HMA Compaction and Constructing Good Longitudinal Joints

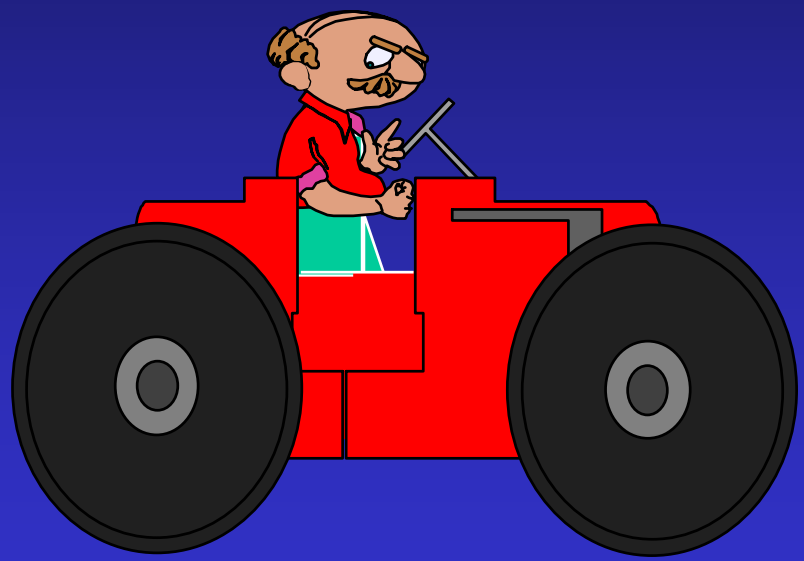
By V. Aurilio

HMA Asphalt Compaction

- Compaction of mix is only possible if:
  - Mixture is at Proper Compaction Temperature
  - Mixture is Confined
    - Top - force from rollers
    - Bottom - base/subgrade
    - Sides - internal Mix Forces
  - Use Proper Procedures

COMPACTION

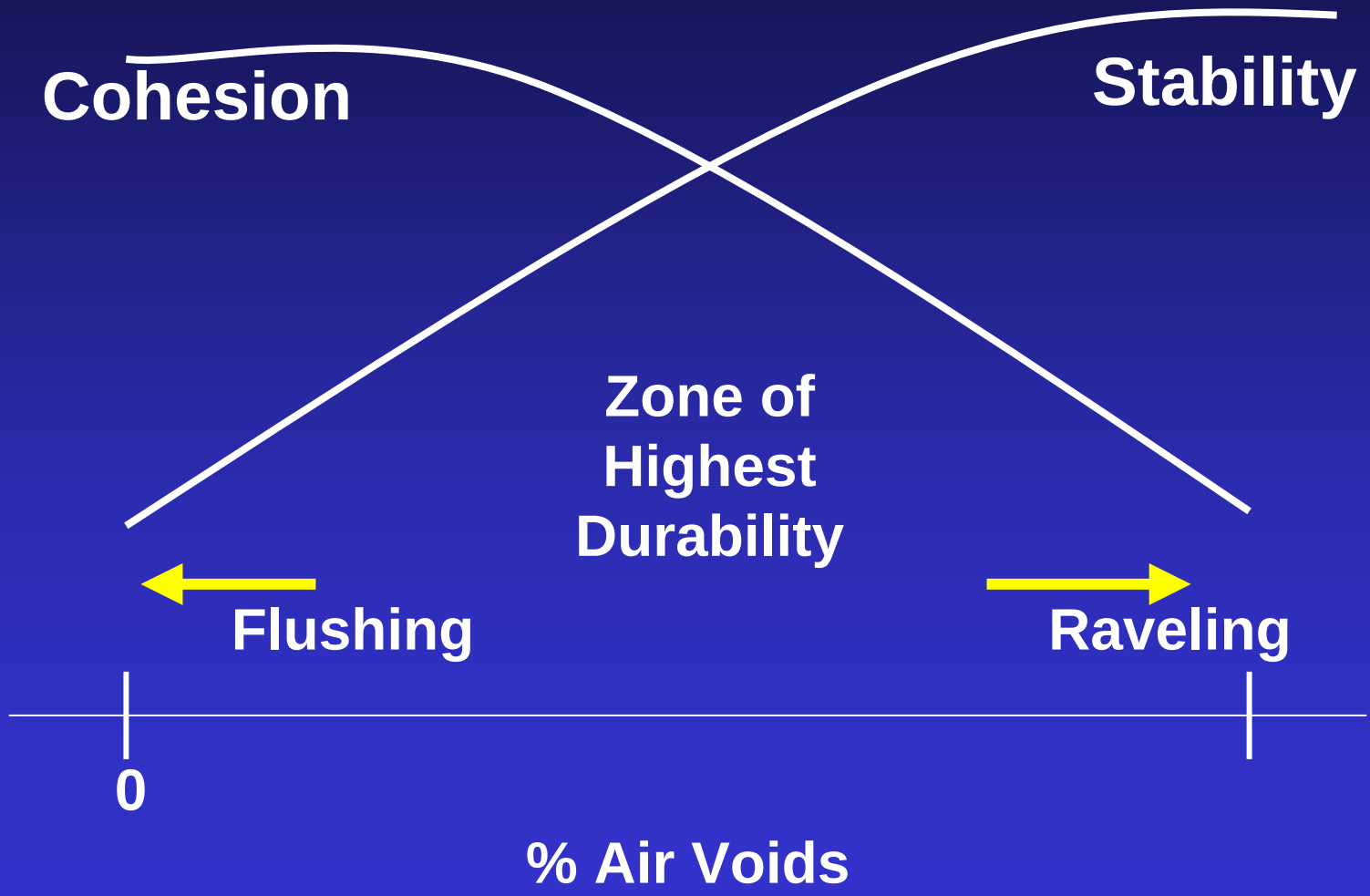
GOOD COMPACTION LEADS TO GOOD PERFORMANCE



