Pennsylvania Asphalt Pavement Association

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2023 Regional Technical Meetings

Balanced Mix Design

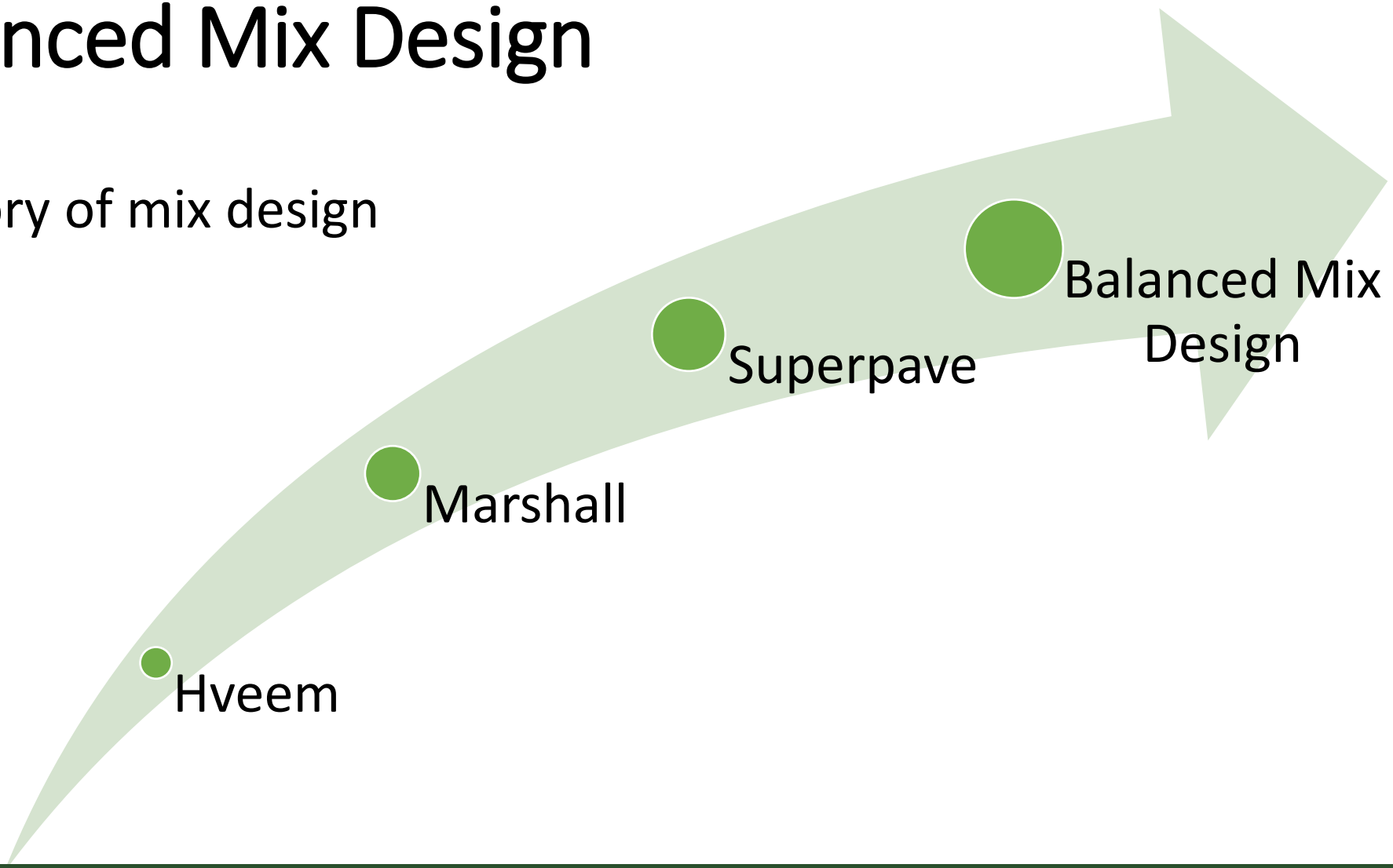
March 14-16, 2023

Mary Robbins, Ph.D., P.E., Director of Technical Services

PENNSYLVANIA ASPHALT PAVEMENT ASSOCIATION

Balanced Mix Design

- History of mix design



Balanced Mix Design

"asphalt mix design using performance tests on appropriately conditioned specimens that address multiple modes of distress, taking into consideration mix aging, traffic, climate and location with then the pavement structure."

