

Segregation

The Cardiac Arrest of Hot Mix Asphalt Pavements

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Our Job is to Evaluate Risk



Rugged review of practices with numerous agencies and contractors throughout the nation has been performed over 20+ years.

Text in your Q:773-874-9800

Minimizing Mechanical Segregation



Columbus, Ohio

THE Ohio State University

Fawcett Center

February 1, 2017

Speaking of 2017



Segregation is the...

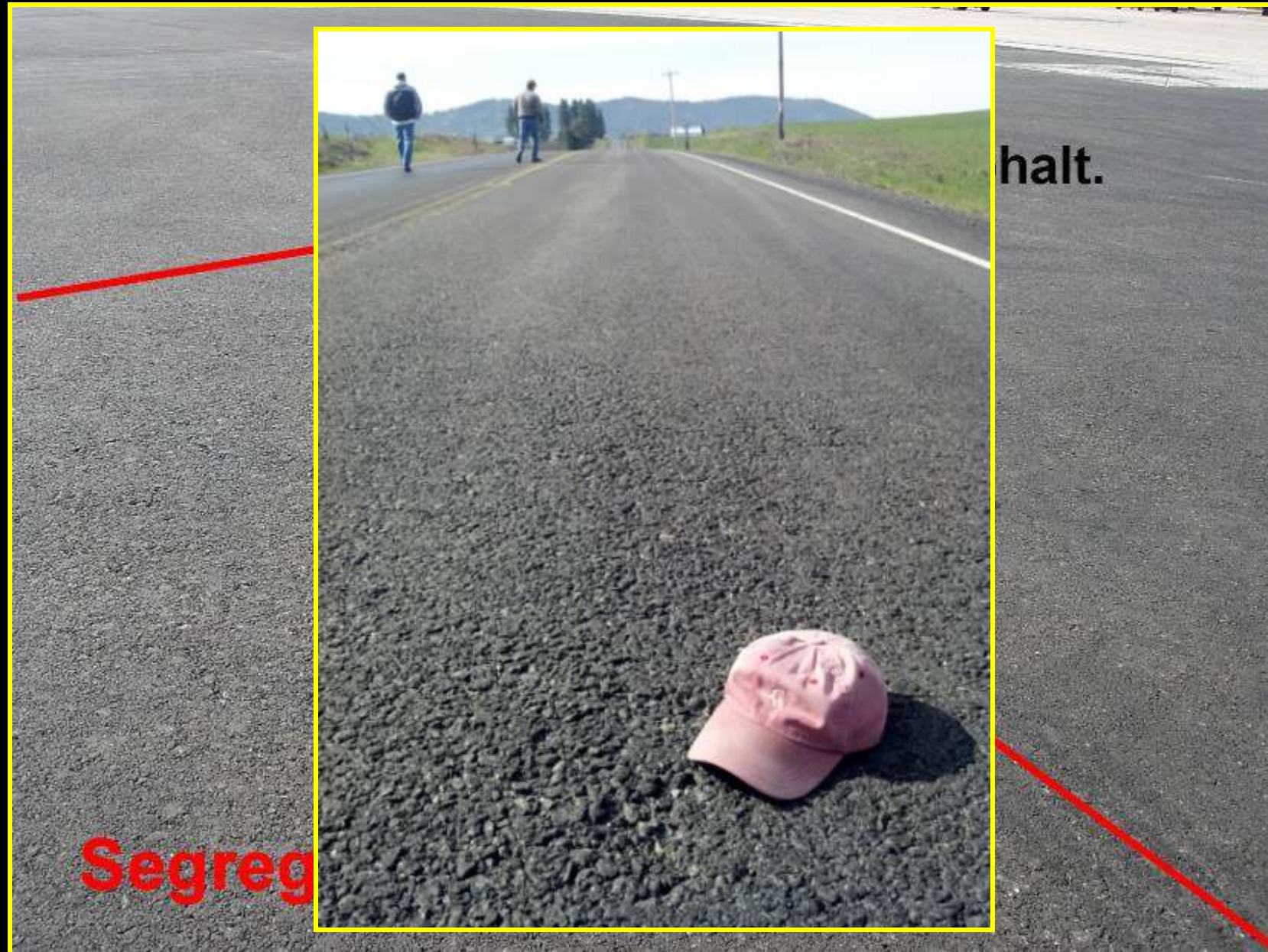
*“non-uniform
distribution of the
various aggregate
sizes throughout the
mass”*



Separation of Coarse & Fine Materials



Separation of Coarse & Fine Materials



Segregation of Asphalt Mixtures



Segregation May Occur Because Of:

- Mix Designs
- Aggregate Handling
- Asphalt Plant Particulars
- Truck Loading & Unloading
- Paver Operations

Segregation of Asphalt Mixtures

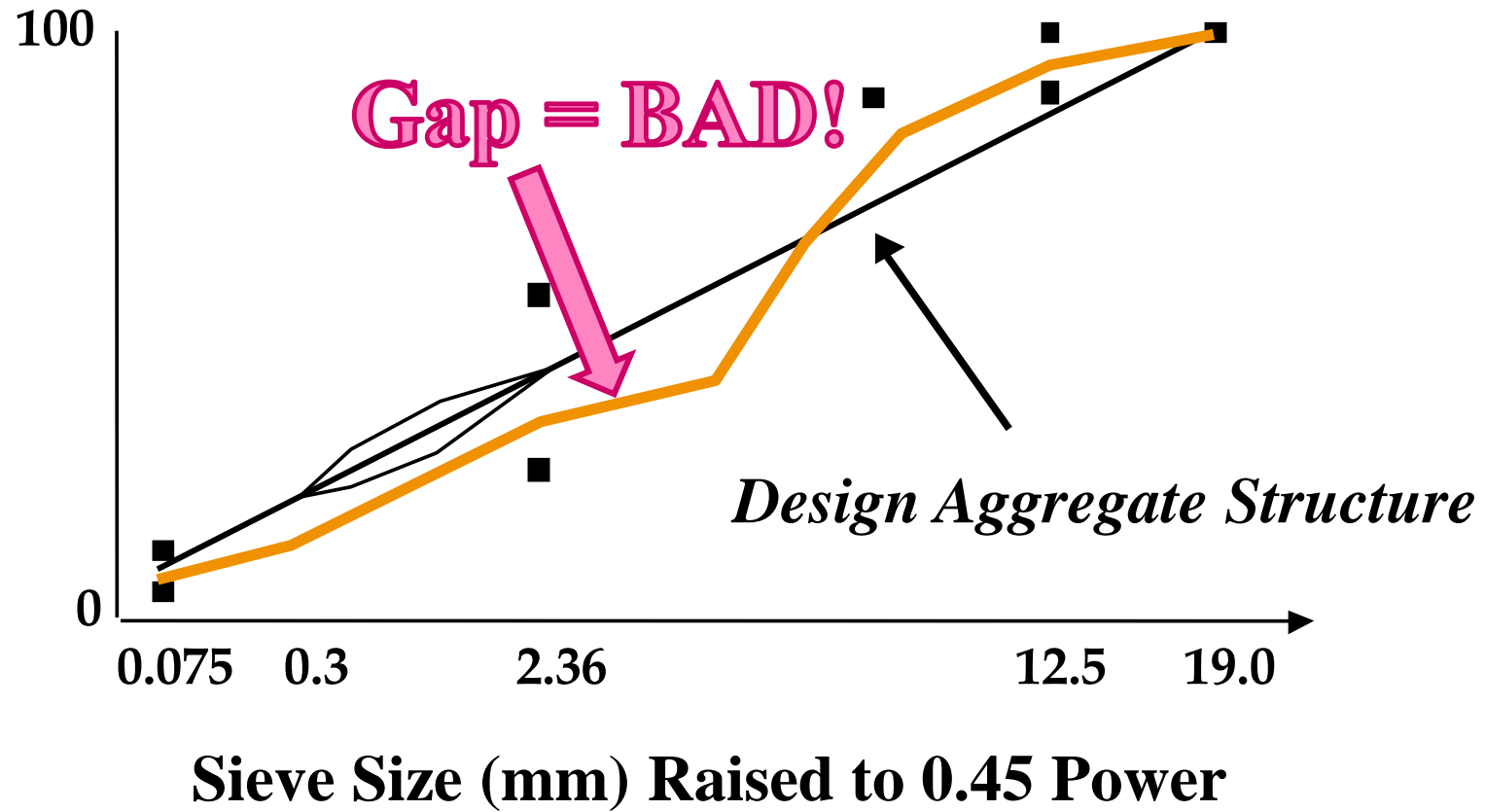


Mix Designs (Gap-Graded)

- Job-Mix Formula Not Well Graded Down Through Fines
- Steep Grading Curve

Large Stone Present Challenges

Percent Passing



Decisions Must Be Made to Avoid a Re-count



A photograph of an airport tarmac with two Delta Air Lines aircraft in the background. The foreground is a wide, dark asphalt surface with a yellow line on the right. Overlaid on the center of the image is pink text.