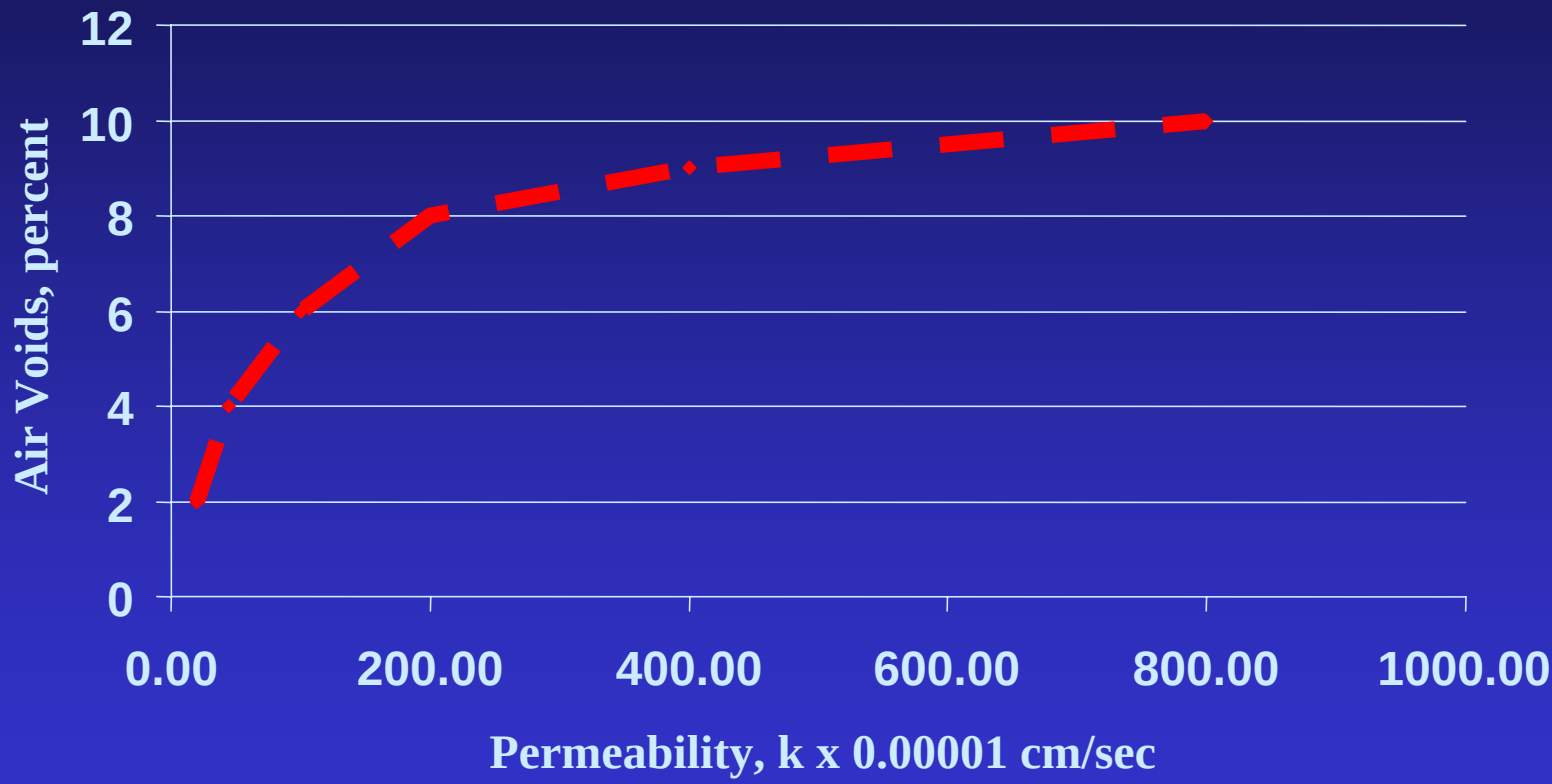
Reason For Compaction

- **To prevent further compaction**
- **To provide shear strength or resistance to rutting**
- **To ensure the mixture is waterproof**
- **To prevent excessive oxidation of the asphalt binder**

