Asphalt Pavement
The Inspector Perspective
Current Issues in Aviation

Canadian Airfield Pavement Technical Group Seminar

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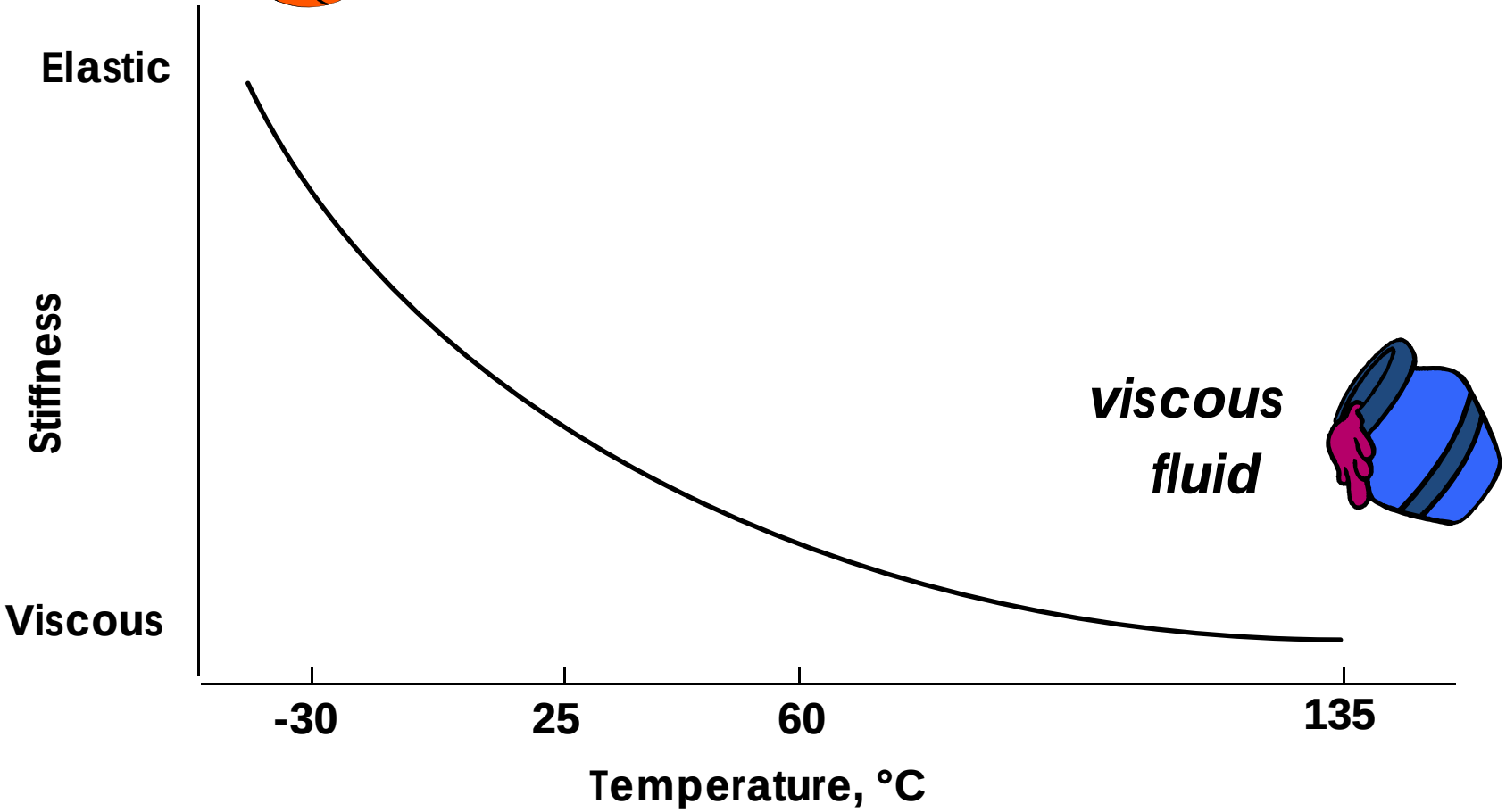
Outline

The Inspector's Perspective

- Better Asphalt Binders
  - Multiple Stress Creep Recovery (MSCR) Test
- Longitudinal Joints
- Smoothness

Asphalt Behavior w/ Temperature

elastic solid



viscous fluid

Reference: MS-22, Figure 2.04


Asphalt Binders that are “Soft” at High Temps can contribute to Rutting
Plastic Deformation (Rutting)

Overly “Stiff” Asphalt Binders are Responsible for Thermal Cracking

Binder in Hot Mix Asphalt (HMA)

- **One of two primary components of HMA**
  - **Roughly 5-8% by weight of mix**
- **Is "glue" of HMA**
- **Influences high temperature, low temp. and aging behaviors of HMA**

Asphalt Behavior Depends On:

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- **Temperature**
- **Time of Loading**
- **Aging**

  (properties change with time)

Asphalt Behavior at Varying Temperatures

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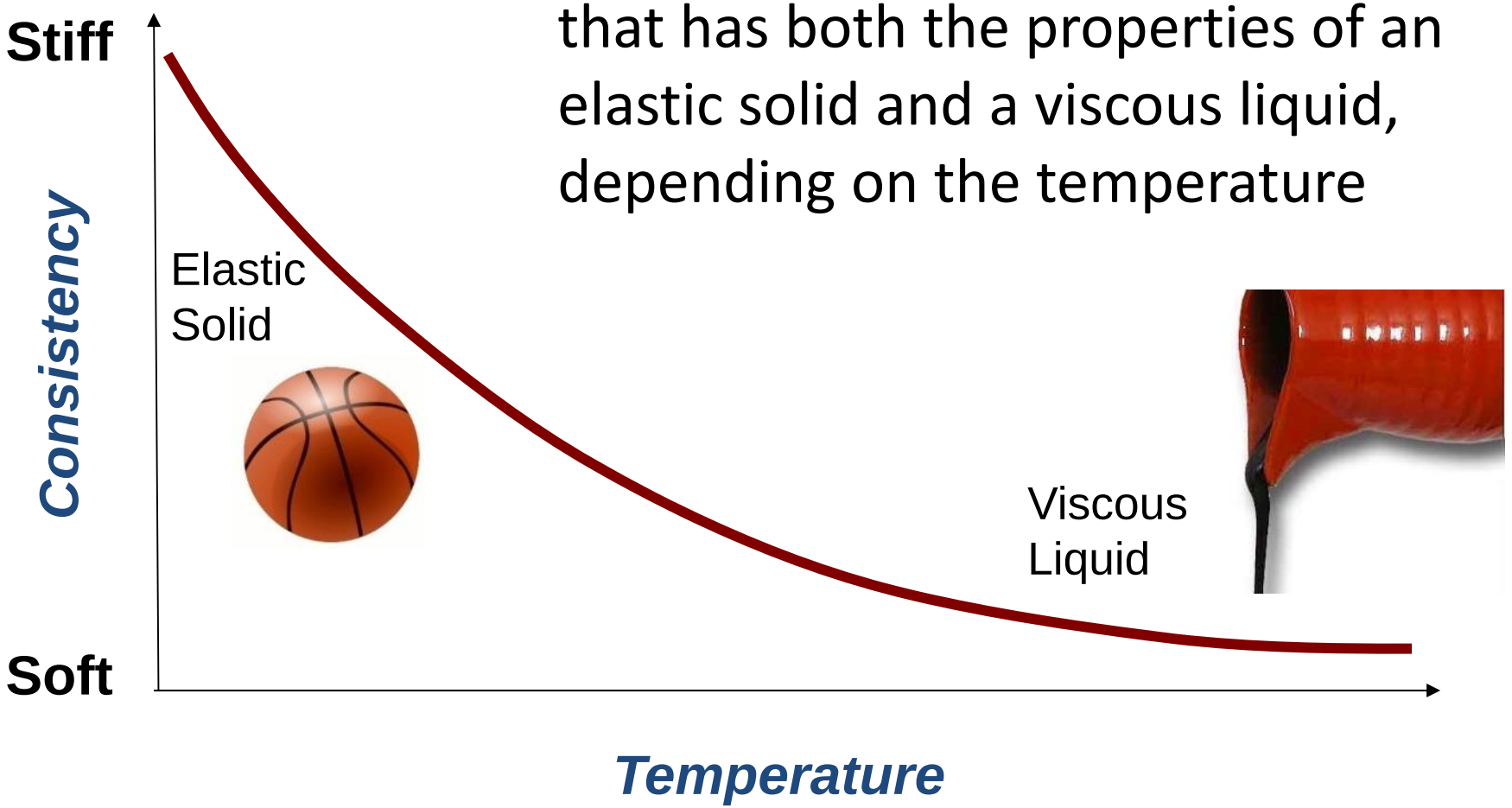
Asphalt is a *viscoelastic* material that has both the properties of an elastic solid and a viscous liquid, depending on the temperature



Asphalt Flow Behavior

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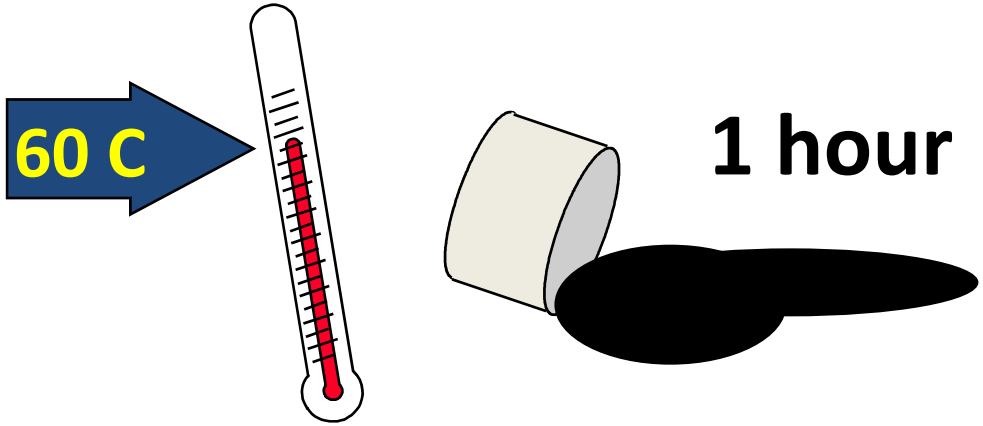