Large Top Size plus
Gap Grading = Trouble

Big Rock Requires Attention to Detail



Increase Effective Volume of Asphalt

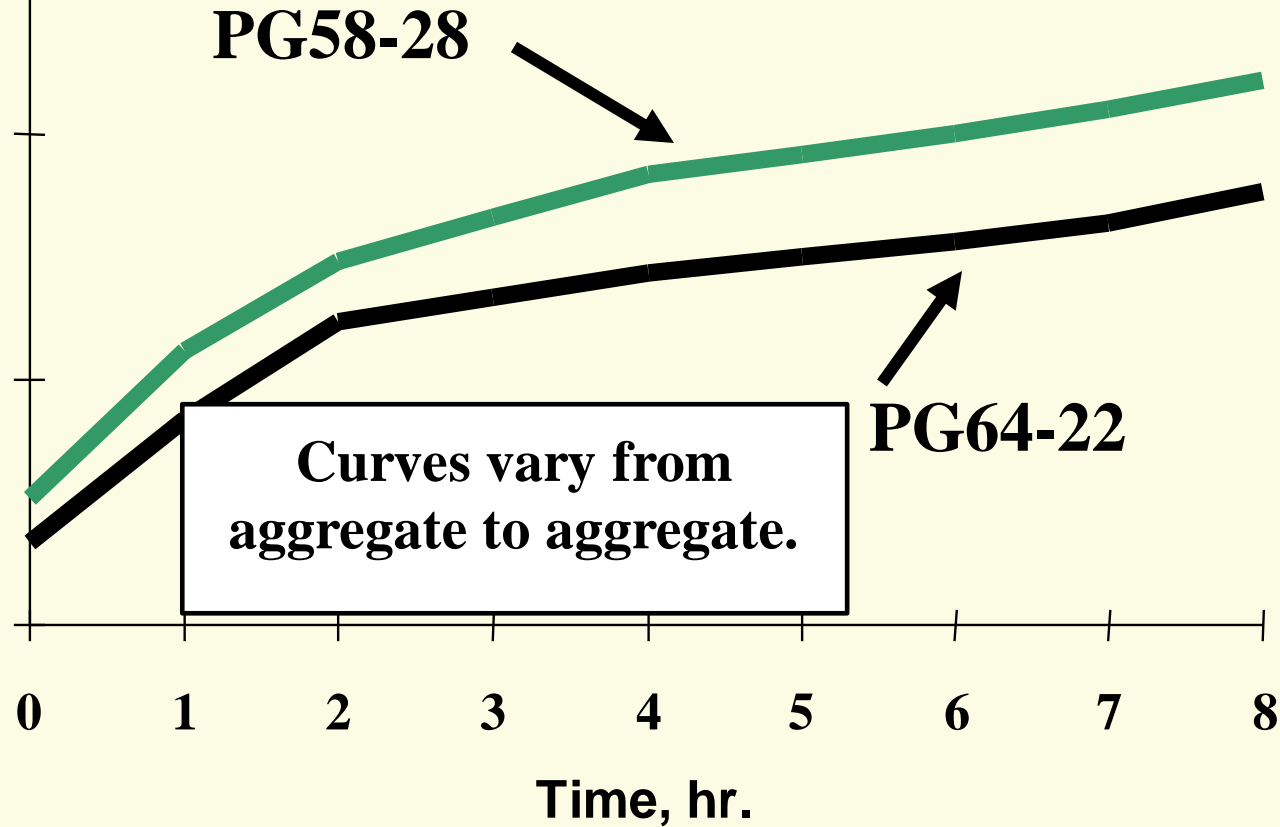


Voids in the Mineral Aggregate (VMA) equals the
Effective Volume of Asphalt (Vbe) plus Air Voids (Va)

$$V_{be} = VMA - V_a$$

Absorption, % Wt. Aggregate
Increasing ↑

Asphalt Absorption vs. Aging



Evaluation of Asphalt Absorption by Mineral Aggregate
AAPT 1991, p. 207-229.

Laboratory Mixture Analysis



Segregation Potential?

- Batch Sample in Laboratory
- Discharge Sample 1 meter
- Analyze Segregated Sample

Laboratory Mixture Analysis



Laboratory Mixture Analysis



Laboratory Mixture Analysis



Laboratory Mixture Analysis

Sieve Size	Outside	Inside	Factor
12.5mm (1/2")	100	100	0
4.75mm (#4)	45	59	14
Marshall Data			
AC	5.5	5.8	0.3
Voids	5.2	3.6	1.6
Stability/Flow			~0

Segregation of Asphalt Mixtures



Segregation May Lead To:

- Smoothness Problems
- Density Below Specification
- Loss Of Overall Mat Durability



At the Plant?



During Haul?

Where do we cause segregation to happen?

Paver?



On the Mat?



Segregation of Asphalt Mixtures

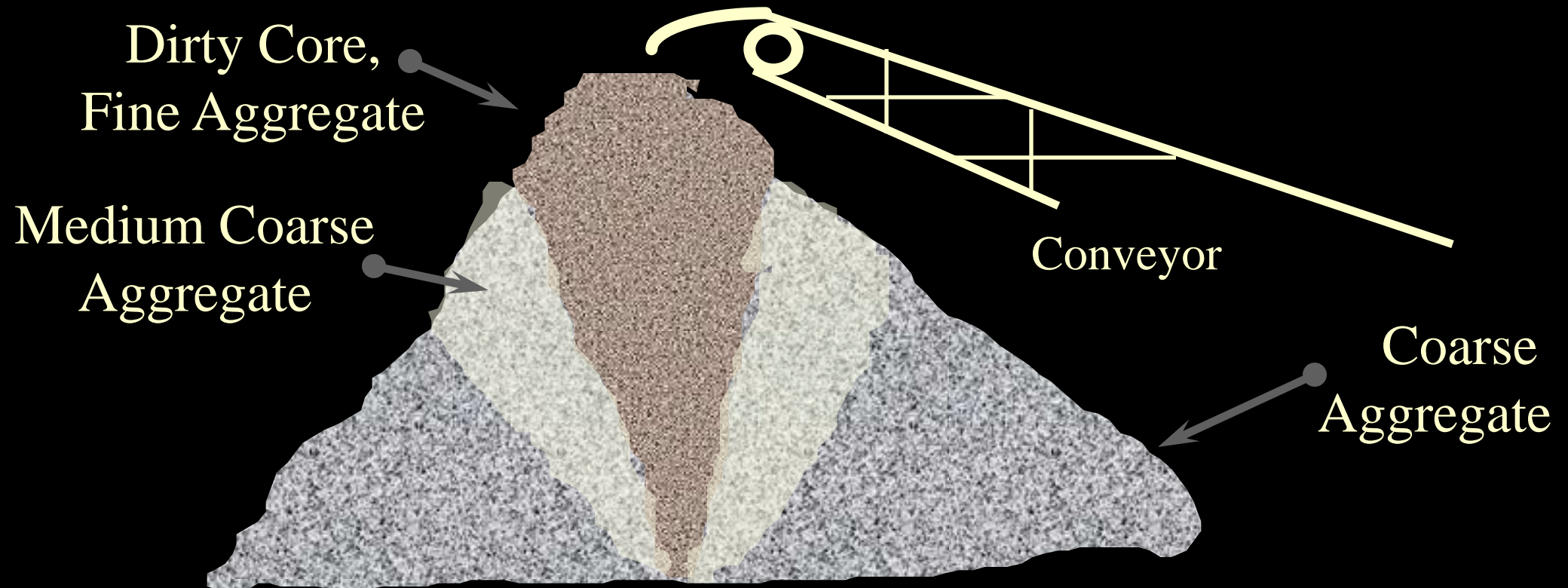


Aggregate Handling

- Producer Stockpiles
- End User Stockpiles
- Loading Cold Bins

Segregation of Asphalt Mixtures

Aggregate Handling



Segregation of Asphalt Mixtures



In General, Segregation Potential
Increases the More a Material is
Handled.