~ AASHTO PP 105-20 & FHWA ETG, Balanced Mix Design Task Force (2015)

Balanced Mix Design

Main asphalt pavement distress:

- Rutting

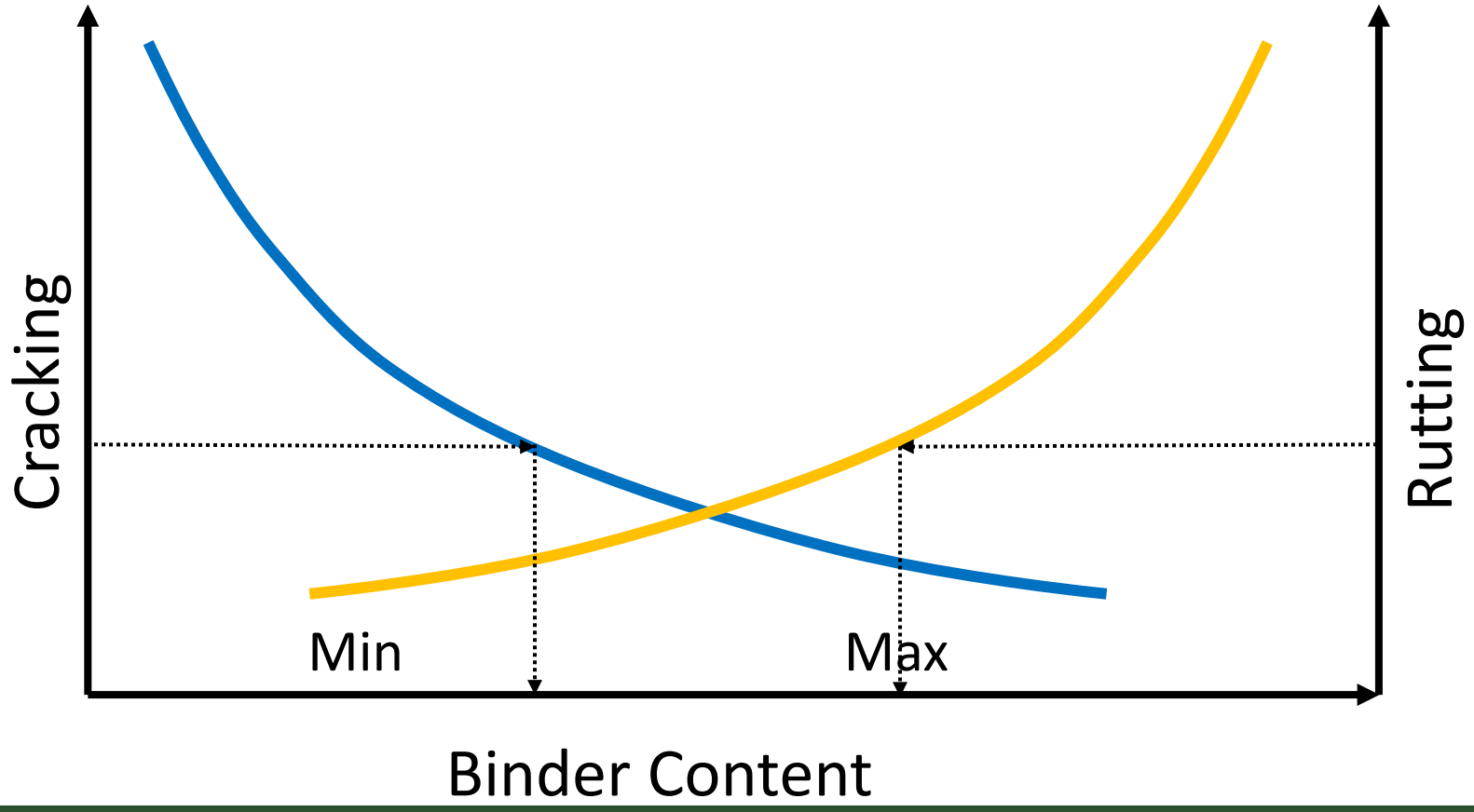
- Fatigue cracking

- Reflection cracking

- Low-temperature cracking

- Moisture damage (stripping)

Balanced Mix Design



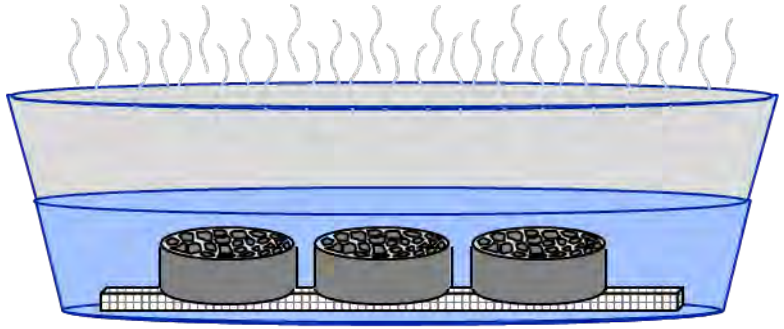
Balanced Mix Design

Approaches:

A. Volumetric design + performance verification
B. Volumetric design + performance optimization
C. Performance-modified volumetric design
D. Performance design