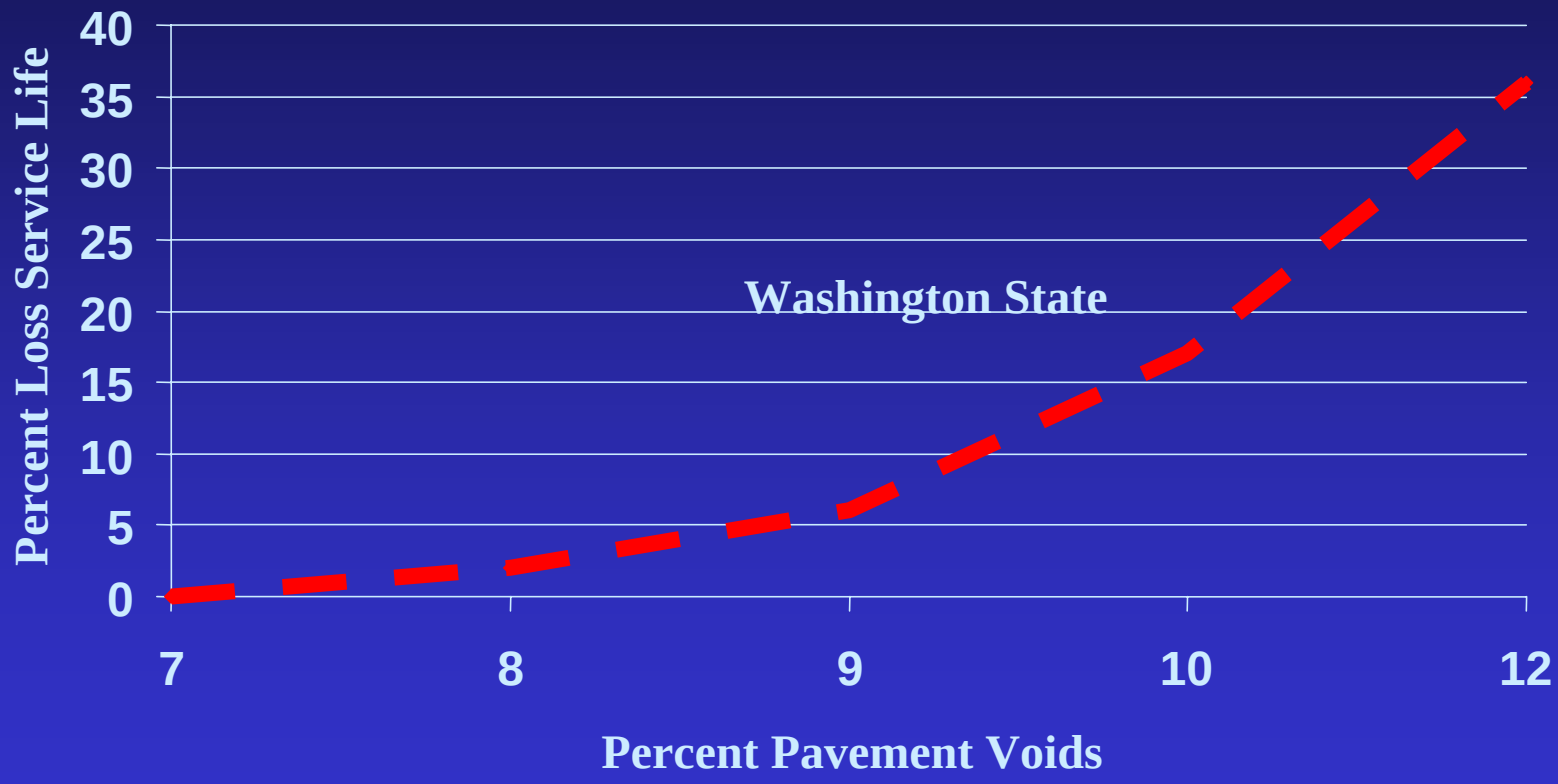
Durability vs. Air Voids



Typical Permeability vs. Voids



Effect of Voids on Life

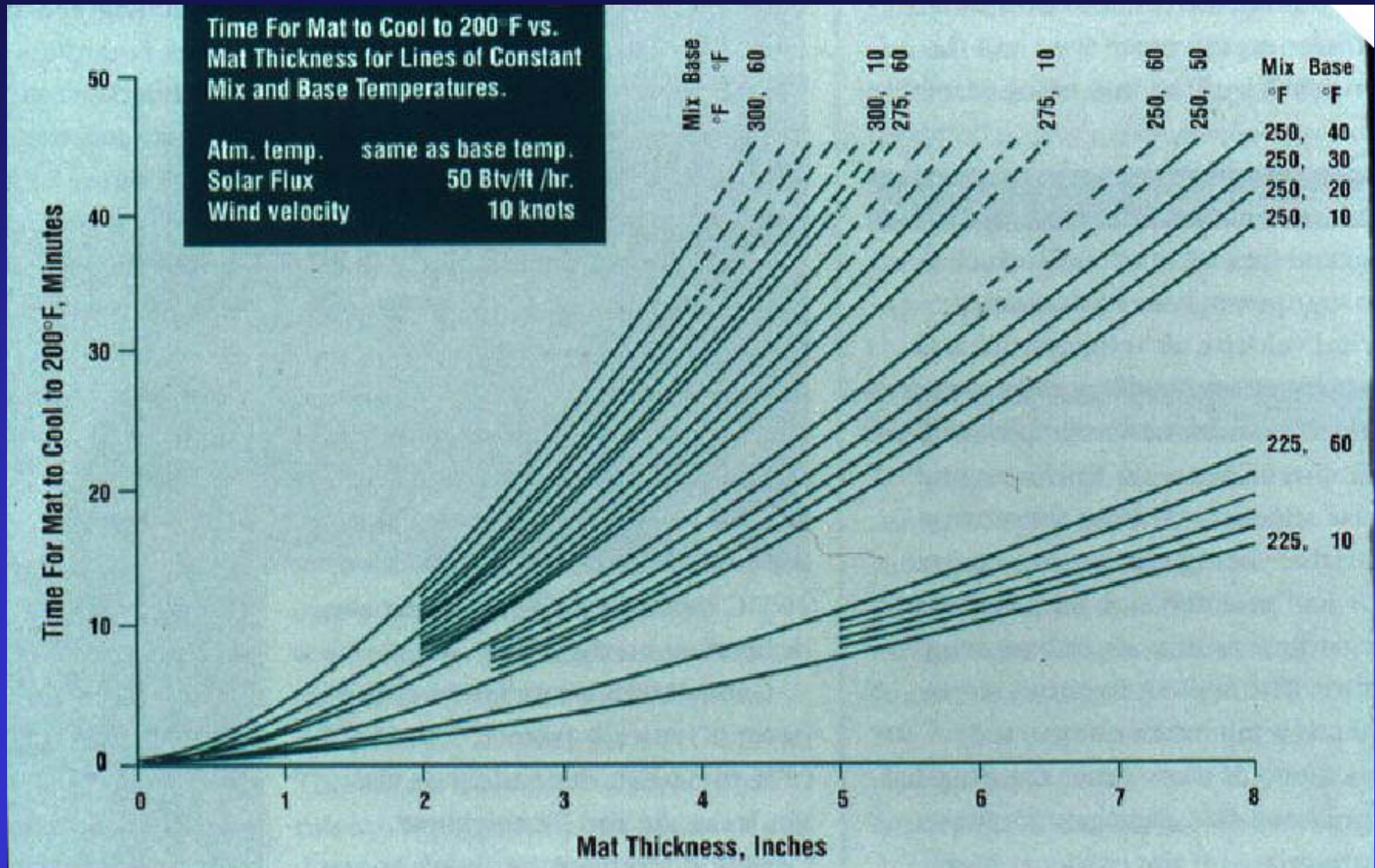


Factors Affecting Compaction

- **Mix Properties**
  - **Aggregate**
  - **Asphalt**
  - **Mix Temperature**
- **Layer Thickness**
- **Environmental Factors**