Cut-Away of Aggregate Handling of Windrow



Segregation of Asphalt Mixtures

Asphalt Plant Particulars

(After Cold Bin Feeding)

- Drum Mixers
- Hot Bins on Batch Plants
- Surge & Storage Bins



Head Pulley and Main Weigh Bridge Discharge

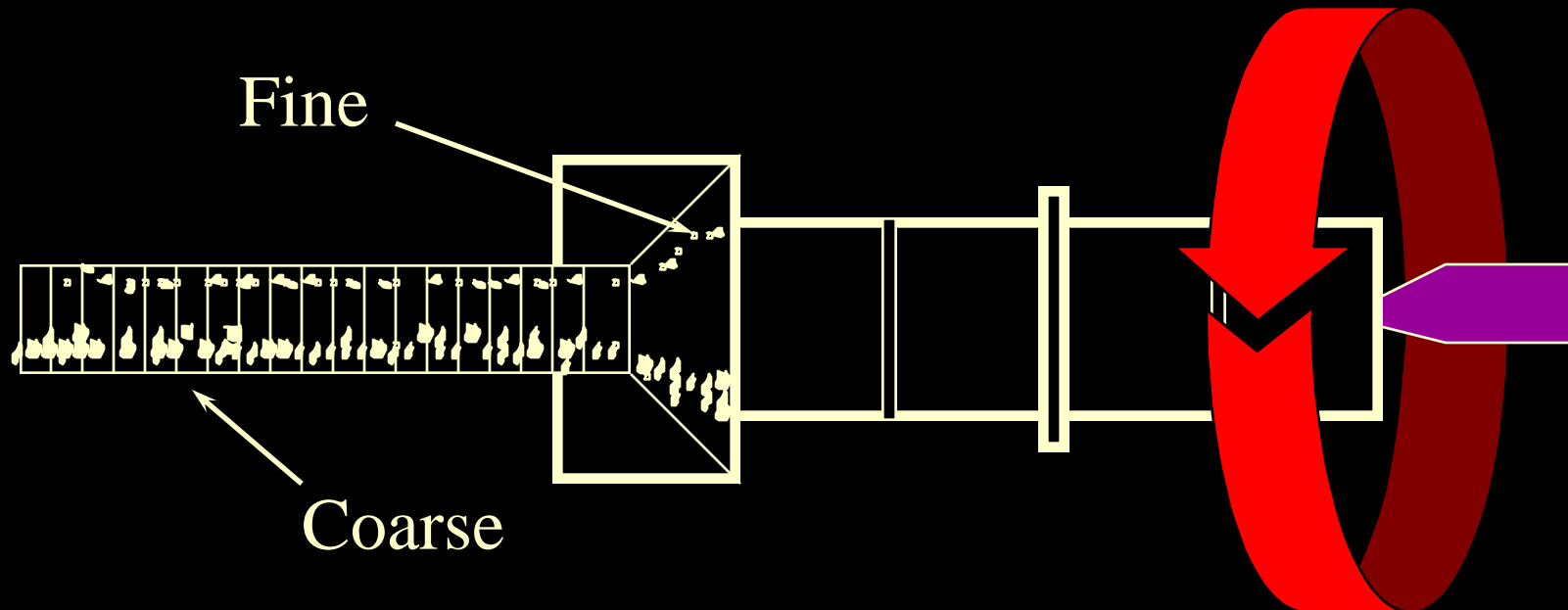


Head Pulley and Main Weigh Bridge Discharge

