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# The Difference Between Reheating and Production

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# Acknowledgements


- Ilker Boz, Ph.D.
- Jhony Habbouche, Ph.D., P.E.

# The Problem

- Logistics require VDOT to reheat loose mix samples before testing
  - Minimal impact - volumetric properties / gradation
  - Significant impact - mechanical properties
- Current acceptance system
  - Producer: QC and QA testing
  - VDOT: independent monitor testing
- **How can you compare when results change due to reheating the mix?**

# Approach - 2021

- BMD tonnage ~72,000T
  - 10 maintenance schedules, selected routes

Testing Frequency (4,000T lot)

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

Contractor will make VDOT specimens.

# Approach – 2022-2023

- 2022 BMD tonnage ~222,000T
  - 13 maintenance schedules – all 9.5/12.5 A/D mix
- 2023 BMD tonnage ~335,000T
  - 15 maintenance schedules – all 9.5/12.5 A/D mix

Testing Frequency (4,000T lot)

| Property/Test | Frequency (tons) | Total Specimens per Lot |
|---|---|---|
| CT index – QC | 2,000 | 10 |
| Cantabro – QC | 2,000 | 6 |
| CT index – 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.**

# Approach - 2024

- Continue increase in BMD tonnage
  - Producers making VDOT samples not sustainable
- VDOT will fabricate own specimens
  - Loose mix - reheated and compacted

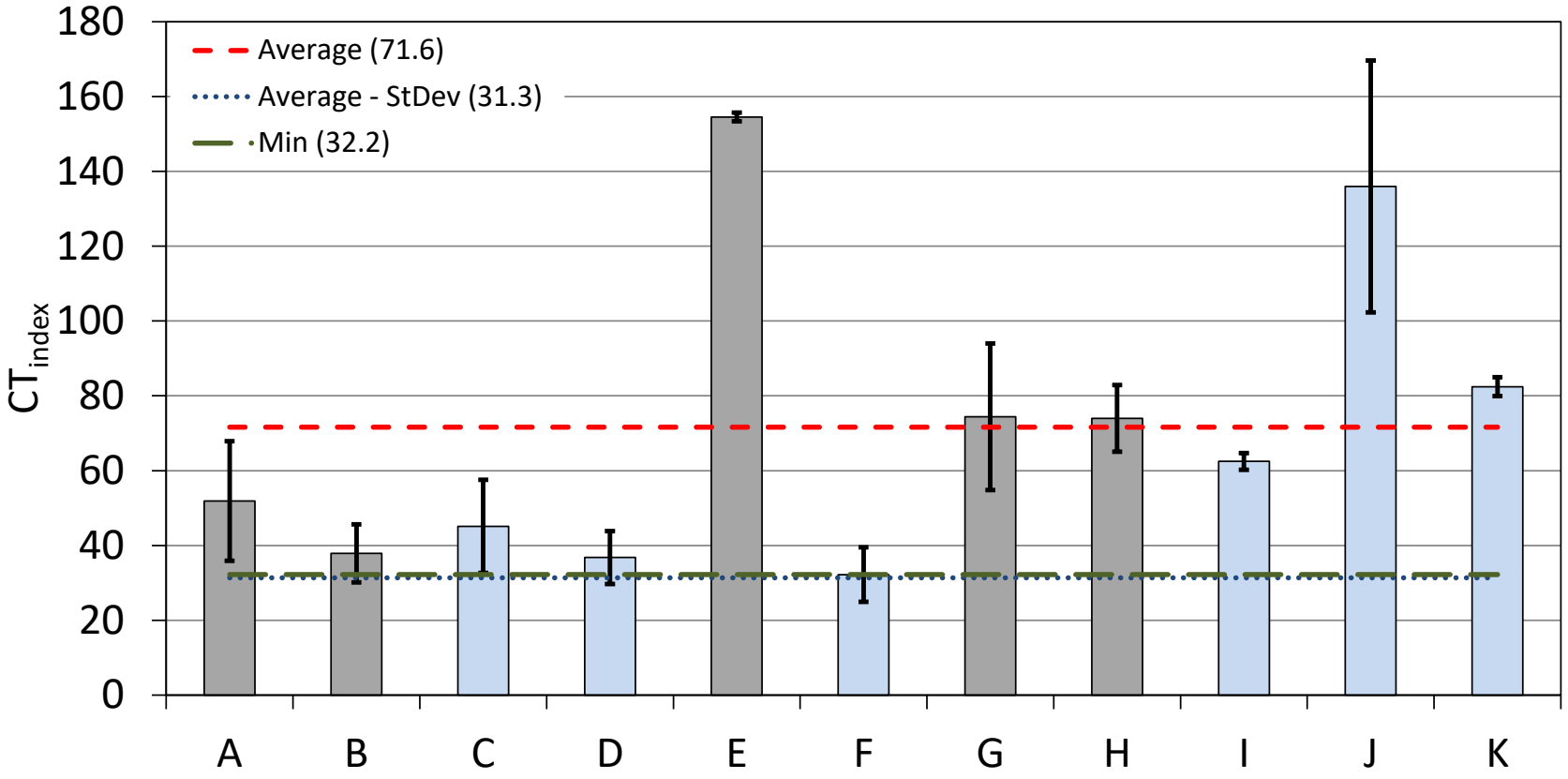
- How do we handle the difference in results?