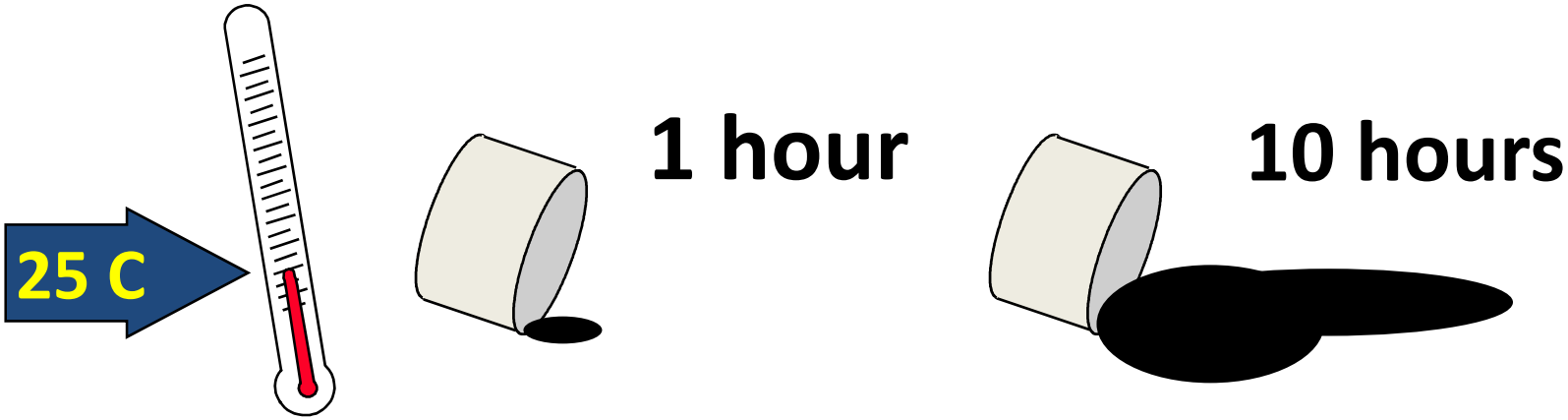

Time of Loading

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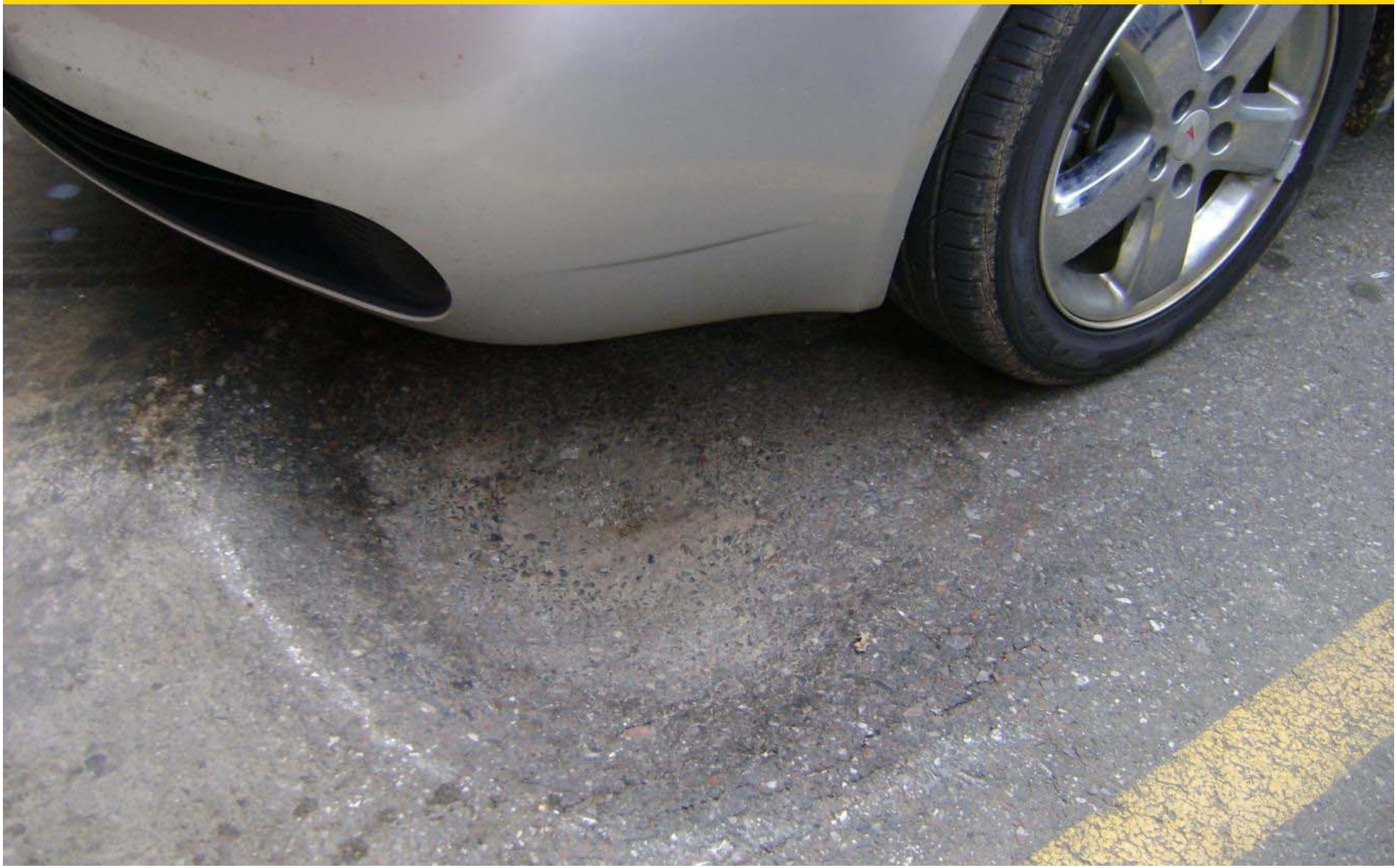

