Request for Quotes

Expanded Lag and Dwell Time Experiment

Deadline for Submissions: May 1, 2024, 5 PM Pacific Time

Email a Letter of Interest with the Required Information to: twollmuth@nd.gov

Background

Lag Time is defined as the time between when a plant-produced asphalt mixture is sampled and when specimens are compacted for BMD tests. Dwell Time is defined as the time between when BMD specimens are compacted and when the specimens are tested. Lag and dwell time have been identified as one of the possible causes of lab-to-lab variability for BMD test results. It is critical that the effects of lag and dwell time be quantified and mitigated as necessary if BMD tests are to be used in Quality Assurance where the results of agency and contractor tests are often compared for mix acceptance decisions. Lag and dwell time experiments already conducted by FHWA and NCAT indicate that the effects of lag time of up to two months and dwell time of up to one week were not statistically significant for the mixtures studied. Replication of the experiment with different materials is needed to determine if lag and dwell time cause differences in BMD test results for a broader range of asphalt mixtures.

Objective

The objective of this project is to expand the lag and dwell time experiments to include mixtures from other parts of the USA containing different binders, aggregates, and additives. This Request For Quotes (RFQ) is an open call for organizations to provide a fixed-price price quote to conduct the Lag and Dwell Time Experimental Plan as detailed below.

Compensation

Organizations selected to participate in this project by the Consortium for Asphalt Pavement Research and Implementation (CAPRI) will invoice CAPRI for their work at their quoted price when all of the tasks are completed.

Mandatory Pre-Selection Web Meeting

Each organization that submits a letter of interest must participate in a webinar to review the details of the Experimental Plan. Questions about the experimental plan from prospective participating organizations will be answered during the webinar. The webinar will be April 15, 2024 at 12:00 noon EDST.

Microsoft Teams meeting

Join on your computer, mobile app or room device

Click here to join the meeting

Meeting ID: 277 073 369 912
Passcode: icq9HH

Download Teams | Join on the web

Lag and Dwell Time Experimental Plan

Organizations selected for the Lag and Dwell Time Experiment must execute all tasks according to the instructions provided in this document. It is critical that all instructions be followed closely. The work will require careful planning and preparation. The following documents provide the required instructions. Failure to follow the instructions may void the experiment and disqualify the organization's invoice.

Safety

Participating organizations are solely responsible for the safety of their personnel involved in the experiment. CAPRI assumes no responsibility for the safety of any personnel involved in this experiment.

Overview

The work includes five major tasks:

1. Sample an asphalt mixture according to your state DOT's procedure, including sample containers approved by the state DOT. Sample containers are the responsibility of the organization. The estimated quantity of mix to be sampled is approximately 1000 pounds. In addition, sample the raw materials (asphalt binder, aggregates, recycled materials, and other additives introduced at the plant).
2. Split the mix sample into portions for test specimens to minimize mix aging following the specific experimental schedule.
3. Compact specimens after the designated lag times (including no lag time) at the correct air void range for the IDEAL-CT and IDEAL-RT specimens. A total of 90 specimens are to be compacted and tested over the entire experiment for each mix.
4. Condition and test the specimens according to the IDEAL-CT and IDEAL-RT procedures,

5. Input the results of the IDEAL-CT and IDEAL-RT into a spreadsheet template that will be provided for the analysis.

Required Information in the Letter of Interest – Due May 1, 2024

1. Organization Name
2. Point of Contact
3. Contact email and phone numbers
4. Address(es) of lab(s) where samples will be compacted and tested
5. Where the mix(es) will be sampled (i.e. plant site, roadway windrow, etc.)
6. Copy of the proposed mix design(s). Suggested 9.5 to 19.0 mm NMAS mixtures.
    a. If the mix design(s) does not include the water absorptions of the aggregates, that must be included with the letter of interest.
    b. Organizations may submit quotes for a single mix design or multiple mix designs.
7. Type of sampling containers
8. Names of all persons who be involved in the experimental plan and their:
    a. Familiarity with the IDEAL-CT (choose one: unfamiliar, novice, experienced, expert)
    b. Familiarity with the IDEAL-RT (choose one: unfamiliar, novice, experienced, expert)
9. Schedule: Expected completion date, no later than October 31, 2024.
10. Fixed-Price Quote to conduct the experiment for each mix.

Dwell and Lag Time Experiment

Instructions for Reheating and Compacting Specimens

(supplemental information to PowerPoint file:

FHWA Dwell Time_NCAT Summary_020524.ppt)

Containers:

The day of production will require 4 x 5-gallon metal buckets full of mix and the re-heating days will require 3 x 5-gallon buckets. Other organizations may use different containers for mix (such as boxes or bags). The instructions below reference buckets, and each bucket contains about 60 lbs. of mix. If you are using other containers, please adjust the number of containers you need accordingly with the mass it will hold.