→ **Criteria for plant-made / non-reheat specimens**

# BMD Criteria Development

- CT index
- Based on benchmarked mixes
  - 11 mixes sampled in 2015
  - Specimens fabricated from **reheated** loose mix
  - Data analysis
    - Method 1 – minimum value
    - Method 2 – average value
    - Method 3 – average ± one standard deviation

# Benchmarking CT index



# Initial Selection

- Cracking is most prevalent distress
  - Fatigue – top-down or bottom-up
  - Reflective cracking
- Need to improve cracking without causing rutting
- Most conservative CT index selected for criteria: **70**
  - Based on **reheated** loose mix
  - 9.5 and 12.5 NMAS surface mixes
  - Ten mixes - PG 64S-22 with 25%+ RAP
  - One mix - PG 64V-22 with 15% RAP

# Addressing Non-reheated Specimens

- What about mix compacted at plant?
  - No reheating = less aging

- Need to develop criteria for specimens fabricated from non-reheated mix at the plant
  - Non-reheat and reheat mix comparisons available
  - 2019, 2020, 2021

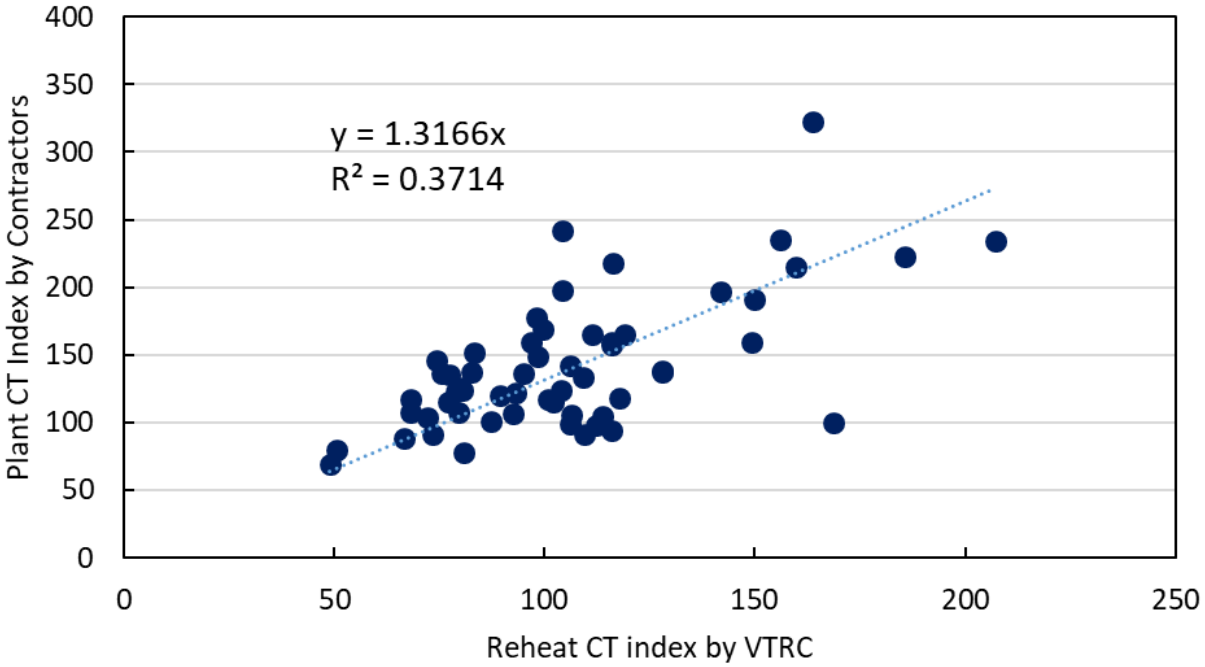
# Non-reheat CTindex Statistical Evaluation

