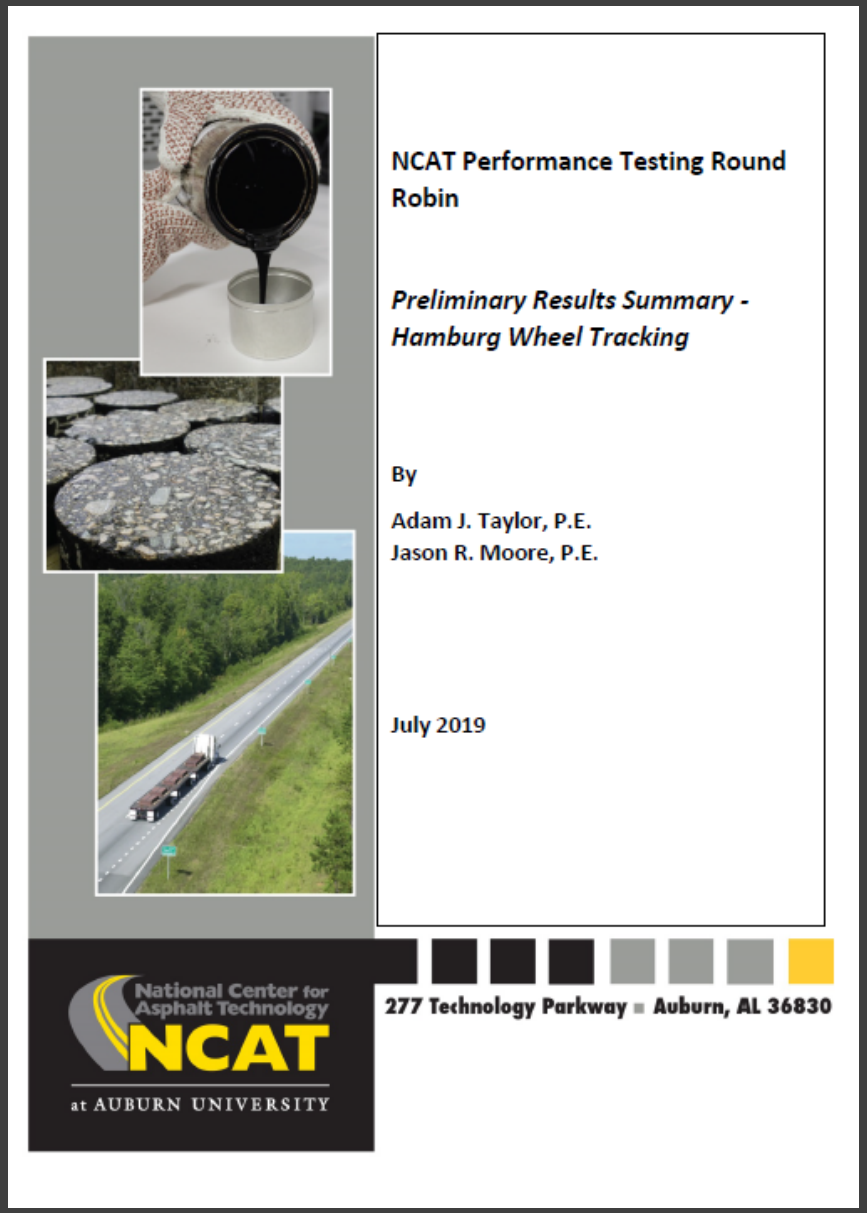
- Concerns
- Distance and travel from Virginia, Maryland and Delaware to Paradise Pennsylvania Central Lab.
- 7% +/- 0.5% Air Voids. Sometimes took multiple tries and material was in the oven for extended periods of time.
- Keeping CT-Index cores dry while bath at 77F

ALLAN MYERS

BMD Testing

- APA Junior for APA Rut Test

2019 NCAT Round Robin



At 10,000 passes we reported 2.62 mm of rut.

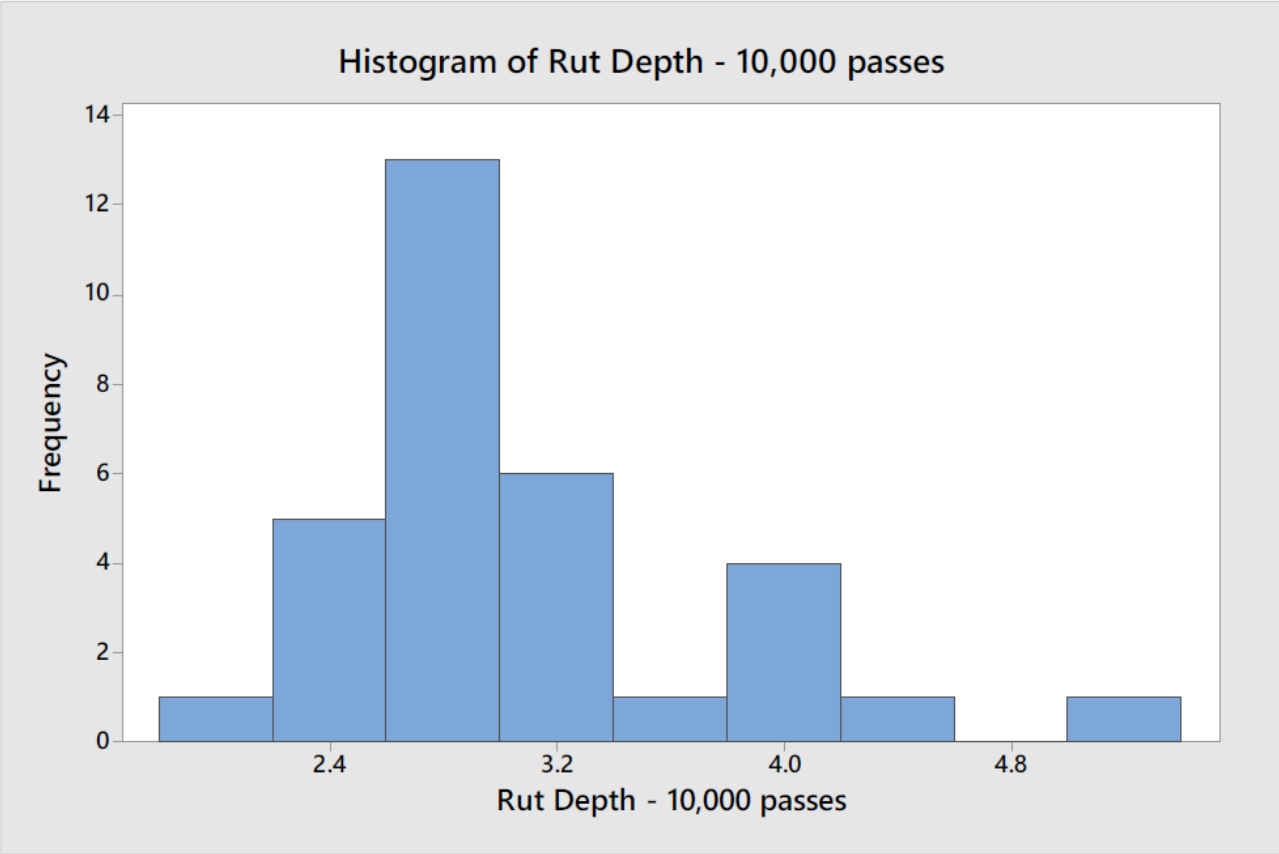


Figure 1: Boxplot and Histogram of Hamburg Rut Depths at 10,000 passes

At 20,000 passes we reported 3.06

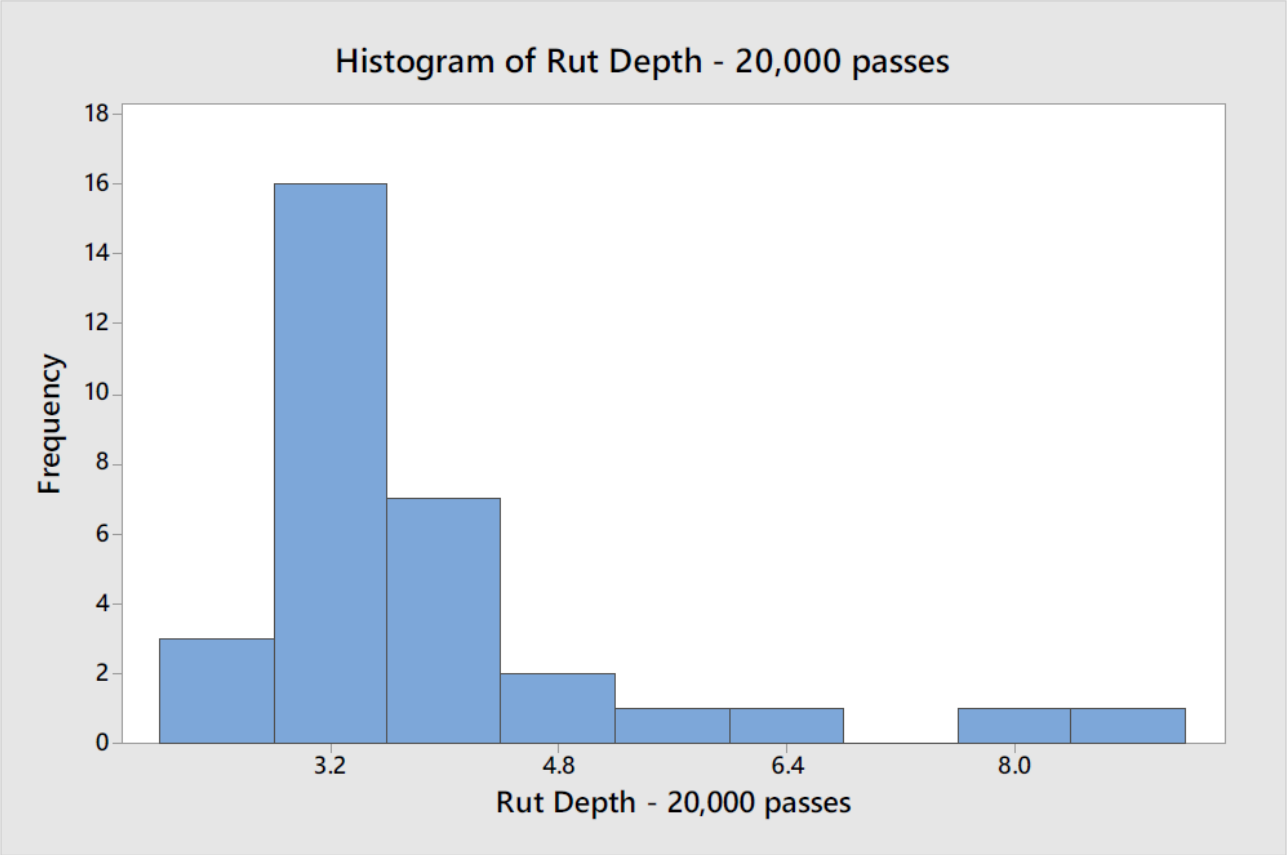


Figure 2: Boxplot and Histogram of Hamburg Rut Depths at 20,000 passes

2020 CT Index Round Robin Ph. 1

VTRC Virginia Transportation Research Council

VDOT

VDOT Round Robin Testing Program for the Indirect Tensile Cracking Test (IDT-CT) at Intermediate Temperature: *Phase I*.

ALLAN MYERS

Summary of Allan Myers results

Summary Data

Table 2. Summary of IDT-CT Parameters for Package 5.

Package ID		Package 5				
Lab Name		Allan Myers Paradise Central			Test Operator	Tim Peffer
Equipment		Instrotek Smart Jig – Pine 850T			Machine Type	Screw-Drive
ID	Data Collection Frequency (Hz)	Average Loading Rate (mm/min)	Reported CT_{index}	Calculated CT_{index}	Observations	
A5	100.0	52.9	38	38	Loading rate outside 50±2 mm/ min	
A59	100.0	52.8	41	41	Loading rate outside 50±2 mm/ min	
A129	100.0	53.1	34	34	Loading rate outside 50±2 mm/ min	
A167	100.0	52.7	50	50	Loading rate outside 50±2 mm/ min	
A221	100.0	52.4	67	67	Loading rate outside 50±2 mm/ min	
Average / Mean			46	46		
Standard Deviation			13.3	13.2		
Coefficient of Variation			28.8	28.8		
B5	100.0	51.9	218	218	No issues	
B63	100.0	51.2	193	192	No issues	
B119	100.0	52.6	107	106	Loading rate outside 50±2 mm/ min	
B176	100.0	51.7	169	169	No issues	
B240	100.0	52.2	127	127	Loading rate outside 50±2 mm/ min	
Average / Mean			163	162		
Standard Deviation			45.9	45.8		
Coefficient of Variation			28.2	28.2		

General Comments:

For test results with loading rate outside the 50±2 mm/min range, the data was only considered in the 2nd analysis "30 data sets per mix type".

Our results were 46 and 163 with COV of 28.8 and 28.2.

A concern with loading rate.

COV over 15 is a concern.

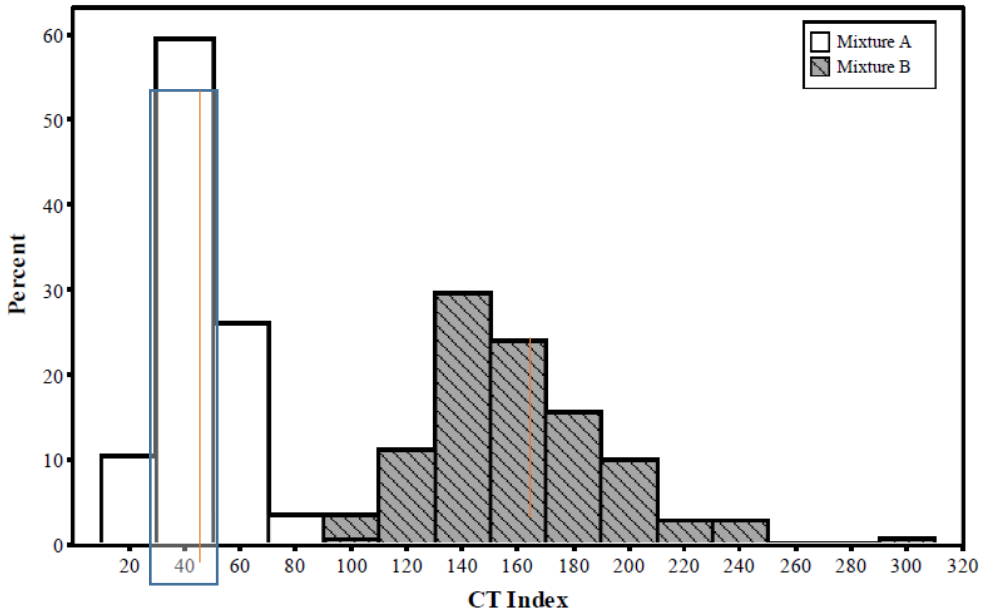


Figure 2. Individual Reported CT_{index} Values for Mixture A and Mixture B.

2021 VDOT BMD Production Testing

Initial Special Provision

2021 Special Provision:

Mix design

Cantabro - design AC and -0.5% AC

APA - design AC and +0.5% AC

CTindex - design AC and ±0.5%, and design AC with long-term aging

Production (4,000T lot)

Property/Test	Frequency (tons)	Total Specimens per Lot
CTindex – QC	1,000	20
Cantabro – QC	1,000	12
CTindex – VDOT QA	2,000	10
Cantabro – VDOT QA	2,000	6
Rutting – VDOT QA	2,000	8

Contractor will make VDOT specimens.

2021 VDOT BMD Pilot at Rockville, Va. Lab

- Design asphalt content stayed the same
- Removed natural sand in order to meet APA Rut.
- Adjusted gradation accordingly
- RAP stayed at 30%. The maximum allowed for the mix spec.
- 2 Lab Technician working exclusively on the BMD testing requirements. A 3rd. Lab Tech worked a second shift to complete Cantabro and CT-Index testing
- Cantabro results were 2% to 5%. Well under the 7.5% maximum.
- CT-Index results were all over 100 but COV's were often over 15%.
- No APA Rut results from VDOT yet.
- Air Voids started at over 5% but were tuned in to 3-4% by end of the project.
- Full incentive pay for AC content = At target and less than .15 StDev

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title

Refine Special Provision

2022 Pilot Projects

Testing Frequency (4,000T lot)

Property/Test	Frequency (tons)	Total Specimens per Lot
CTindex – QC	2,000	10
Cantabro – QC	2,000	6
CTindex – VDOT QA	4,000	5
Cantabro – VDOT QA	4,000	3
Rutting – VDOT QA	Once per mix	4 per mix

Testing halved from 2021

Contractor will make VDOT specimens.
Report results w/in 1 week (recommended 48hrs)

No pay adjustment for performance tests
- If failure, stop production and make corrective actions
- Acceptance ranges for volumetrics/gradation follow section 211
- BMD is eligible for Std. Deviation Bonus (and asphalt price adjustment)

2022 VDOT BMD Pilot at Leesburg, Va. Lab

- Design asphalt content increased 0.1 to 0.2% to increase CT-Index
- Removed natural sand to meet CT-Index and Cantabro.
- Adjusted gradation accordingly.
- RAP stayed at 30%. The maximum allowed for the mix spec.
- 2 Lab Technicians working exclusively on the BMD testing. We did not require a 3rd with reduced requirements from 2021
- Cantabro results on 12.5mm were higher, up 6%
- CT-Index for 12.5mm were lower but still over 100. COV on 5 sample sets were almost always over 15%.
- No APA Rut results yet from VDOT
- Air voids all within spec. Lessons learned from 2021
- Full Incentive Pay for AC content

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VDOT BMD Production Criteria (2024)

Distress	Test	Limit
Cracking	IDT-CT (reheat)	70 (min)
	IDT-CT (non-reheat)	95 (min)
Rutting	APA rut test	8mm (max)
	IDT-HT	Report
Durability	Cantabro	7.5% (max)
Moisture	Tensile Strength Ratio	80% (min)

PennDOT Pilot Projects

- CT-Index as low as the 80’s
- Hamburg Rutting approaching 7
- Lab Mix Only
- Requires additional design time
- 2023 Design submittal season so far has seen results in line with prior results.
- No significant changes to existing designs. – SO FAR

Test	AASHTO	DelDOT	Maryland SHA	PennDOT	VDOT
APA Rut	T340	Yes	Design Only		Yes
Hamburg	T324			Design Only	
CT-Index		Yes	Yes	Design Only	Yes
HT-IDT	AMRL 8225		Yes		Yes
Cantabro	TP108				Yes
Texas Overlay		Yes			

Current tests in our footprint

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Lessons Learned

- Hamburg Testing – make sure side spacers are fully locked to the bottom of the spacer plate
- Hamburg Testing – Allow bottom reservoir to rinse often after test completion. Especially if breakdown occurred.
- CT-Index make sure LVDT is slightly compressed at the start of testing 2-5mm
- Reheating material will typically lower CT-Index results???
- Cantabro results are impacted by temperature, Test area should be 75-80F
- Calibration and maintenance of APA Jr. is important.

2024 Updates

- Concern with Dwell and Lag Times. We never considered the time between making the cores and how long until we tested. Many cores were transported from Virginia to Pennsylvania for testing. Some of our early results might be questionable.
- Powhattan and Petersburg, Virginia plants did BMD jobs in 2023. APA is no longer required but now at “request of engineer”
- Concerns at Petersburg as Volumetrics were tight. BMD testing resulted in adding 0.2 to 0.3% AC. Current Virginia specs require BMD and Volumetrics we (Allan Myers) believe DOT’s will need to choose one or the other in the future.
- Currently both Maryland and Virginia are specifying HT-IDT testing, a surrogate test to APA Rut. However, they differ on specimen size – 62 vs 95mm, and temperature. We would like to see uniformity.

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Thanks!

- Tim Peffer
- Director of Asphalt QC
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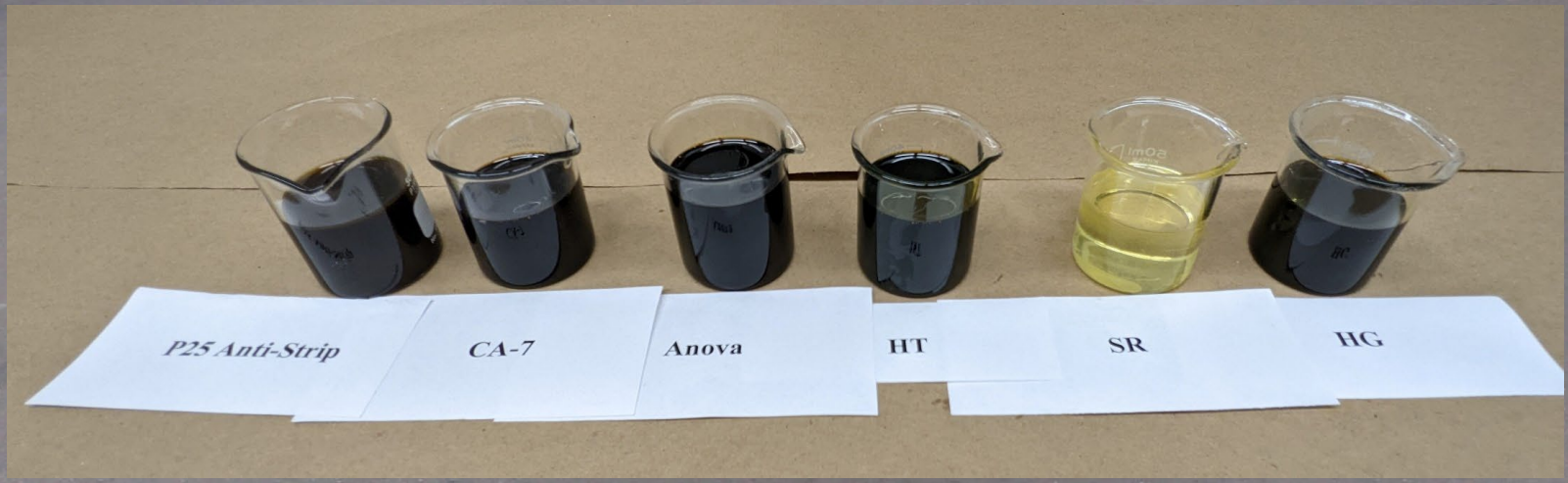
PENN STATE

Asphalt Rejuvenating Agents



Plant Technician Certification Program 2024

Northeast Center of Excellence For Pavement Technology
NECEPT

Acknowledgement

- PennDOT Sponsored Research
- Project Start Date: September, 2019
- Project End Date: September, 2022
- Project Manager: Heather Sorce (PennDOT)
- Project Technical Advisors: Neal Fannin & Kevin Gnegy
- Research Team:
  - Mansour Solaimanian (PI)
  - Scott Milander (Lab Coordinator)
  - Mahsa Tofighian (MS Student)

Outline

1. Background on Rejuvenating Agents (RA)
2. Experimental Study
   - Binder Study
   - Mixture Study
3. Results & Findings
4. Usage Guide

1 Background on Rejuvenating Agents (RA)

What Are Rejuvenators

- The higher the ratio of asphaltene to maltenes, the higher brittleness and cracking potential of asphalt binder
- Asphalt Rejuvenators peptize and polarize asphaltenes
- Rebalance the ratio of Asphaltenes to Maltenes
- Reduce cracking potential
- Maintain long-term effectiveness

Peptizing: Dispersing and Deflocculating

Where do we need rejuvenators?

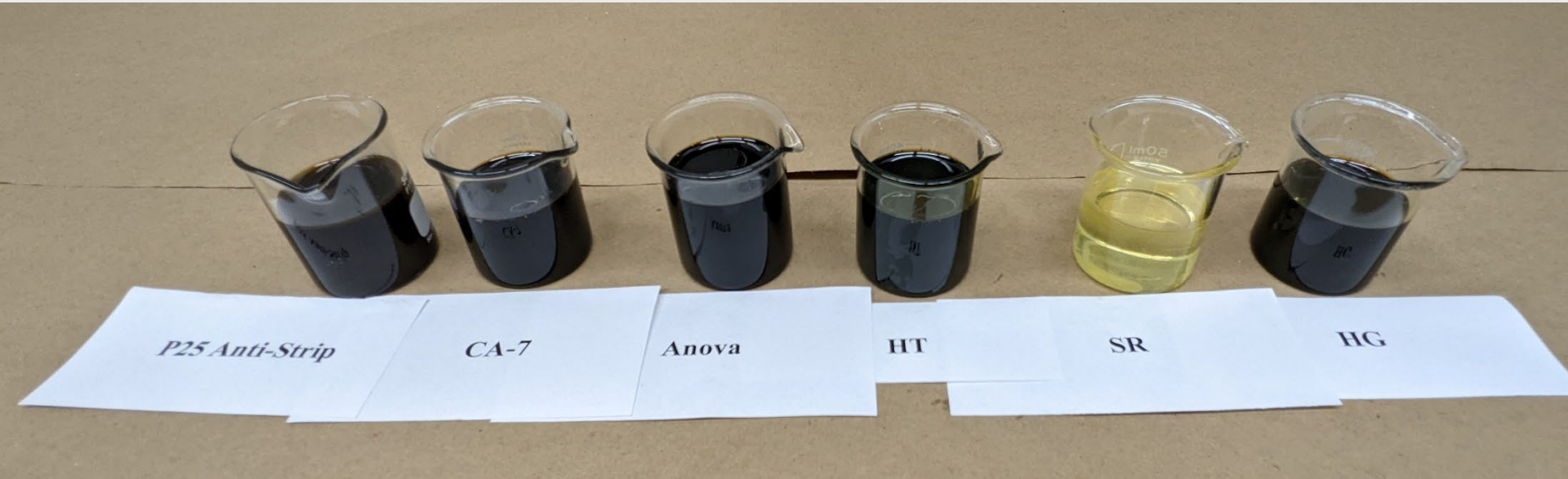
- **Most often when the RAP content or RAS content is high, or when a combination of RAP and RAS is used in the asphalt mixture**

- **Need to consider several elements to decide if RA is needed and at what dosage rate:**

  - **RBR (reclaimed binder ratio) from RAP/RAS**
  - **Performance grade of all binders (Virgin, RAP, RAS, and Target)**
  - **Design binder content**

Rejuvenator Types

- **Two Principal Categories:**
  - **Petroleum Based**
    - **Paraffinic oil, aromatic extracts, engine oil**
  - **Plant Based (Bio-Based)**
    - **vegetable oil (virgin, modified, or waste), tall oil**



Dosage Rate Definition

- Defined in four ways based on ratio of the rejuvenator mass to the material of interest (reported in percentage).