Reheating and Compacting Specimens:

1) Put sampled buckets of mix in an oven set to the mix compaction temperature for 3 hours.
    a. A timed oven may be used so that the mix is hot in the morning for the days the mixture is re-heated.
    b. Production day will require 4 buckets (or equivalent mass of mix for other containers) of mix and re-heating days will require 3 buckets (or equivalent) of mix.
        i. If smaller containers such as boxes are used instead, less time may be required in the oven at the compaction temperature to achieve mix workability. The objective is to get the mix hot enough where it is easily workable without aging the material unnecessarily.
2) After 3 hours, blend and homogenize buckets using a quartering device and put Buckets 2 of the 4 buckets back in the oven.
3) Immediately split Bucket #1 into 2 x G_{mm} (>1,500 grams for 12.5 mm NMAS or smaller), 2 x N_{des} specimens (≈ 4,700 grams), and one to two 62 mm trial weight specimens (≈2,500 g)
    a. Use the 'NCAT Trial Mix Weight Estimating Spreadsheet' to calculate the initial trial mass prior to sampling and splitting the material.
        i. https://www.asphaltpavement.org/expertise/engineering/resources/bmd-resource-guide/bmd-tools
    b. Trial weights for the 62 mm specimens are mixture dependent and the initial trial weight can be calculated using the G_{mm} and the percent passing the #8 sieve from the JMF.
    c. Record the time of the split for this bucket.
4) Immediately compact the trial weight specimen to the predicted mass at 62 mm in height control mode in the gyratory compactor.
    a. Cool this specimen rapidly under a fan.
5) Test G_{mm} as soon as possible after the samples have cooled and been broken up.
6) Compact 2 design pills at N_{des} gyrations when the mix reaches the compaction temperature.

7) Bulk the trial weight specimen after it has cooled down and is cool to the touch.
8) Calculate air voids for trial weight specimen using the specimen G_{mb} and the G_{mm} from Step 5).
    a. If the air voids of the trial specimen are within ± 0.25% of 7.0%, proceed with the same weight for compacting the remaining specimens.
    b. If the air voids of the trial weight specimen are outside of this range, use the NCAT trial mix weight adjustment sheet to determine the necessary adjustment.
9) When a compaction weight is finalized, split Bucket #2 into as many pans as possible to the target specimen weight ± 3 grams.
    a. Record the time of this split.
    b. Place all split specimens in the oven at the compaction temperature.
10) Begin compaction of 62 mm specimens.
    a. Record the time compaction started.
    b. From this point, the gyratory should be running practically continuously until all specimens are compacted.
        i. It helps to have a second set of hands to extrude specimens from the gyratory.
    c. Verify the mass of each specimen prior to compaction. The preferred method is to have a mix transfer funnel sitting on top of a scale. Fine adjustments may be made to the mass of the mixture at this point.
11) When you are ≈75% through one of the buckets, split the next bucket into pans for individual specimens.
    a. Record the time each bucket is split.

NOTE: The day of production will require 30 total specimens, and reheating days will require 20 total specimens.

12) Label the first ten (10) specimens from the first bucket as #1 - #10.
    a. Specimen numbers for extra samples from the first bucket should begin at #31.
    b. For reheating days, label the first seven (7) specimens from each bucket instead of ten (10). Extra samples will be labeled beginning at #22.
13) Label the first ten (10) specimens from the second bucket as #11 - #20.
    a. Specimen numbers for extra samples from the second bucket should pick up where the extra specimens from Bucket #1 left off.
14) Label the first ten (10) specimens from the third bucket as #21 - #30
    a. Specimens numbers for extra samples from the second bucket should pick up where the extra specimens from Bucket #2 left off
15) Separate specimens into the random groups and bulk all the specimens.
    a. On production day, select one of the groups of specimens and immediately proceed to testing.

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Expanded Lag Dwell Time and Lag Time Experiment Overview and Specimen Preparation Instructions