Asphalt aging over the pavement life

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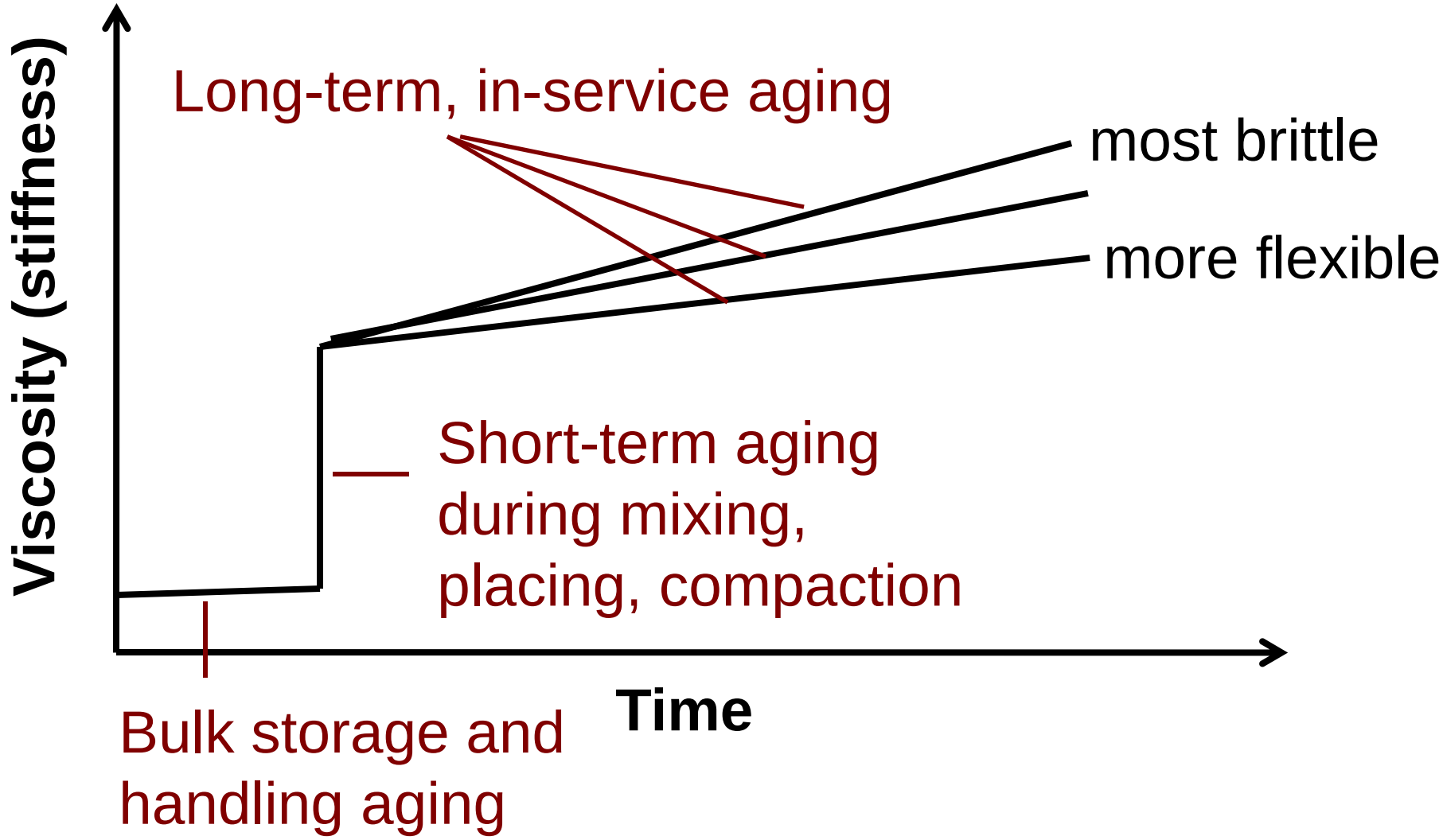
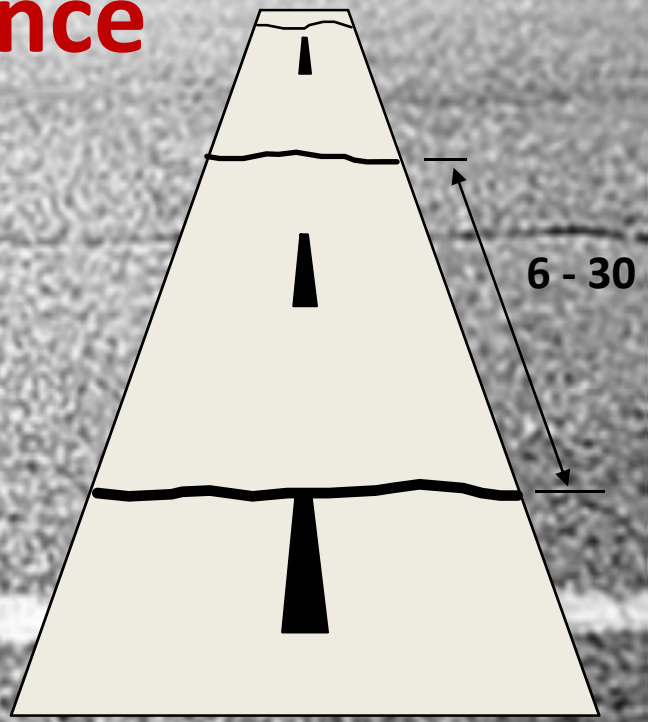
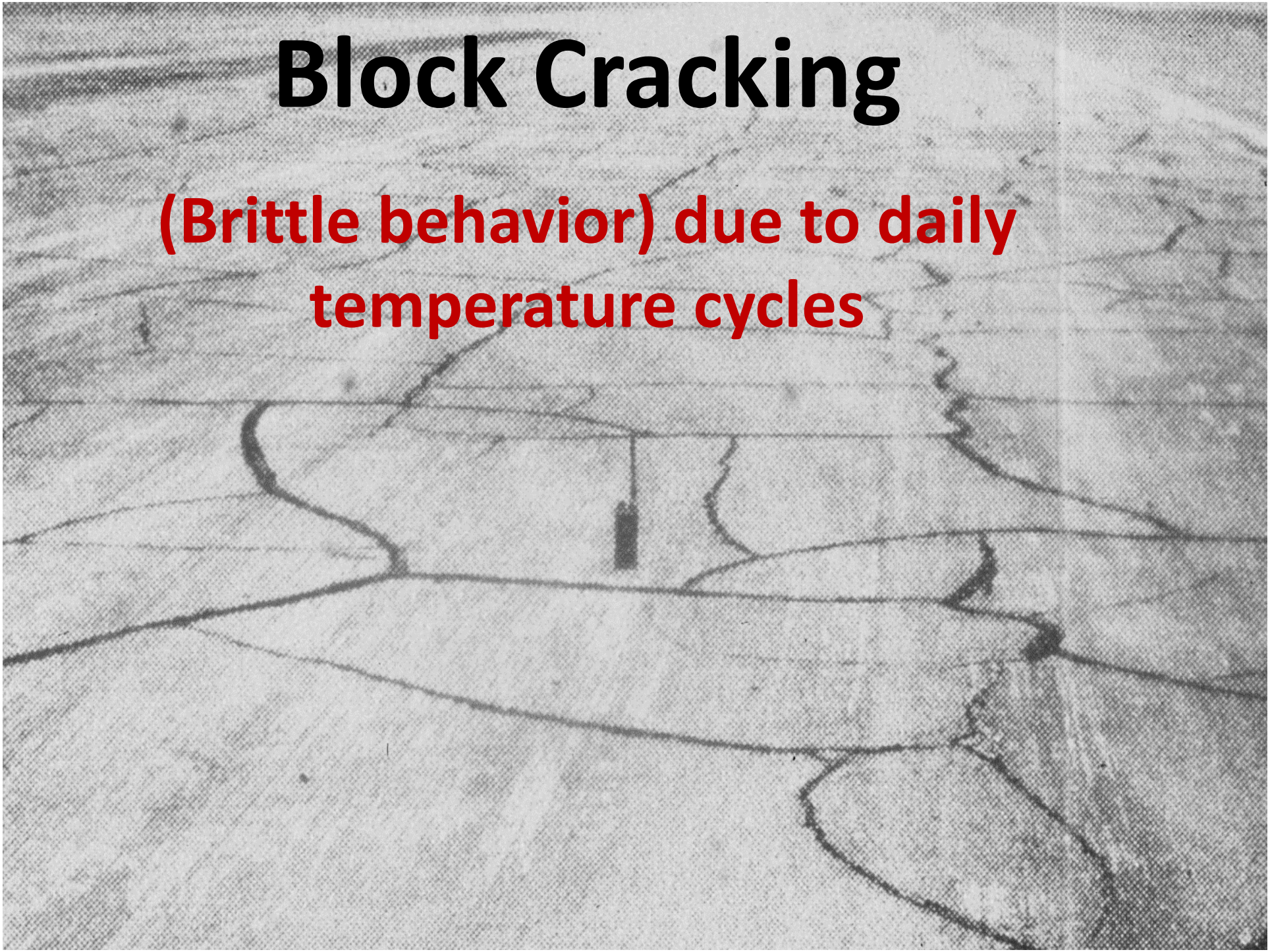


Thermal (Low Temp) Cracking

single event occurrence



Block Cracking



(Brittle behavior) due to daily temperature cycles

Polymer-modified Asphalt Binder

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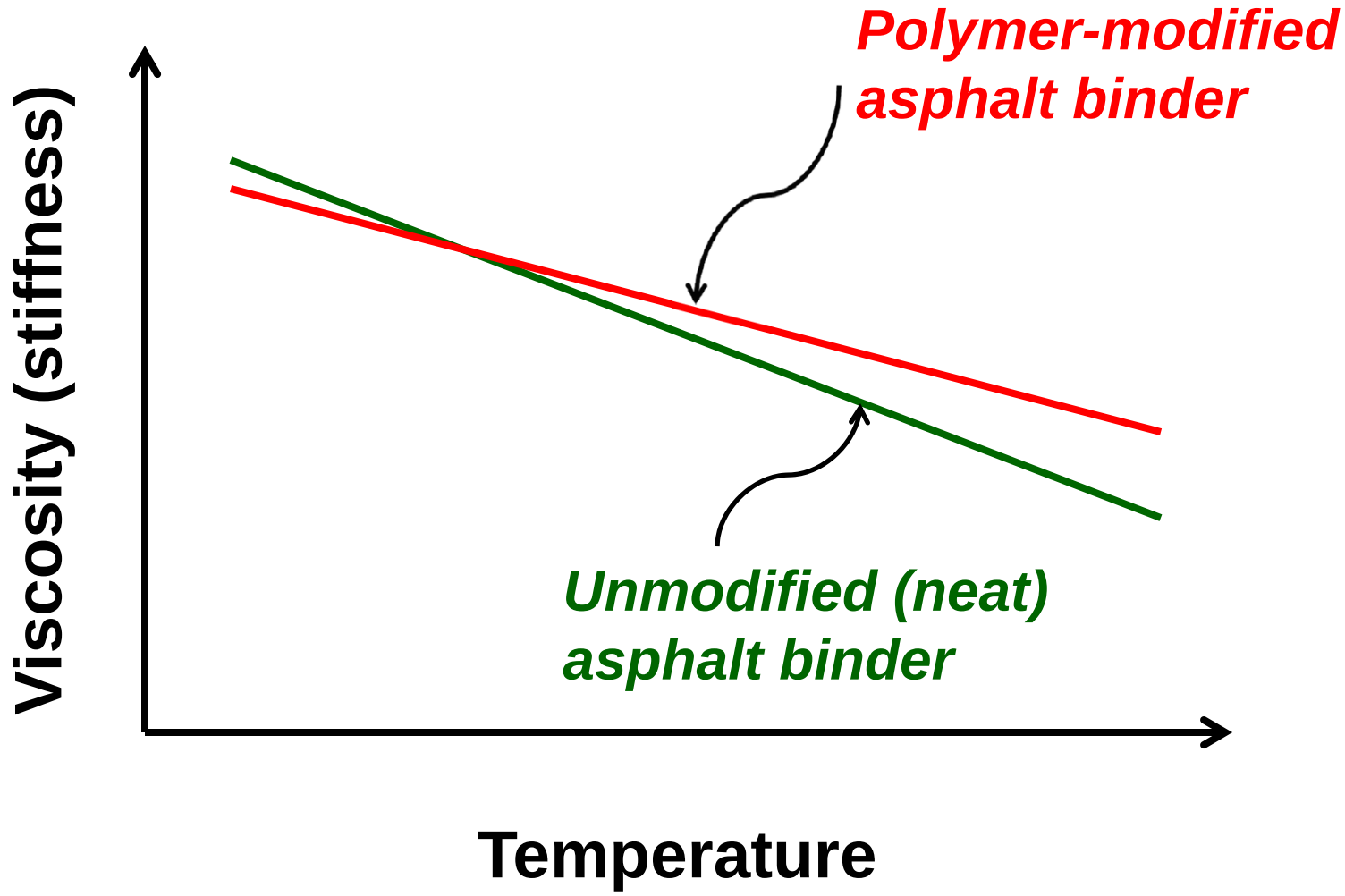
General Performance



Shortcomings of PG Binder Spec

- Current PG specifications are based on studies of "neat" asphalt
- G* and δ are measured in linear range
- This is okay for **neat asphalts** because the flow behavior is more linear and not sensitive to stress level
- For **polymer modified asphalt**, flow behavior is stress-sensitive
  - polymer chains can be re-arranged as stress levels increase

Ready for the MSCR?