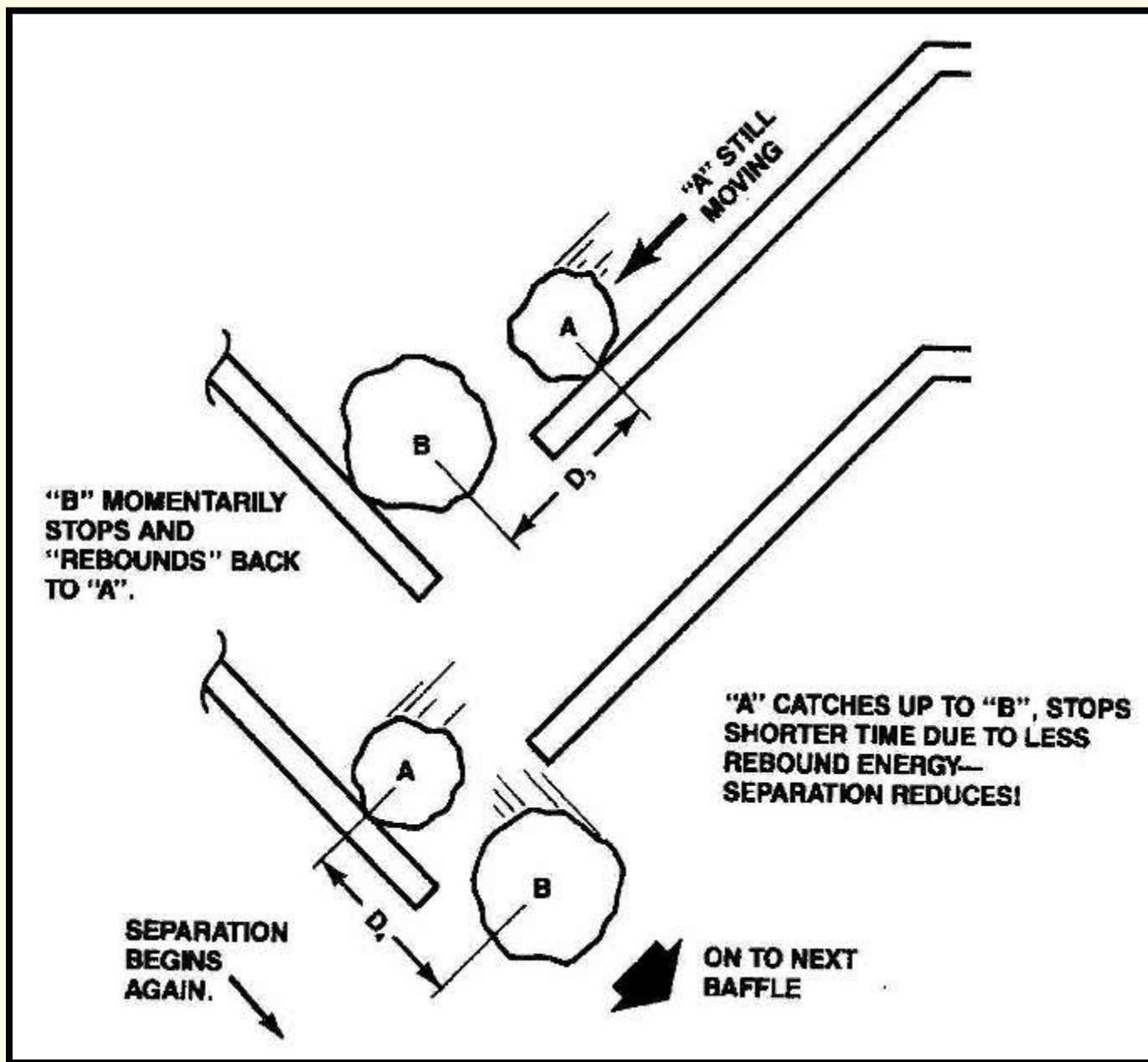


Segregation of Asphalt Mixtures

Drum Mixers

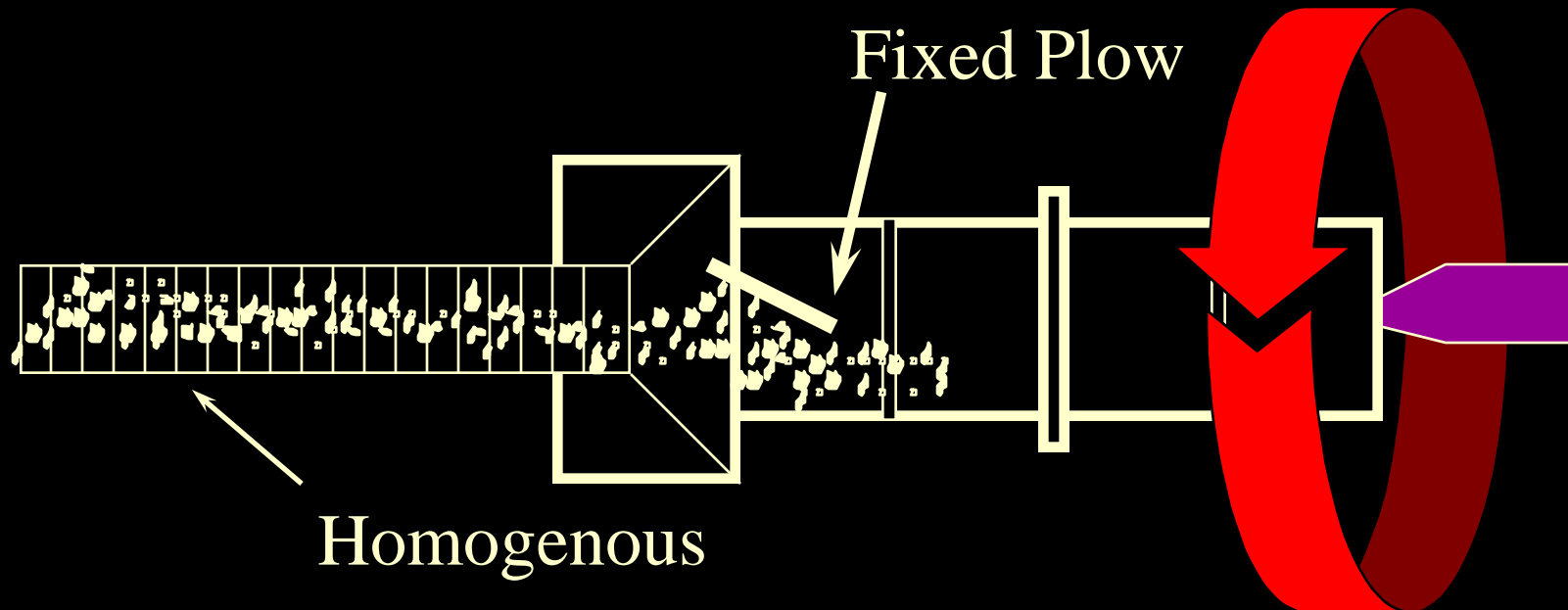


Segregation During Drum Discharge



Segregation of Asphalt Mixtures

Drum Mixers



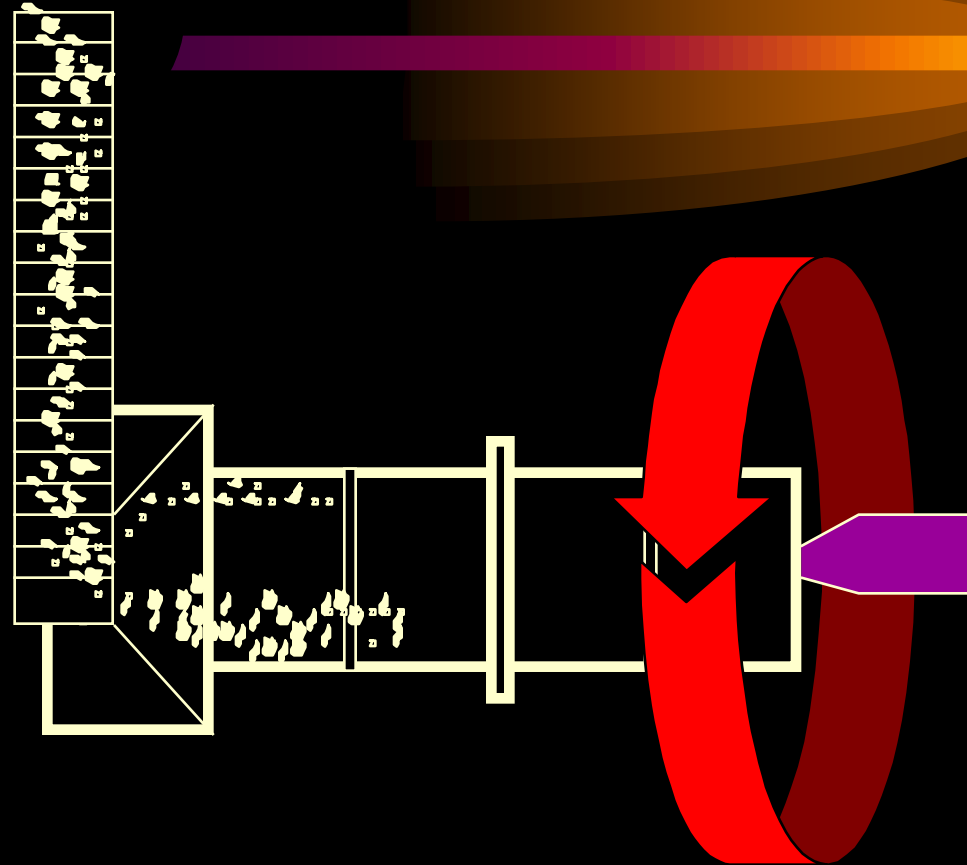
Uniformity During Drum Discharge
By Fixing a Plow At Point of Discharge