- Dosage Rate can be reported as a percentage of

  - 1. Virgin Binder
  - 2. Recycled asphalt binder (from RAP/RAS)
  - 3. Total asphalt content (or total fluid content)
  - 4. Total mass of the asphalt mixture

2 Experimental Study

- **Binder Study**
- **Mixture Study**

Selection of Rejuvenators

Company	Product	Description	Abbreviation Used in this Study
Holly Frontier	Hydrolene H90T	Extracts (petroleum), heavy paraffinic distillate solvent	HT
Cargill	ANOVA 1815	Biobased additive	AN
Ingevity	Evoflex CA-7	Engineered additive designed to work with Evotherm®, production temperatures lower than 275°F	IN
Green Asphalt Tech	Hydrogreen S	100% natural mixtures of plant extracts, Rosins, Rosin Esters, fatty acids, and vegetable oils	HG
Krayton	Sylvaroad RP1000	Crude Tall Oil (CTO), a renewable raw material that is a by-product of the paper industry	SR

- **Selection of Binders**
  - **PG 58S-28 (61.0—30.0)**
  - **PG 64S-22 (69.0-24.5)**
- **Selection of RAP/RAS**
  - **One Source of RAP (PG 90.2-17.9), BC: 5.3%**
  - **One Source of RAS (PG 143.0-11.9), BC: 22.7%**

Binder Testing

Binder Test	AASHTO Standard	Response	Purpose
Dynamic shear rheometer at high and intermediate temperatures	T 315	Modulus and phase angle	Performance grade based on AASHTO M 320
Bending Beam Rheometer at low temperature	T 313	Binder stiffness and relaxation value (m-value)	Critical cracking temperature and ΔTC
Multiple Stress Creep and Recovery	T 350	Creep compliance and percent recovery	Potential for rutting and elastic recovery, Performance Grade based on AASHTO M 332
Short-Term Conditioning (Aging)	T 240	To deliver short-term oxidized aged material for testing and evaluation	Evaluate effect of rejuvenator on short-term aged binder
Long-Term Conditioning (Aging)	R 28	To deliver long-term oxidized aged material for testing and evaluation	Evaluate effect of rejuvenator on long-term aged binder

Dosage Rate for Binder Selection

Type of Blend	Rejuvenator Content as Percent of Total Binder
Rejuvenator + Virgin Binder	3
Rejuvenator + RAP Binder	5 and 10
Rejuvenator + Virgin Binder + RAP Binder	2

Types of Mixtures Used in This Research

Mix Type	%RAP	%RAS	Control Mix (No Rejuvenator)?	Mixes Designed with Rejuvenators			
1	15	5	Yes	IN	AN	HT	HG
2	35	0	Yes	IN	AN	HT	HG
3	0	5	Yes	IN	AN		

Mixtures Containing RA Short Term Aged

Mix Information										
MIX ID	Virgin AC, %	Total AC, %	RAP %	RAS %	Rejuv. Type	Rej. % of Total binder	Rej. % of Virgin binder	RBR from RAP	RBR from RAS	Total RBR
Specimens are short-term aged at 135C for 4 hours, followed by conditioning at 150C for 1 hour before compaction.										
Experimental Mixes (i.e., mixes with the recycling agents)										
#4	3.2	4.7	12.0	4.0	CA-7	2.38	3.54	0.13	0.19	0.33
#5	4.2	5.7	12.0	4.0	CA-7	2.58	3.54	0.11	0.16	0.27
#18	3.8	5.7	15.0	5.0	CA-7	2.35	3.54	0.14	0.20	0.34
#20	3.8	5.7	15.0	5.0	CA-7	2.35	3.54	0.14	0.20	0.34
#21	3.8	5.7	15.0	5.0	CA-7	4.70	7.08	0.14	0.20	0.34
#23	3.8	5.7	15.0	5.0	CA-7	5.30	7.99	0.14	0.20	0.34
#38	3.7	5.6	35.0	0.0	CA-7	3.20	4.80	0.33	0.00	0.33
#24	4.1	6.0	15.0	5.0	Anova	1.30	1.91	0.13	0.19	0.32
#39	3.7	5.6	35.0	0.0	HT	2.88	4.32	0.33	0.00	0.33
#40	3.7	5.6	35.0	0.0	HG	2.50	3.75	0.33	0.00	0.33
#42	3.7	5.6	35.0	0.0	Anova	1.10	1.65	0.33	0.00	0.33
#35	4.6	5.7	0.0	5.0	CA-7	1.90	2.37	0.00	0.20	0.20
#36	4.6	5.7	0.0	5.0	Anova	0.80	1.00	0.00	0.20	0.20
#25	4.1	6.0	15.0	5.0	HT	2.88	4.24	0.13	0.19	0.32
#26	4.1	6.0	15.0	5.0	HG	2.50	3.68	0.13	0.19	0.32

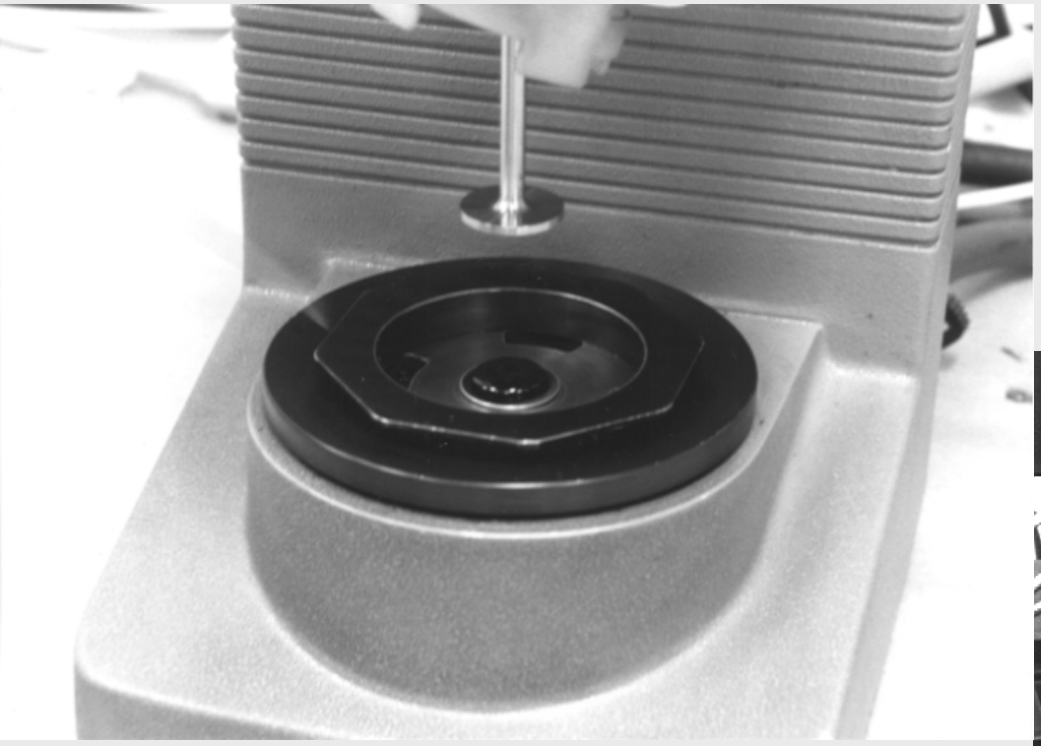
Mixtures Containing RA Long-Term Aged

Mix Information										
MIX ID	Virgin AC, %	Total AC, %	RAP %	RAS %	Rejuv. Type	Rej. % of Total binder	Rej. % of Virgin binder	RBR from RAP	RBR from RAS	Total RBR
Specimens are long-term aged at 135C for 8 hours, followed by conditioning at 150C for 2 hours before compaction.										
Experimental Mixes (i.e., mixes with the recycling agents)										
#24	4.1	6.0	15.0	5.0	Anova	1.30	1.91	0.13	0.19	0.32
#33	3.8	5.7	35.0	0.0	None	0.00	0.00	0.33	0.00	0.33
#39	3.7	5.6	35.0	0.0	HT	2.88	4.32	0.33	0.00	0.33
#23	3.8	5.7	15.0	5.0	CA-7	5.30	7.99	0.14	0.20	0.34
#38	3.7	5.6	35.0	0.0	CA-7	3.20	4.80	0.33	0.00	0.33

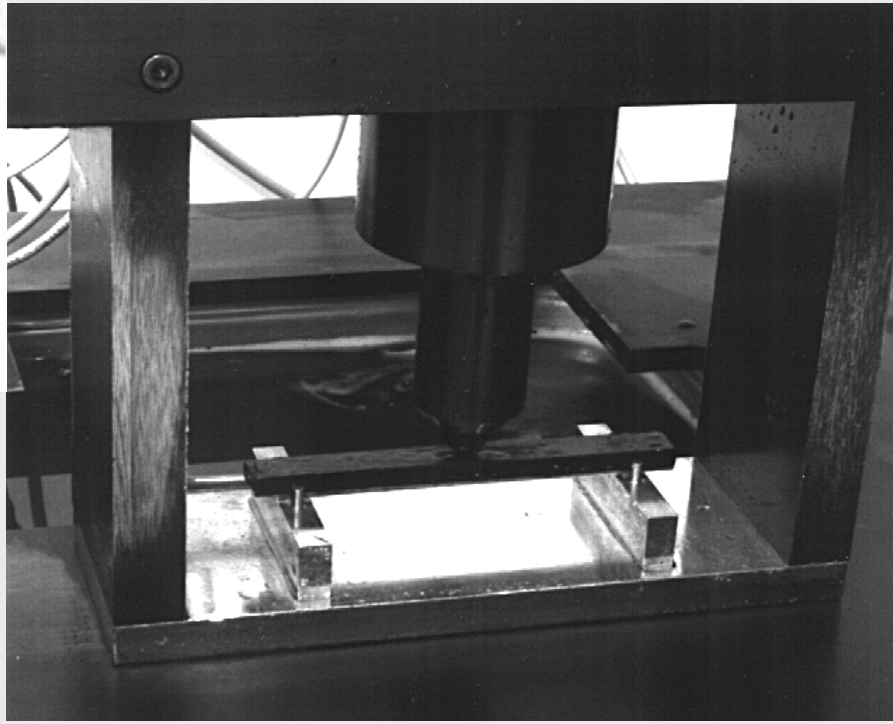
Control Mixtures (NO RA)

Mix Information										
MIX ID	Virgin AC, %	Total AC, %	RAP %	RAS %	Rejuv. Type	Rej. % of Total binder	Rej. % of Virgin binder	RBR from RAP	RBR from RAS	Total RBR
Specimens are short-term aged at 135C for 4 hours, followed by conditioning at 150C for 1 hour before compaction.										
Control Mixes (i.e., mixes without recycling agents)										
#19	3.8	5.7	15.0	5.0	None	0.00	0.00	0.14	0.20	0.34
#33	3.8	5.7	35.0	0.0	None	0.00	0.00	0.33	0.00	0.33
#37	4.6	5.7	0.0	5.0	None	0.00	0.00	0.00	0.20	0.20

Characterizing the Binders



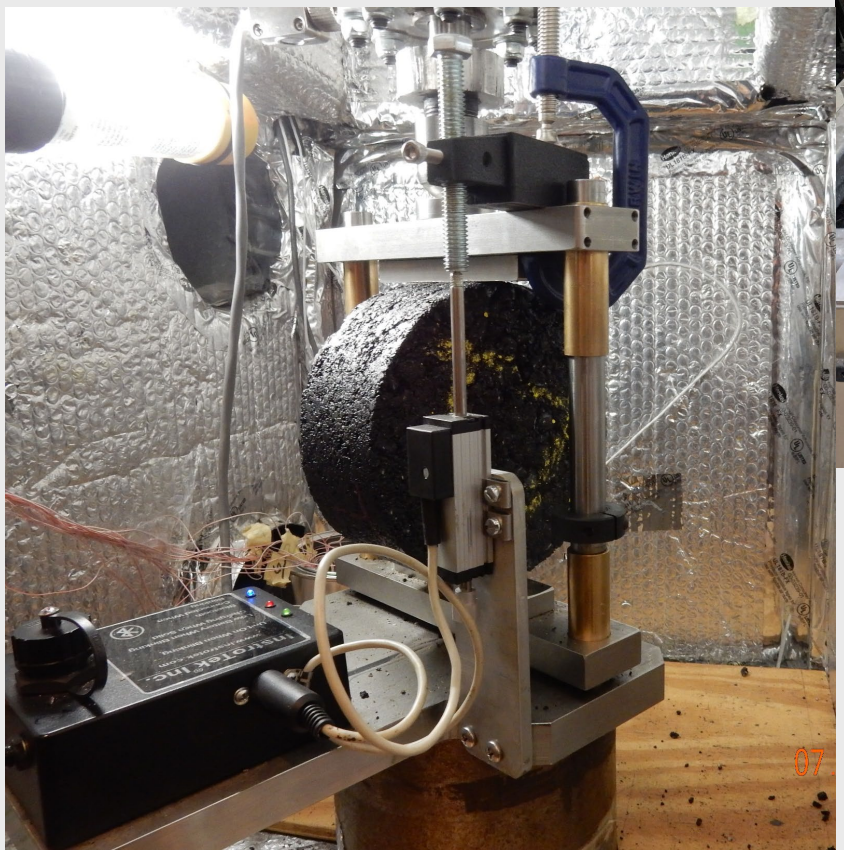
DSR

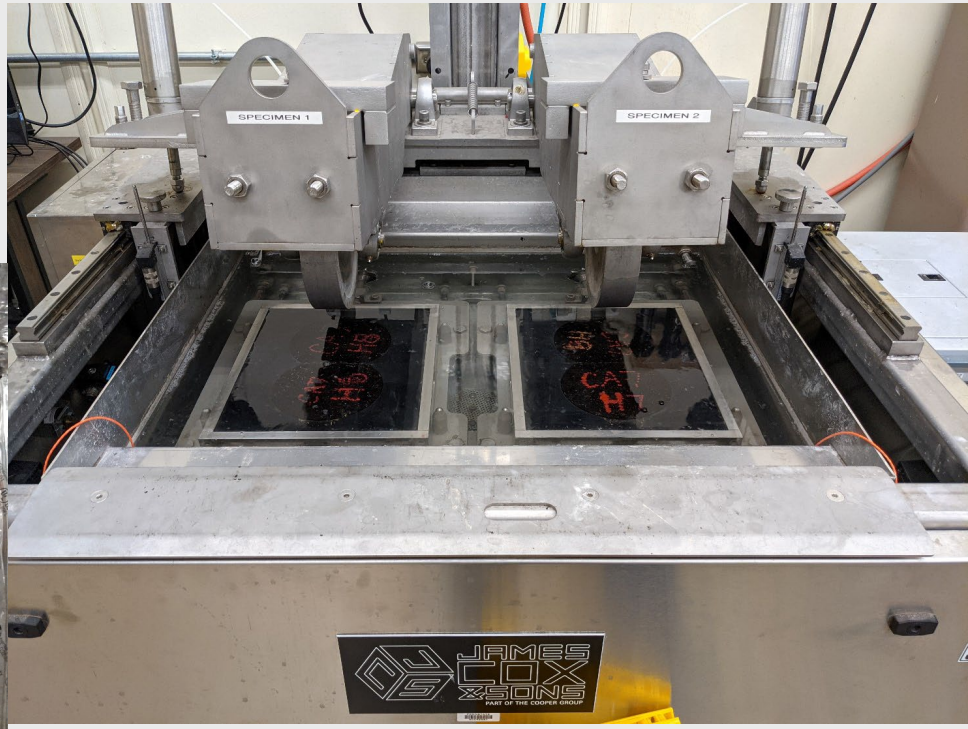


BBR

Mixture Performance Index Tests

HWT



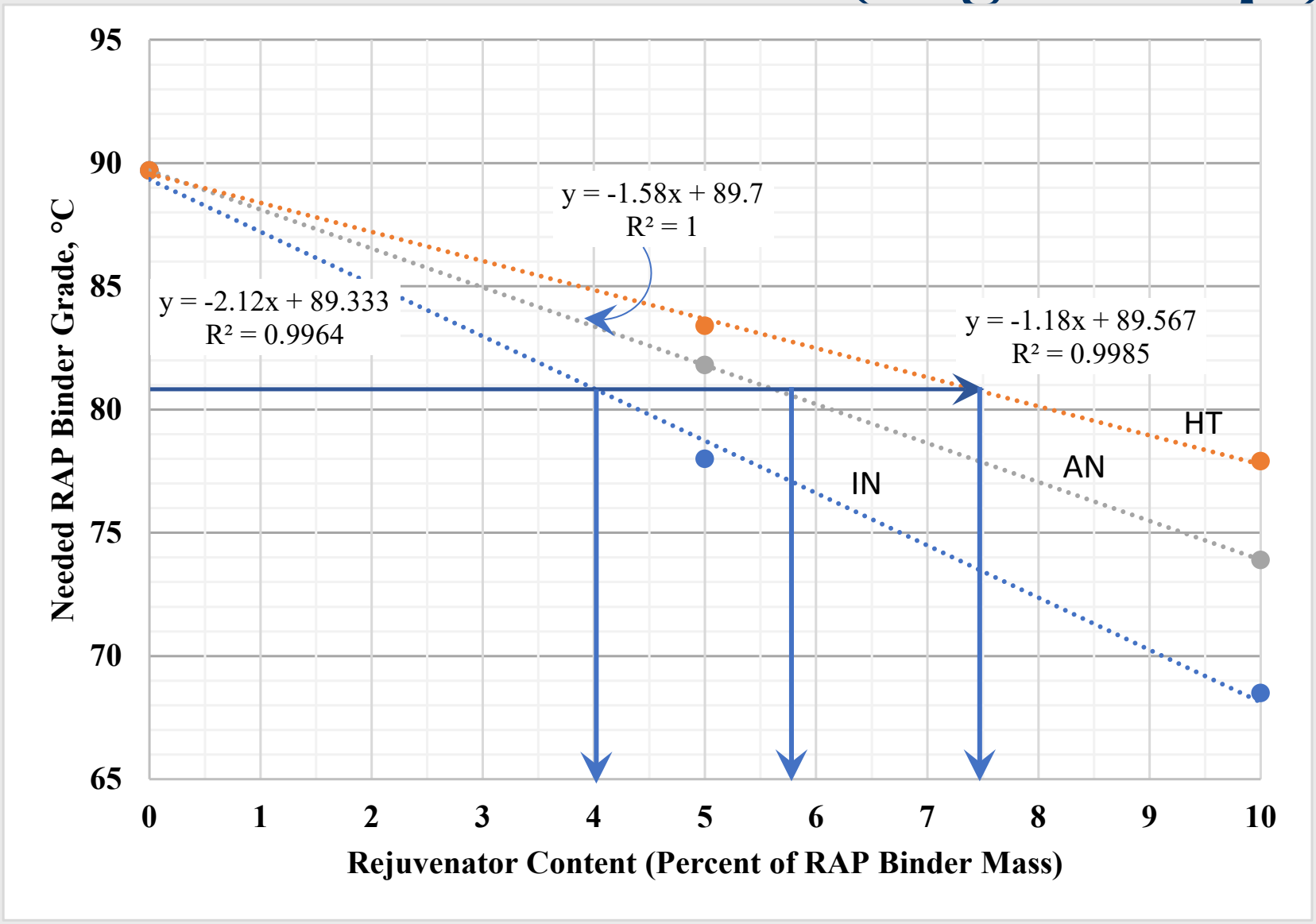


IDEAL-CT

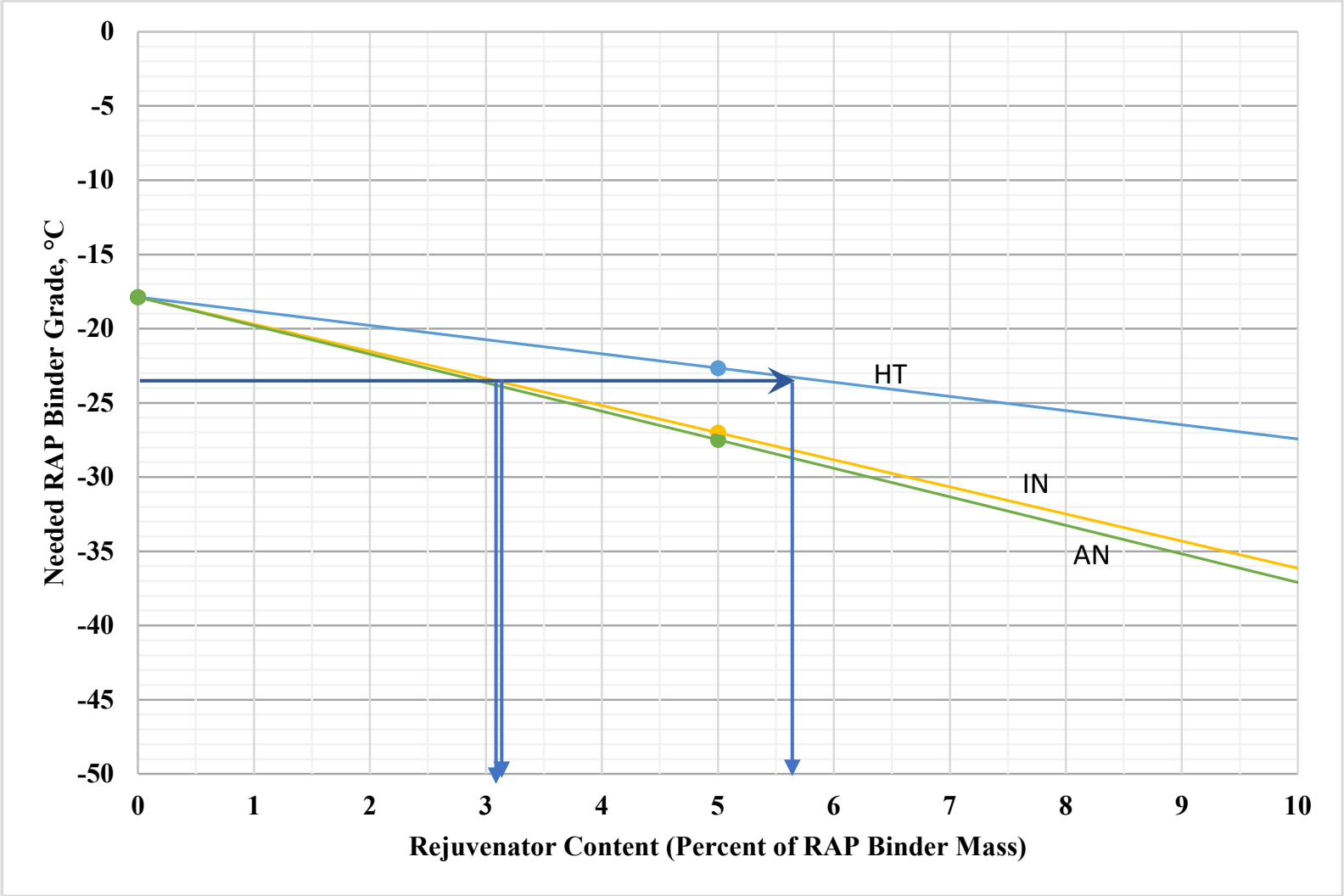
Results & Findings

Testing the Binders

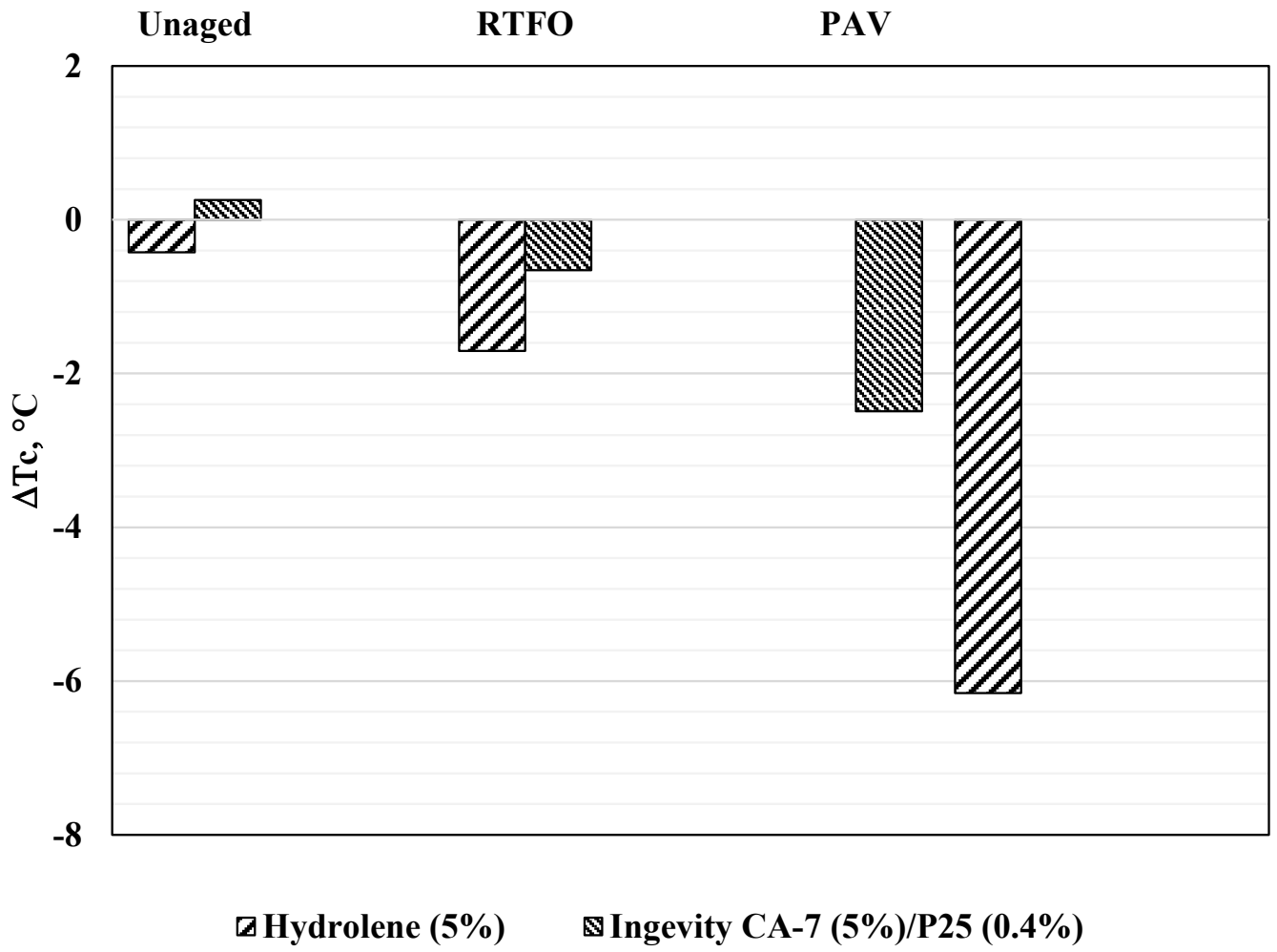
Effect on RAP Binder (High Temp.)