Adam J. Taylor, P.E. and Nathan Moore, P.E

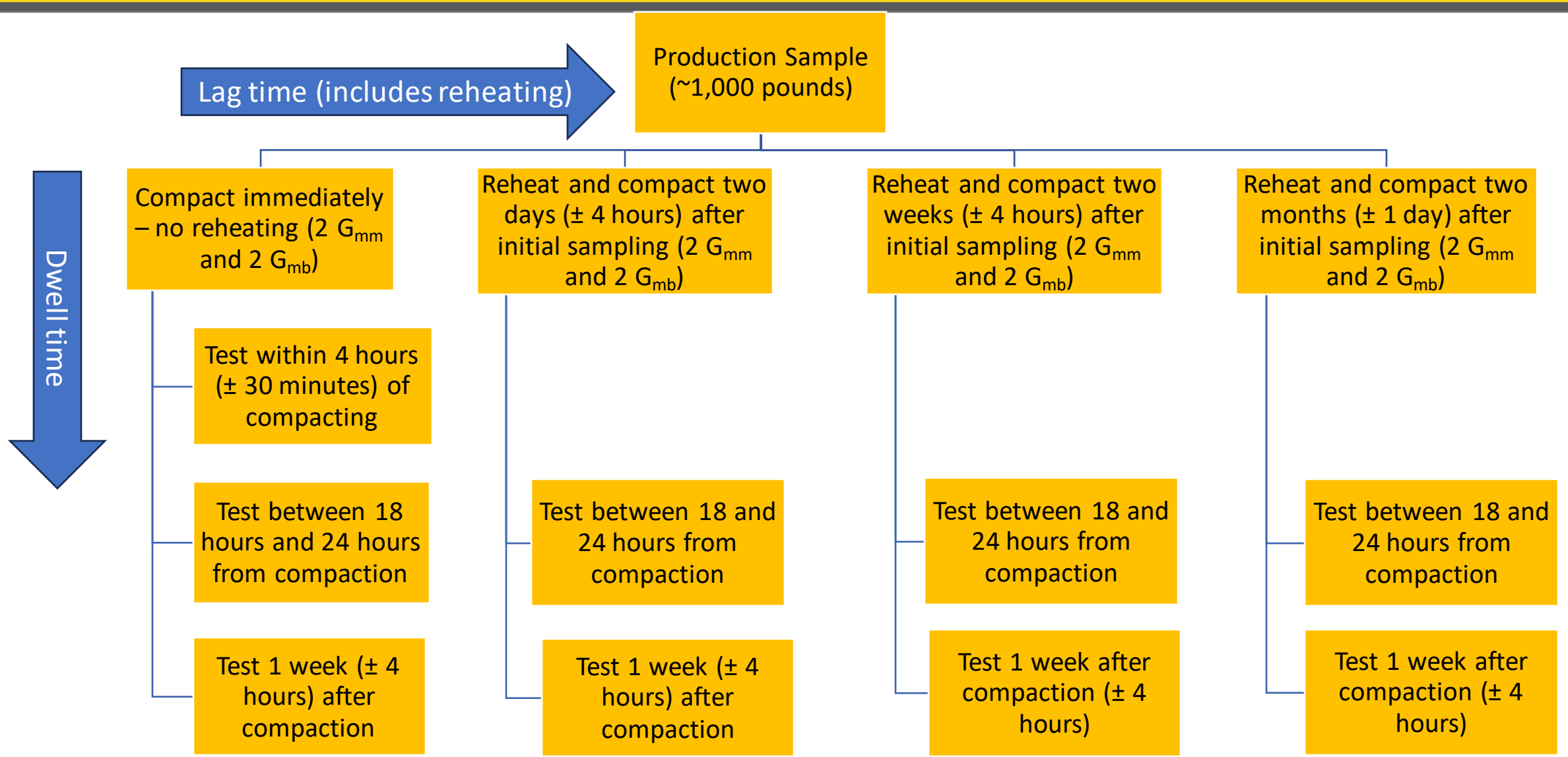
Definitions

- Lag Time
  - The time between mixture sampling and specimen compaction
- Dwell Time
  - The time between laboratory compaction of specimens and the time when those specimens are tested.