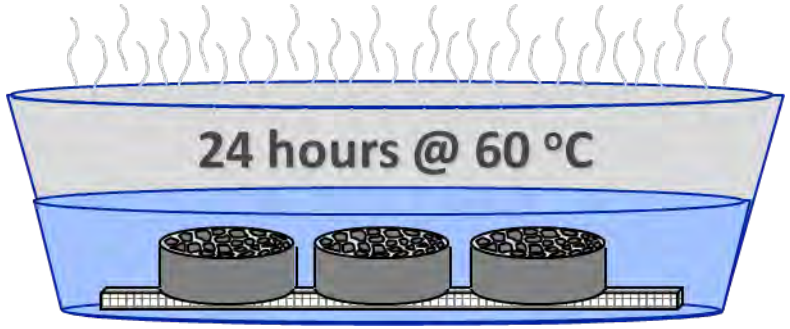
Balanced Mix Design

- Performance Tests
  - Moisture Susceptibility: AASHTO T 283



3 Conditioned Specimens

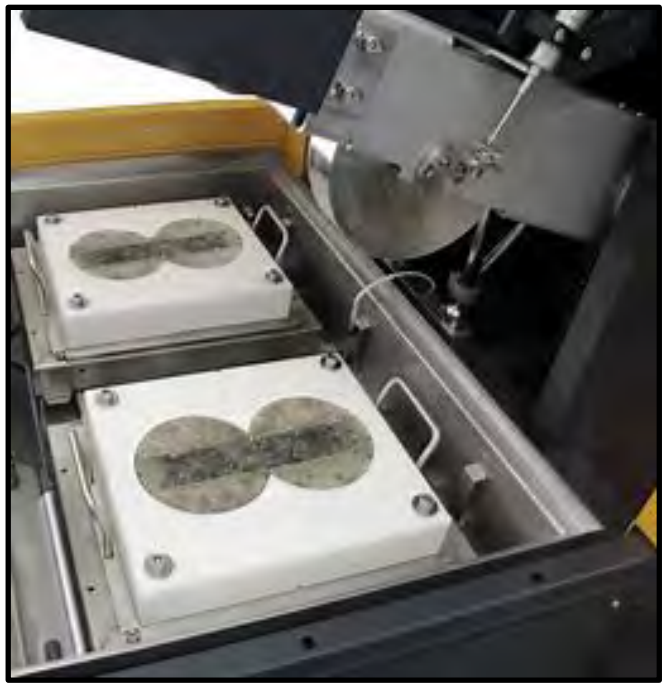
3 Dry Specimens



Tensile Strength Ratio (TSR) > 80%

Balanced Mix Design

- Performance Tests: Rutting
  - Hamburg Wheel Track Test (HWTT)
  - AASHTO T 324
    - 20,000 passes
      - Steel wheel