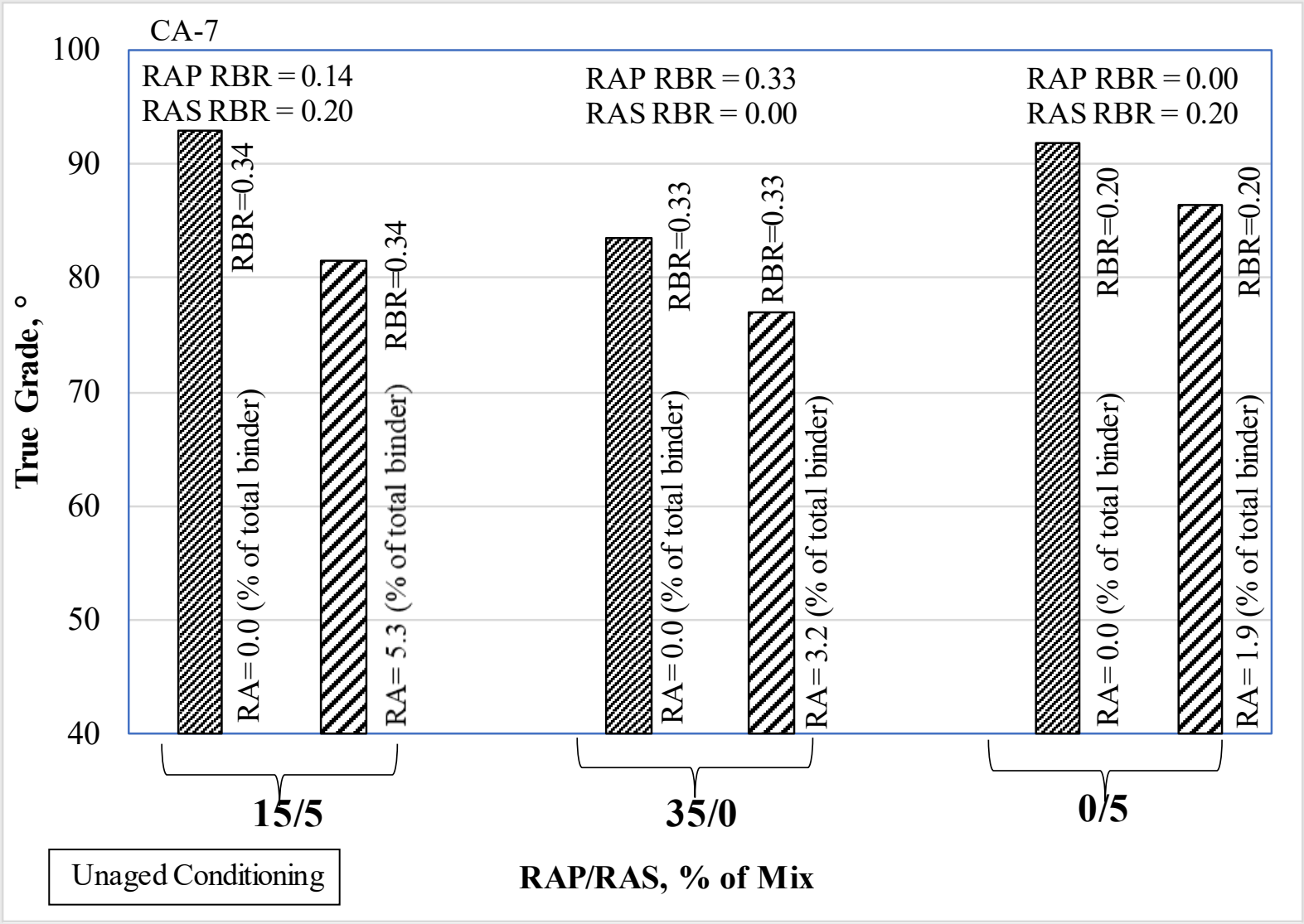
Effect on RAP Binder (Low Temp.)



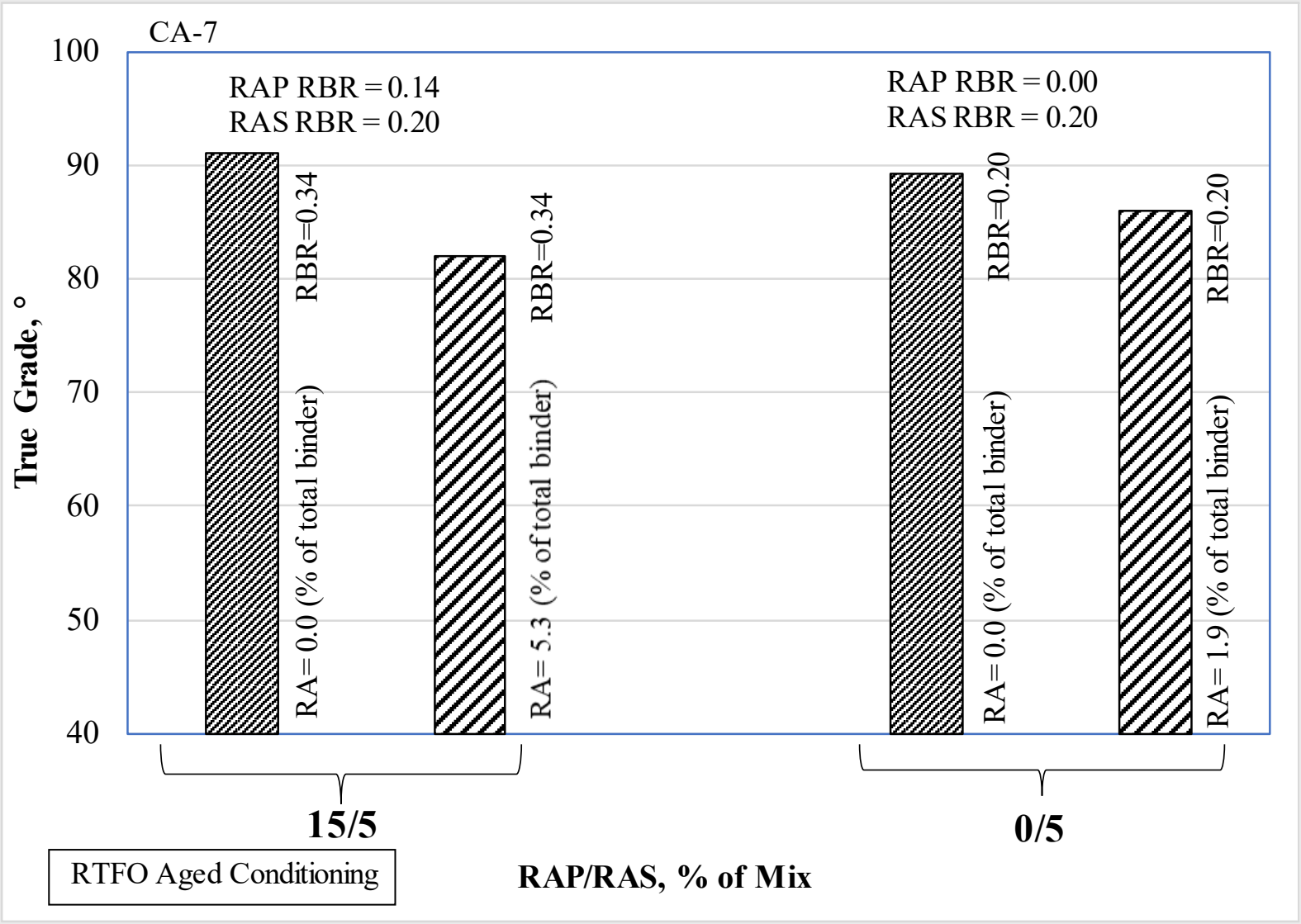
Effect on ΔTc (RAP Binder)