- **M**ultiple **S**tress **C**reep **R**ecovery
- Creep and Recovery

  Standard test protocol whereby a specimen is subjected to a constant load for a fixed time period and then allowed to relax (recover) at zero load for a fixed time period.

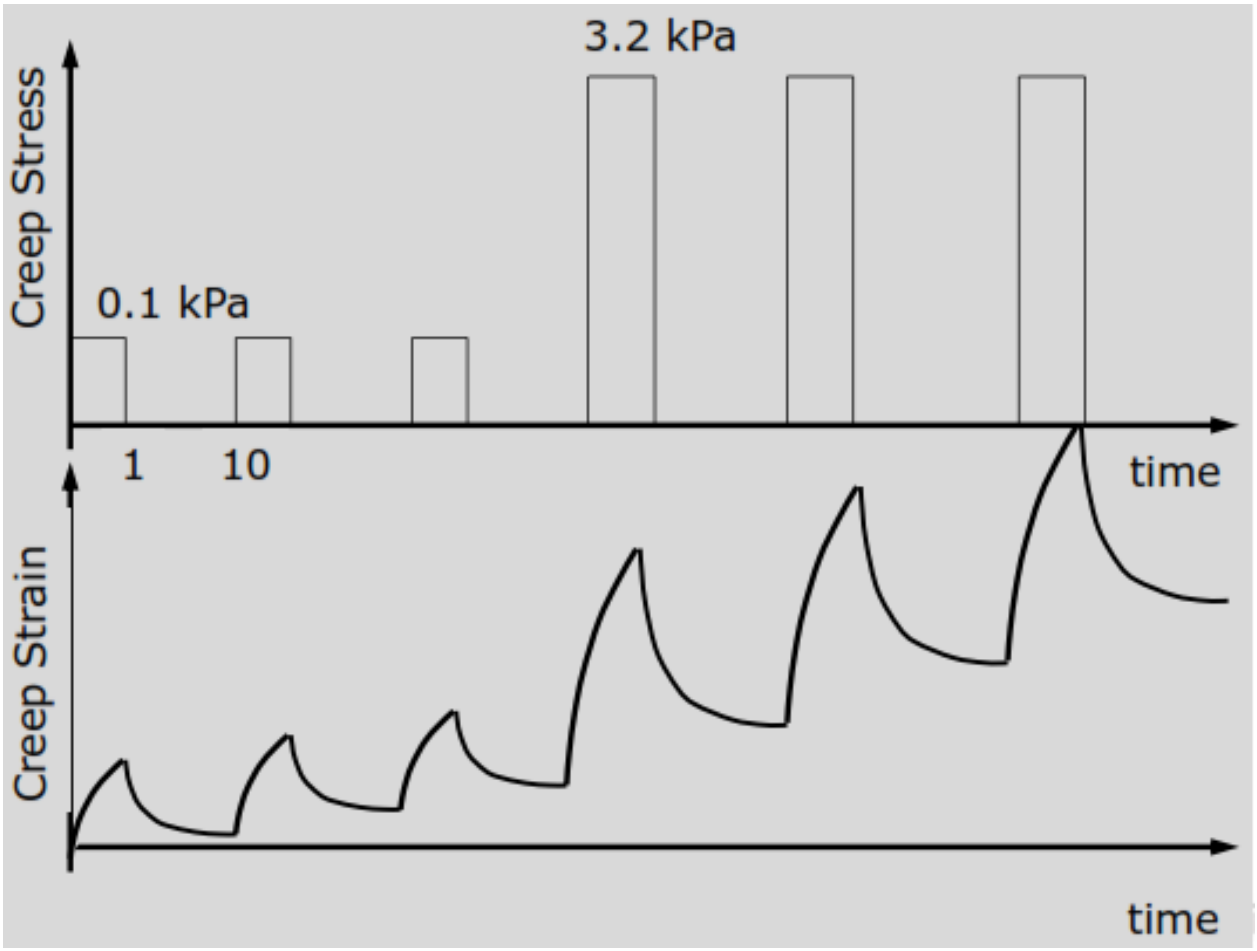
- Percent Recovery

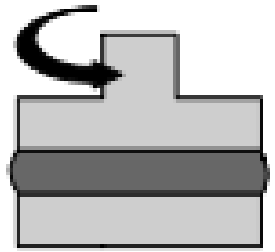
  A measure of how much the sample returns to its previous shape after being repeatedly stretched and relaxed.

- Non-recoverable Creep Compliance, J_{nr}

  A measure the residual strain left in the specimen after creep and recovery, relative to the applied stress.