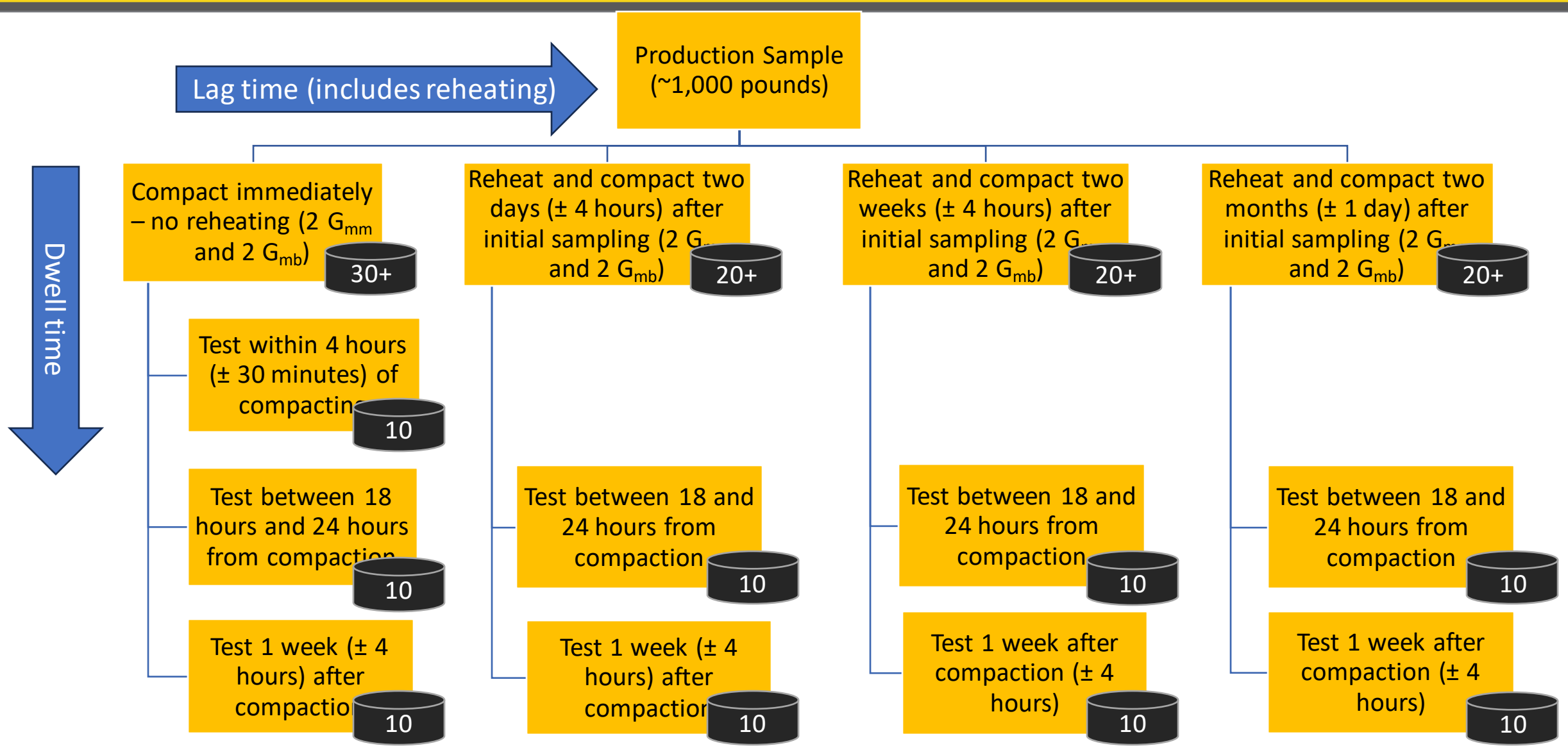
Experiment Objectives

- Quantify the impact of Lag Time and Dwell Time on plant-produced mixtures
  - Cracking: IDEAL-CT
  - Rutting: IDEAL-RT
- Impact of testing mix during production versus re-heating later at various times
- Impact of compacting specimens and testing them right away or testing them later

Testing Plan



Testing Plan



Scheduling Example

- Plan ahead!
- Scheduling conflicts on testing or compaction days
  - Weekends/Holidays/Staff Availability

Reheating Time	Specimen Compaction Day	CT and RT Testing Days		
		No Dwell Time	18-24 hrs Dwell	One Week Dwell
No Reheating	5/17/23	5/17/23	5/18/23	5/24/23
2 days	5/19/23	[redacted]	5/20/23	5/26/23
2 weeks	5/31/23	[redacted]	6/1/23	6/7/23
2 monts	7/17/23	[redacted]	7/18/23	7/24/23

Required Staff

- Executing this testing plan is a **minimum** 2-person job
  - A third set of hands is very beneficial
    - Two people to split out and compact mix
    - One person to bulk samples, run Rices, and start conditioning/testing
- Production Day
  - Recommend four available people on mix production day
  - Two people for sampling four buckets for the production-day compaction and, transport to the lab, and testing and compaction
  - Two more people remained at the plant to sample the additional buckets for the future tests
    - 2-day, 2-week, and 2-month re-heat samples

Raw Materials Sampling

- Obtain at least 10 lbs. of each aggregate and recycled material in the mix design.
- Obtain at least one quart can of the binder used in the mix design.
- Obtain other mix additives introduced at to the plant in a suitable container.
- Label each container of material with the following:
  - “Lag/Dwell Experiment”
  - Sampling date
  - Material description
- Retain the raw materials samples at the organization’s facility until further notice, pending the outcome of the experiment.

Production Day Testing – Mix Sampling

- Need a minimum 13 **FULL** 5-gallon metal buckets to conduct the testing plan
  - Recommend sampling a few extra for factor of safety
  - Each bucket holds about 60 lbs.
    - 13 buckets x 60 lbs. = 780 lbs.
    - Recommend sampling ~1,000 lbs. of mix
    - Number of containers will depend on the type of container you use
      - i.e. Sample enough boxes or bags to get this same amount of material if those are used instead of buckets

Production Day Testing – Mix Sampling

- Re-heating Times
  - Day of Production (4 buckets) – min 240 lbs.
  - 2-day reheat (3 buckets) – min 180 lbs.
  - 2-week reheat (3 buckets) – min 180 lbs.
  - 2-month reheat (3 buckets) – min 180 lbs.
- Asked contractor to make a mini-stockpile of mix in the parking lot to sample from:
  - It would take a long time to get this amount of buckets from the sampling stand
  - Sampling from the roadway is not recommended due to volume of material

Mix Sampling

Production Testing – Mix Transport

Production Day Testing – Mix Transport

- Transport mix from plant to lab
  - Covered truck bed
  - Buckets wrapped in insulation
  - AL Mix 1
    - 10 minute haul time
    - Arrival temperature = 260°F
  - AL Mix 2
    - 1 hour haul time
      - Note: Would not recommend longer haul time than this
    - Arrival temperature = 260°F

Production Day Testing – Homogenize Mix

- ‘Quartermaster’ used to blend buckets together upon arrival
  - AASHTO R47 – ‘Mechanical Splitter Type A’
- Purpose was to blend buckets together to minimize segregation between individual bucket samples
- Proceed to split out 1 blended bucket
  - Place 3 blended buckets back in the oven with lid
- Note: You will always have 4 buckets after using the Quartermaster
  - 3 full buckets will yield 4 x ¾-full blended buckets

Production Day Testing – Splitting Mix

- Hypothesis – Larger volumes of mix age less quickly due to less air exposure
- As a result, we minimize the time that split mix samples are in small pans stay in the oven to limit oxidation
  - Leave mix in covered buckets in the oven until they are ready to be split and compacted
    - Don't split the next bucket until you are almost done compacting all of the pans from the previous bucket
  - Once the mix is split into small pans, a team of two people works to compact them as quickly as possible.
  - Work Quickly!