      - 52 passes/min.



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Balanced Mix Design

- HWTT: AASHTO T 324-22
  - Determine:
    - Slope and intercept
      - First steady-state portion
      - Second steady-state portion
  - Calculate
    - Stripping Inflection Point (SIP)

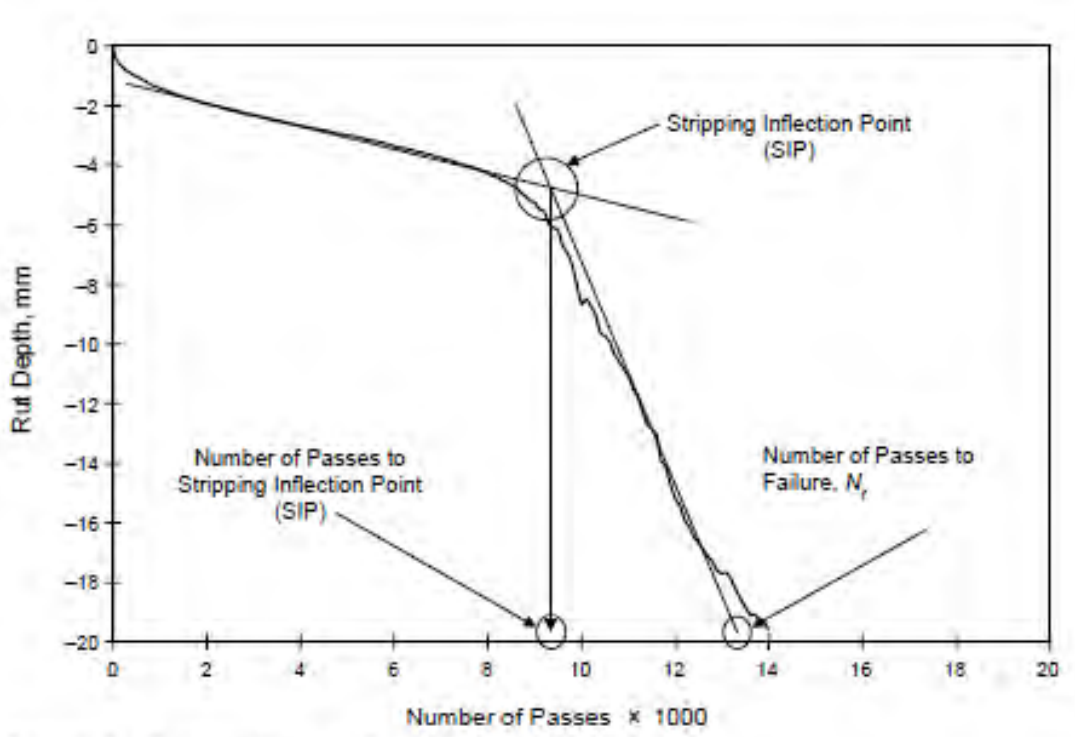
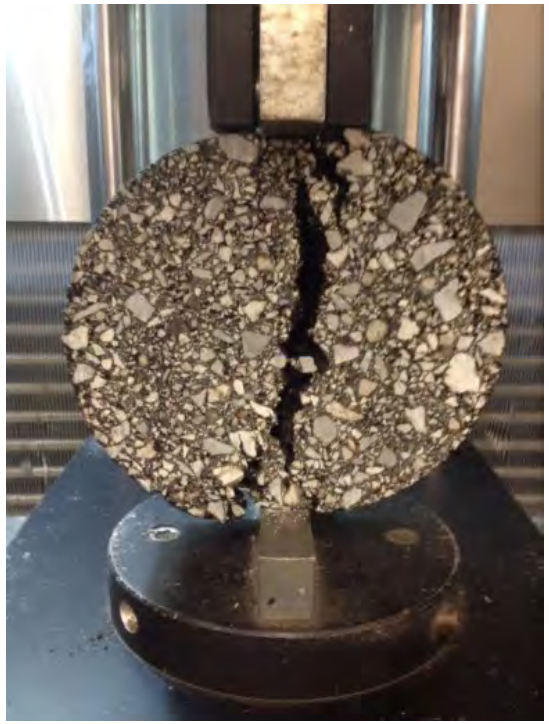