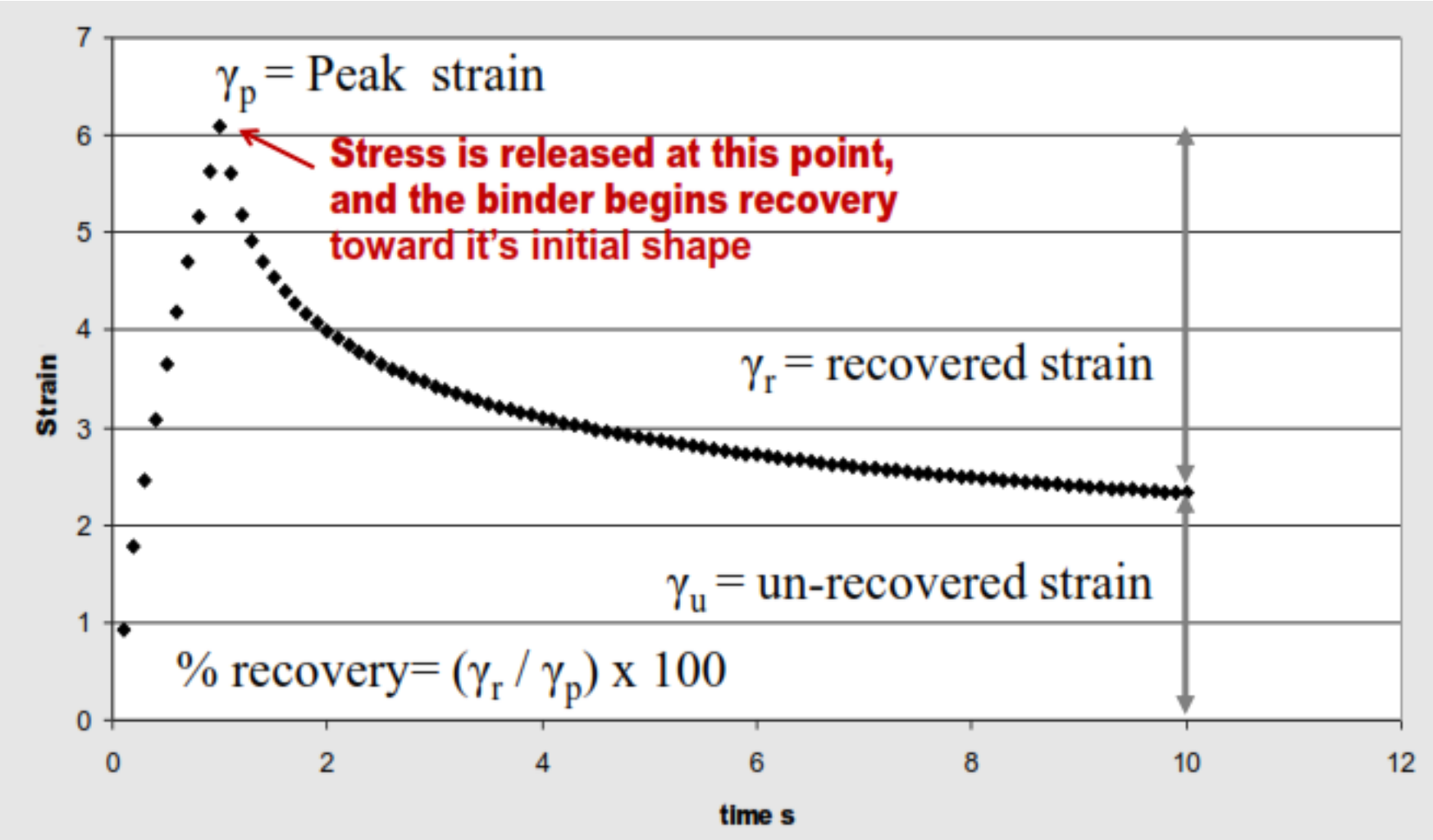
MSCR



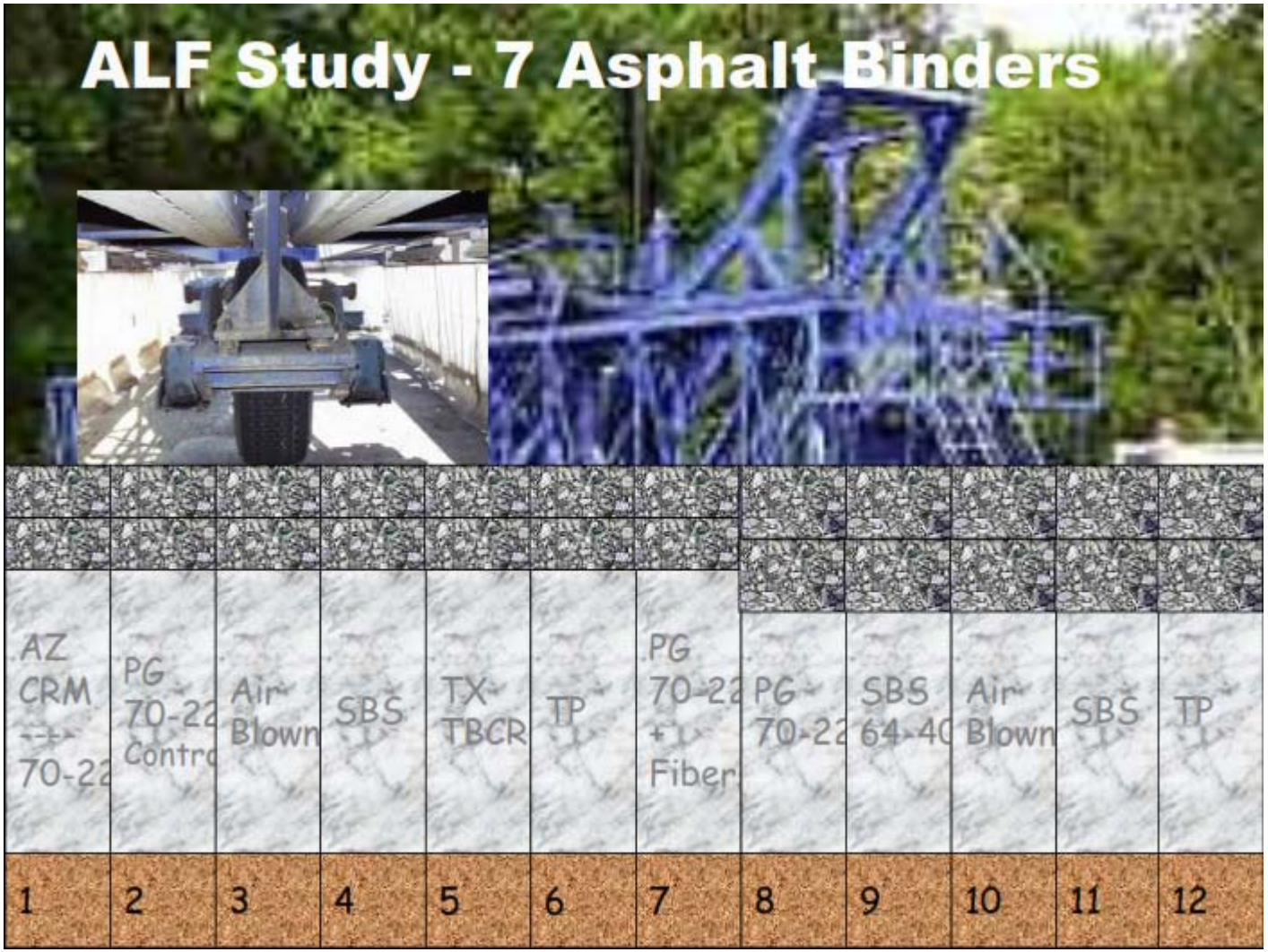


Standard **Dynamic Shear Rheometer** equipment modified to apply a 1 second load followed by a 9 second recovery

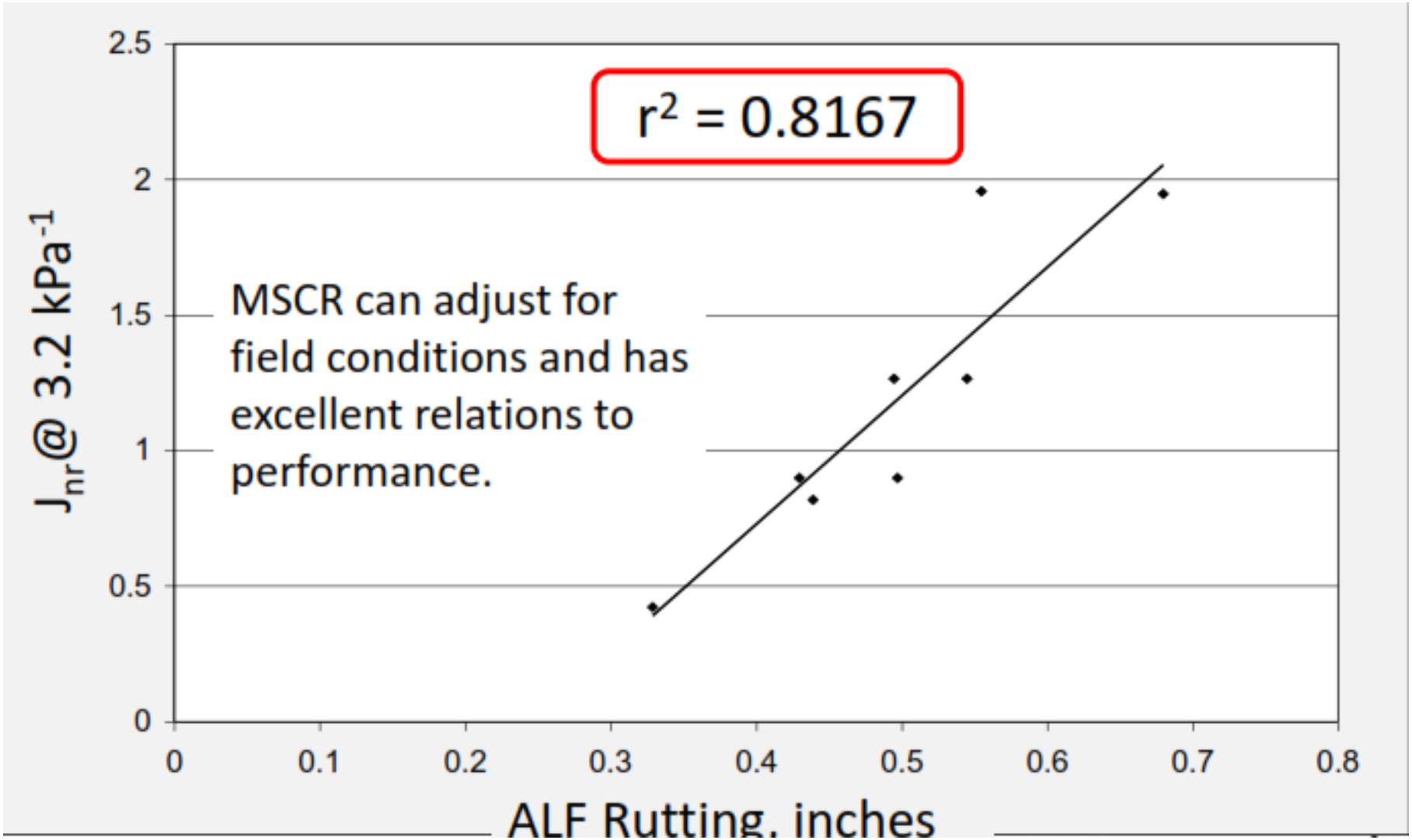
Measuring % Recoverable Strain



J_{nr} Correlates to Rut Performance



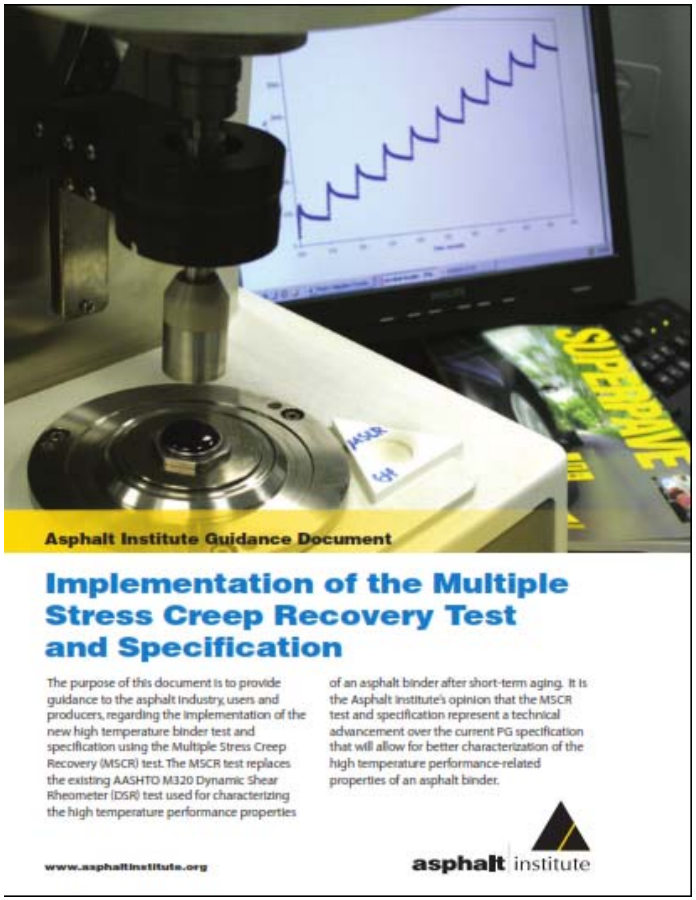
J_{nr} Correlates to Rutting Performance



For Further Information

- Asphalt Institute website has a free 2 hour webinar and other downloadable information.