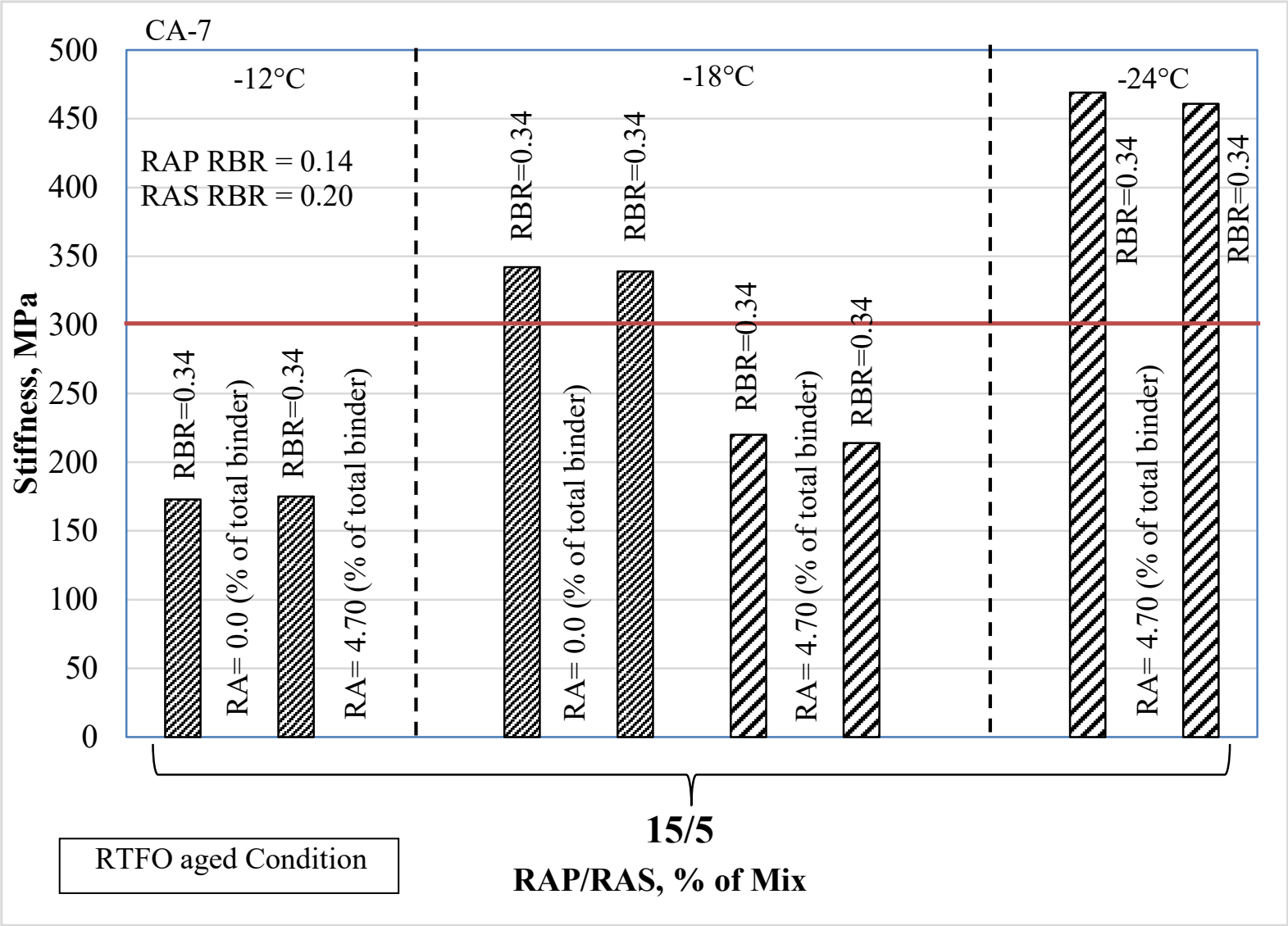
Recovered Binder High Temp. Grade



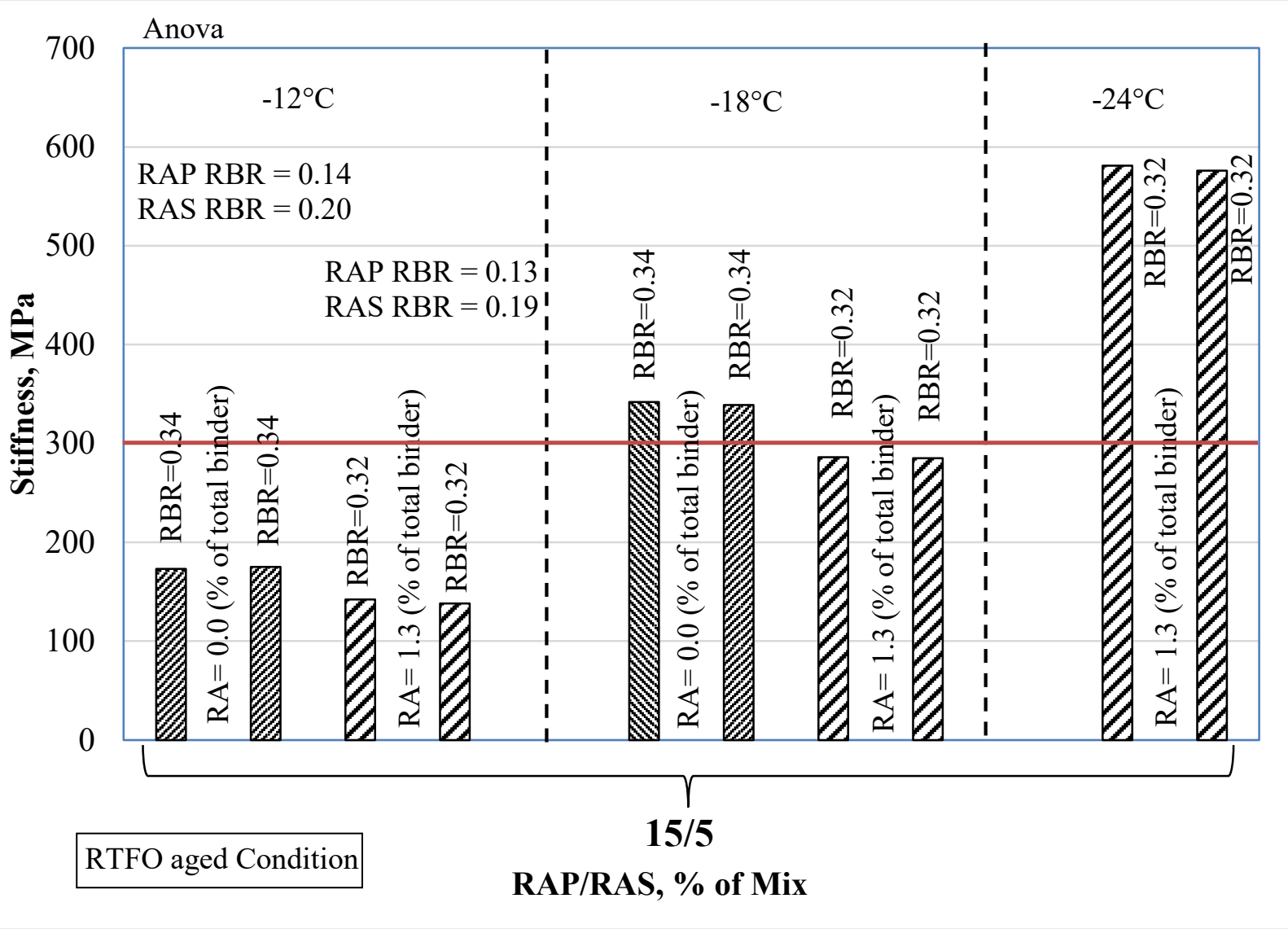
Recovered Binder High Temp. Grade



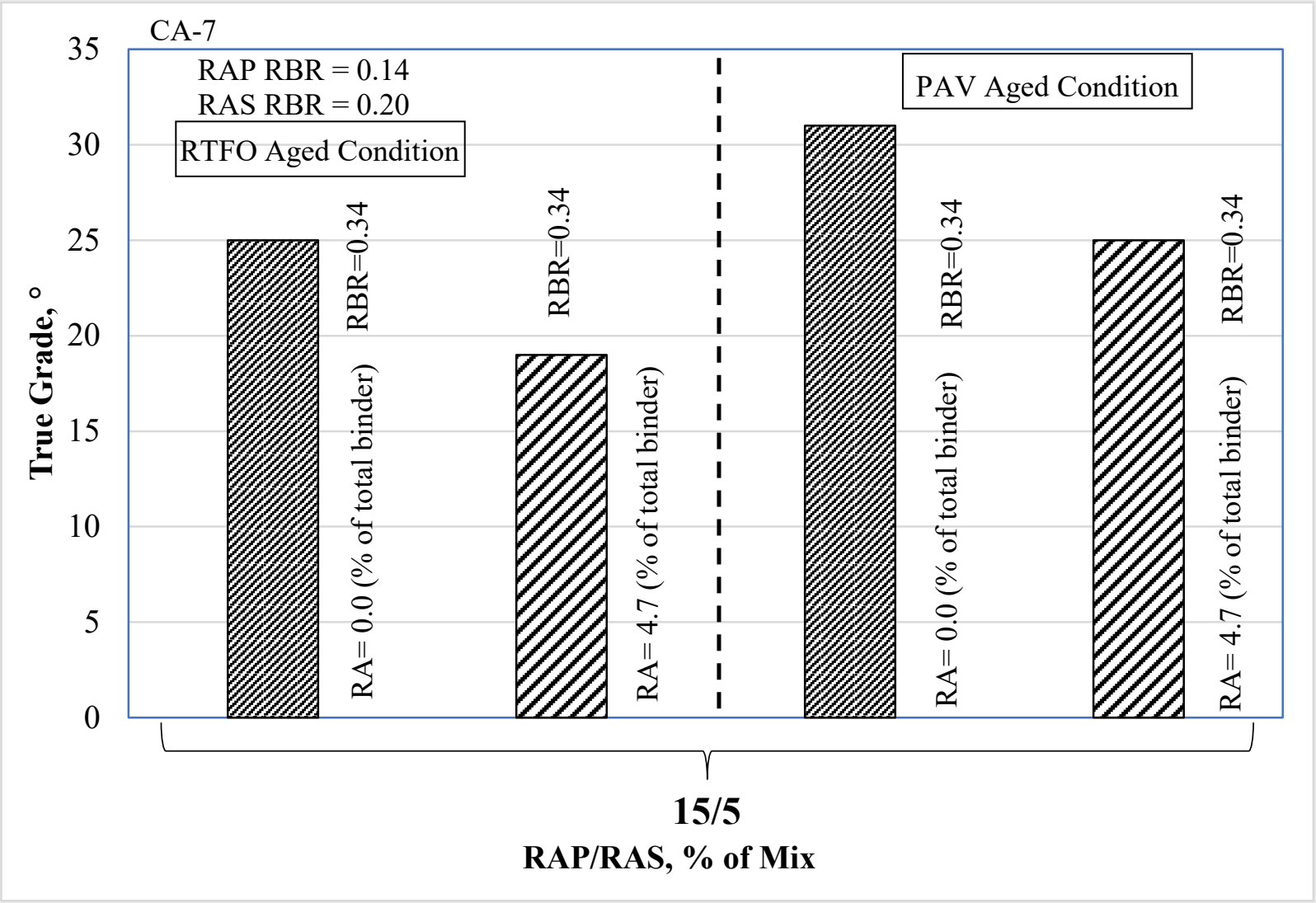
Recovered Binder Low Temp. Stiffness



Recovered Binder Low Temp. Stiffness



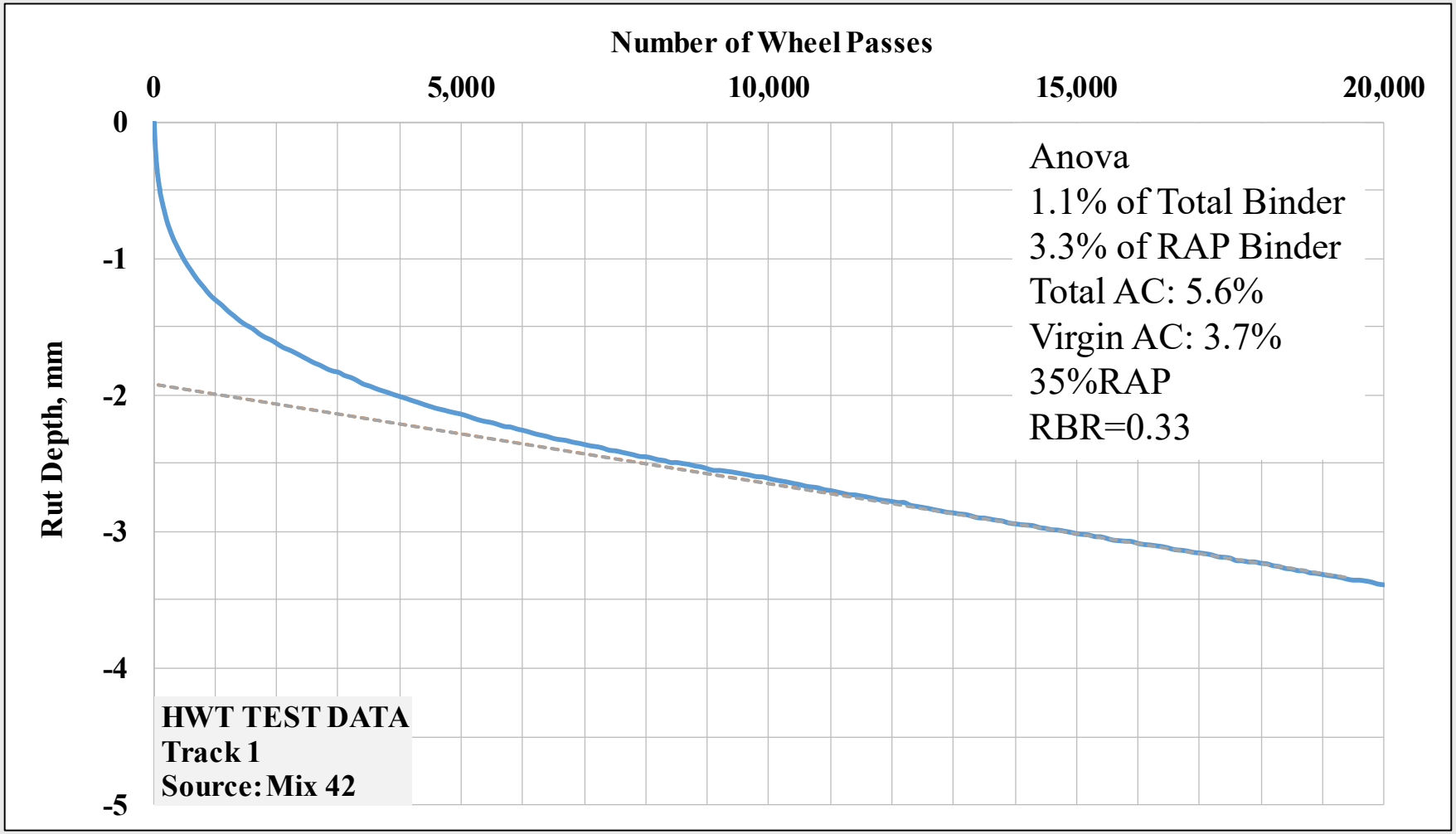
Recovered Binder Interm. Temp. Grade



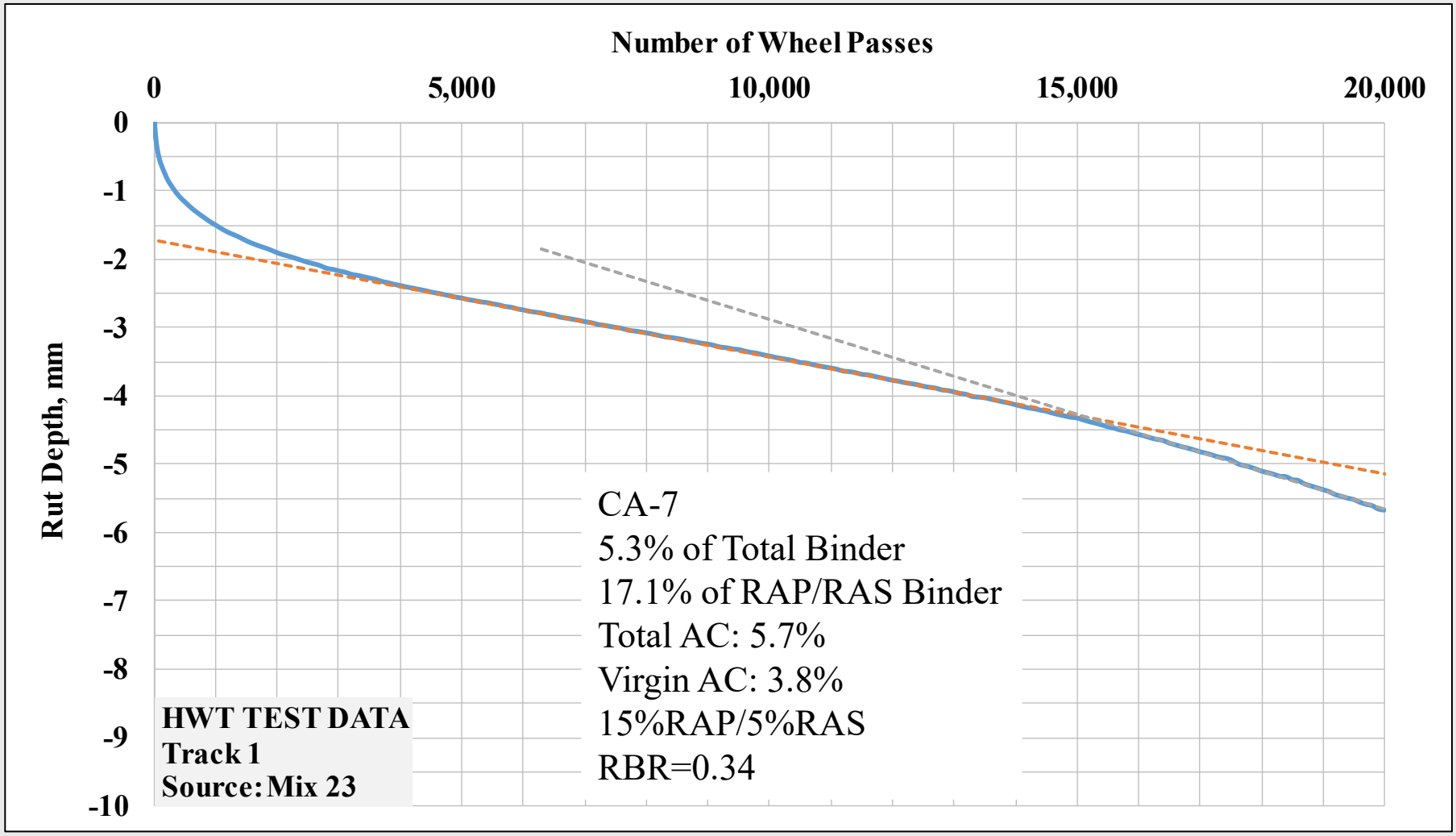
Results & Findings

Testing the Mixtures

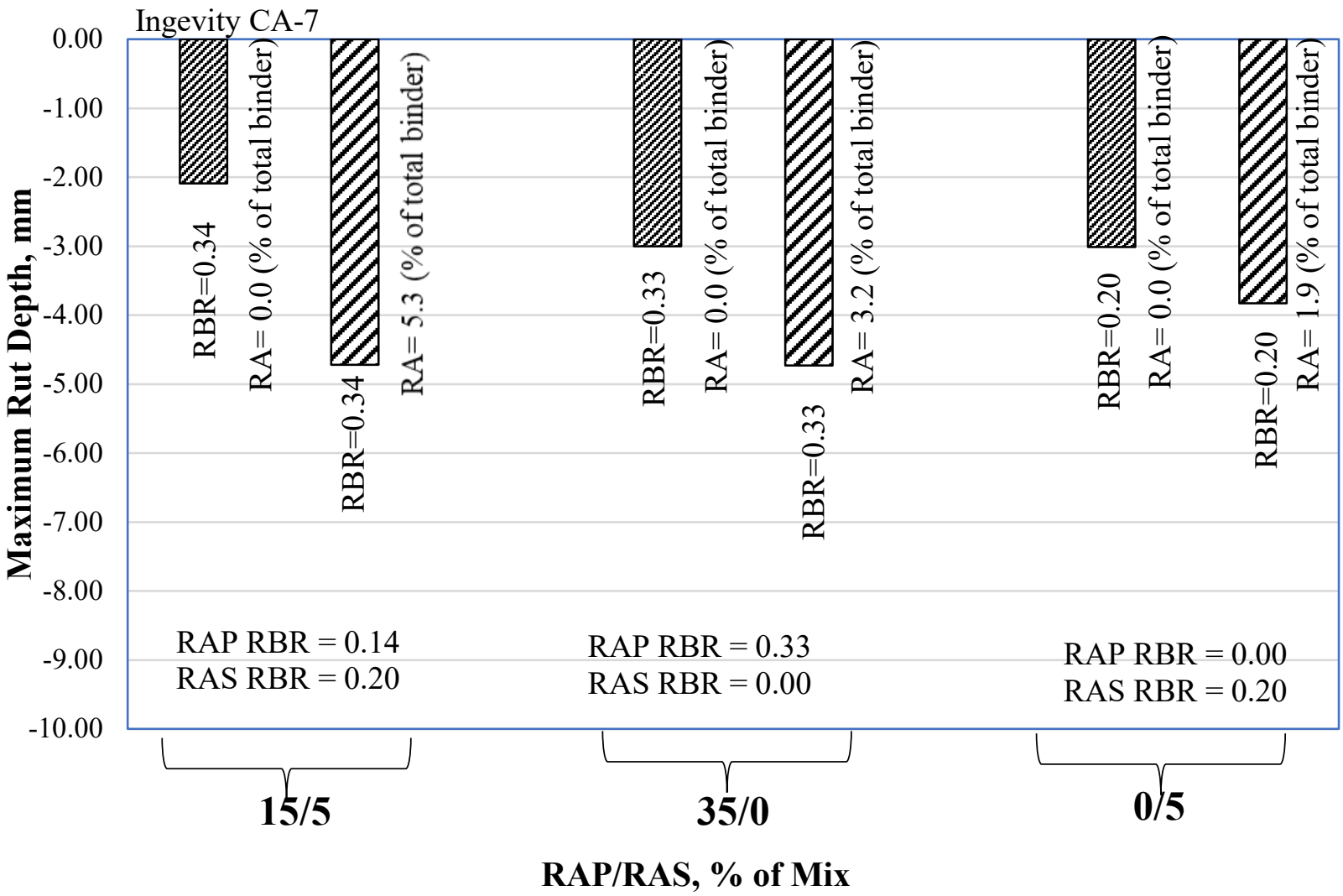
Results from HWT Test



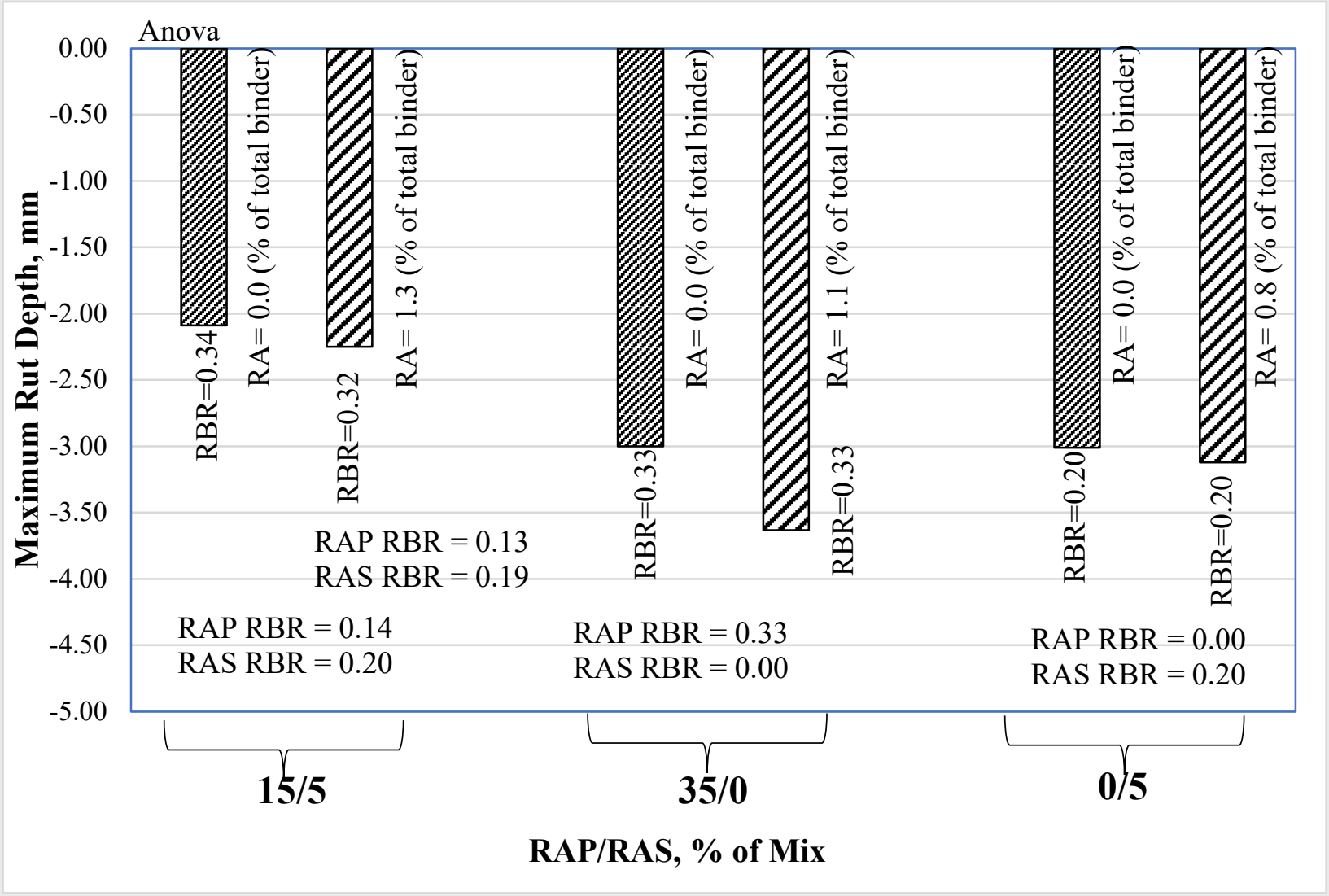
Results from HWT Test



Results from HWT Test



Results from HWT Test



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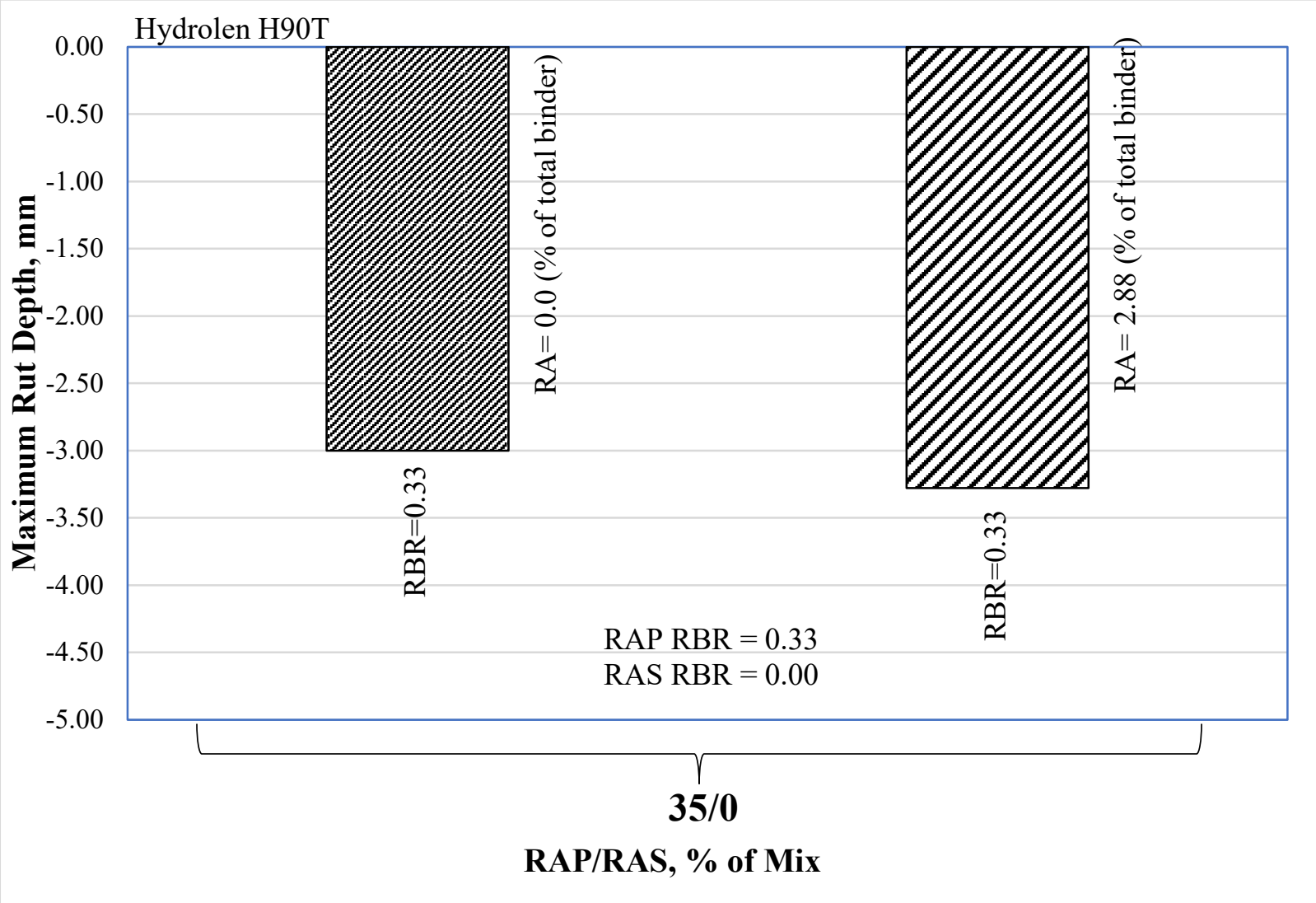
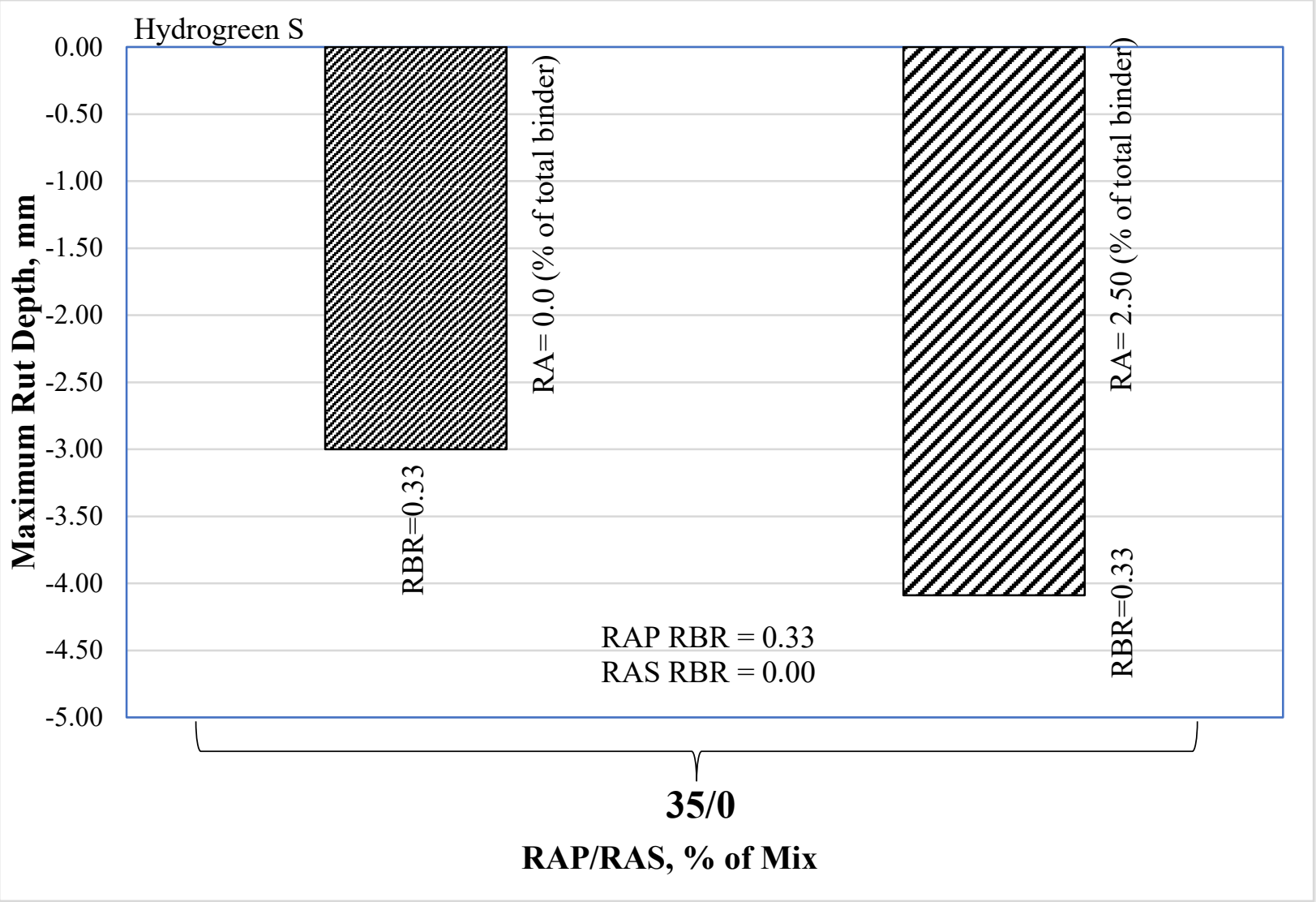
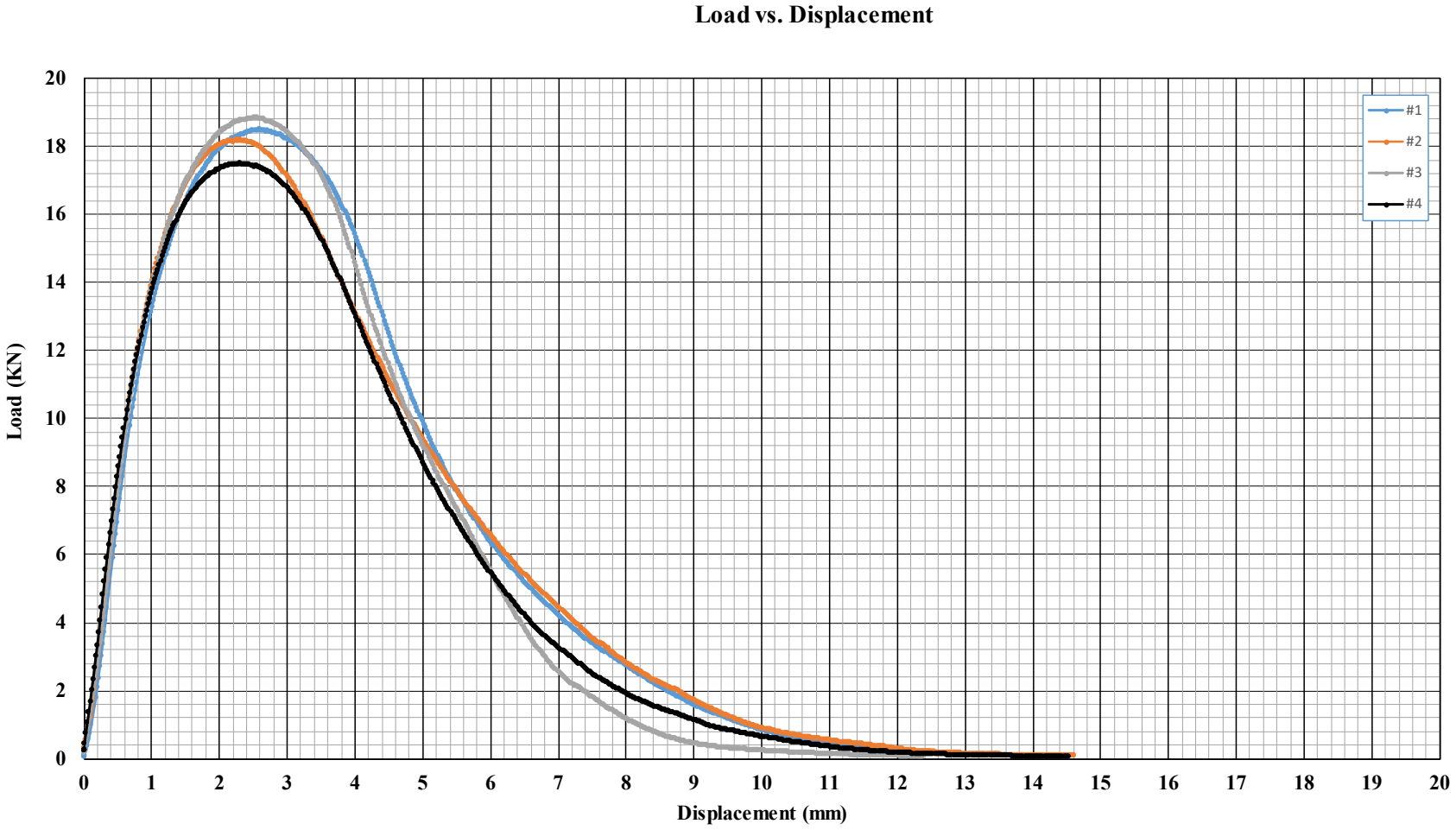