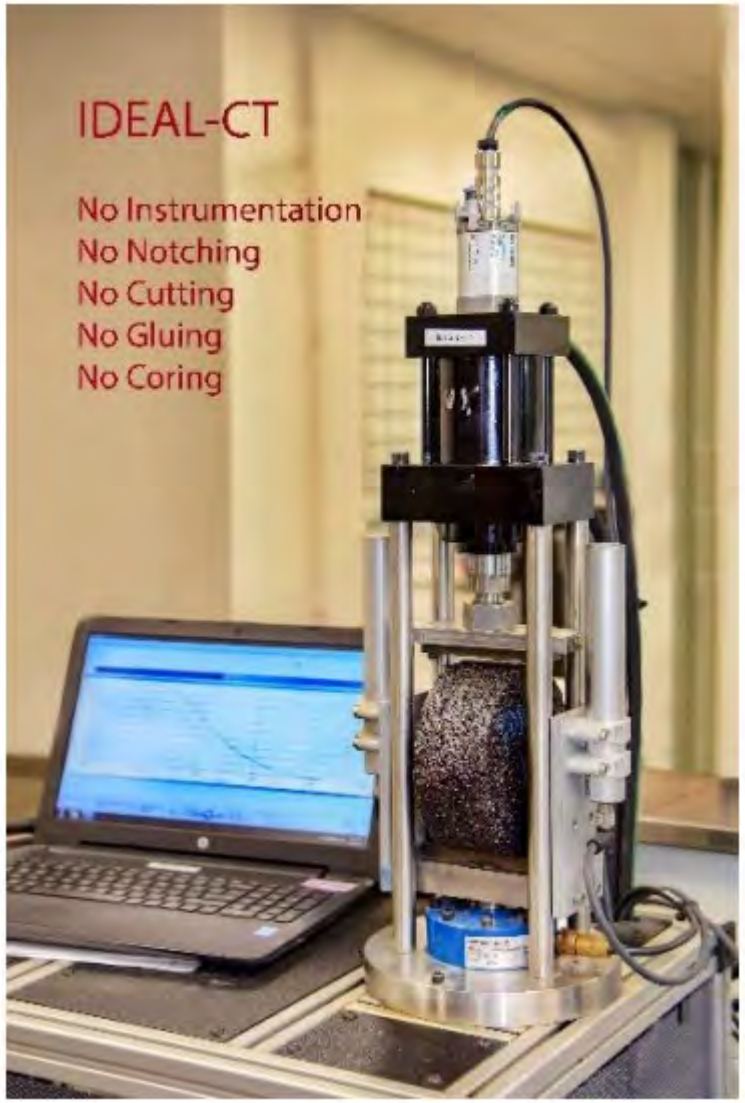
Figure 3—Hamburg Curve with Test Parameters

$$SIP = \frac{intercept\ (2nd\ portion) - intercept\ (1st\ portion)}{slope\ (1st\ portion) - slope\ (2nd\ portion)}$$

Balanced Mix Design

- Performance Testing: Cracking
  - IDEAL CT (ASTM D8225)
    - 50 mm/min load rate
    - 62 mm height
    - 25C test temperature