www.asphaltinstitute.org



Longitudinal Joints

Compacting Confined Edges

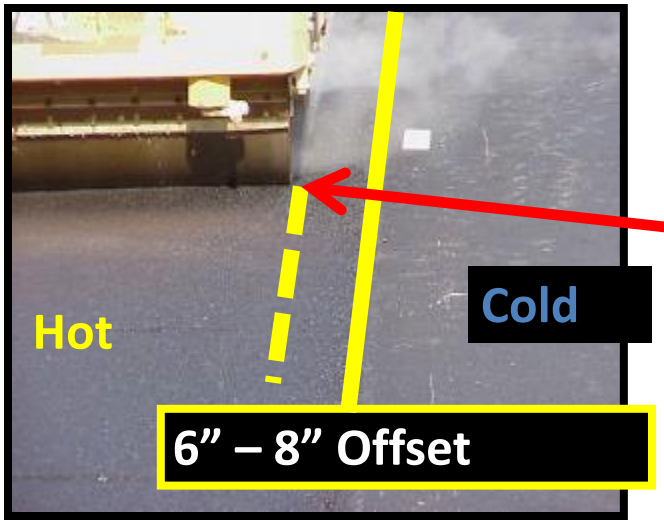
- Roll in vibratory mode "on the hot side" to force material against the joint
- Overlap cold joint 4-6"
- Only if necessary, roll in static mode to avoid breaking aggregate on the cold side
- Never starve joint
  - Enough mix at the joint to prevent bridging

Longitudinal Joints

Compacting Confined Edges

Additional Option # 1

- First pass keep both drums in vibratory mode on the hot side to force material against the joint
- Second pass about 6” overlapping the cold side



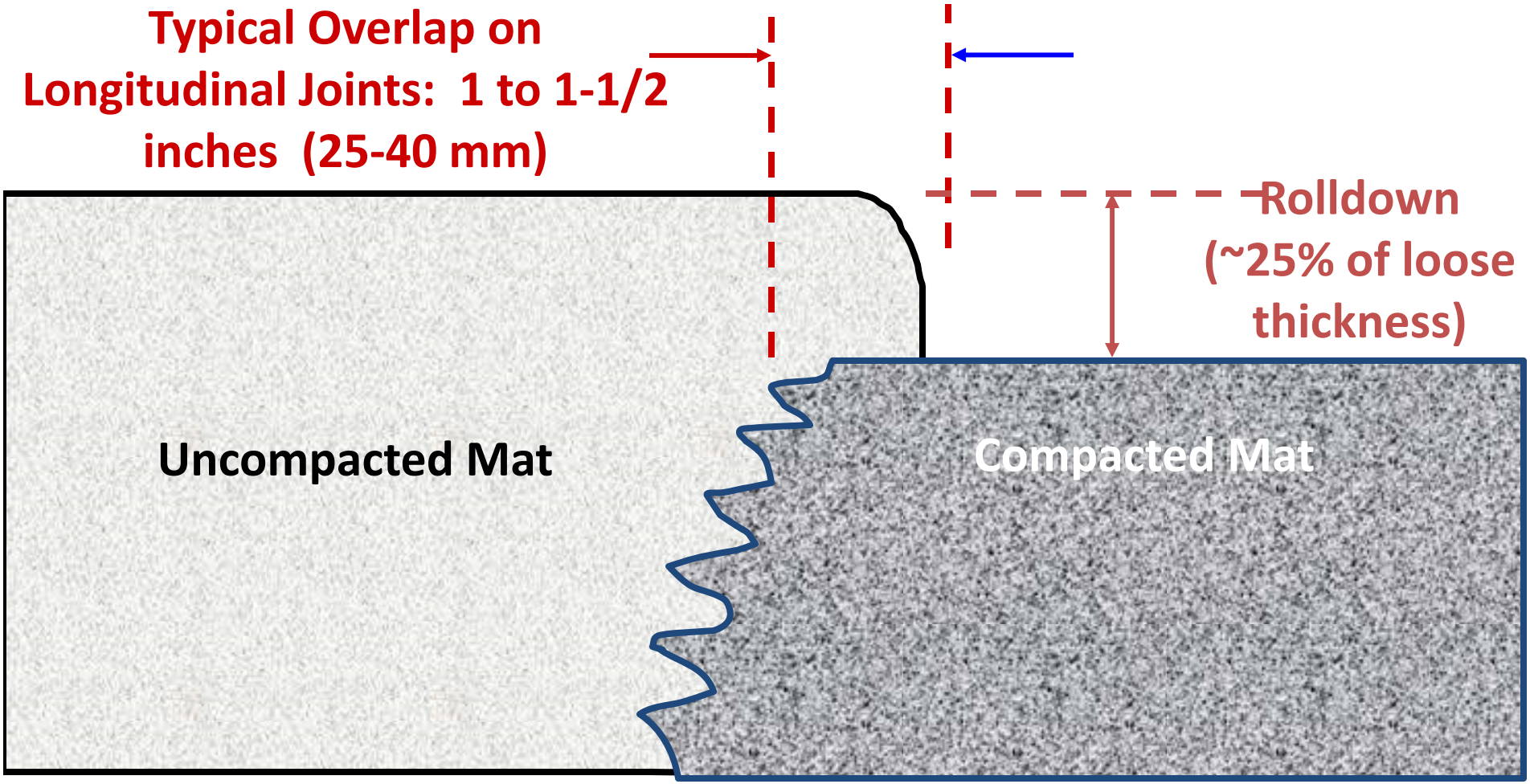
Additional Option # 2

- First pass about 6” inside the joint on hot side
- Second pass about 6” overlapping the cold side

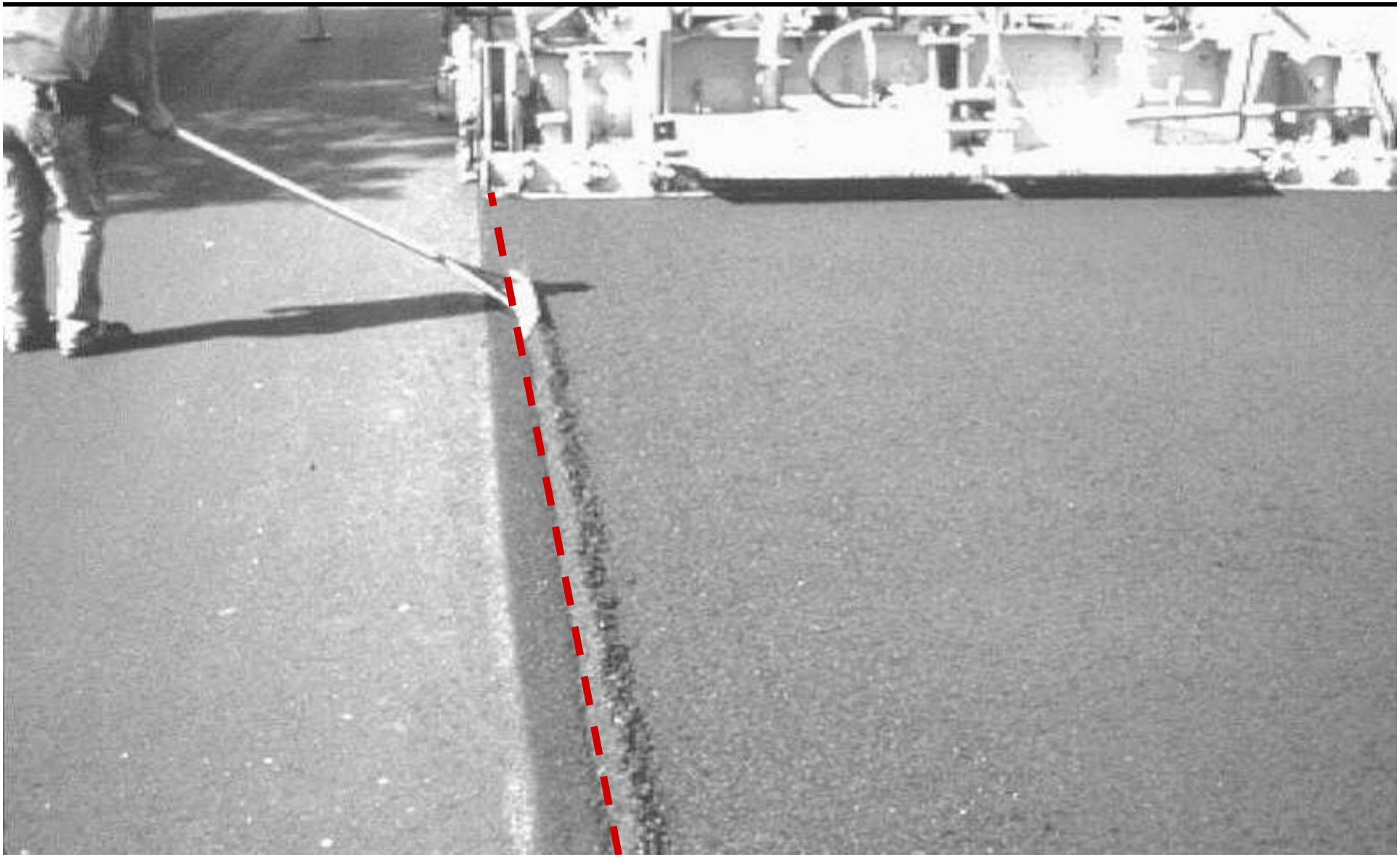
Not a Good Idea - Rolling from the Cold Side

- Pavement was rolled from the cold side, overlapping the hot side about 6”
- It was rolled in vibratory mode, fracturing the aggregate in a line on the cold side
- You can count the impacts, far less than 10 per foot