Drum Discharge



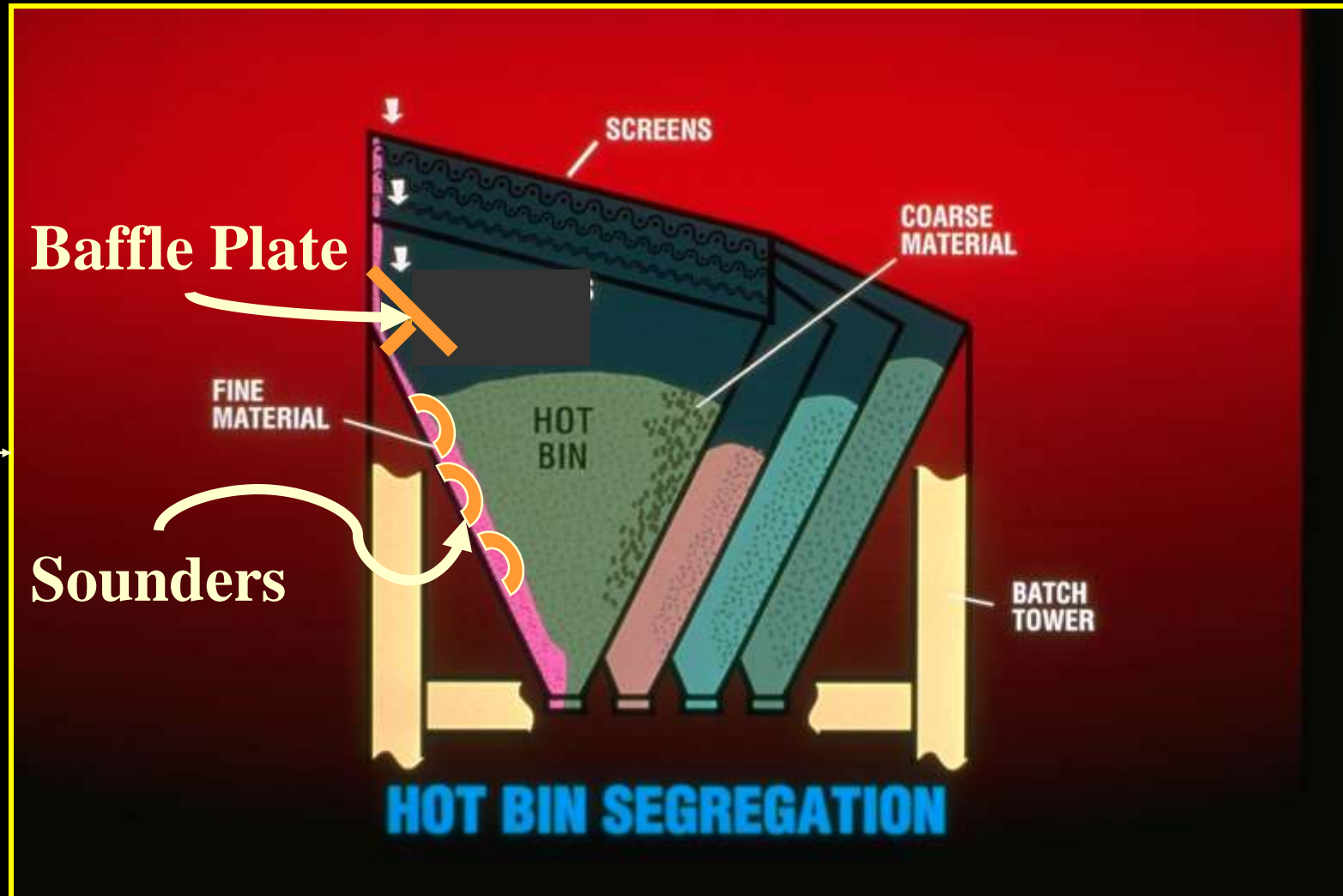
Segregation of Asphalt Mixtures

Drum Mixers



Uniformity During Drum Discharge
By Turning Drag Chain 90°

Batch Plant Bin #1





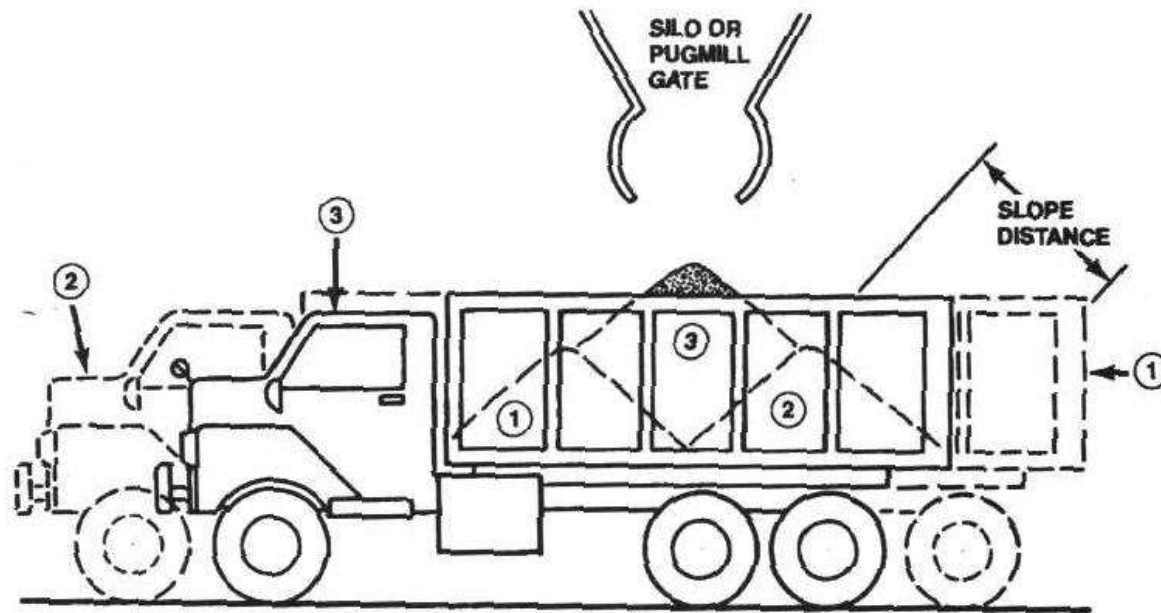
Minimizing Silo Segregation

Always use batcher or “gob” hopper

Maintain as uniform height of mix as possible 30-70%

Load out trucks in multiple drops.

Segregation of Asphalt Mixtures

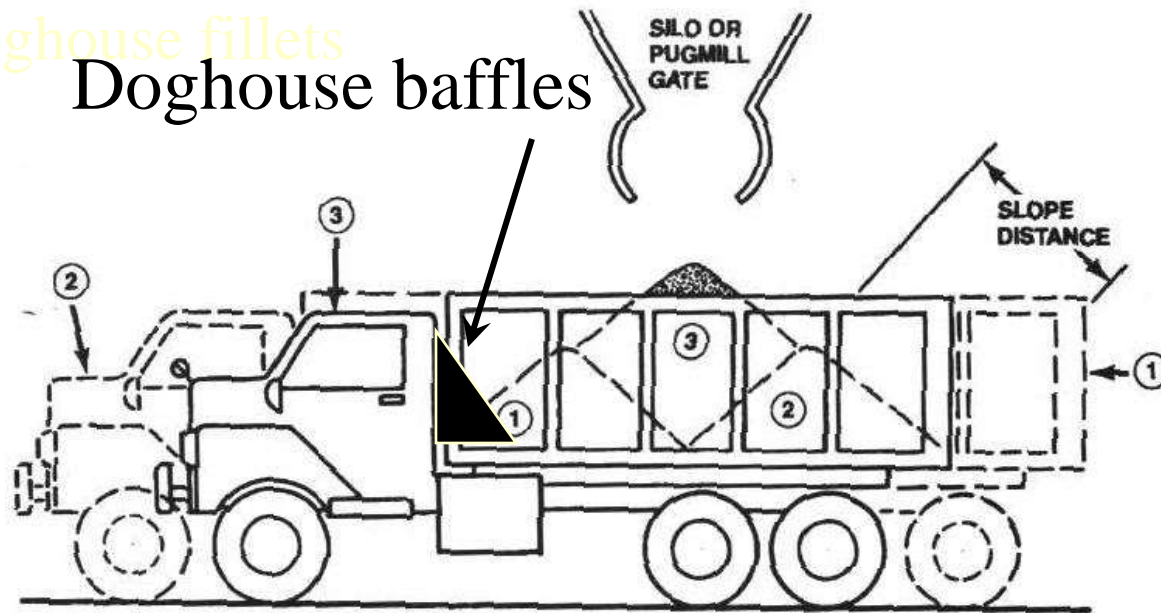


TRUCK MOVED TO 3 DISCHARGE POSITIONS.

Segregation of Asphalt Mixtures

Doghouse fillets

Doghouse baffles



TRUCK MOVED TO 3 DISCHARGE POSITIONS.

Segregation of Asphalt Mixtures



Truck Unloading

- Tip the Truck Bed Prior to Releasing Tailgate
- Baffles at the Point of Discharge
- Flood the Paver Hopper

**End of load segregation
with belly-dump.**



Segregation of Asphalt Mixtures



Segregation May Lead To: (Cont'd.)