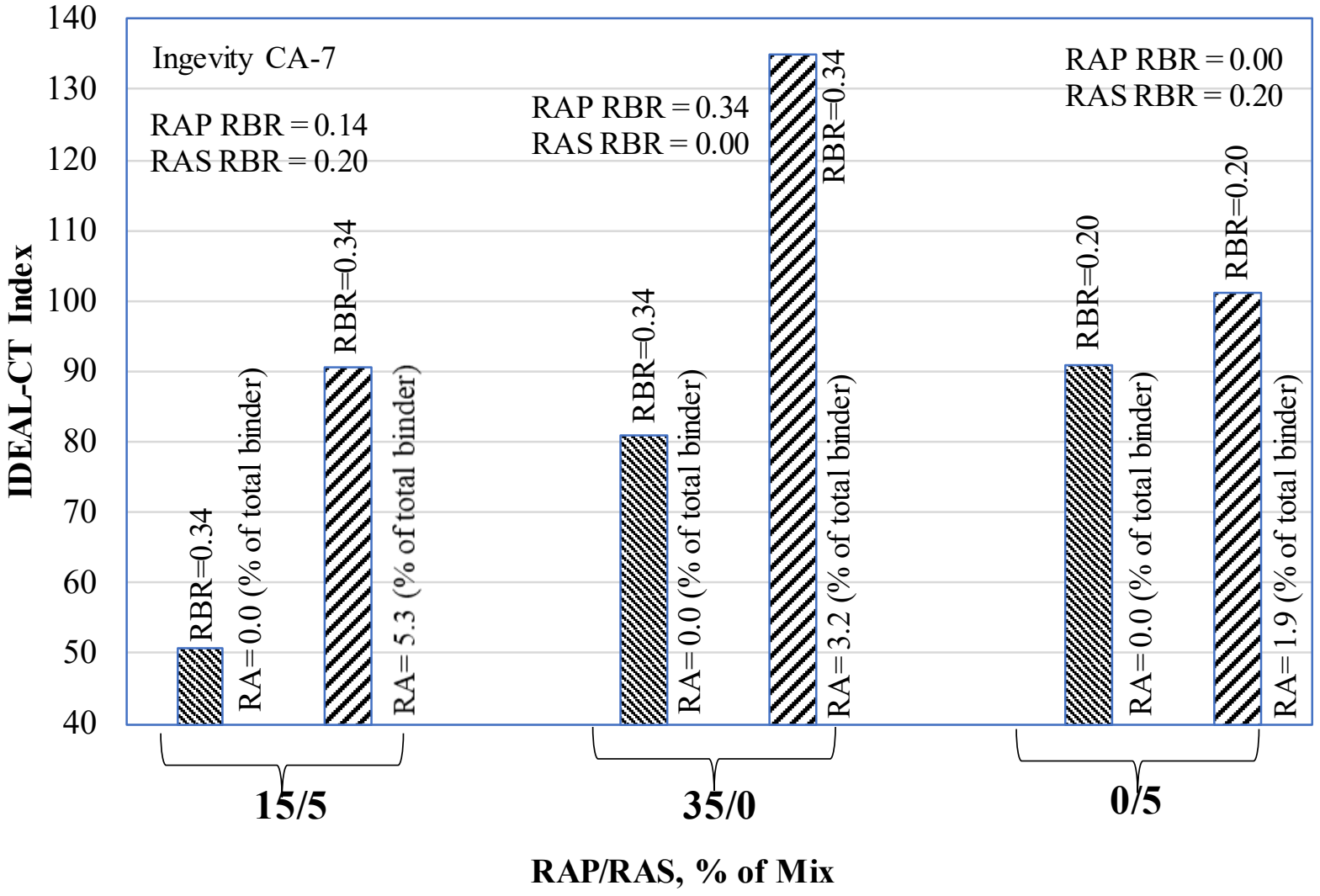
Results from HWT Test



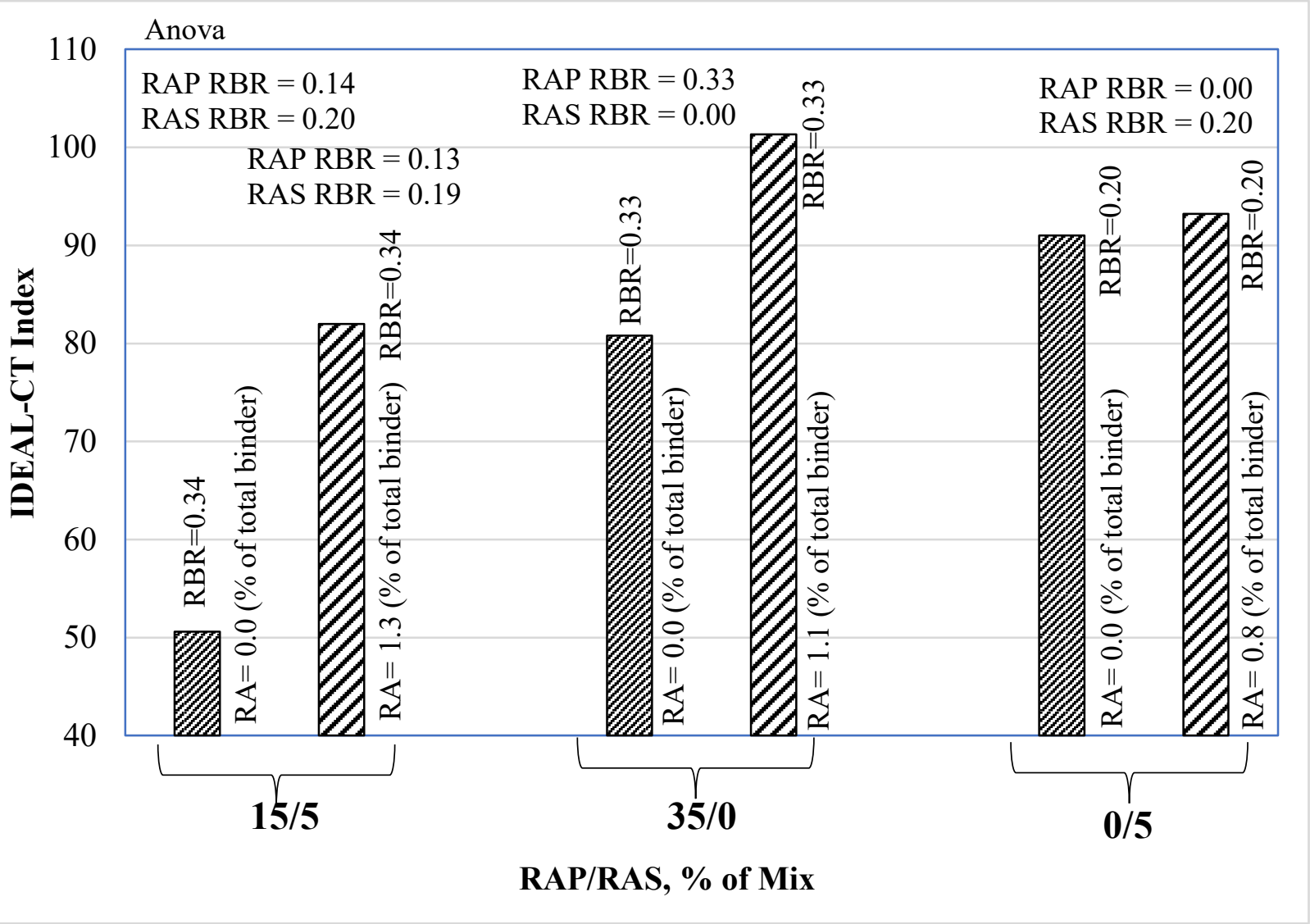
Results from IDEAL-CT Test



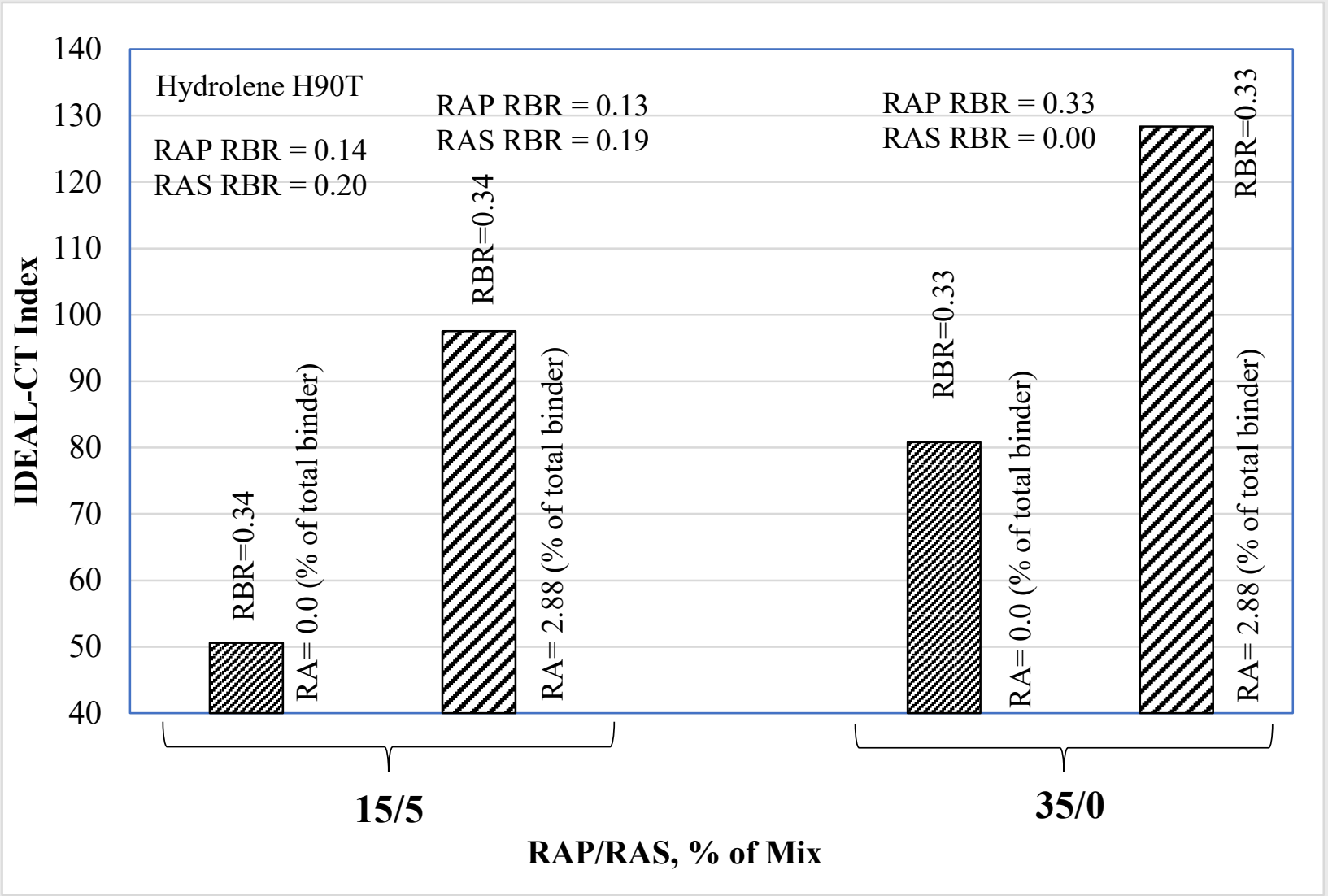
Results from IDEAL-CT Test



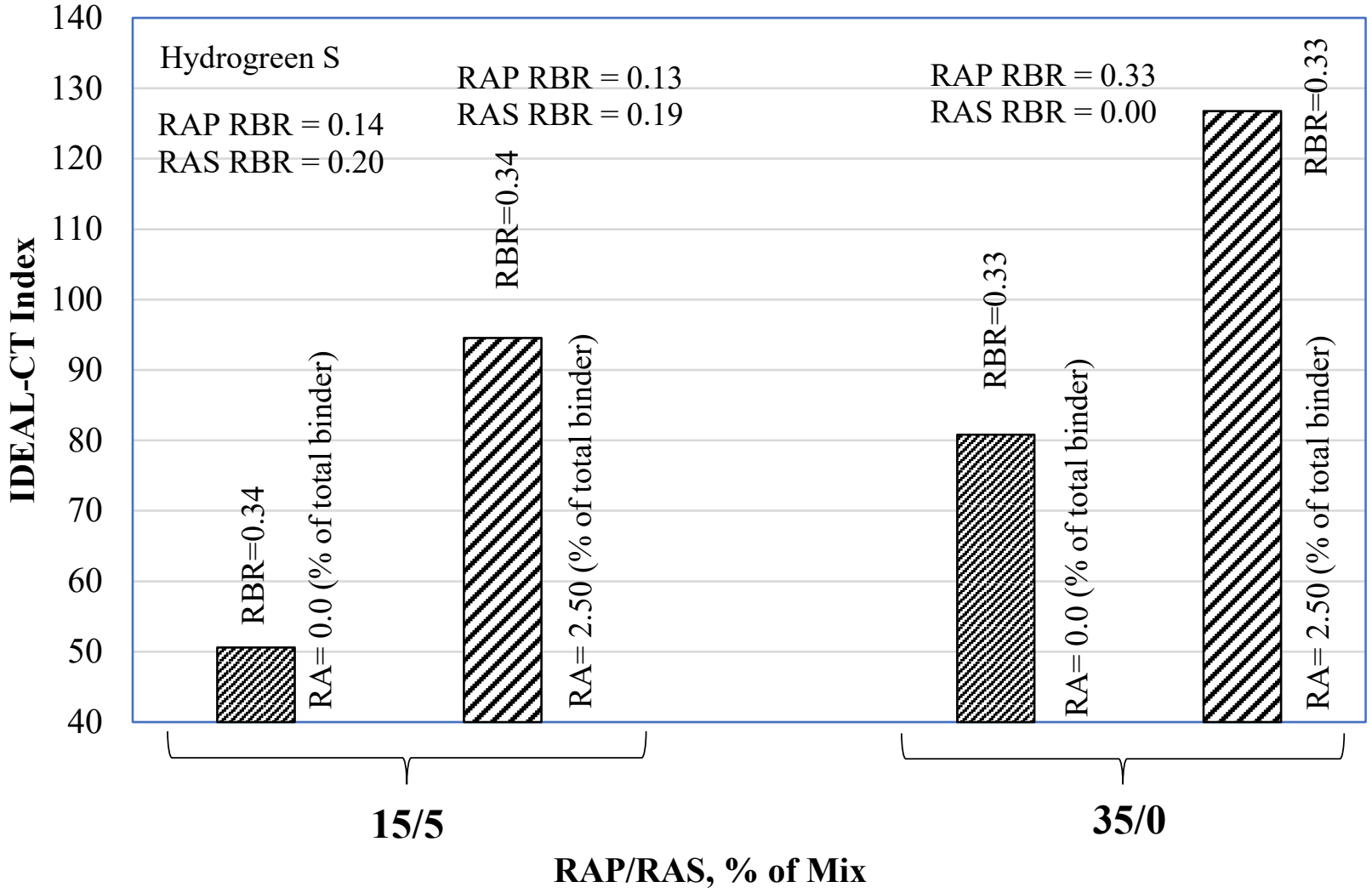
Results from IDEAL-CT Test



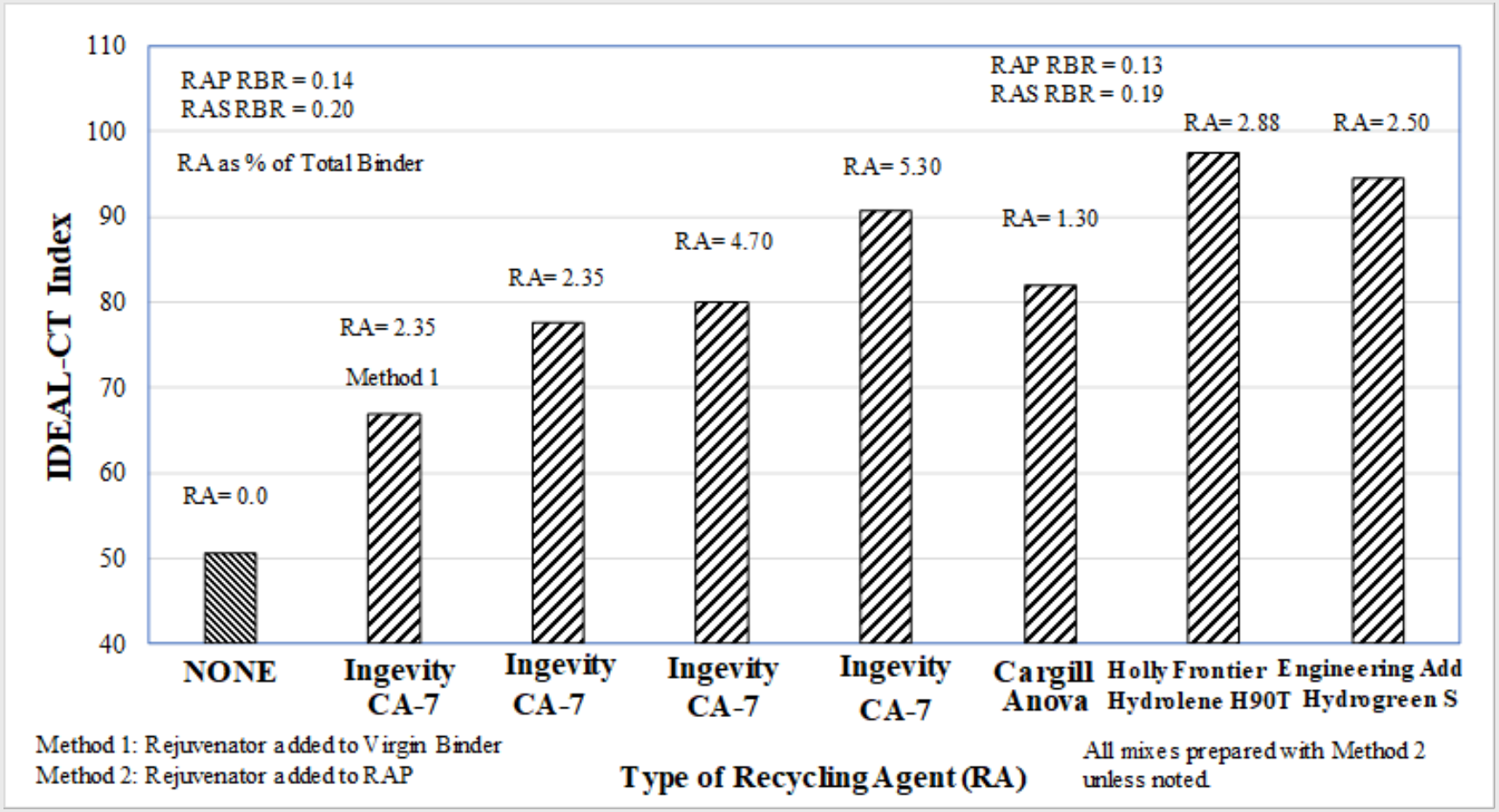
Results from IDEAL-CT Test



Results from IDEAL-CT Test

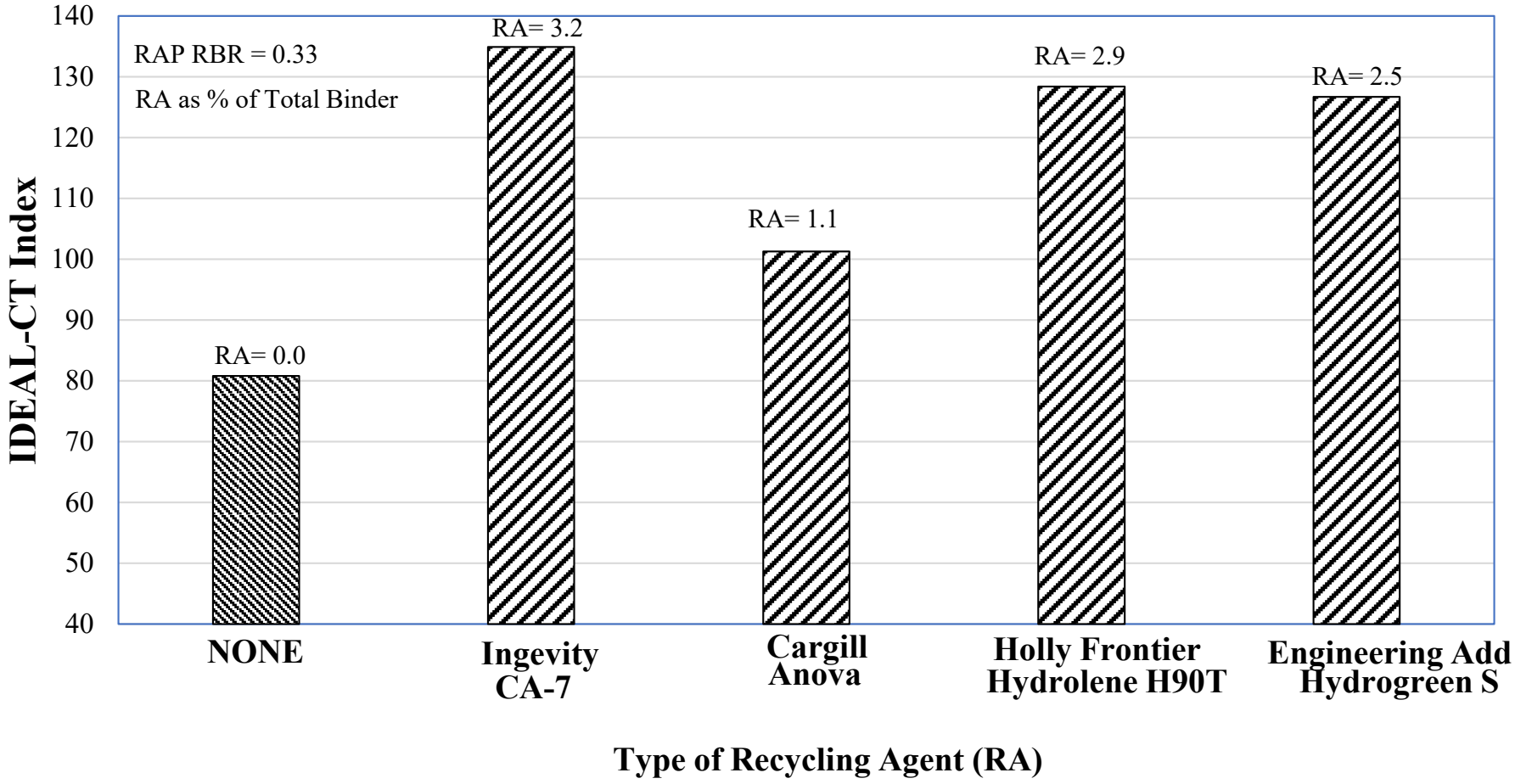


Results from IDEAL-CT Test



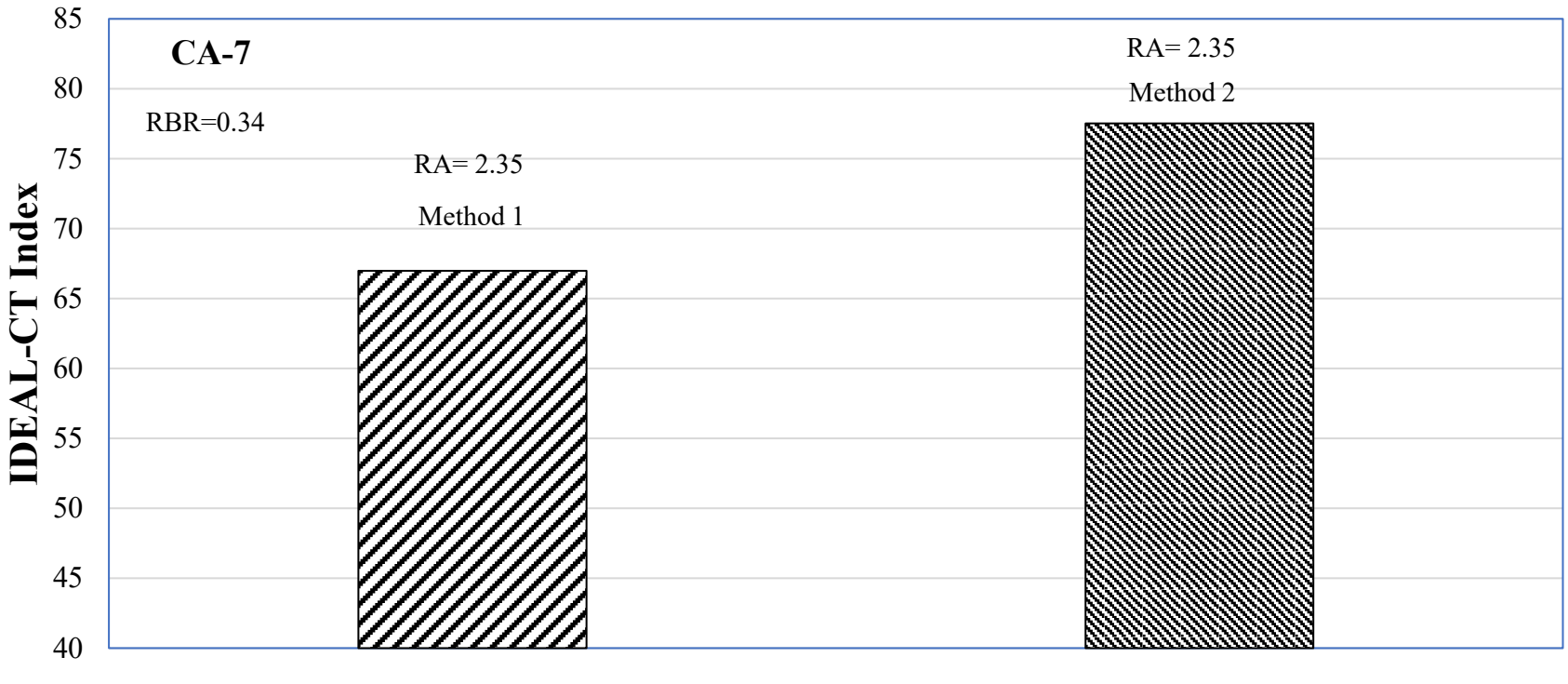
All Mixtures with 15%RAP/5%RAS

Results from IDEAL-CT Test

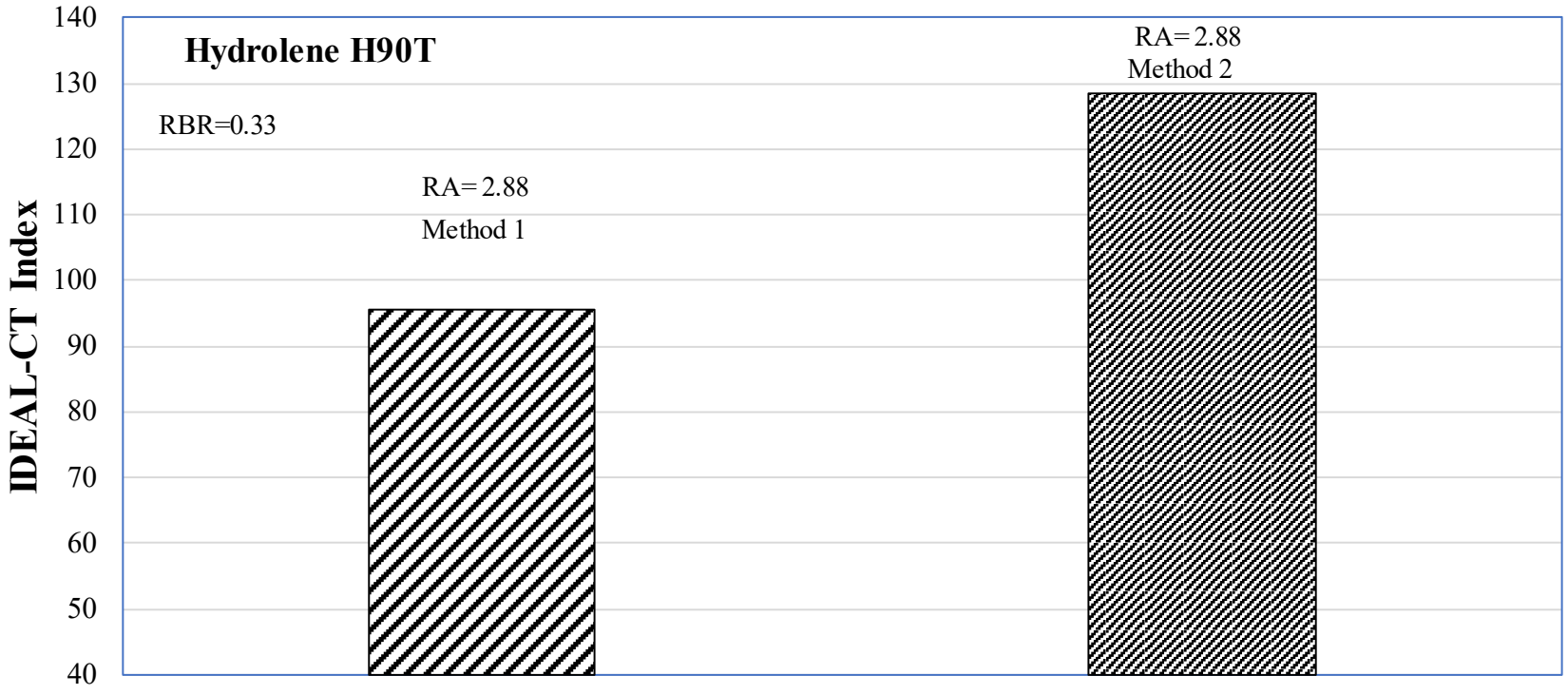


All Mixtures with 35%RAP

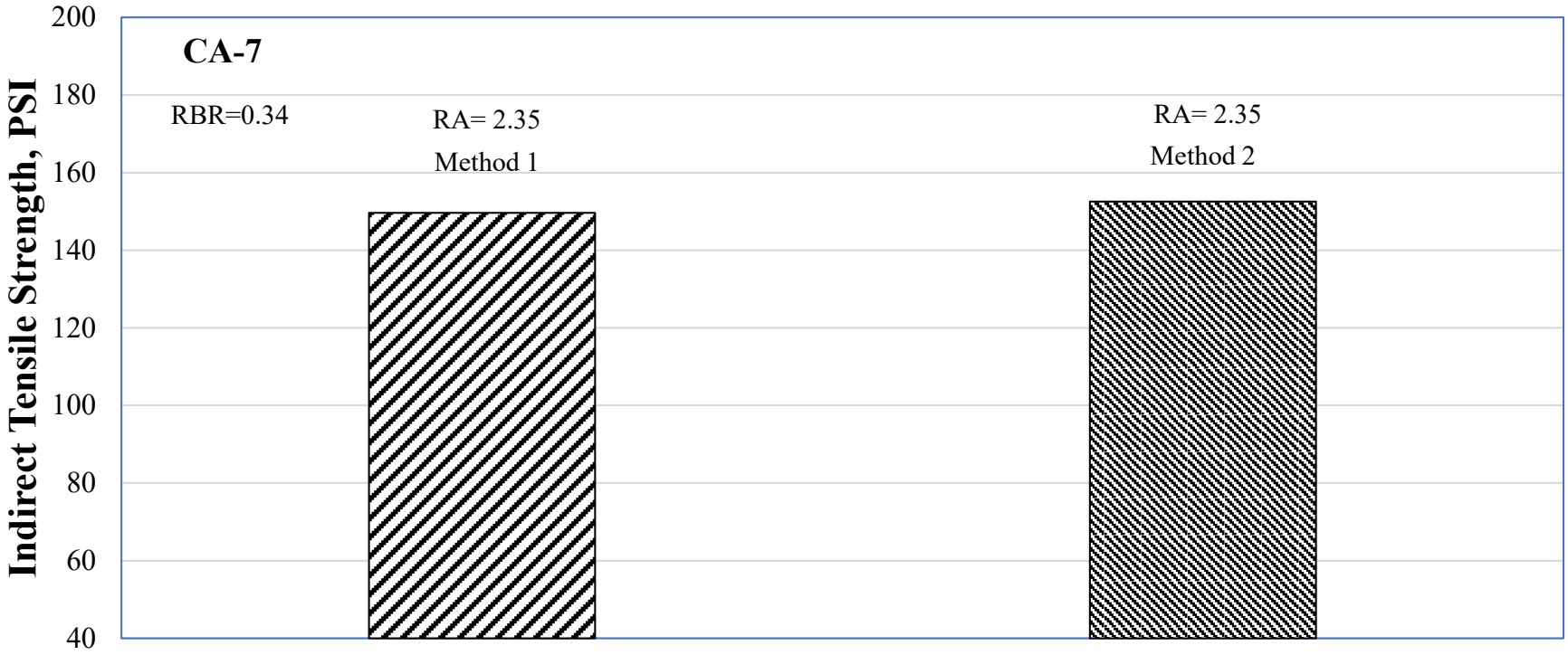
Effect of Blending Technique



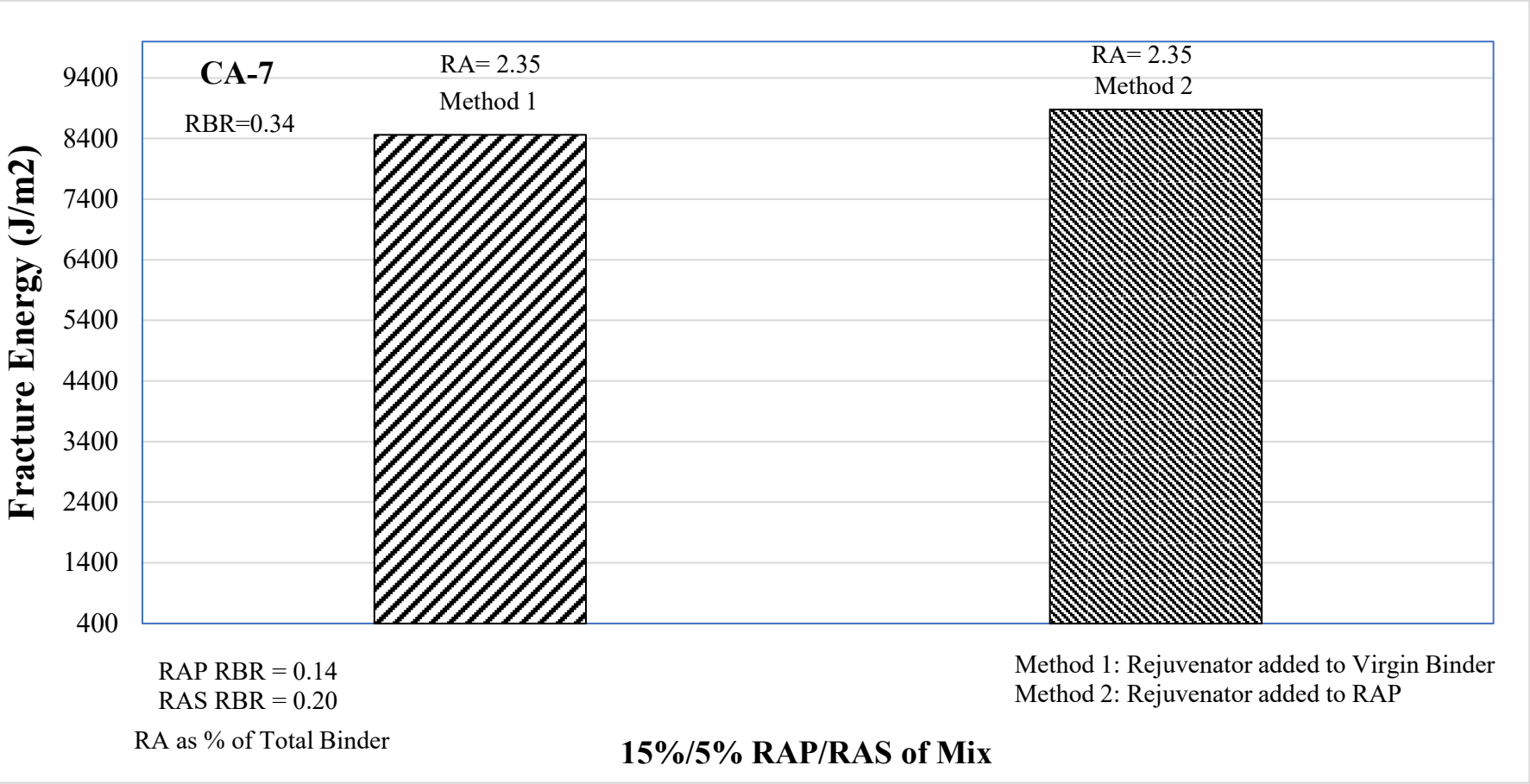
Effect of Blending Technique



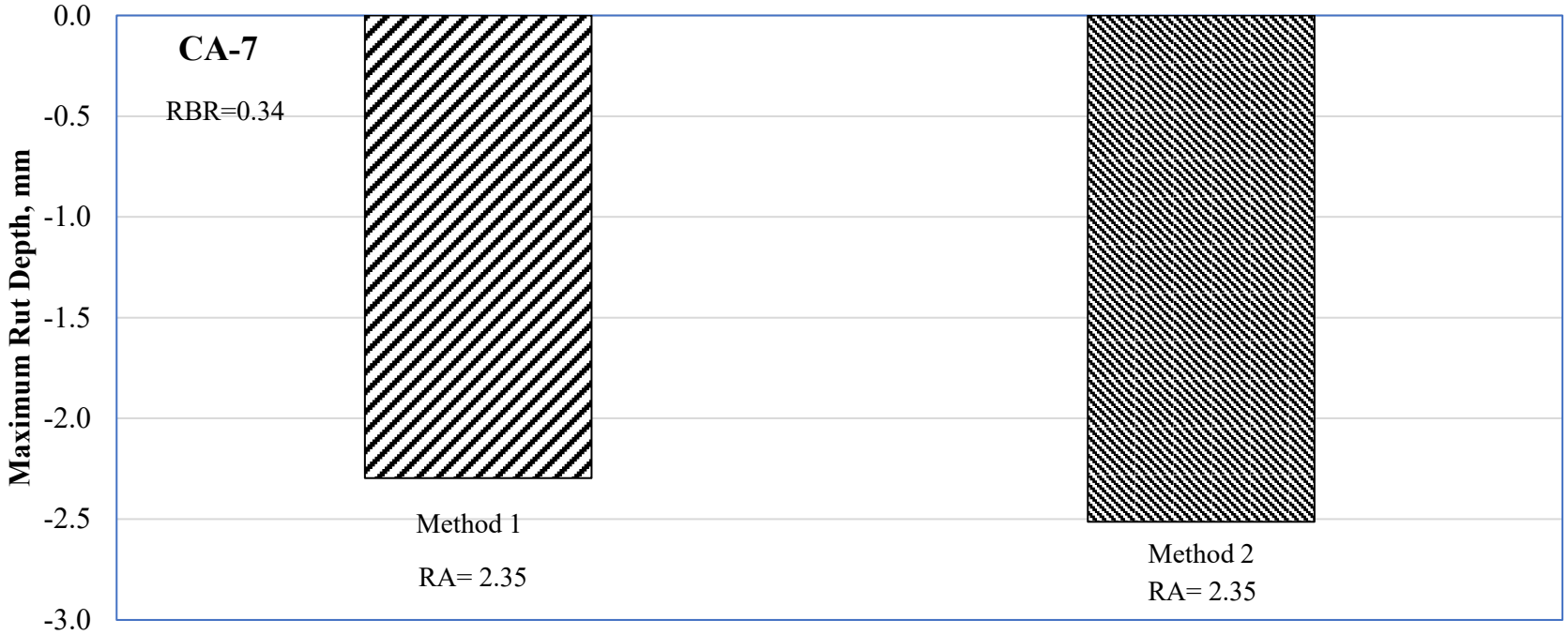
Effect of Blending Technique



Effect of Blending Technique



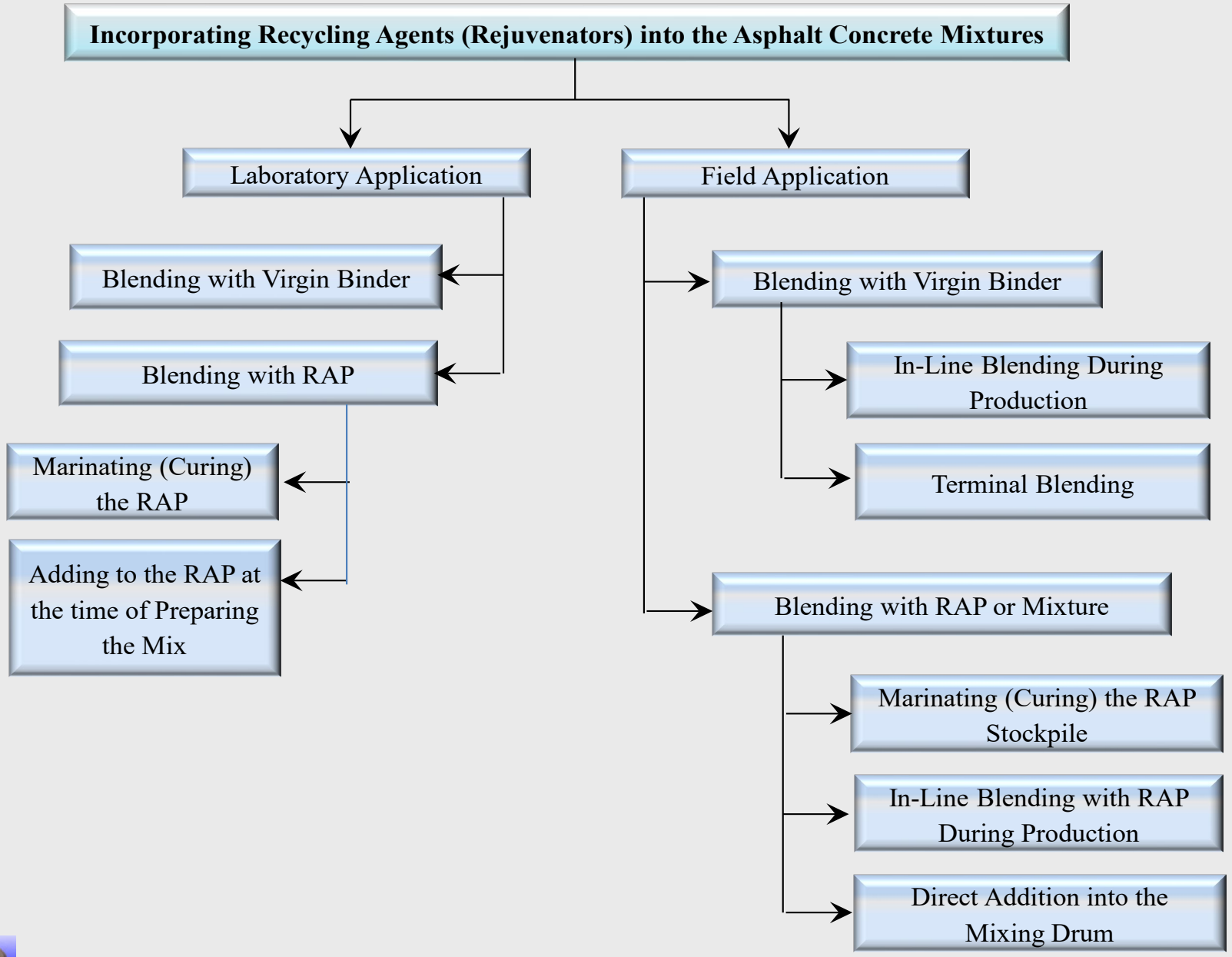
Effect of Blending Technique



4 Usage Guide

- **The Usage Guide Covers the Following:**
  - **Terminology and References**
  - **Types of Rejuvenators**
  - **Blending Techniques**
  - **Dosage Rate Selection**
  - **Evaluation of Long-Term Effectiveness**

Blending Methods



Dosage Rate Selection

- 1. Manufacturer's Recommendation
- 2. Blending Chart
- 3. Performance Testing and BMD

Evaluation of Long-Term Effectiveness

❖ 1. Through Binder Testing

Parameter (measured on PAV aged binder)	Change after incorporation of the rejuvenator at the recommended dosage rate
G*.sinδ at intermediate test temperature	Decrease of at least 25% in G*.sinδ
Stiffness (S) at low temperature	<300 MPa, and decrease of at least 25% in S
Relaxation parameter (m-value) at low temperature	Increase of at least 25% in m
ΔTc at low temperature	>-5°C, and increase of at least 25% in ΔTc

❖ 2. Through Mixture Testing

Parameter (measured on long term aged mixture)*	Change after incorporation of the rejuvenator at the recommended dosage rate
IDEAL-CT Index	Increase of at least 30% in the calculated index compared to the mix with no rejuvenator

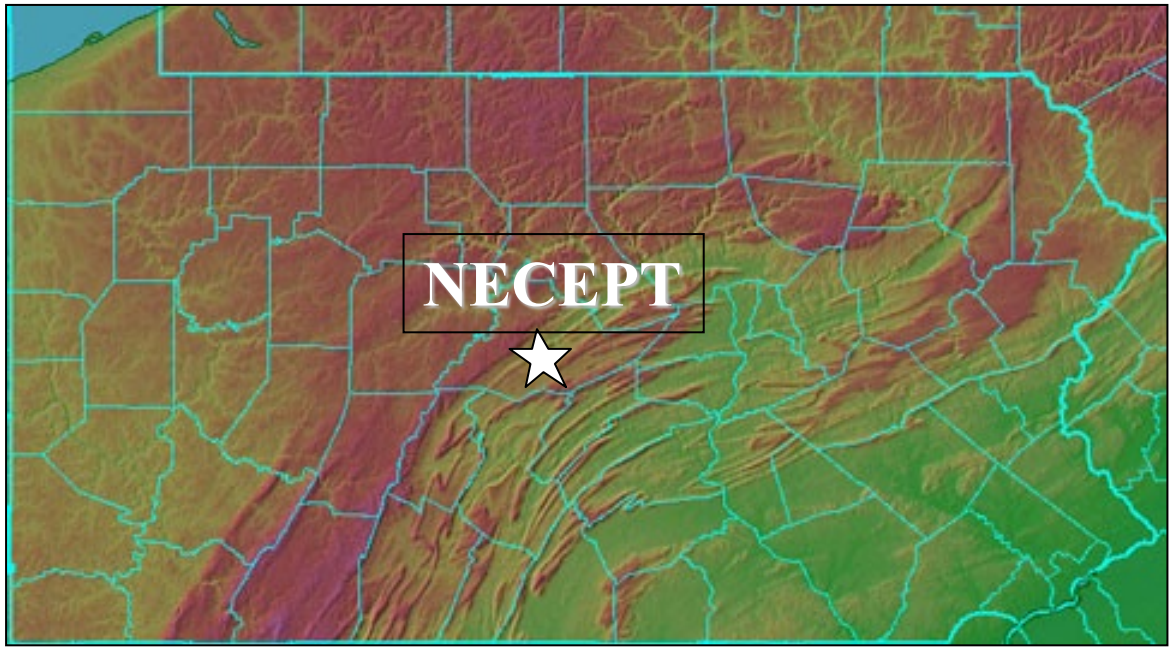
**** Long-term aging achieved through conditioning loose mixture through the NCAT protocol***

Summary and Conclusions

- Five RAs used in binder evaluations (one petroleum based)
- Four RAs used in mixture evaluation (one petroleum based)
- Binder evaluation through rheological tests
- Mixture evaluation through performance index tests
- RA Dosage Rates very in a wide range depending on RA type
- RAs proved to be effective both short term and long term
- Different methods were reviewed for determination of the RA dosage rate
- Different techniques were proposed for evaluating long-term effectiveness


Thank You!

Balanced Mix Design for Asphalt Concrete



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Asphalt Concrete Balanced Mix Design

We will discuss:

- Concept of BMD
- Levels of BMD Design
- BMD Specifications
- Performance Tests
- PennDOT BMD
- MD State Highway Agency BMD

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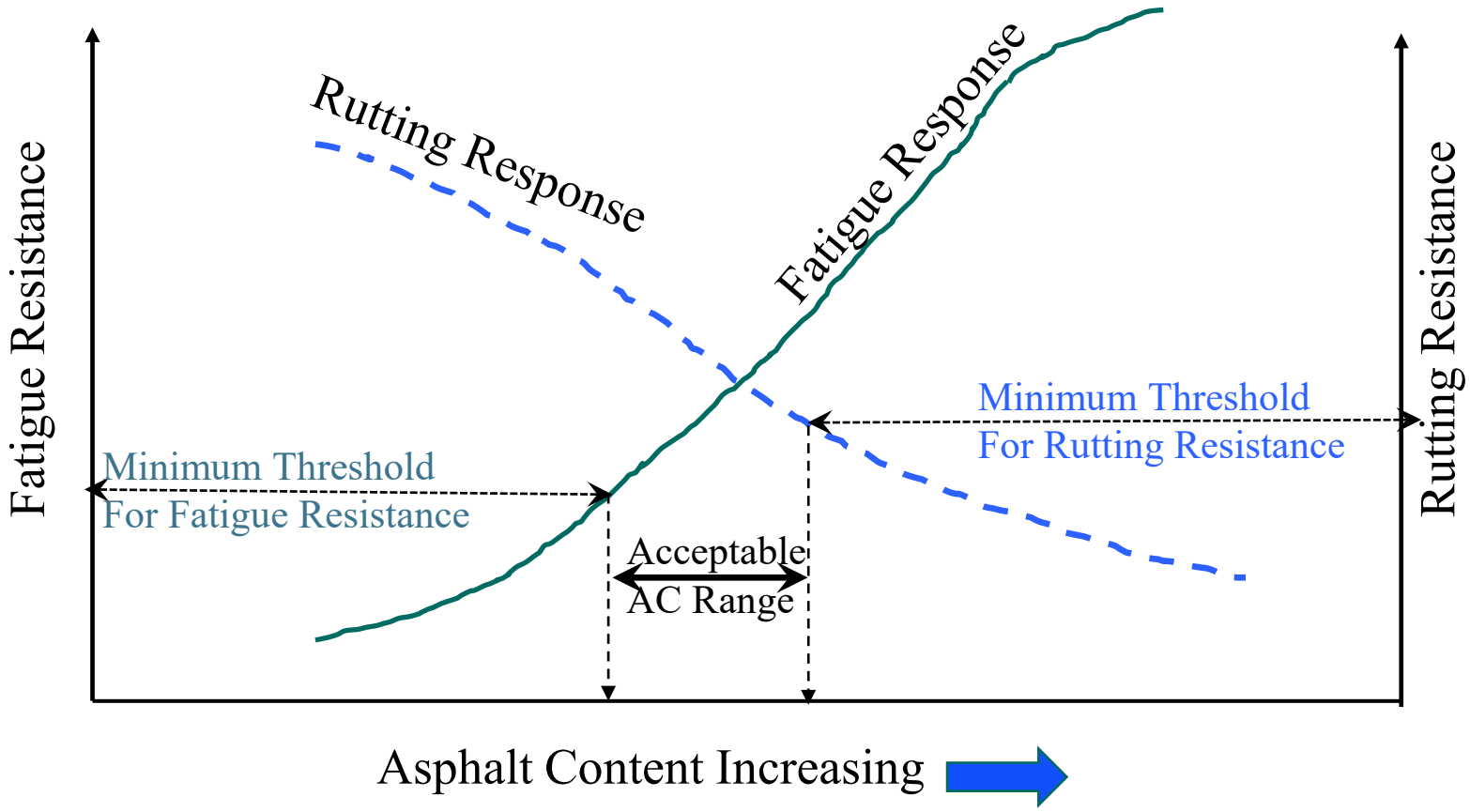
Balanced Mix Design



AASHTO Standards for Balanced Mix Design

- **Designation PP 105-20 (2022):**

  Standard Practice for Balanced Mix Design

- **Designation MP 46-22:**

  Standard Specification for Balanced Mix Design

Standard Practice for Balanced Mix Design

- **AASHTO Designation PP 105-20**
  - **Balanced Mix Design Approaches (Levels of Design):**
    - **A - Volumetric Design with Performance Verification**
    - **B – Volumetric Design with Performance Optimization**
    - **C – Performance-Modified Volumetric Mix Design**
    - **D – Performance Design**

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Standard Practice for Balanced Mix Design

- **AASHTO Designation PP 105-20**
  - **Approach A (Volumetric Design with Performance Verification)**

1 – Start with volumetric design and find optimum AC.

2 – Check the designed mix with performance tests.

3 – If not acceptable repeat with changes in materials, mix proportions.