Production Day Testing – Splitting Mix

- Split samples from buckets into individual pans using a large sampling pan and the ‘quartering’ method from AASHTO R47
  - Homogenize remaining material as you split out the specimens
- Large flat-bottomed scoop

Large Sampling Pan

Individual Specimen Pan

Production Day Testing – Compaction

- Weigh every specimen before compaction
- Transfer device tared on scale recommended
- One pour – no shaking or stopping

Production Day Testing – Bucket #1

- Split out the following
  - 2 x Design Pills,115 mm target height (~4,700 – 4,800 grams typically)
  - 2 x Rices (~1,500 grams)
  - 2 x 62 mm Trial Weight Specimens (~2,500 grams)
    - May have enough mix for an extra design pill or trial weight specimen
  - One person is splitting while second person is helping transport pans to the oven
  - Compact the trial weights ASAP while the second person is running Rices
  - Hopefully the trial weight specimens will be bulked around the same time the Rices are finished

Achieving Target Specimen Air Voids

- *NCAT Trial Mix Weight Estimating Spreadsheet*
  - NAPA BMD Resource Guide --- 'Tools'
  - Uses
    - Estimate mass of mix in gyratory mold to achieve target air voids
    - Refine trial specimen mass
      - Either one or two trial specimens
  - Detailed Instructional Video
  - *https://www.asphaltpavement.org/expertise/engineering/resources/bmd-resource-guide/bmd-tools*

Estimate Initial Trial Weight (First Trials)

Inputs

- G_{mm}
- Target Air Voids
- Percent Passing #8 Sieve

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NCAT Trial Weight Estimating Spreadsheet

Mix Gmm:	2.485
Specimen Height (mm):	62
Target Air Voids (%)	7
Passing #8 Sieve (%)	45
	CF
Estimated CF	1.029
User Input CF	
Estimated Weight (g):	2,461
Rounded Weight (g):	2,460

Input
Result

Typical Values		
Test	*Specimen Height (mm)*	*Target Air Voids (%)*
HB/IDEAL	62	7.0
APA	75	7.0
TSR	95	7.0
OT/IDT	125	7.5 - 8.0
I-FIT/DCT	160	7.5 - 8.0

Average Starting CF Values	
Height (mm)	*Average CF*
62	1.036
75	1.031
95	1.030
125	1.028
160	1.024

Refine Trial Weight (Remaining Specimens)

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Use this sheet after compacting 1 Trial Specimen

		Explanation
Mass of Trial Specimen (g) =	2460.0	Trial Specimen Dry Weight
Air Voids of Trial Specimen (%) =	7.3	Calculated Air Voids of Trial Specimen
Target Air Voids (%) =	7.0	Target Air Voids
Adjusted Trial Mass (g) =	2468	Adjusted Specimen Mass for Future Specimens

1 Trial Specimen

2 Trial Specimens

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Use this sheet after compacting 2 Trial Specimens

Target Air Voids(%) = 7.00

	Weight (g)	Air Voids (%)
Trail Specimen 1	2,480.5	6.7
Trail Specimen 2	2,460.2	7.3

Instructions:
Input Trial Specimen Info In Green Cells
Rounded Target Weight in Orange Cell

Target Weight = 2,470 grams

Rounded Target Weight = 2,470 grams

Production Day Testing – Buckets #2 through #4

- Using the optimized trial weight for 62 mm specimens, split the next bucket (#2) out into pans at that trial weight
  - Throw away any extra remaining material that isn't enough to make a specimen
  - Put pans back in the oven and work to compact them as quickly as possible
- Repeat for remaining buckets
  - Typically one person starts splitting the next bucket when there are one or two specimens left to compact from the previous bucket

Sample Conditioning and Testing

- Test G_{mb} and calculate Air Voids for all specimens
  - This is where the third person is helpful, so this can be done in parallel rather than in series with specimen compaction
- IDEAL-CT
  - 6 specimens per set
  - 2 hours pre-conditioning
    - Environmental Chamber at 25°C
- IDEAL-RT
  - 4 specimens per set
  - 1 hour pre-conditioning
    - Water Bath at 50°C

Reheating Procedure

- Prepare containers for re-heating
  - Buckets – Remove plastic handle and rubber lid gasket
- Heat for the amount of time required to achieve workability
  - Don’t heat in the oven for an extended period to avoid oxidation
  - Metal Buckets – 3 to 4 hours
  - Able to go through a quartermaster in a flowable state
- The remainder of the fabrication and testing on the re-heated days is similar to that of the production day
  - “We’ve reduced this to a problem we’ve previously solved”

Production Day Timing (Example AL Mix 1)

- Sample Mix at Plant (12:00 PM)
- Arrive at Main Lab (12:25 PM)
  - Split Bucket #1 (12:30 PM)
  - Split Bucket #2 (1:30 PM)
  - Split Bucket #3 (2:00 PM)
  - Split Bucket #4 (2:45 PM)
- Finish Compaction (3:45 PM)
- IDEAL-CT Conditioning (3:30 PM)
  - IDEAL-CT Testing (5:30 PM)
- IDEAL-RT Conditioning (4:00 PM)
  - IDEAL-RT Testing (5:00 PM)

Specimen Fabrication

- The G_{mm} will vary slightly between the production specimen and the re-heated specimens
- Barring a dramatic change in G_{mm}, we recommend keeping the 'optimized' specimen weight in the mold constant between the production test and the future re-heats
  - The IDEAL-CT and IDEAL-RT tests are very sensitive to specimen density
  - i.e. If 2,485 grams is the target mass in the mold for the production test, keep this mass in the mold for future re-heats
  - May differ for mixes with highly absorptive aggregates

Specimen Randomization

- Stratified Random Specimen Selection
  - Purpose: It takes time to compact this many specimens and time in the oven is critical
    - We don't want to compare sets of specimens that had markedly differing times in the oven
    - We also want to make sure that each of the split buckets is represented in the groups
  - IDEAL-CT specimens come from the front end (≈60%) of the population
    - This was done so that these specimens could start conditioning faster on production day.
    - Also done for re-heated specimens for consistency.
  - IDEAL-RT specimens come from the back end (≈40%) of the population

Sample Selection Example

- Example – Production Day
- Four buckets into Quartermaster
  - Bucket #1 used for N_{des}, G_{mm}, & Trial Weights
- Need 30 Specimens from the remaining 3 buckets
  - Split first 10 specimens from Bucket #2 and label #s 1-10
    - Extra specimens from Bucket #2 should be numbered starting at #31
  - Split first 10 specimens from Bucket #3 and label #s 11-20
    - Extra specimens from Bucket #3 should continue from where Bucket #2 stopped.
  - Split first 10 specimens from Bucket #4 and label #s 21-30
    - Extra specimens from Bucket #4 should continue from where Bucket #3 stopped.