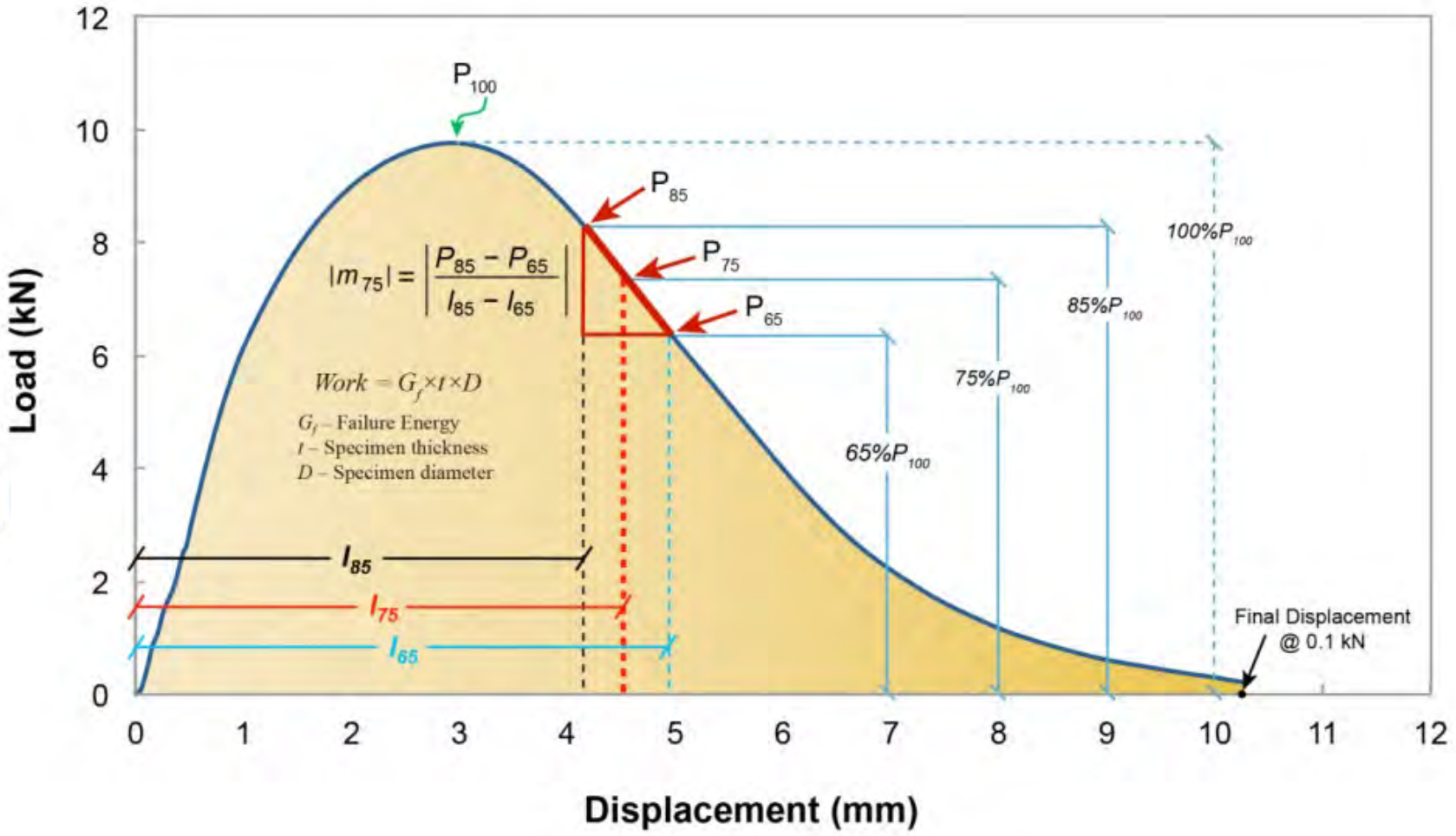


Zhou, F. (2019). NCHRP IDEA Project 195.