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Standard Practice for Balanced Mix Design

- **AASHTO Designation PP 105-20**
  - **Approach B (Volumetric Design with Performance Optimization)**

1 – Start with volumetric design and find initial optimum AC.

2 – Do performance tests at optimum and two or more AC.

3 – Determine the final optimum AC satisfying all criteria.

4 – If none found, repeat with changes in materials, mix proportions.

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Standard Practice for Balanced Mix Design

- **AASHTO Designation PP 105-20**
  - **Approach C (Performance Modified Volumetric Mix Design)**

1 – Start with volumetric design and find optimum AC.

2 – Do performance tests at optimum.

3 – Use performance test data to adjust the mix components and proportions until performance criteria are satisfied.

4 – Note that final design may not satisfy all volumetric criteria.

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Standard Practice for Balanced Mix Design

- **AASHTO Designation PP 105-20**
  - **Approach D (Performance Design)**

1 – Establish initial requirements on asphalt and aggregate (satisfy material specifications)

2 - Prepare the mixes at different AC's and conduct performance tests (No initial volumetric design is needed.)

3 – Choose the mix that satisfies all performance criteria.

Standard Specification for Balanced Mix Design

- **AASHTO Designation MP 46-22**
  - **Rutting Tests**
  - **Cracking Tests**
  - **Moisture Damage Tests**

Standard Specification for Balanced Mix Design

- **AASHTO Designation MP 46-22**
  - **Rutting Tests**
    - **Asphalt Pavement Analyzer (T 340)**
    - **Flow Number Test (T 378)**
    - **Hamburg Wheel Tracking Test (T 324)**
    - **Hveem Stability Test (T 246)**
    - **Superpave Shear Tester (T 320)**

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Standard Specification for Balanced Mix Design

- **AASHTO Designation MP 46-22**
  - **Cracking Tests**
    - **BBR Mixture Bending Test (TP 125)**
    - **Direct Tension Cyclic Fatigue Test (T 400)**
    - **Disc-Shaped Compact Tension Test (ASTM D7313)**
    - **Flexural Bending Beam Fatigue Test (T 321)**
    - **IDEAL Cracking Test (ASTM D8225)**
    - **Indirect Tensile Creep Compliance and Strength Test (T 322)**
    - **Energy Ratio Test (Univ. of Florida)**

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Standard Specification for Balanced Mix Design

- **AASHTO Designation MP 46-22**
  - **Cracking Tests (Continued)**
    - **Overlay Test (Tex-248-F and NJDOT B-10)**
    - **Semi-Circular Bend Test at Low Temperature (T 394)**
    - **Abrasion Loss of Asphalt Mixture Specimens (T 401)**
    - **Small Specimen Geometry Cyclic Fatigue Test (TP 133)**
    - **N_{flex} Factor Test (TP 141)**

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Standard Specification for Balanced Mix Design

- **AASHTO Designation MP 46-22**
  - **Moisture Damage Tests**
    - **Hamburg Wheel Tracking Test**
    - **Tensile Strength Ratio (TSR) (T 283)**
    - **Moisture Induced Stress Tester (ASTM D7870/D7870)**

Standard Specification for Balanced Mix Design

- **AASHTO Designation MP 46-22**
  - **Pass/Fail Criteria for Each Test?**

Criteria have been established for some tests but for many tests, they remain to be established pending further investigation.

Overview of Various Tests Used in BMD

Asphalt Mixture Performance Tests (AMPT)

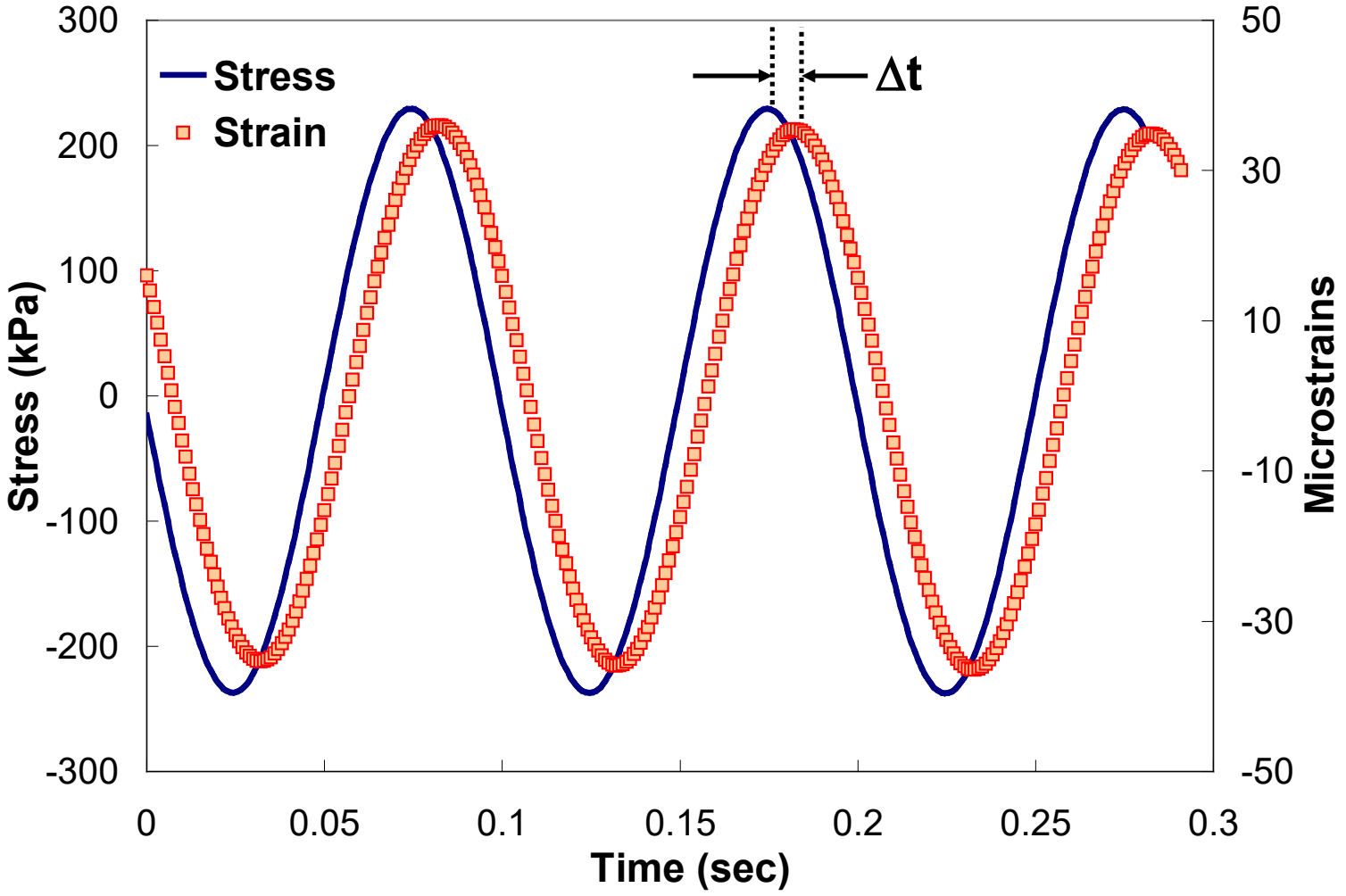
Test for Rutting Resistance

Tests with AMPT

- **Dynamic Modulus**
- **Creep Test (Flow Time Test)**
- **Repeated Load Test (Flow Number Test)**

Flow Number is referred to in AASHTO Spec MP 46-22

Loading and Response in AMPT



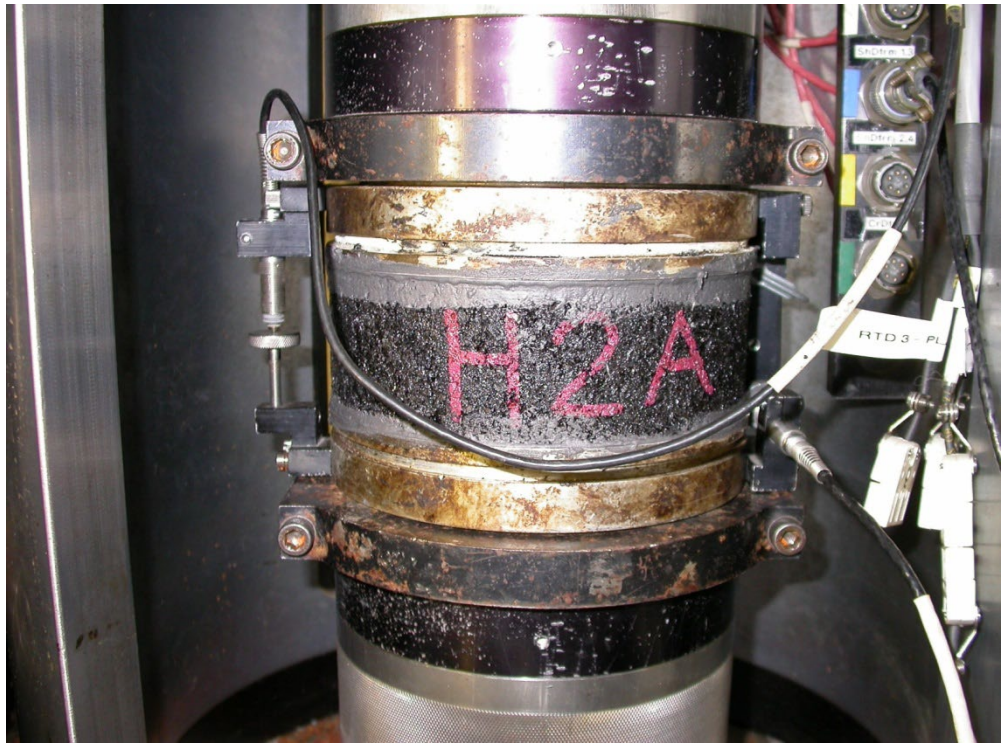
Specimens for DM and Flow Tests

Coring (left) and sawing (right) of a gyratory compacted specimen

Specimen Assembly for DM and Flow Tests

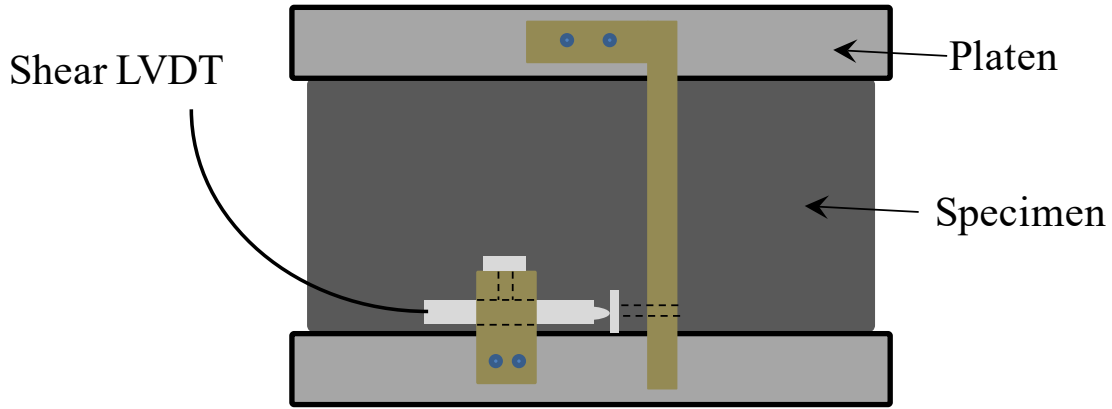
Either Use LVDTs or Extensometers to Capture Deformation