- Evaluate threshold based on statistical distribution of non-reheat CTindex values from BMD mixes
  - similar to how the reheat threshold was established

| Variable | N | Mean | StDev | Min | Q1 | Q3 | Max |
|---|---|---|---|---|---|---|---|
| CTindex | 57 | 141.7 | 49 | 69 | 106.4 | 162.2 | 322.8 |

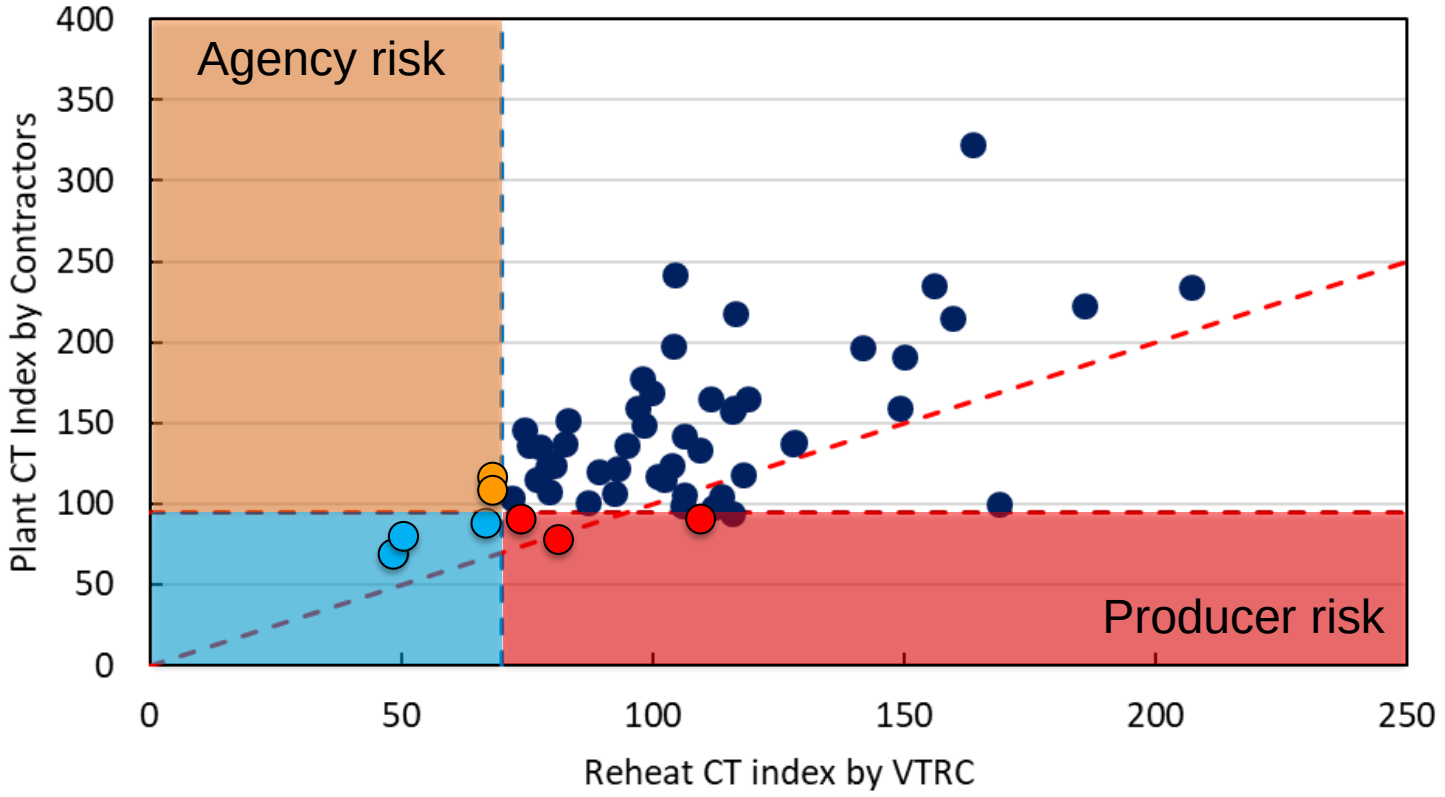
  - Mean – 1 StDev: 92.7
  - Q1 value (25%): 106.4
  - Other percentiles: 88.4 (5%), 94.4 (10%), 99 (15%), and 104 (20%)