Balanced Mix Design

- Cracking: IDEAL CT
  - Fracture energy, G_f:
    - Area under the curve
  - Strain tolerance = l_{75}/D

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



Status of Performance Testing

Testing Status

- HWTT
  - 20 – 100% of mixes tested
  - Average = 79%

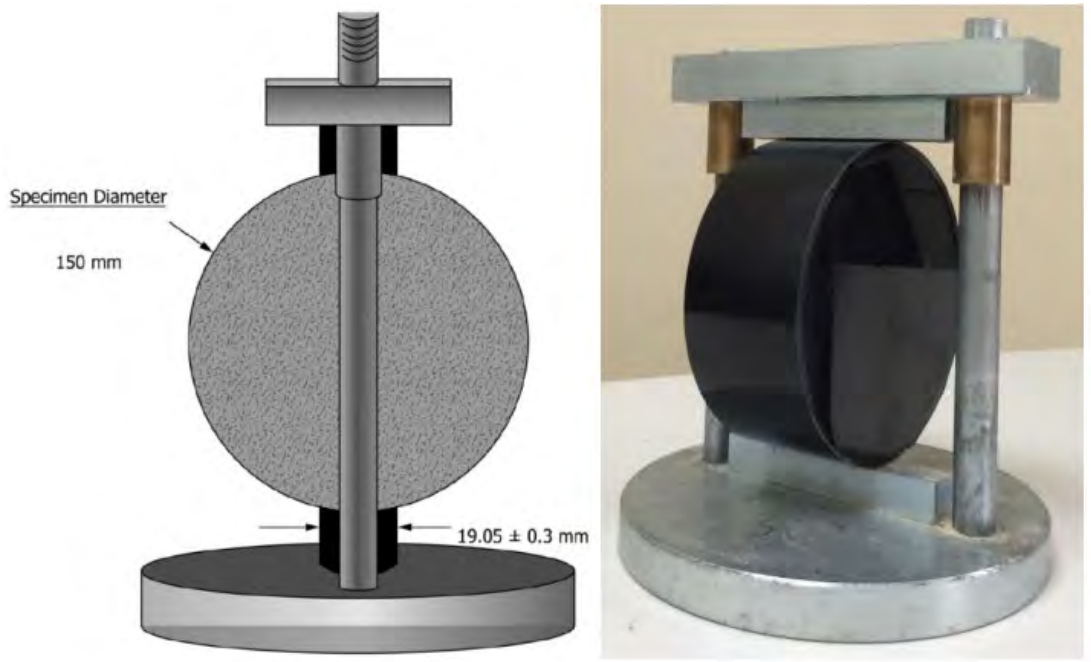
- IDEAL CT
  - 30 – 100% of mixes tested
  - Average = 80%

Testing Status

- HWTT Testing Delays
  - 7 out of 10 experiencing testing delays
  - Outside lab
    - Backlog
    - Software does not output required parameters
  - In-house lab
    - Too many mixes
    - Equipment delayed
    - Software does not output required parameters

Testing Status

- IDEAL CT Testing Delays
  - 3 out of 10 experiencing testing delays
  - Outside lab
    - Backlog
  - In-house lab
    - Too many mixes