Sample Selection Example (continued)

- Goal: 10 specimens per bucket available for random selection
- Randomly split 30 specimens into three groups using a random number generation tool
  - If any of the first 30 specimens fail air voids, replace them with extras.
- Test the first 6 specimens within a group for IDEAL-CT
- Last 4 specimens in the group are for IDEAL-RT

Lag Time (Buckets)	Dwell Time (Specimens)	Specimen ID	Test ID
Production Day	< 4 hours	4	CT
Production Day	< 4 hours	7	CT
Production Day	< 4 hours	8	CT
Production Day	< 4 hours	9	CT
Production Day	< 4 hours	14	CT
Production Day	< 4 hours	18	CT
Production Day	< 4 hours	19	RT
Production Day	< 4 hours	21	RT
Production Day	< 4 hours	22	RT
Production Day	< 4 hours	25	RT
Production Day	18-24 hours	1	CT
Production Day	18-24 hours	5	CT
Production Day	18-24 hours	6	CT
Production Day	18-24 hours	12	CT
Production Day	18-24 hours	13	CT
Production Day	18-24 hours	16	CT
Production Day	18-24 hours	20	RT
Production Day	18-24 hours	26	RT
Production Day	18-24 hours	29	RT
Production Day	18-24 hours	30	RT
Production Day	1 week	2	CT
Production Day	1 week	3	CT
Production Day	1 week	10	CT
Production Day	1 week	11	CT
Production Day	1 week	15	CT
Production Day	1 week	17	CT
Production Day	1 week	23	RT
Production Day	1 week	24	RT
Production Day	1 week	27	RT
Production Day	1 week	28	RT

Sample Selection for Re-heating Days

- Similar process as for Production testing day but with a few differences
  - Re-heated day testing uses 3 full sample buckets instead of 4
    - Splitting buckets into 2 sets instead of 3
  - Use Quartermaster to split into 4 even buckets
  - Bucket #1 is still used for Ndes, Gmm, & trial weights
  - Goal: 7 specimens per remaining 3 buckets available for random selection
  - Only need 20 specimens randomized into 2 groups instead of 3

IDEAL-CT – Database Example

Mix ID	*Test Date*	*Lag Time (Buckets)*	*Dwell Time (Specimens)*	*Specimen ID*	*Air Voids (%)*	*Peak Load (kN)*	*L75 (mm)*	*Fracture Energy (J/m²)*	*Slope (kN/mm)*	*CT Index*
AL 9.5 mm PG 67-22	5/17/2023	1) Production	1) < 4 hours	1	7.1	14.371	3.681	6,036	4.611	32.1
AL 9.5 mm PG 67-22	5/17/2023	1) Production	1) < 4 hours	6	7.0	15.153	3.994	6,700	5.305	33.6
AL 9.5 mm PG 67-22	5/17/2023	1) Production	1) < 4 hours	8	7.0	16.004	3.862	7,030	5.917	30.6
AL 9.5 mm PG 67-22	5/17/2023	1) Production	1) < 4 hours	9	6.9	16.411	3.532	6,410	6.502	23.2
AL 9.5 mm PG 67-22	5/17/2023	1) Production	1) < 4 hours	13	7.0	15.273	3.677	6,376	5.824	26.8
AL 9.5 mm PG 67-22	5/17/2023	1) Production	1) < 4 hours	16	6.8	16.274	3.848	7,346	5.751	32.8
AL 9.5 mm PG 67-22	5/18/2023	1) Production	2) 18-24 hours	3	6.9	15.277	3.750	6,476	6.256	25.9
AL 9.5 mm PG 67-22	5/18/2023	1) Production	2) 18-24 hours	4	7.0	15.172	3.598	6,479	5.961	26.1
AL 9.5 mm PG 67-22	5/18/2023	1) Production	2) 18-24 hours	10	6.6	15.226	3.829	6,791	5.436	31.9
AL 9.5 mm PG 67-22	5/18/2023	1) Production	2) 18-24 hours	11	7.0	15.590	3.621	6,624	4.998	32.0
AL 9.5 mm PG 67-22	5/18/2023	1) Production	2) 18-24 hours	12	6.8	15.599	3.671	6,838	4.878	34.3
AL 9.5 mm PG 67-22	5/18/2023	1) Production	2) 18-24 hours	17	7.1	16.396	3.453	6,582	6.396	23.7
…	…	…	…	…	…	…	…	…	…	…