Superpave Shear Test

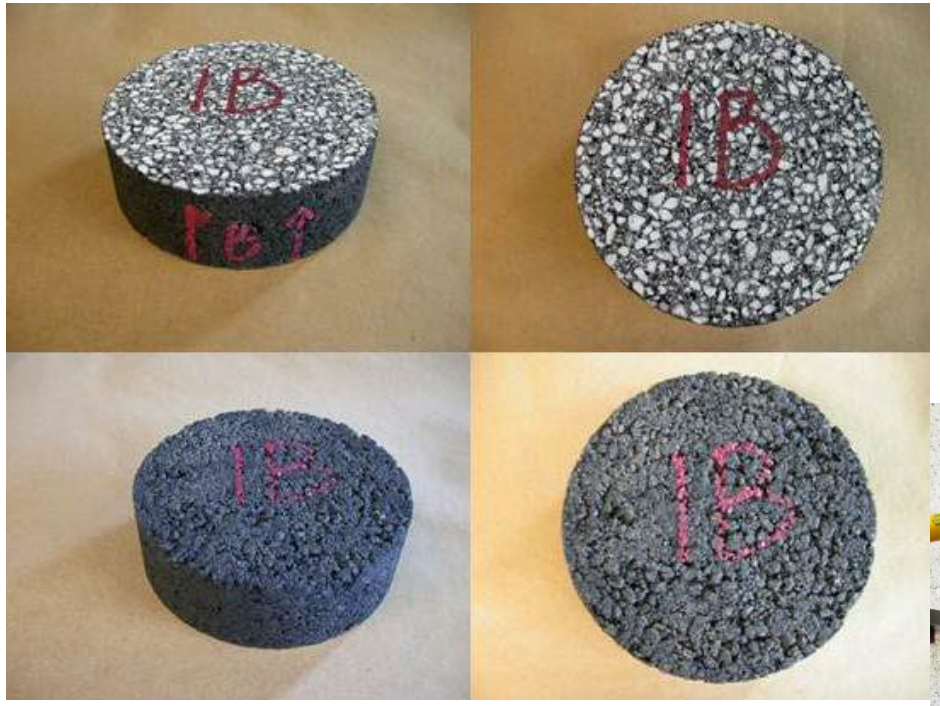


Test for Rutting Resistance

Could be used for Fatigue Resistance

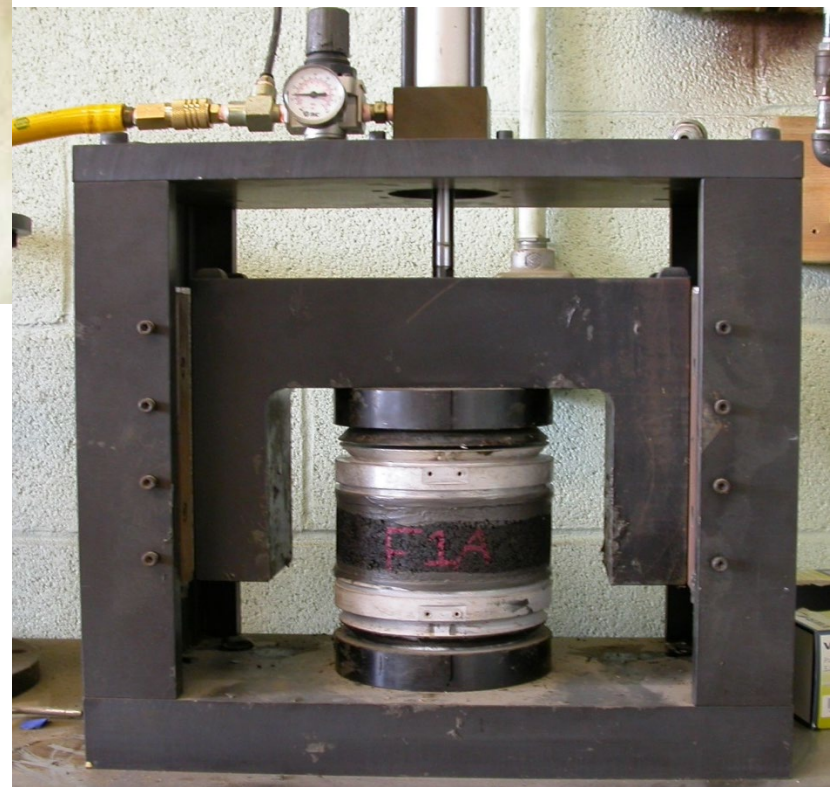


Superpave Shear Test



Specimens Prepared for Testing

Specimen Glued to Platens



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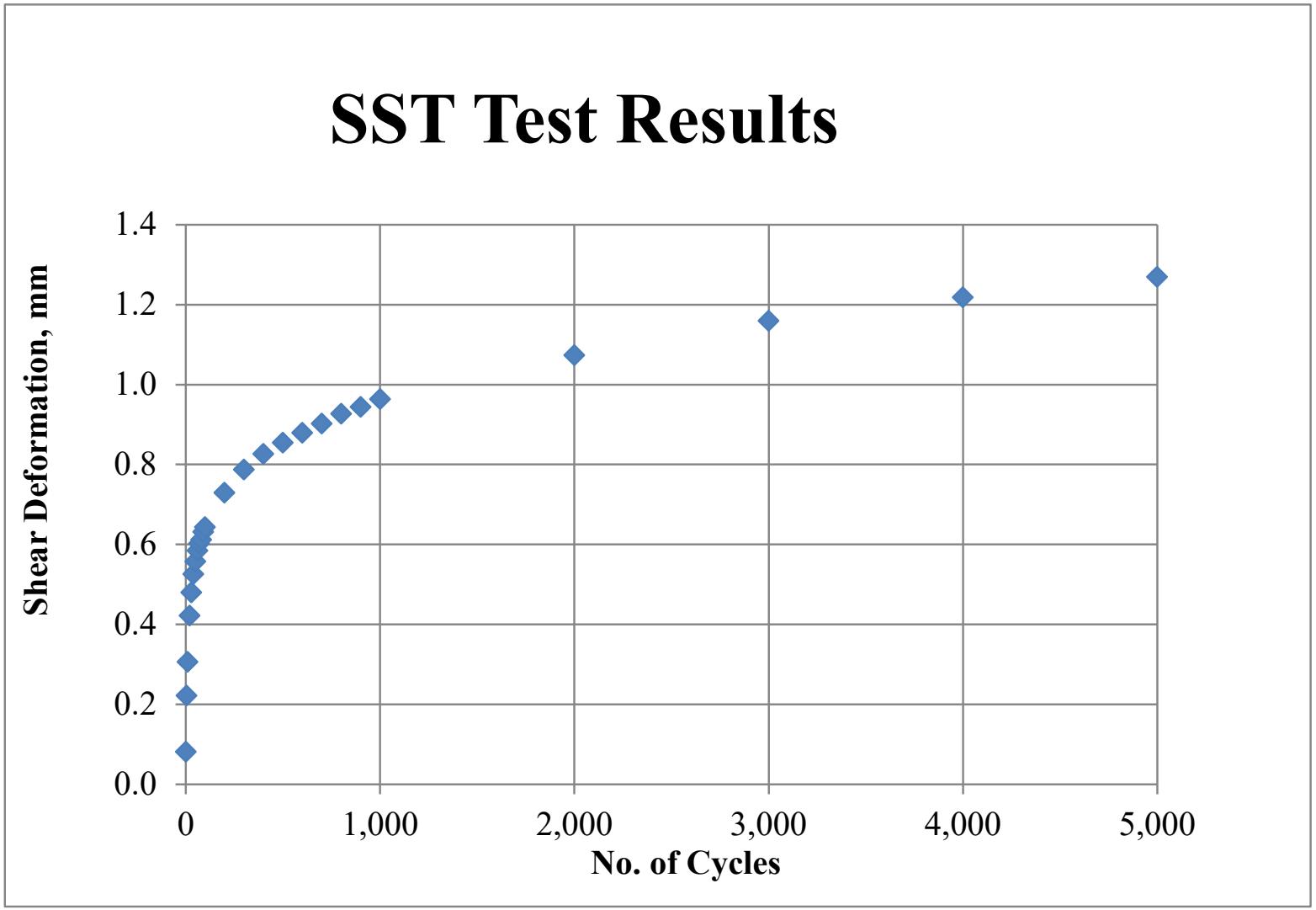
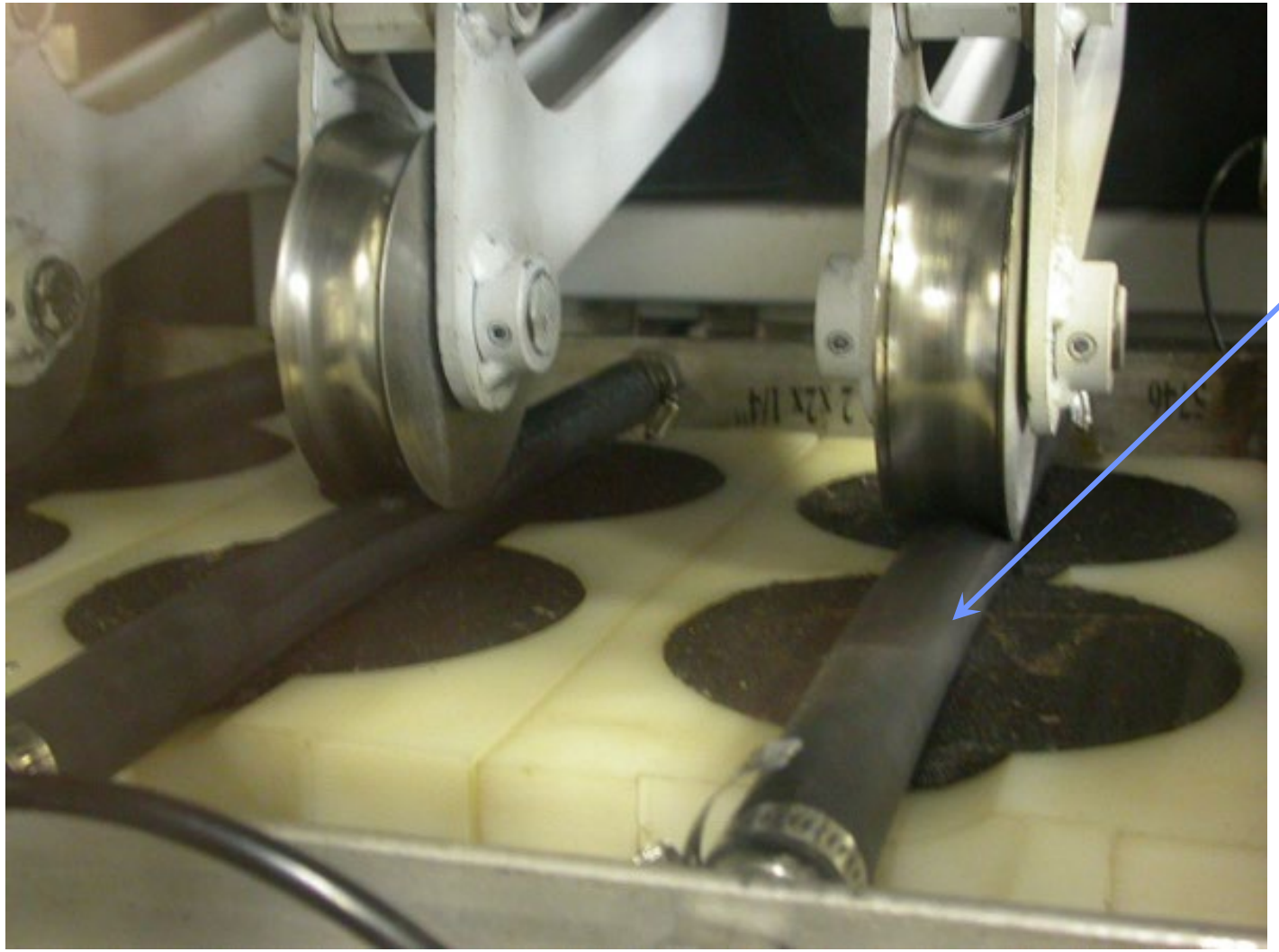
Superpave Shear Test



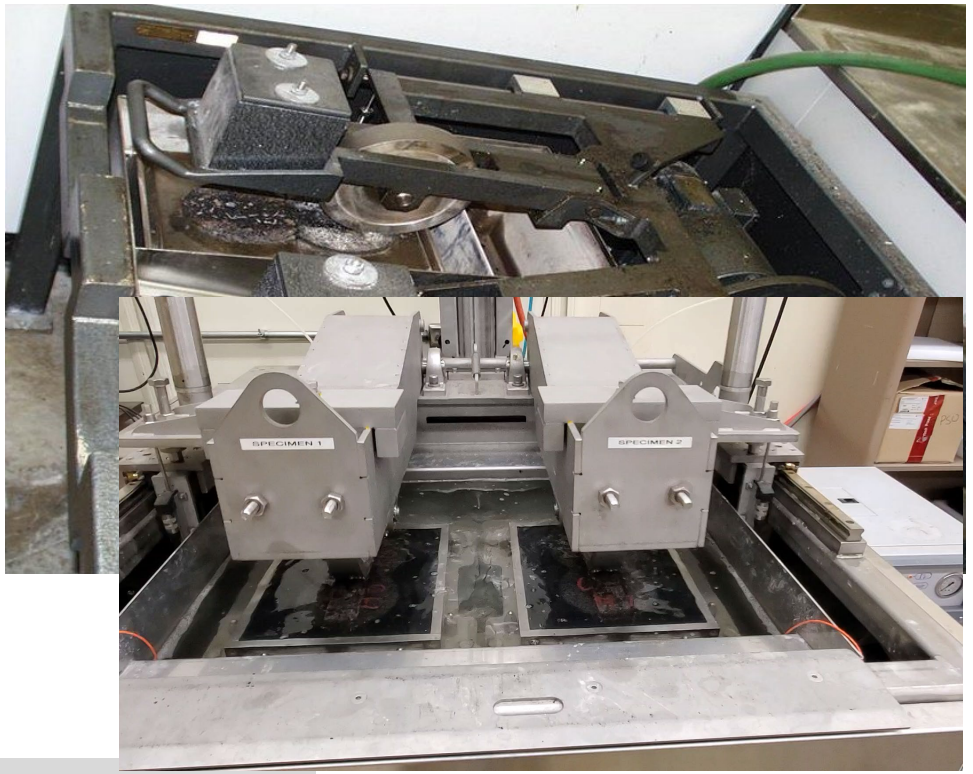
Asphalt Pavement Analyzer (APA)

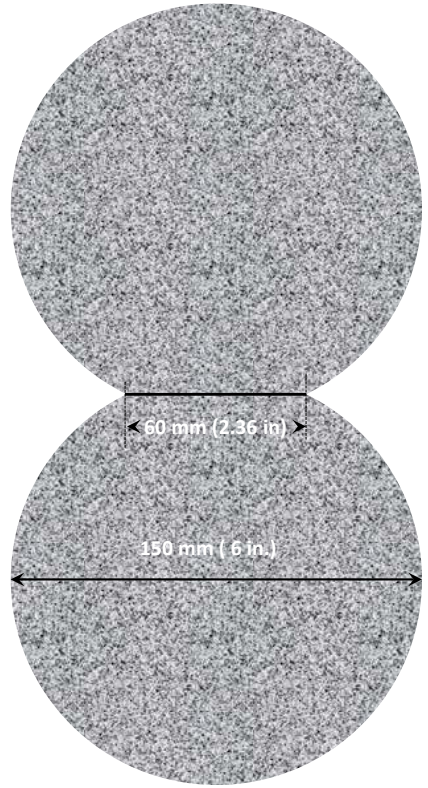


Pressurized Hose

Test for Rutting Resistance

Hamburg Wheel Tracking Test



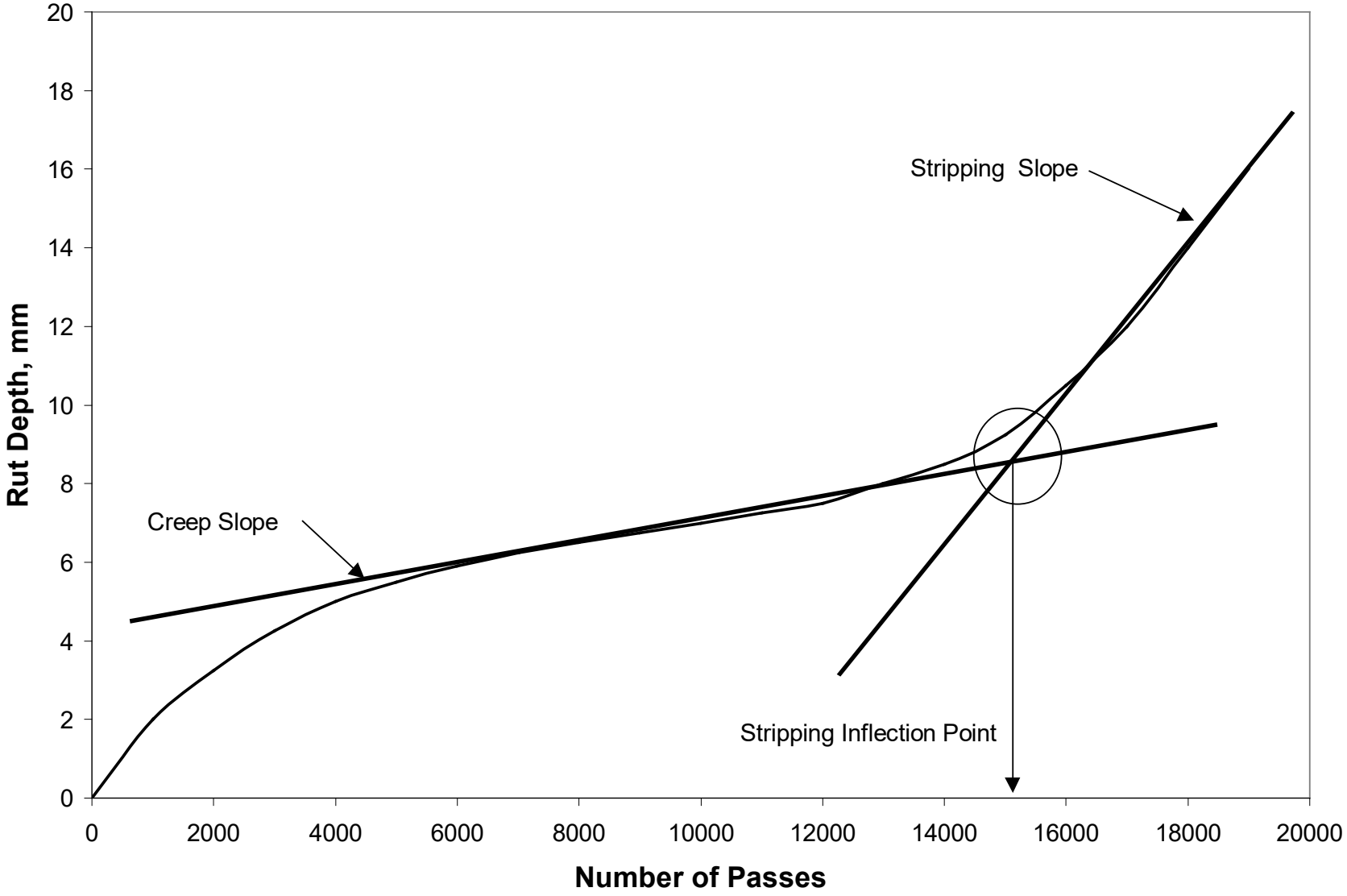


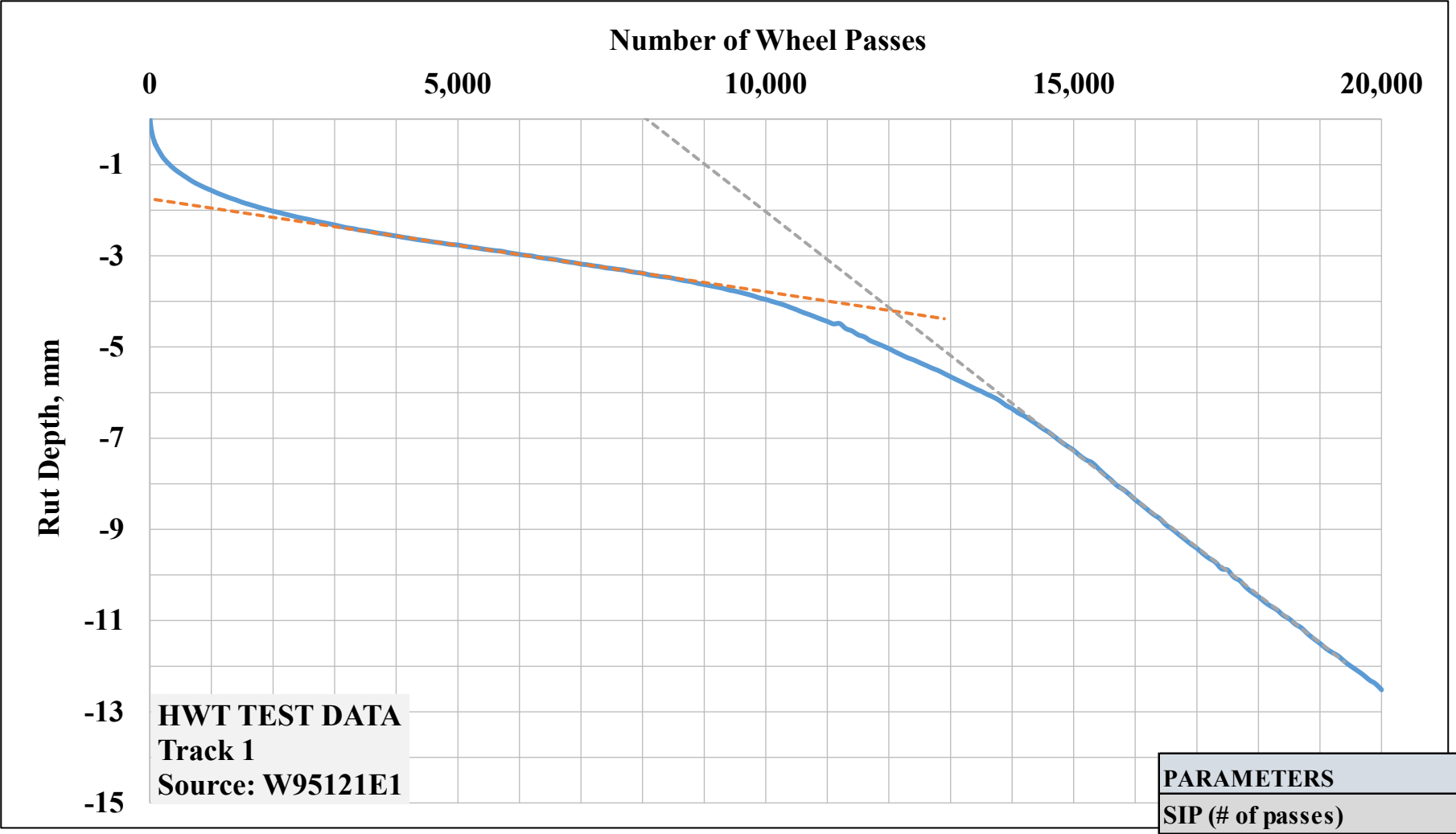
Test for
Rutting & Moisture Damage Resistance

- Test Standard: AASHTO T 324
- Number of wheel passes: 20,0000
- Test Temperature: 50 °C

Hamburg Wheel Tracking Test

Hamburg Wheel Tracking Test





An Example Output from Hamburg Wheel Tracking

PARAMETERS	Track 1	Track 2	Average
SIP (# of passes)	12,075	12,985	12,530
Ratio of the slope (strip/creep)	5.16	6.50	5.83
Max Rut Depth (mm)	-12.52	-15.09	-13.80
No. of Passes to maximum rut depth	20,000	20,000	20,000
No. of Passes to 10 mm rut depth	17,584	16,258	16,921
No. of Passes to 12.5 mm rut depth	19,963	17,889	18,926
Rut depth at 10,000 passes, mm	-3.95	-4.58	-4.27
Creep Slope (mm/1000 passes)	0.20	0.24	0.22
Stripping Slope (mm/1000 passes)	1.05	1.53	1.29

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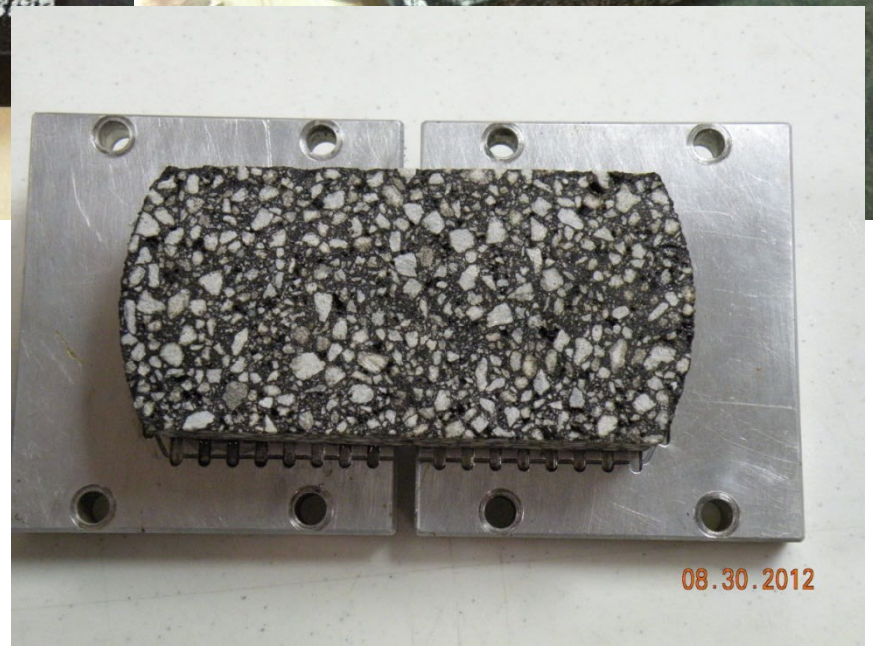
Texas Overlay Tester – Fatigue Test



Test for Cracking Resistance

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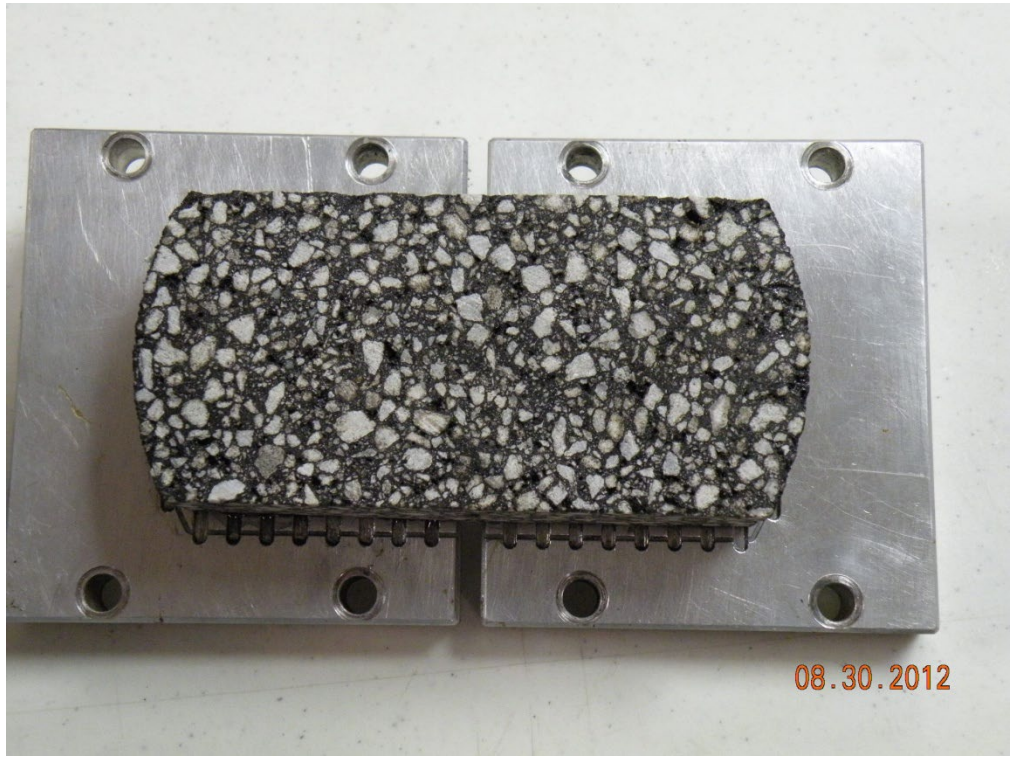
Texas Overlay Tester – Fatigue Test