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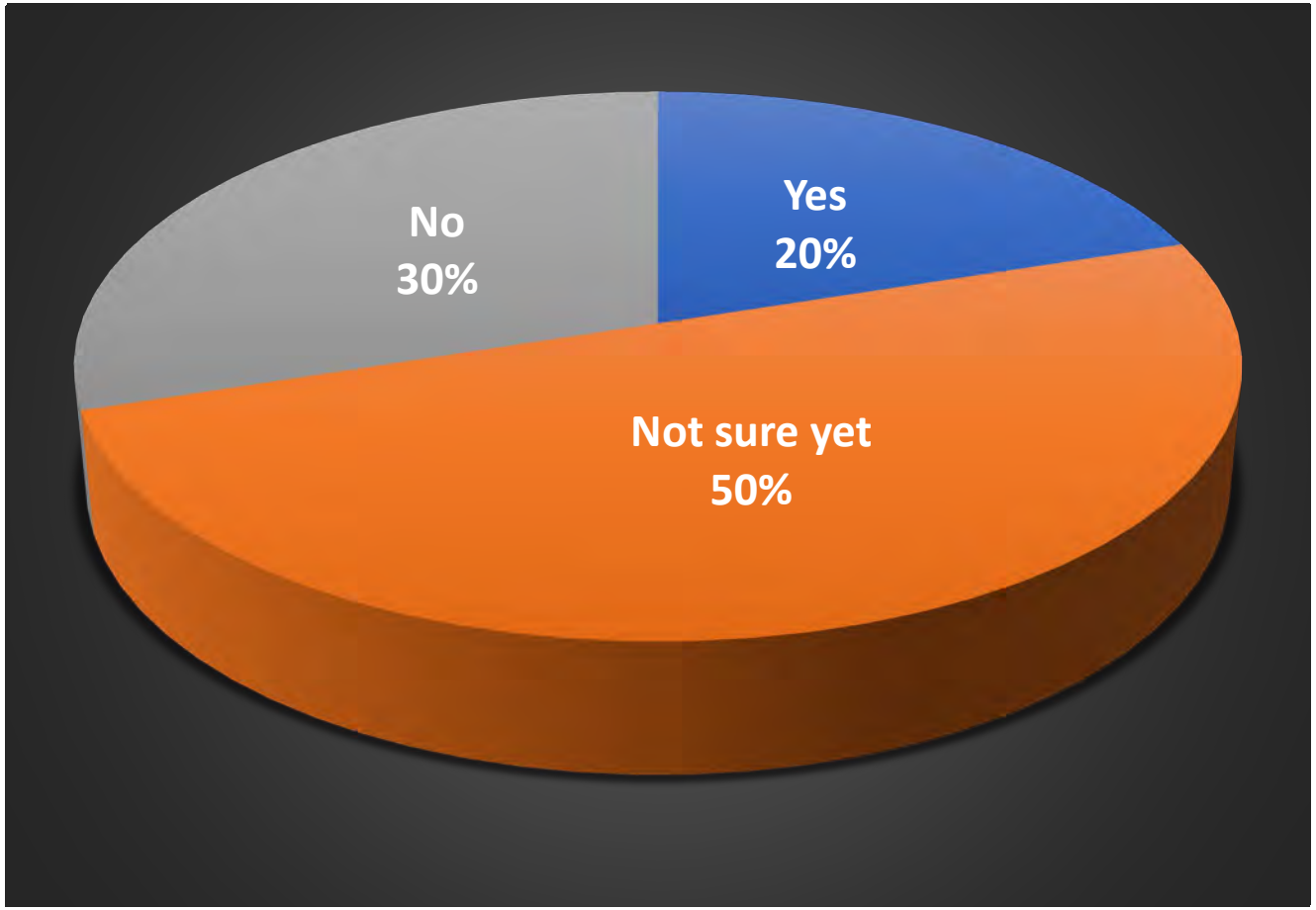
Testing Status

- JMF Submission Delays



Testing Status

- Challenges with eCAMMS
  - HWTT:
    - Entries are numerical, but we get "N/A" from software
      - Passes to 12.5 mm < 10 or 20k
      - SIP can be “N/A”
    - Negative slope or negative SIP
    - Required parameters are not output by all software programs
      - Especially challenging with outside labs
    - drop down menu is not user friendly/not the easiest way to enter data
  - IDEAL CT:
    - Required parameters are not output by all software programs or are labeled differently

Thank you

Mary Robbins, Ph.D., P.E.
Director of Technical Services
mary@pa-asphalt.org
(717) 657-1881 ext. 2
(419) 290-6360