IDEAL-RT – Database Example

Mix ID	*Test Date*	*Lag Time (Buckets)*	*Dwell Time (Specimens)*	*Specimen ID*	*Va (%)*	*Shear Strength (MPa)*	*Peak Load (kN)*	*RT Index*
AL 9.5 mm PG 67-22	5/17/2023	1) Production	1) < 4 hours	18	6.8	1.786	5.910	118.2
AL 9.5 mm PG 67-22	5/17/2023	1) Production	1) < 4 hours	19	6.9	1.702	5.631	112.6
AL 9.5 mm PG 67-22	5/17/2023	1) Production	1) < 4 hours	21	7.0	1.537	5.086	101.7
AL 9.5 mm PG 67-22	5/17/2023	1) Production	1) < 4 hours	25	6.8	1.615	5.345	106.9
AL 9.5 mm PG 67-22	5/18/2023	1) Production	2) 18-24 hours	20	7.0	1.837	6.079	121.6
AL 9.5 mm PG 67-22	5/18/2023	1) Production	2) 18-24 hours	22	6.8	1.530	5.063	101.3
AL 9.5 mm PG 67-22	5/18/2023	1) Production	2) 18-24 hours	28	6.9	1.731	5.728	114.6
AL 9.5 mm PG 67-22	5/18/2023	1) Production	2) 18-24 hours	29	6.9	1.634	5.405	108.1
AL 9.5 mm PG 67-22	5/24/2023	1) Production	3) 1 week	24	6.9	1.458	4.824	96.5
AL 9.5 mm PG 67-22	5/24/2023	1) Production	3) 1 week	26	6.8	1.531	5.067	101.3
AL 9.5 mm PG 67-22	5/24/2023	1) Production	3) 1 week	27	7.1	1.633	5.405	108.1
AL 9.5 mm PG 67-22	5/24/2023	1) Production	3) 1 week	30	7.0	1.522	5.036	100.7
…	…	…	…	…	…	…	…	…

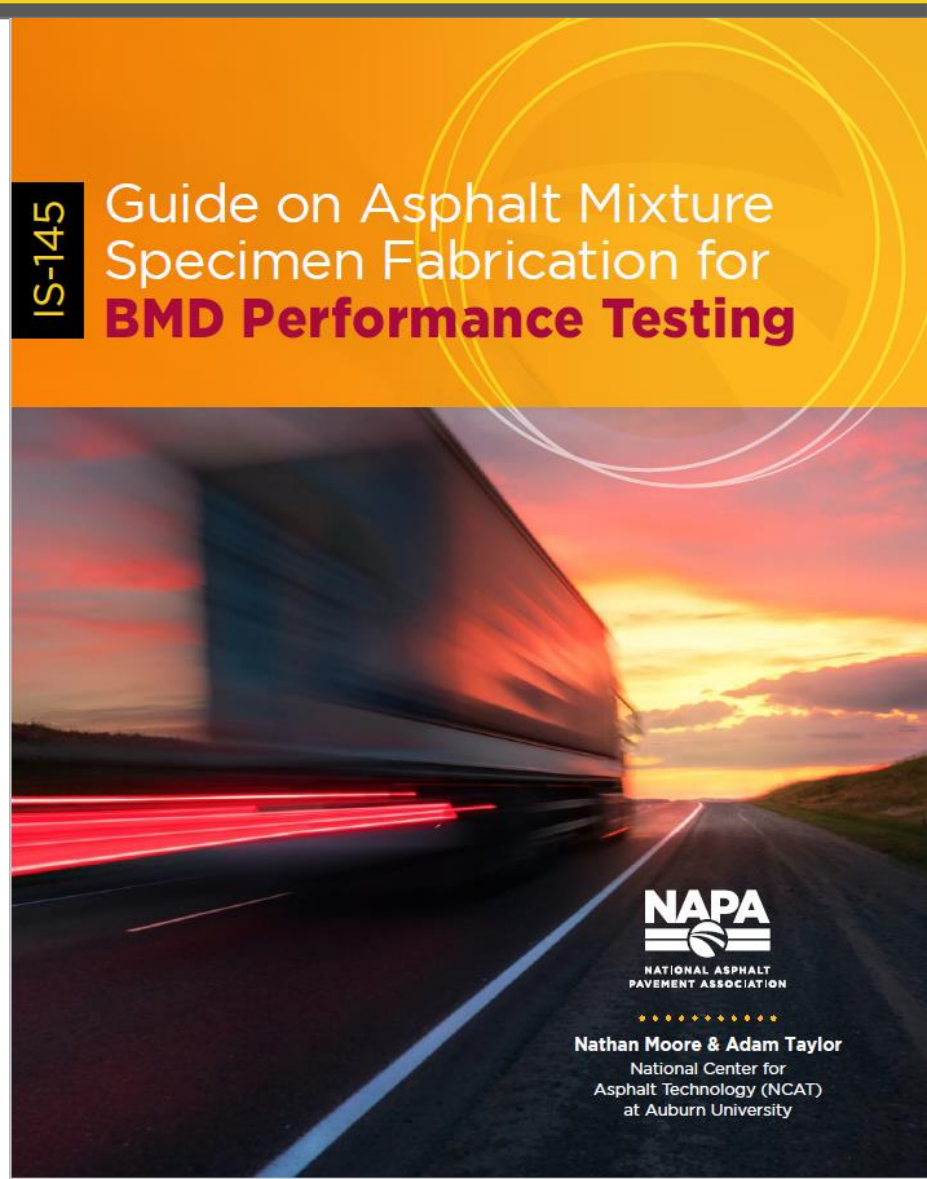
Final Thoughts

- This is tough the first time, but it gets easier with practice
- Planning ahead goes a long way
- Our process has evolved considerably with experience and learning what works and what doesn’t