Longitudinal Joints

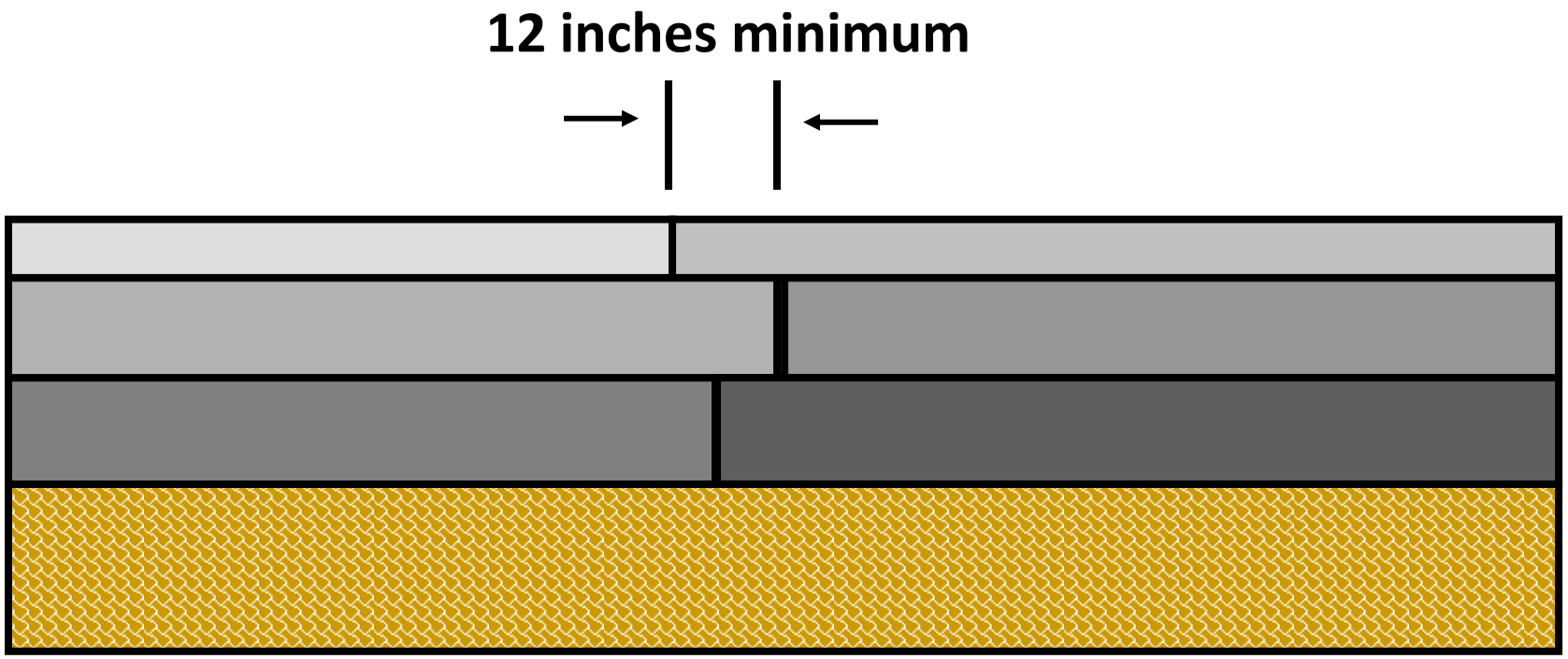


Bumping Longitudinal Joint



Starving Joint

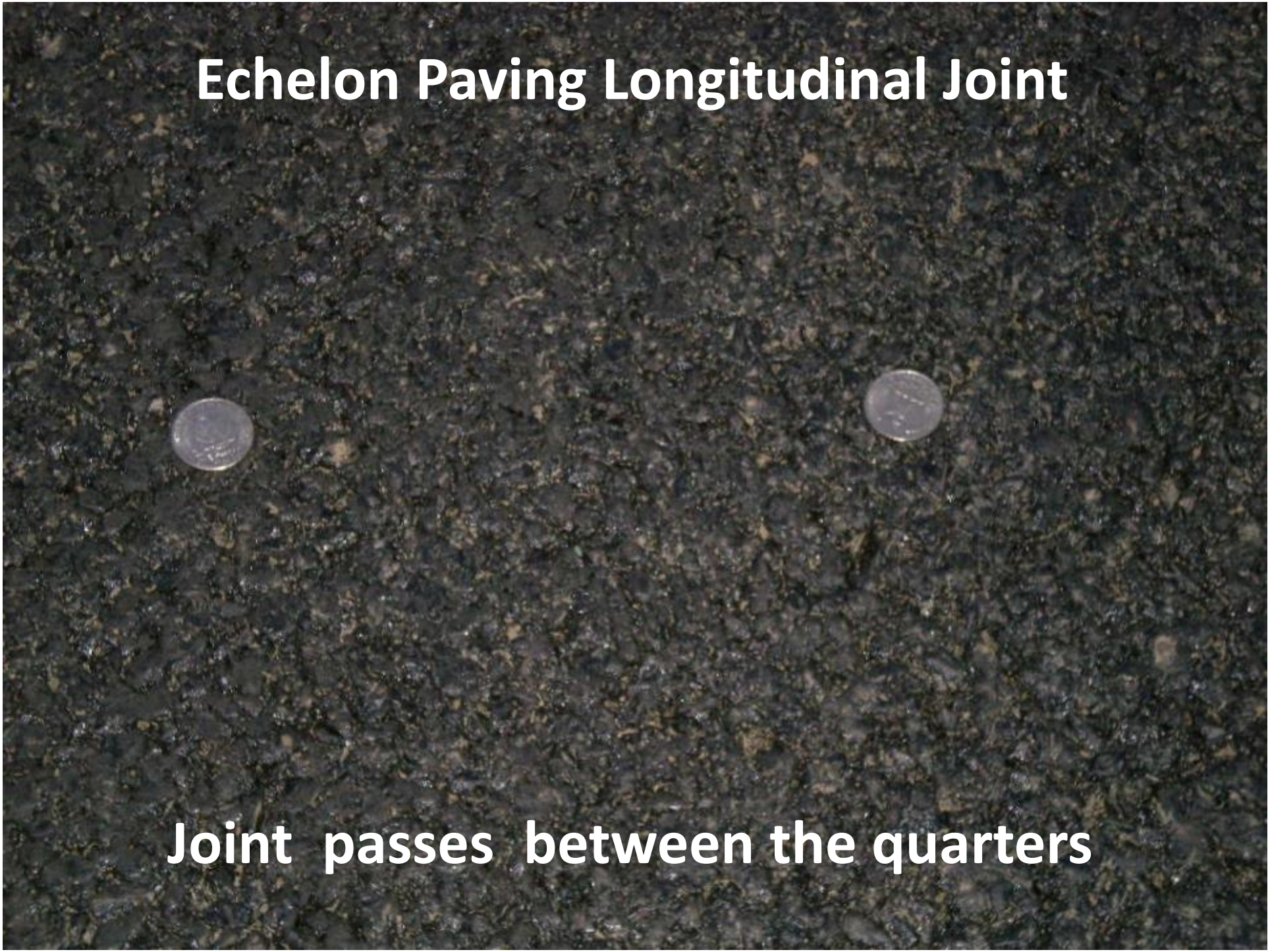
Staggered Longitudinal Joints



Surface joint must fall on centerline

The Best Longitudinal Joint:
Echelon Paving

Rolled Hot


Echelon Paving Longitudinal Joint
Joint passes between the quarters

Surface Irregularities

The primary purpose of smoothness testing is to identify areas that may be prone to ponding of water which could lead to hydroplaning.

Surface Irregularities

Initial Pavement Smoothness vs Average Annual Maintenance Costs

Source: Janoff 1991, in NCHRP 1-31

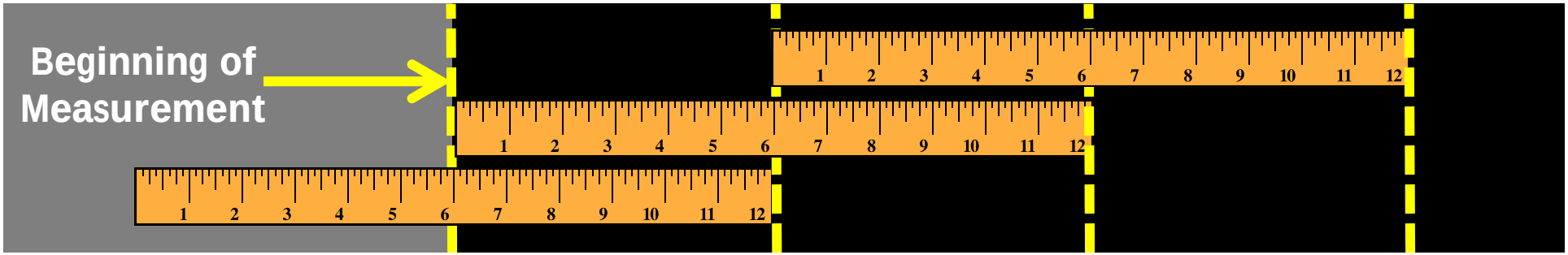
ACCEPTANCE CRITERIA - SMOOTHNESS

The 12-Foot Straightedge

ACCEPTANCE CRITERIA - SMOOTHNESS

12-Foot Straightedge

- Performed within 24 hours of placement of material for each lot
- Used to test LONGITUDINAL short sections (<200ft) and TRANSVERSE direction
- How to measure: Start with ½ the length of the straight edge off the new mat. Continue to measure by overlapping with ½ the length of the straight edge.
- Max deviation 0.25-inch (6mm) per 12-feet (3.7m) straightedge
- High points will be corrected using diamond grinding per paragraph 401-4.15 or by removing and replacing full depth of the surface course.