- Moisture Damage & Raveling
- Cracking
- Streaky Pavement Surfaces

Segregation Leads to Failure



Moisture Often Plays a Role

Moisture Damage from Segregation





Far-Away of HMA



Segregation of Asphalt Mixtures



Streaky Pavement Surfaces Resemble:

- Chevrons
- Longitudinal Streaks
- Blotchy Areas



Segregation of Asphalt Mixtures

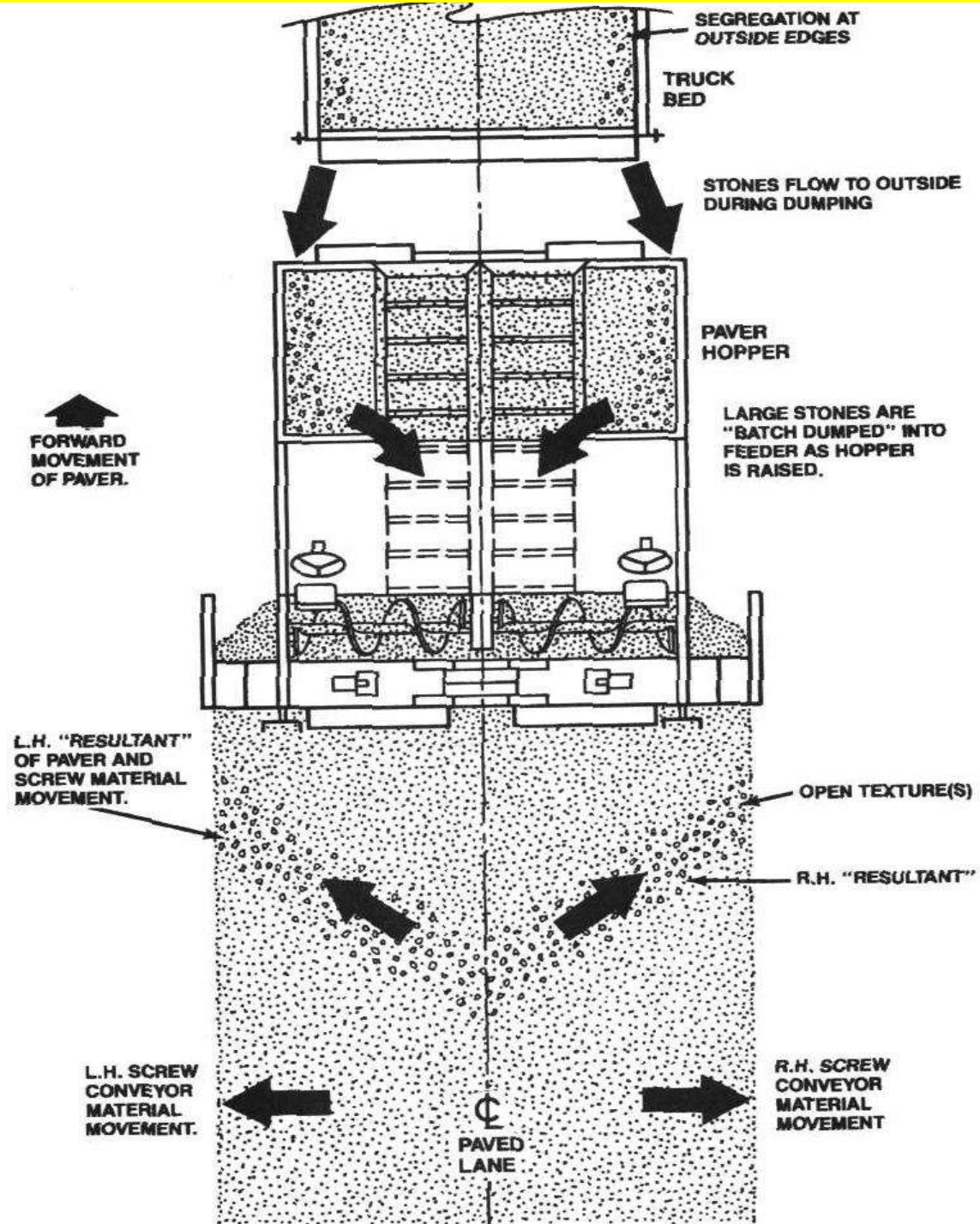


Paver Operation

- Keep The Paver Moving
- Maintain 25% Capacity in Hopper
- Dump Wings Only When Material is in Hopper

Paver Operation





Segregation of Asphalt Mixtures



Paver Operation (Cont'd.)

- Fillets in Corners
- Kick-Back Plates
- Head in Augers
- Auger Extensions

Paver Operation, Hopper

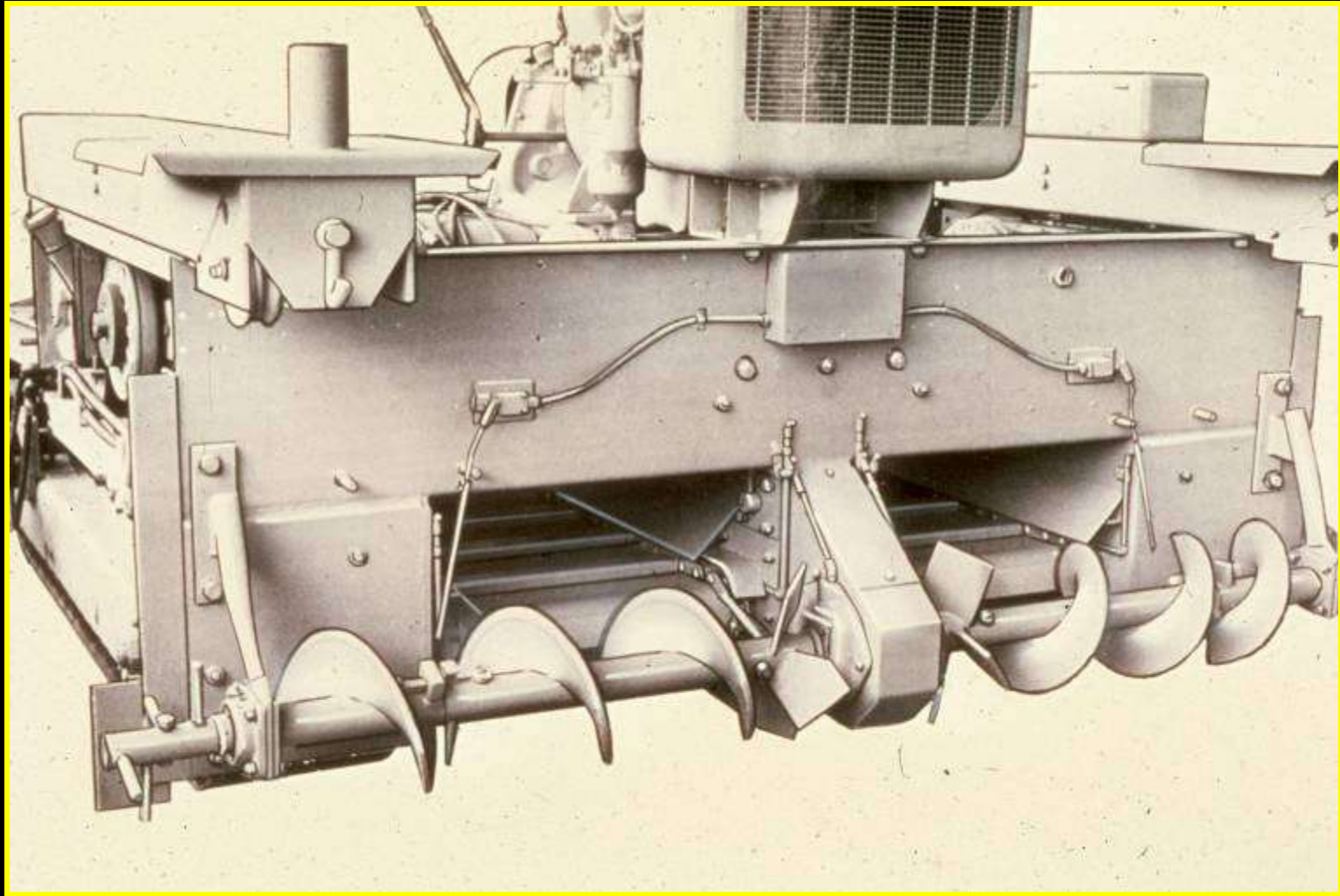


Superpave Specification Requirement



Reverse screw augers with a minimum efficiency of 75% shall be installed at the gear box for all paving activities.

Longitudinal Cracking Mitigation



Longitudinal Cracking Mitigation





Extended screeds must be installed...



Extended screeds shall be provided with corresponding auger and tunnel extensions to ensure a uniform head of fresh material across the entire screed.