BMD Specimen Preparation Guide

- NAPA IS-145
  - NAPA BMD Resource Guide
  - Under: *Training and Resources*

  - *https://www.asphaltpavement.org/expertise/engineering/resources/bmd-resource-guide/training-resources*



Specimen Preparation Videos

- NAPA BMD Resource Guide
  - Under: *Training and Resources*
  - Quick Overview Instructional Videos (total ~16 minutes)
    - Aggregate Processing
    - Aggregate Batching
    - Mixture Heating and Mixing
    - Mixture Sampling, Re-heating, and Splitting
    - Mixture Aging and Compaction
  - Supplement to Detailed Information in the Specimen Preparation Guide

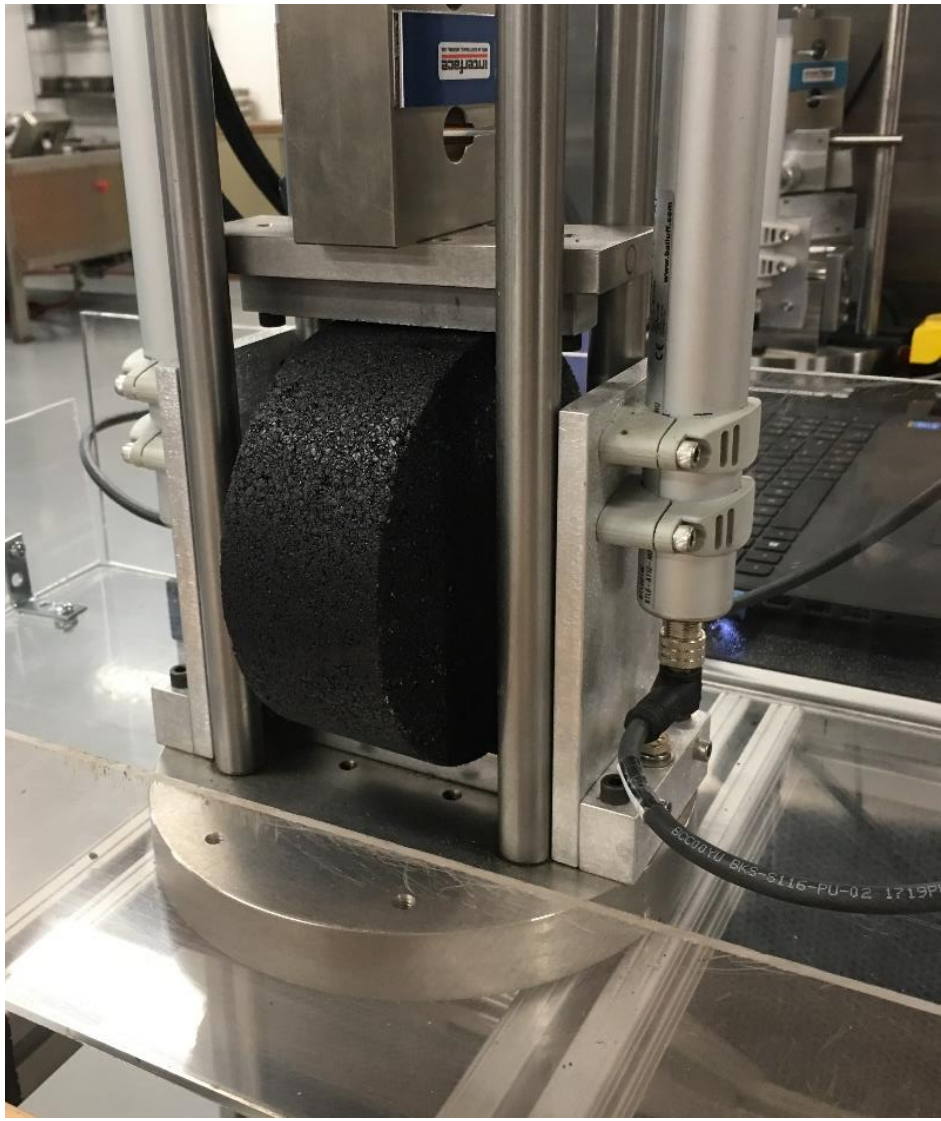
Thank You

Discussion

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

IDEAL-CT

- ASTM D8225-19
  - 25°C (2 hour condition)
  - 50 mm/minute
  - CT Index
    - Index Parameter
      - Cracking Resistance
      - Higher is Better
  - Thresholds vary by State
    - Range from 50 to 125 for BMD/DGA



IDEAL-RT – Rapid Rutting Test

- ASTM D8360-22
- 50°C Test Temperature (1 hr – water)
- 50 mm/minute load rate
- 62 mm specimens
- 4 replicates - 7.0 ± 0.5 percent air voids
- Specialized Jig Attachment - Shear
- Record Peak Load – Calculate RT Index

- For mixtures with PG64-XX (or lower) with 95% confidence: $RT_{Index} \geq 60$,
- For mixtures with PG70-XX with 95% confidence: $RT_{Index} \geq 65$, and
- For mixtures with PG76-XX (or higher) with 98% confidence: $RT_{Index} \geq 75$.

Zhou, Steger, and Mogawer - 2021