ACCEPTANCE CRITERIA - SMOOTHNESS

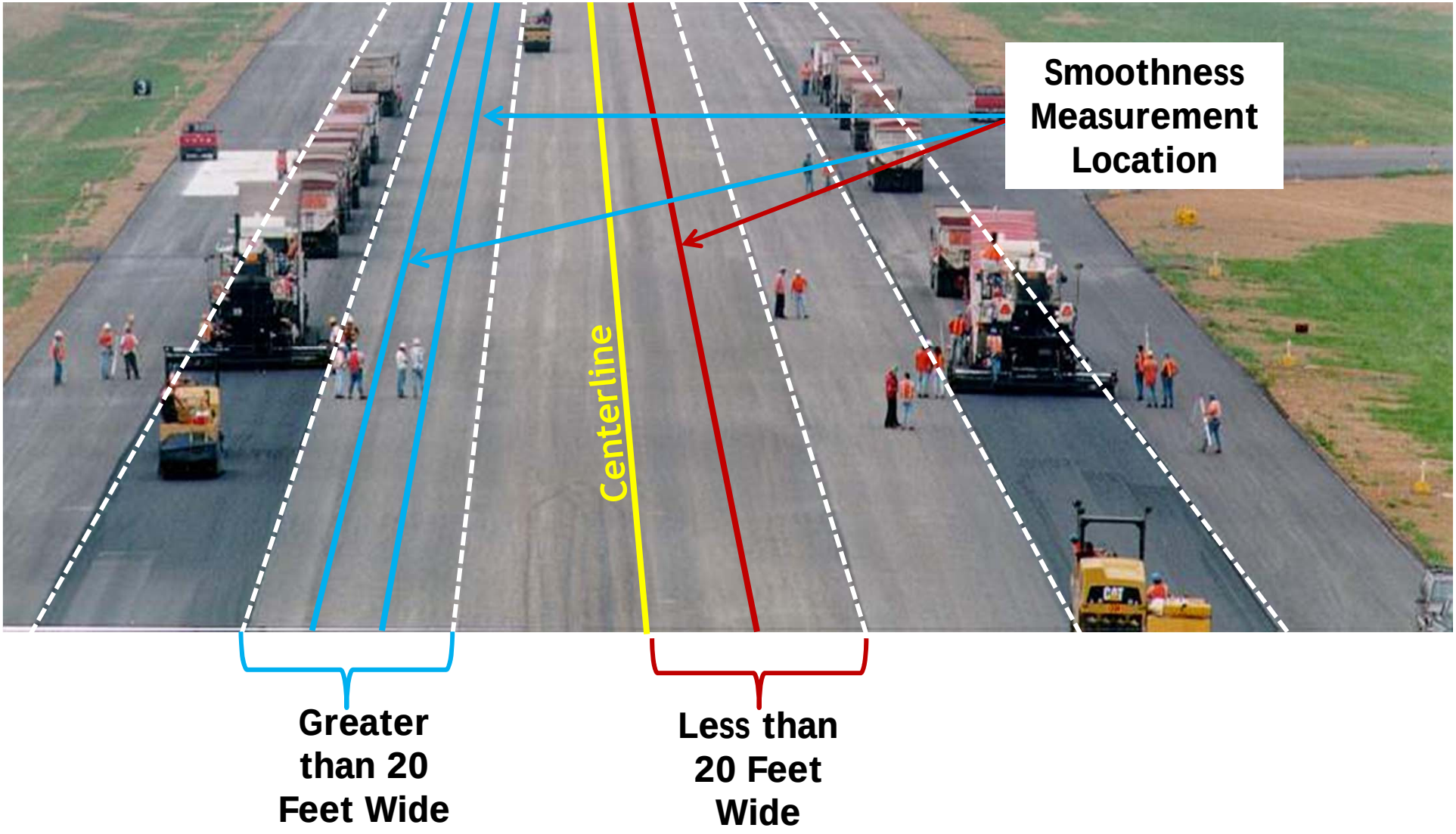
12-Foot Straightedge

- Transverse Measurements – A minimum of every 50-feet (15m) perpendicular to the pavement centerline

- Joint Measurements – testing shall be continuous across all joints. The joints between lots shall be tested separately.

- Longitudinal Short Section Measurements – testing shall be conducted the same as the profilograph in the longitudinal direction.

Longitudinal Measurements – Taken parallel to the pavement centerline in the middle of the paving lane if it is less than 20-feet (6m) wide; and at the third points of paving lane when the width exceeds 20-feet (6m)



ACCEPTANCE CRITERIA - SMOOTHNESS

Profilograph Testing

ACCEPTANCE CRITERIA - SMOOTHNESS

Profilograph - ASTM E-1274

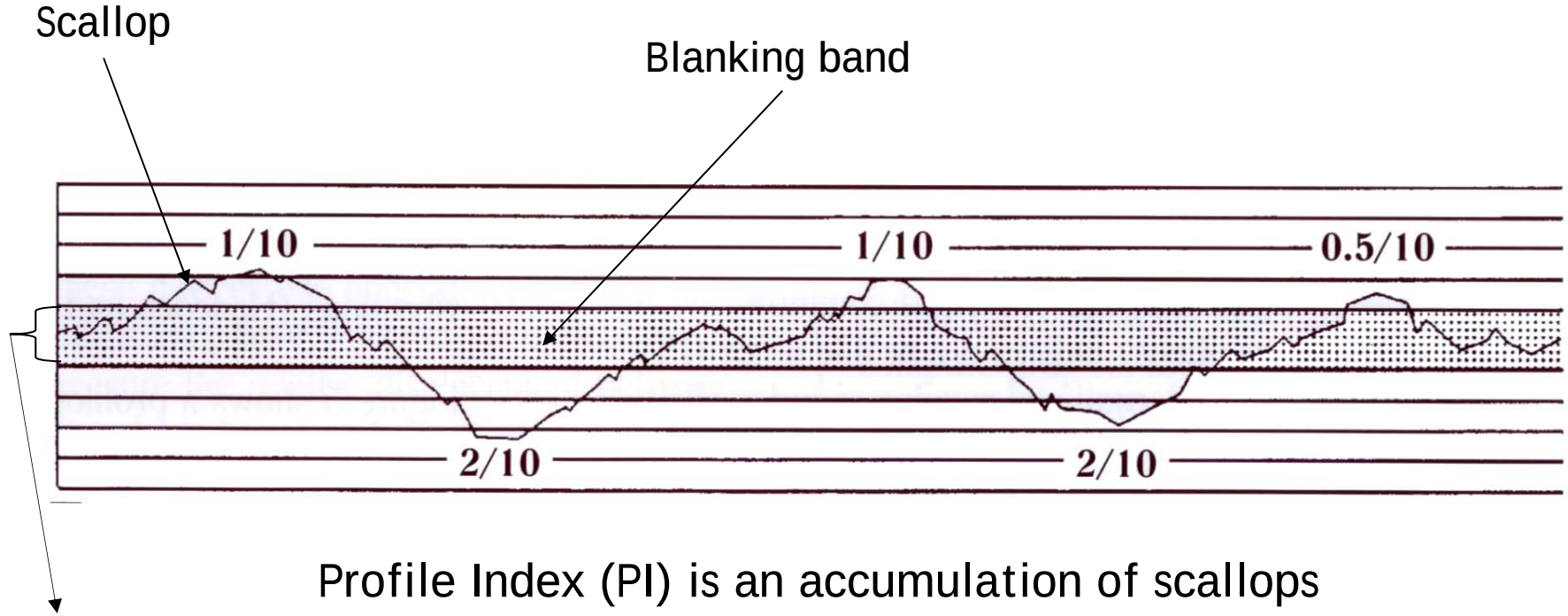
- Must indicate "must grind" bumps and the Profile Index (PI) using a 0.2-inch (5mm) blanking band.

- Longitudinal Scale 1-inch (25mm) = 25-feet (7.5m)
- Vertical Scale 1-inch (25mm) = 1-inch

- PI section length is 1/10th mile

ACCEPTANCE CRITERIA - SMOOTHNESS

Typical Profilograph Trace



Profile Index (PI) is an accumulation of scallops

- PI is in inches/per mile
- Usually reported per 1/10th mile.
- Accounts for multiple bumps in succession

PAYMENT CRITERIA FOR RUNWAY SMOOTHNESS

FAA 150/5370-10G Section 401-8.1.e

(Tons of asphalt concrete in lot) × (lot pay factor) ×
(unit price per ton) × (smoothness pay factor) = payment for lot

Table 7. Profilograph Average Profile Index Smoothness Pay Factor

INCHES PER MILE PER 1/10 MILE	SHORT SECTIONS	PAY FACTOR
00.0 - 7	00.0 - 15.0	100%
7.1 - 9	15.1 - 16	98%
9.1 - 11	16.1 - 17	96%
11.1 - 13	17.1 - 18	94%
13.1 - 14	18.1 - 20	92%
14.1 - 15	20.1 - 22	90%
15.1 & up	22.1& up	Corrective work required[1]

[1] The Contractor shall correct pavement areas not meeting these tolerances by removing and replacing the defective work. If the Contractor elects to construct an overlay to correct deficiencies, the minimum thickness of the overlay should be at least three times the maximum aggregate size (approximately four (4) times the nominal maximum aggregate size). The corrective overlay shall not violate grade Criteria and butt joints shall be constructed by sawing and removing the original pavement in compliance with the thickness/ maximum aggregate size ratio. Skin patching shall not be permitted

Final Profilograph Test

- PAGE 245
- Conducted within 48 Hours of Paving Completion
- Full Length of the Runway
- Used for **INFORMATION ONLY**
  - Smoothness Between Lots

Questions?

Merci!

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