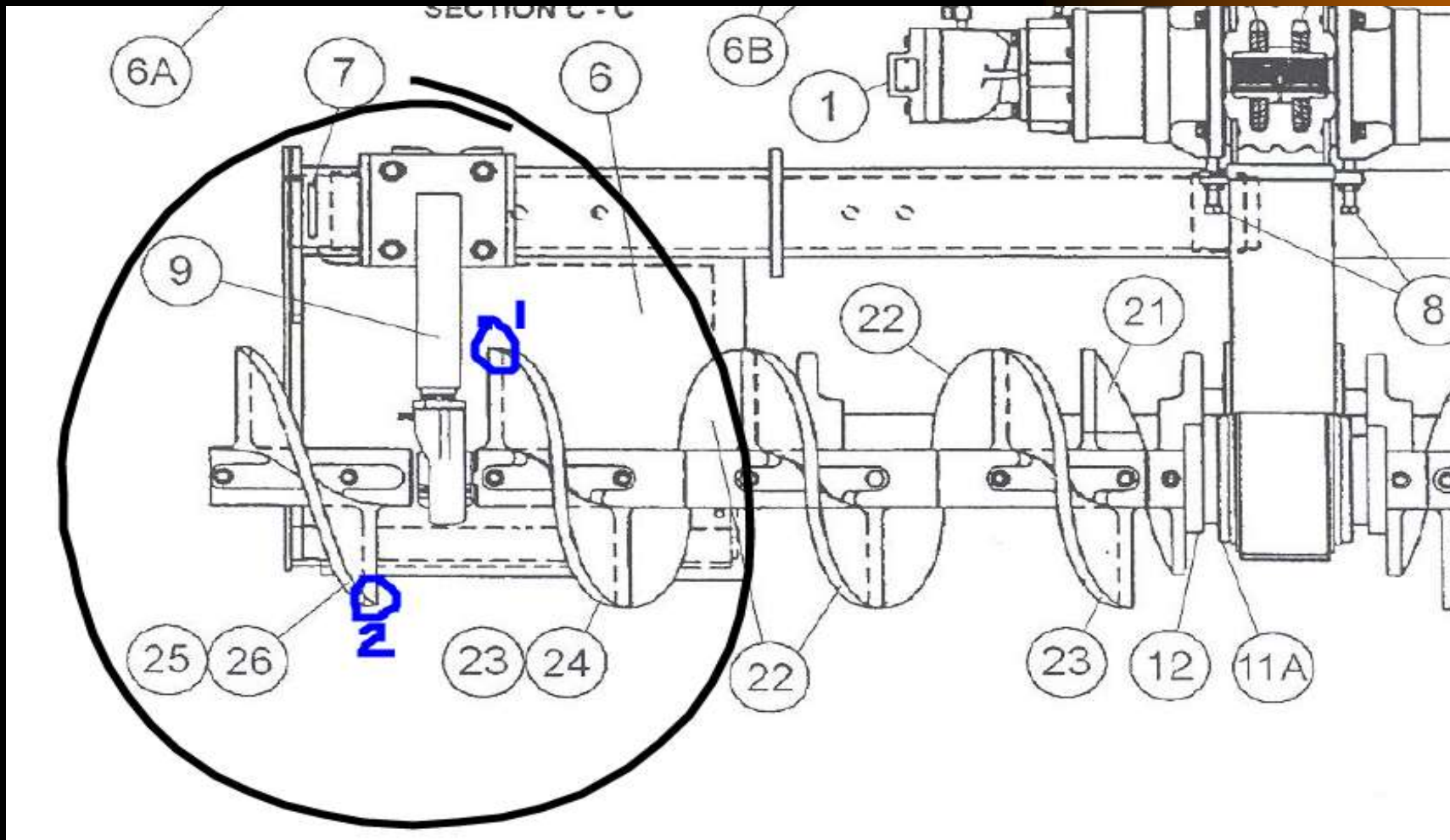
**Right side
segregation.**

Auger 'hold' point



**My mother always told me,
'The devil is in the details.'**

Bearing / hanger





Luting



Model Segregation Specification



Agencies now use one of the following for quantifying segregation:

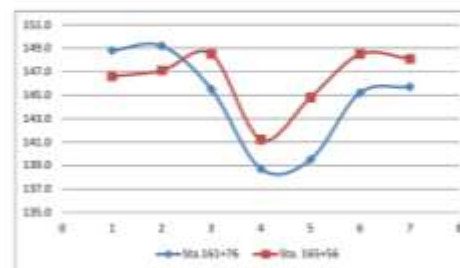
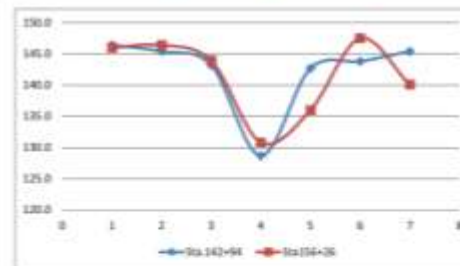
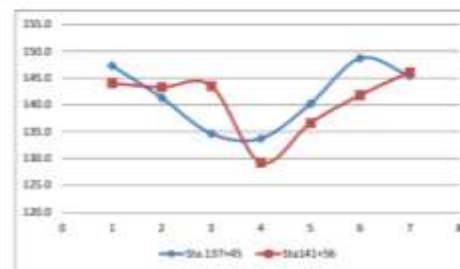
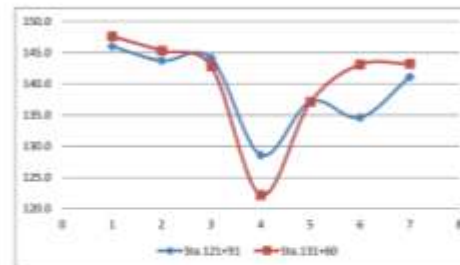
- Deviation from the approved JMF via extraction
- Sand patch measurement
- Nuclear density gauge