# Reheat vs Non-reheat




- Non-reheat CT index of 92.2 corresponds to reheat CT index of 70
- Select non-reheat CT index of 95 for simplicity

# Risk of Failure: Non-reheat CT index < 95

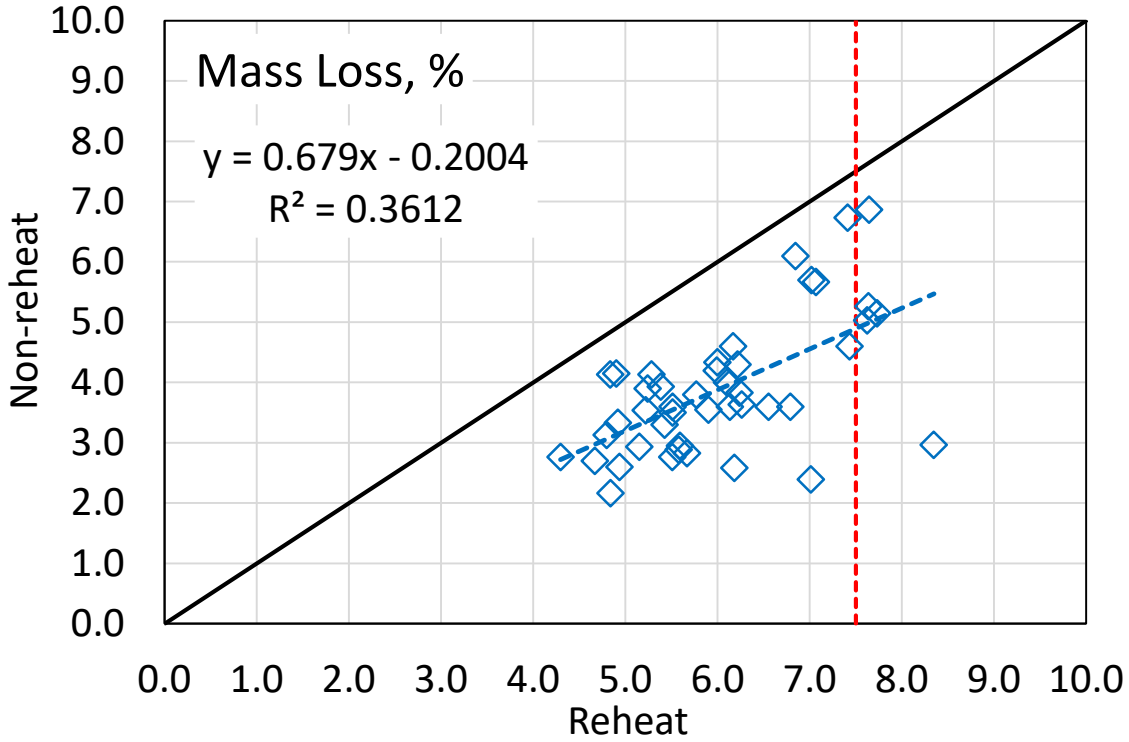


# VDOT BMD Criteria (2024)

| Distress | Test | Limit |
|---|---|---|
| Cracking | IDT-CT (reheat) | 70 (min) |
| | IDT-CT (non-reheat) | 95 (min) |
| Rutting | APA rut test | 8mm (max) |
| | IDT-HT (wet) | report only<br>100kPa (min) |
| Durability | Cantabro | 7.5% (max) |
| Moisture | Tensile Strength Ratio | 80% (min) |

# Next Steps – Other Tests

- Cantabro Mass Loss
- IDT-HT Strength



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# Thank you!

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