Test Temperature: 25ºC
# of load cycles: 1000
Or until load reduced to 93% of original

Repeated loading (triangular form) under constant deformation deformation
magnitude per load cycle: 0.025 inches (0.6 mm)
Duration of each load cycle: 10 seconds

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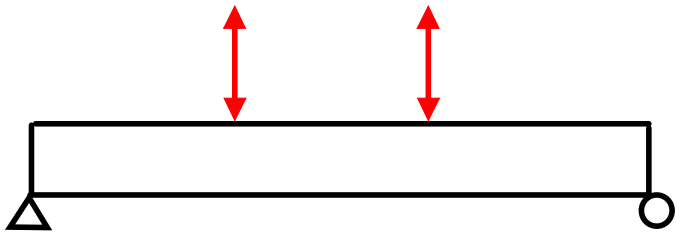
Texas Overlay Tester – Fatigue Test

Flexural Beam Fatigue Test

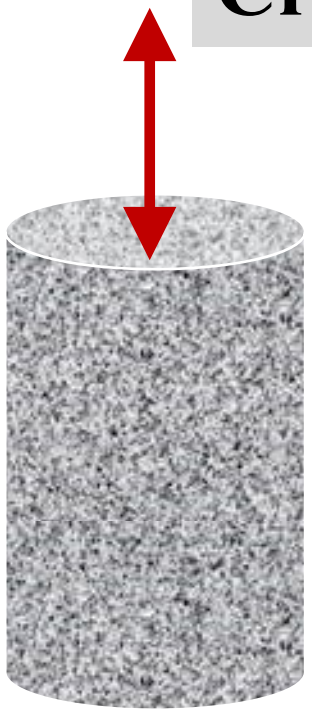


4-Point Bending Test

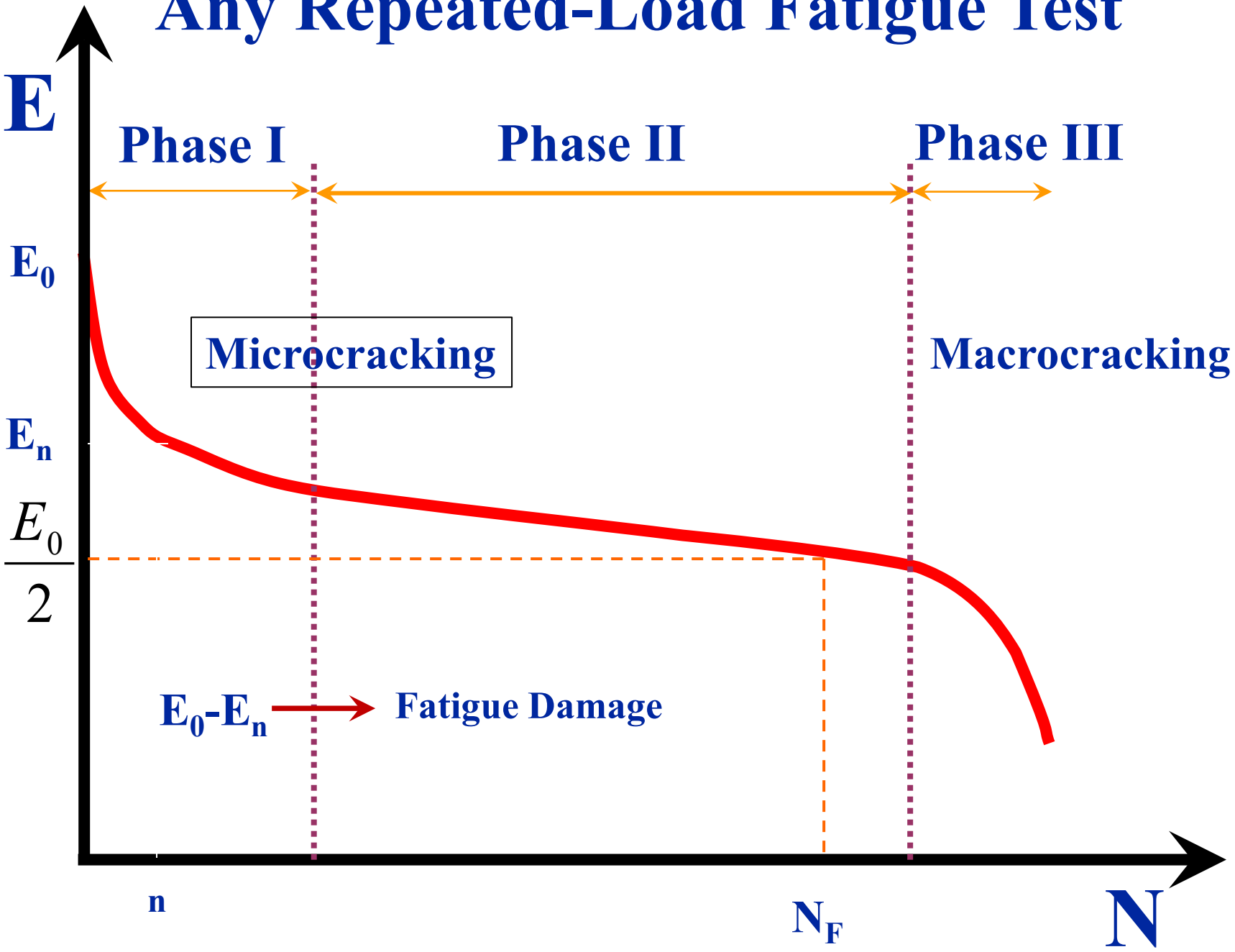
Test for Cracking Resistance

Cyclic Uniaxial Tension/Compression (Push-Pull Fatigue Test)

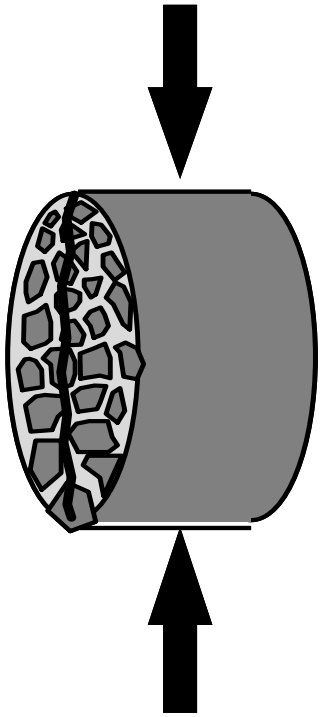
Test for Cracking Resistance

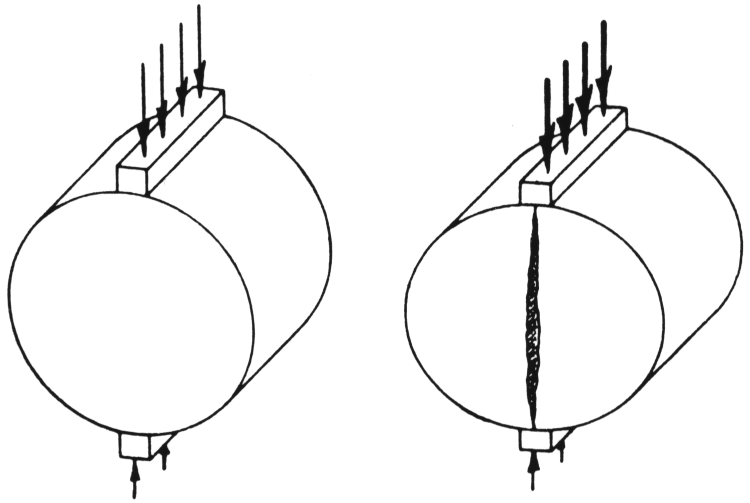


Any Repeated-Load Fatigue Test



Indirect Tensile Test (IDT)





If High Temperature

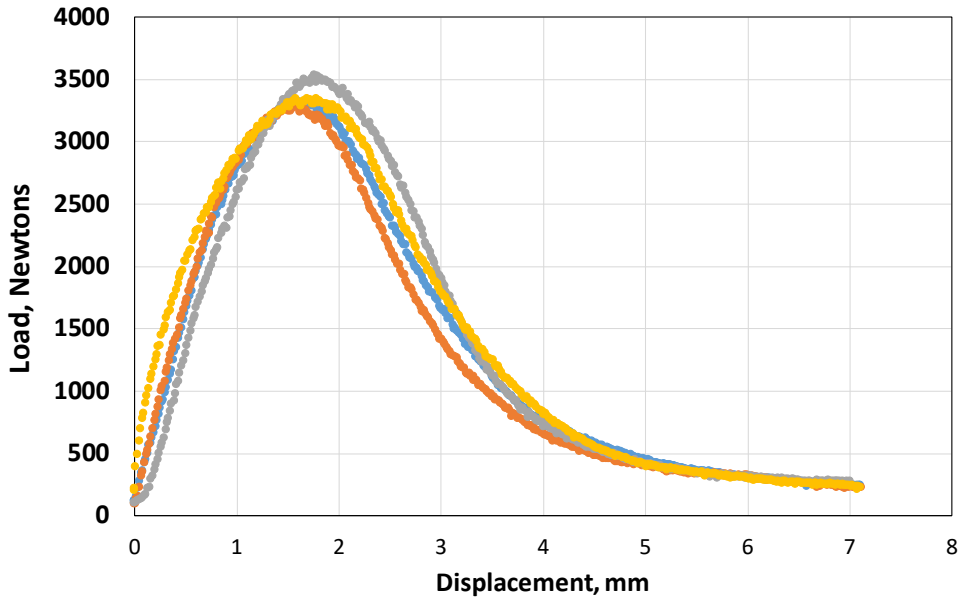
Test for Rutting Resistance

AND

If Intermediate Temperature

Test for Cracking Resistance

Semi-Circular Bend (SCB) Test



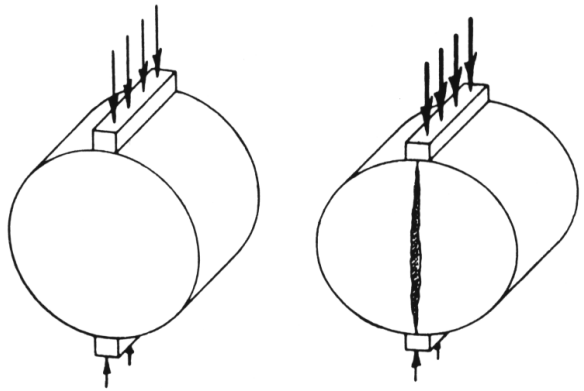
Fracture Energy

$$G_f = \frac{W_f}{B \cdot L}$$

Flexibility Index

$$FI = A \times \frac{G_f}{abs(m)}$$

IDEAL Cracking Test for Asphalt Concrete

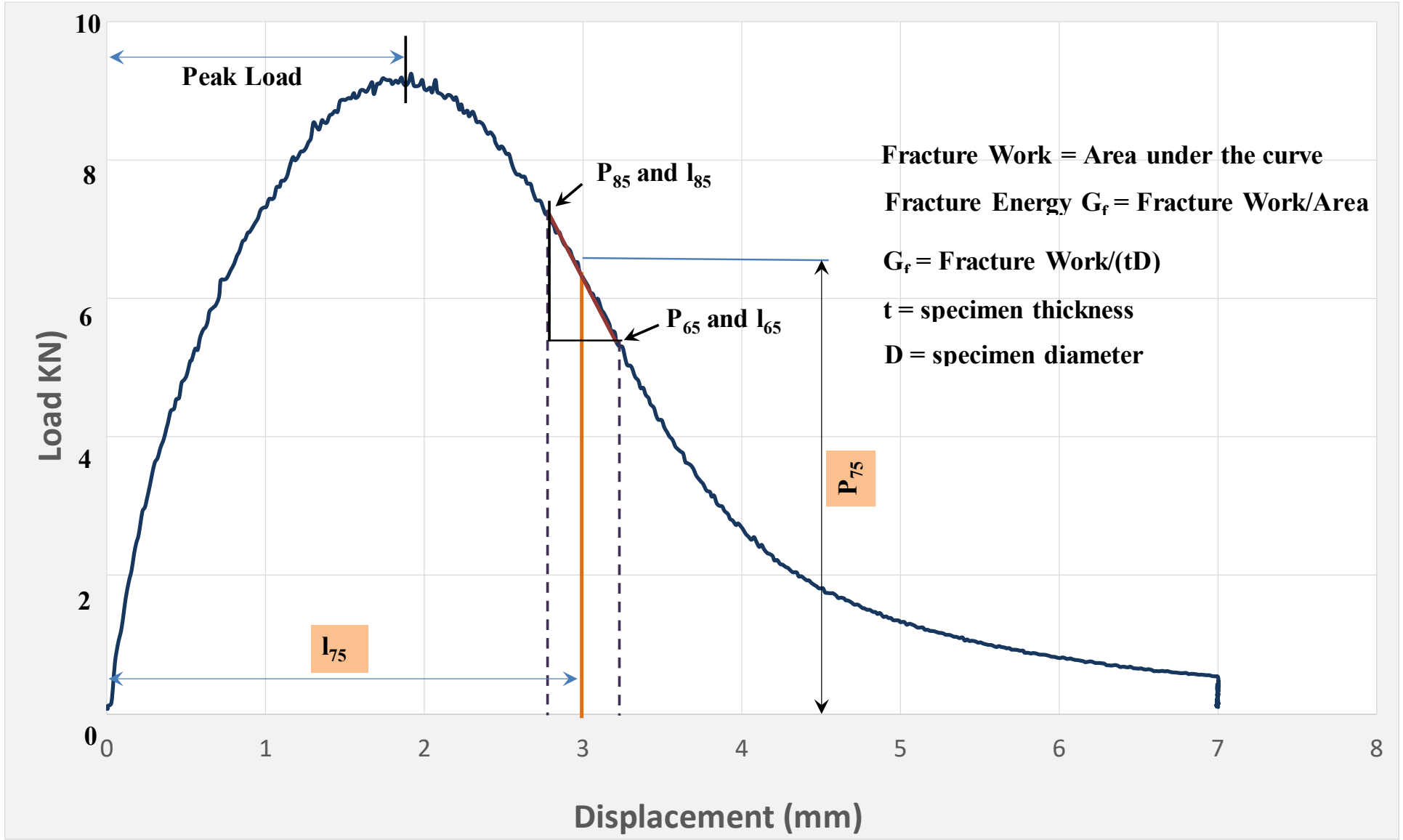


Indirect T**e**nsile **A**spha**l**t
Cracking **T**est

- Test Standard: ASTM D8225
- Displacement rate: 50 mm/minute
- Test Temperature: 25 °C

IDEAL-CT

IDEAL – Test Results



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IDEAL – Test Results

Criteria established based on CT_{Index}

$$CT_{Index} = \frac{t}{62} \times \frac{G_f}{\frac{P}{l}} \times \left(\frac{l_{75}}{D}\right)$$

$$\frac{P}{l} = |m_{75}| = \frac{P_{85} - P_{65}}{l_{85} - l_{65}}$$

t = specimen thickness in mm

G_f = energy of fracture, J/m^2

P/l = post peak slope at 75% Peak Load, N/m

l_{75} = displacement at 75% peak load, mm

D = diameter in mm

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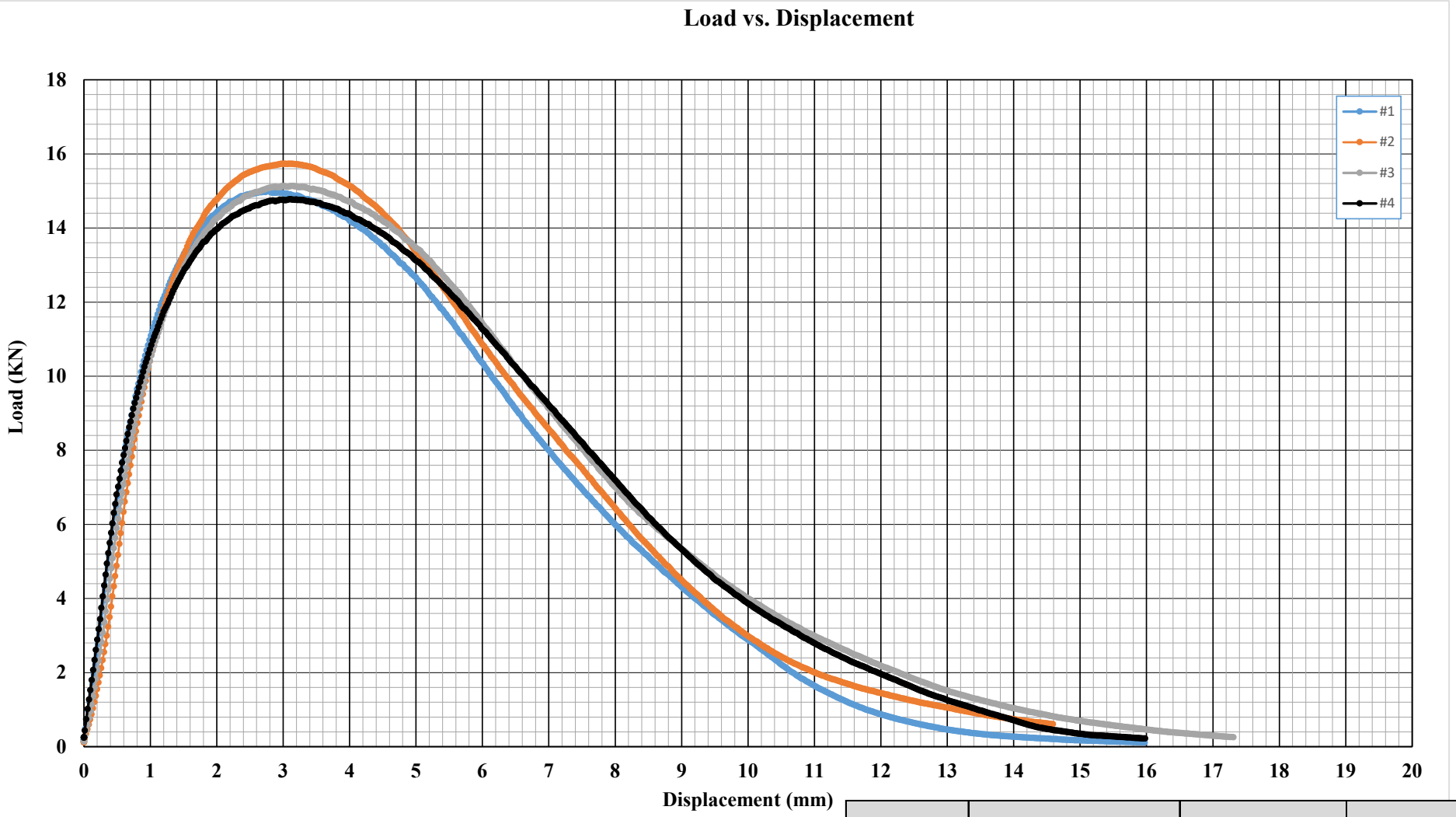

An Example Output from IDEAL-CT Test

Specimen	Peak Load (N)	Fracture Energy (J/m^2)	IDEAL-CT Index	Peak Tensile Stress (KPa)	Peak Tensile Stress (PSI)	Strain at Peak Stress (%)
IDEAL 1	14989.1	11218.1	182.1	1033	150	1.85
IDEAL 2	15734.2	11910.3	178.7	1084	157	2.01
IDEAL 3	15135.3	12492.7	222.4	1043	151	2.09
IDEAL 4	14776.2	12167.5	244.2	1018	148	2.06
Average	**15158.7**	**11947.2**	**206.8**	**1044**	**151**	**2.00**
Stand. Dev.	**411.0**	**541.3**	**31.8**	**28.3**	**4.1**	**0.11**
Coef. of Var.	**2.7**	**4.5**	**15.4**	**2.7**	**2.7**	**5.4**

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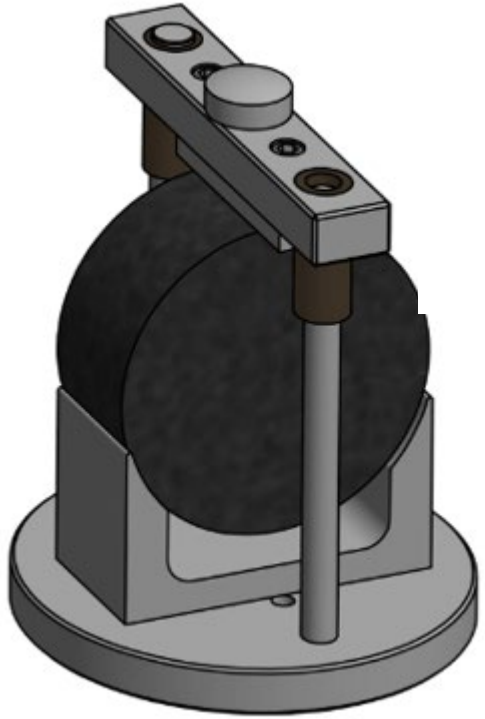
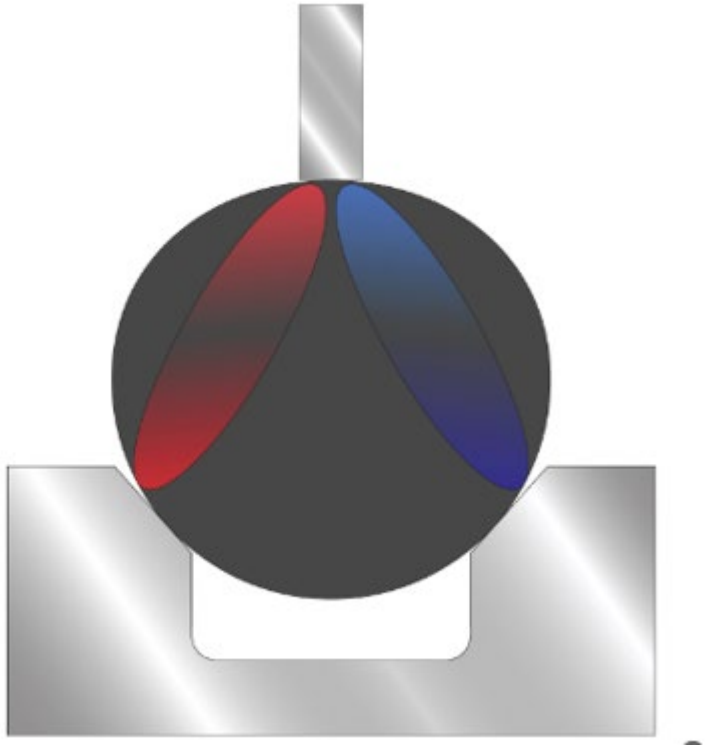
IDEAL-RT for Determination of Rutting Resistance

- Test Standard: ASTM D8360-22
  Displacement rate: 50 ± 2.0 mm/minute
- Sampling Rate: Min. 40 data points/second
- Test Temperature: 50 ± 15 °C
- Complete the test in 2 minutes





IDEAL-RT for Determination of Rutting Resistance

$$\tau_f = 0.356 \times \frac{P_{max}}{t \times w}$$

$$RT_{index} = 6.618 \times 10^{-5} \frac{\tau_f}{1\ Pa}$$

T_f = shear strength (Pa)
P_{max} = maximum load (N)
t = specimen thickness (m), and
w = width of upper loading strip (=0.0191 m)
RT_{index} = rutting tolerance potential

Performance Tests Selected by PennDOT

Wheel Tracking
for rutting and moisture damage

IDEAL-CT for Cracking

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Bulletin 27: Chapter 2A – Performance Tests

Table 9 – Performance Testing Limits: Rutting

Specification	AASHTO T 324 – Hamburg Wheel Track			
Property	Traffic Level (Millions of ESALs)	Max. Rut Depth at 20,000 Passes (mm)	SIP (min. passes)	Min. passes at 12.5-mm Rut Depth
Rutting & Moisture Susceptibility	<3	≤ 15	N/A	N/A
		≤ 20	14,000	10,000
		≤ 25	16,000	12,000
	3 to <10	≤ 10	N/A	N/A
		≤ 15	14,000	12,000
		≤ 20	16,000	14,000
	≥10	≤ 10	N/A	N/A
		≤ 12	16,000	15,000

Bulletin 27: Chapter 2A – Performance Tests

Table 9 – Performance Testing Limits: Cracking

Specification		ASTM D8225	AASHTO PP 78
Property	Traffic Level (Millions of ESALs)	CT_{Index}	ΔTc
Cracking	<3	>70	
	3 to <10	>80	
	≥10	>90	
High RAP/RAS (≥ 0.35 RBR)	All		>-5.0C

Bulletin 27: Chapter 2A – Performance Tests

Table 10 – Exceptions to JMF when Meeting Table 9 Requirements

Property	AASHTO Specification	Existing PA Specification Requirement	Specification Requirement if Table 9 Limits are Met
Percent Air Voids at N_{design}	R 35 Table 2	4.0	3.0 to 4.1
Moisture Susceptibility	R 35 - Sect. 4.4, M 323- Sect. 7.3, & T 283	<0.8 AASHTO T 283 TSR, mandatory anti-strip	AASHTO T 283 and mandatory anti-strip waived
Asphalt PG	M 323 Sect. 5. and as specified	As specified	PG bumping of all performance testing limits allowed

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Performance Tests Selected by MD SHA

Indirect Tensile at High Temperature for rutting

IDEAL-CT at Intermediate Temperature for Cracking

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MD SHA Standard Spec. (Draft)

- **Section 904 – Balanced Mix Design for Surface Mixtures**

Design Level	20-Year Design Traffic, ESALs (millions)	N_{design}
1	<0.3	50
2	0.3 to <3	65
3	3 to <10	80
4	10 to <30	80
5	>30	100

MD SHA Standard Spec. (Draft)

- **Performance Testing Requirements**

Test	# of pills	Air Voids Range, %	Loos Mix Conditioning Time, hrs.	Test Temp. C	Criteria
Cracking Tolerance Index	5[1]	7±0.5	4	25±1	$CT_{index} \geq 80$
IDT High Temp.	3	7±0.5	2	43±1	Tensile Strength ≥ 160 KPa

[1] *5 pills are required only for mix design, and 3 pills are enough for testing during production.*

MD SHA Standard Spec. (Draft)

- **Production Testing**

Performance Testing Frequency

Test	Frequency (Tons)	Number of Specimens (per lot)
Cracking Tolerance Index	2,000[1]	9
IDT High Temp.	2,000[1]	9

[1] Collect additional two boxes each for both QC and QA, to prepare 3 HT IDT and 3 CR Index specimens from behind the paver.

Summary

- Concept of Balanced Mix Design
- Levels of BMD Design and Specifications
- Various Laboratory Performance Tests
- PennDOT & MD SHA Performance Tests

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