Model Segregation Specification: Measuring Segregation with a Nuke Gauge

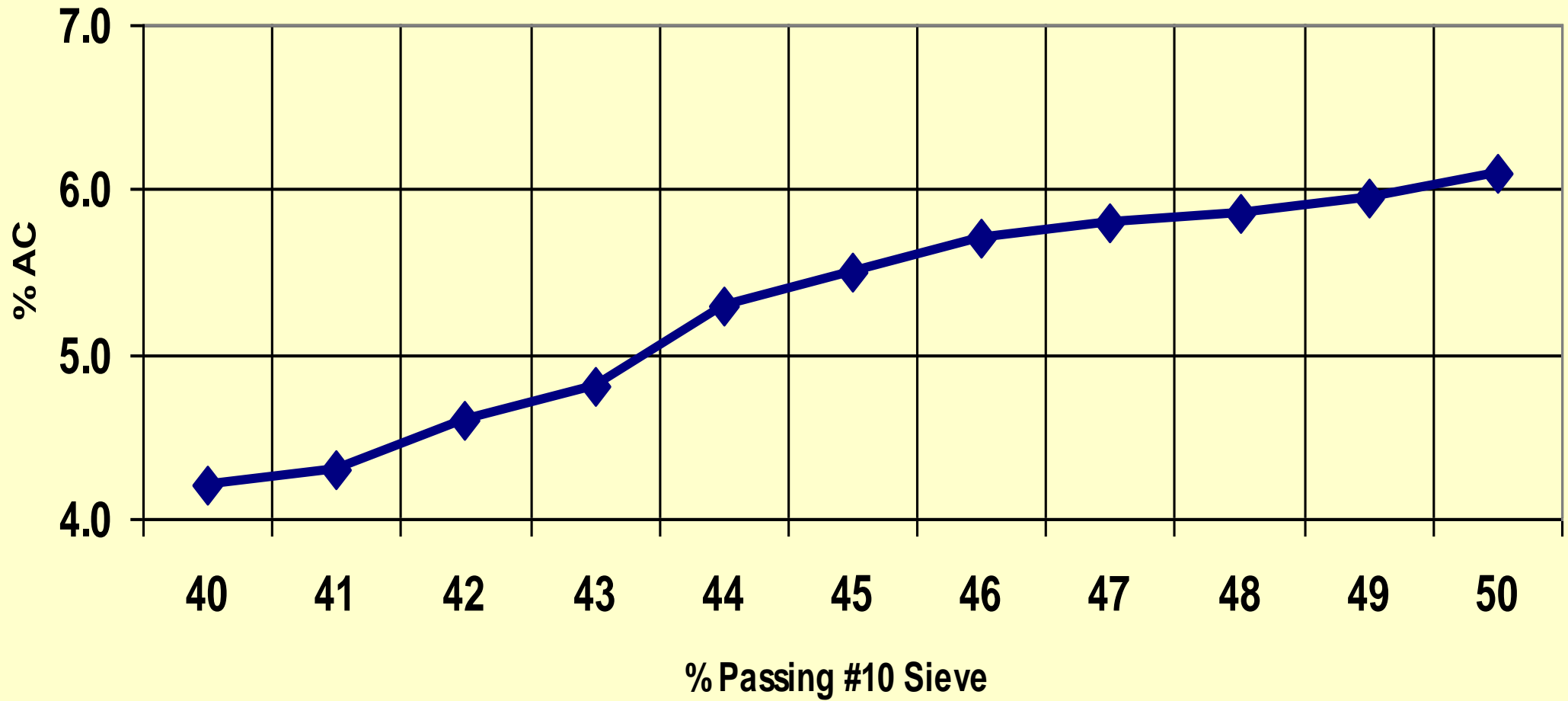


Northbound Locations

Sta. 121+91	1	140.1	146.9		146.0
	2	143.5	140.5	146.9	141.7
	3	143.6	144.5		144.1
	4	129.2	127.8		128.6
	5	138.3	136.0		137.2
	6	137.8	133.1	129.5	137.5
	7	141.0	138.7	147.9	136.9
Sta. 131+40	1	148.1	147.0		147.6
	2	145.0	145.5		145.3
	3	142.5	143.0		142.8
	4	121.0	121.5		122.2
	5	133.3	137.4	137.8	140.0
	6	144.0	142.1		143.1
	7	144.4	141.9		143.2
Sta. 137+45	1	145.5	148.1	144.1	151.6
	2	140.3	142.8		143.3
	3	133.4	135.7		134.6
	4	130.6	134.6	132.4	137.1
	5	141.0	139.4		140.2
	6	148.9	152.9	146.9	147.0
	7	144.8	145.9		145.4
Sta. 141+56	1	141.7	144.3		144.0
	2	146.2	140.3	142.4	144.2
	3	142.8	144.1		143.5
	4	129.9	128.5		129.2
	5	135.9	137.3		136.6
	6	141.3	142.2		141.8
	7	147.0	145.1		146.1
Sta. 142+94	1	146.0	146.8		146.4
	2	144.5	146.2		145.4
	3	145.7	139.7	141.0	146.3
	4	127.4	120.8	129.8	136.9
	5	141.6	143.7		142.7
	6	143.1	145.9	142.6	143.6
	7	145.6	145.2		145.4
Sta. 156+26	1	145.3	146.4		146.0
	2	146.9	146.4		146.4
	3	142.7	145.0		143.9
	4	135.1	129.6	126.6	131.9
	5	138.2	131.0	125.5	139.2
	6	146.5	146.4		147.5
	7	139.6	140.5		140.1
Sta. 161+76	1	148.7	149.2		148.8
	2	150.2	148.1		149.2
	3	145.1	145.8		145.5
	4	144.8	129.3	141.1	139.4
	5	144.8	129.3	141.1	142.8
	6	145.9	144.4		145.2
	7	144.8	147.6	146.7	143.6
Sta. 165+56	1	144.5	147.8	147.4	146.7
	2	147.4	146.8		147.1
	3	148.9	148.0		148.5
	4	138.3	142.0	141.5	142.0
	5	143.3	140.5	144.6	150.9
	6	148.1	148.9		148.5
	7	148.4	147.8		148.1



Segregation After Mixing



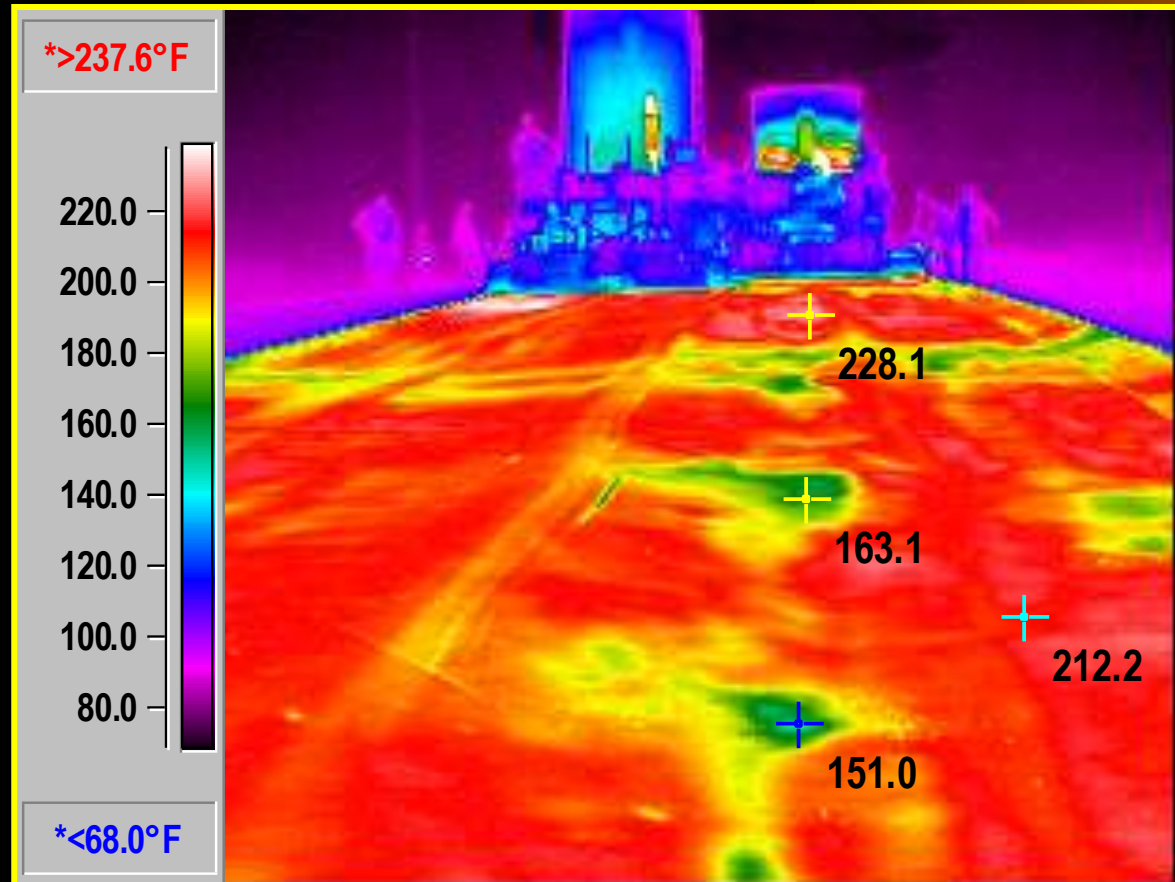
A Few References on Segregation



Enhanced MS-22 Coming Soon...
Just Ask Wayne!

Infrared Photo

(End Dump Mix Behind Paver)



Real-time PAVE-IR (from MOBA)

PAVE-IR™ SCAN :: INCREASING ROAD QUALITY BY DECREASING THERMAL SEGREGATION



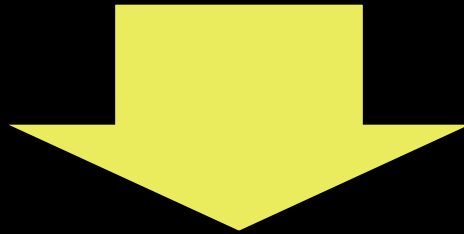
Real-time PAVE-IR (from MOBA)



Segregation of Asphalt Mixtures



Homogeneous Asphalt Mixtures Ensure Us
Of Having



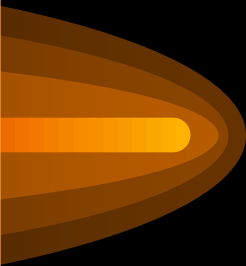
Smoother and More Durable Asphalt
Pavements

Murphy's Material Minute



Asphalt Production & Construction:

'Use all equipment in accordance with the manufacturers recommendation.'





Questions?

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