- **Rollers**

Temperature is critical

Mix Too Cold


Time For Mat to Cool to 200 F vs.
Mat Thickness for Lines of Constant
Mix and Base Temperatures.
Atm. temp. same as base temp.
Solar Flux 50 Btv/ft /hr.
Wind velocity 10 knots
Mix °F
Base °F
300, 60
300, 275, 10 60
275, 10
250, 60
250, 50
Mix °F
Base °F
250, 40
250, 30
250, 20
250, 10
225, 60
225, 10
Time For Mat to Cool to 200°F, Minutes
0
10
20
30
40
50
0
1
2
3
4
5
6
7
8
Mat Thickness, Inches

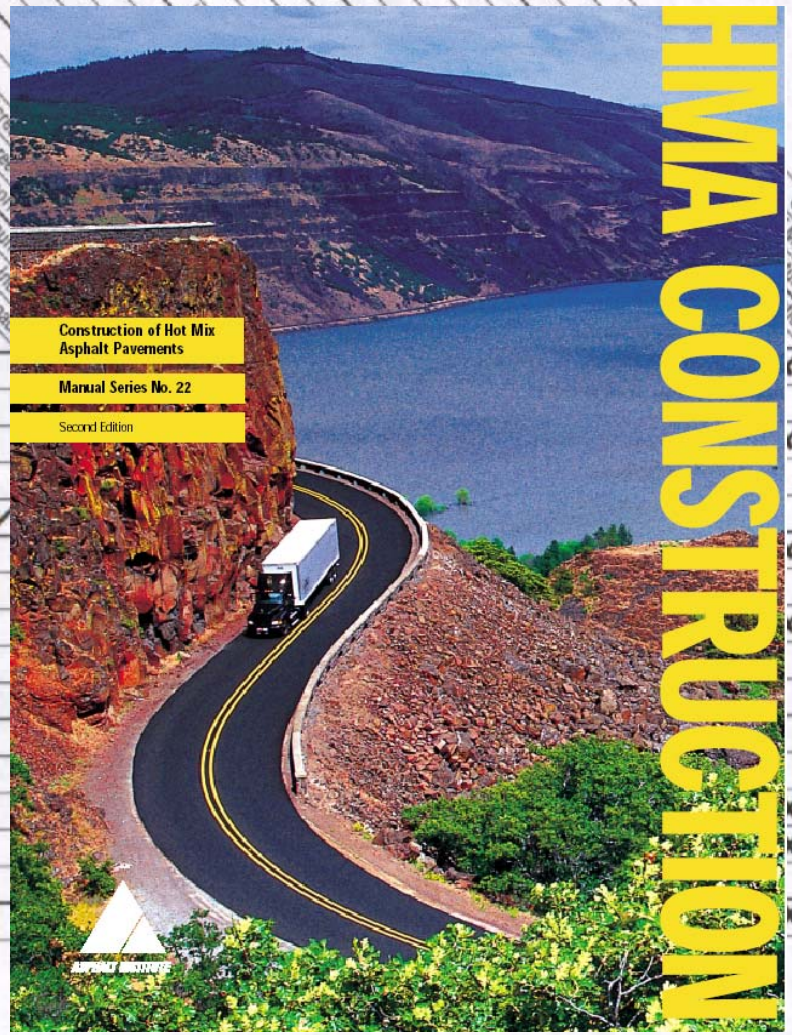
Rolling Factors

MAJOR FACTORS AFFECTING ROLLING TIME	allows MORE time	allows LESS time
MAT THICKNESS	THICK	THIN
MIX TEMPERATURE	HIGH	LOW
BASE TEMPERATURE	HIGH	LOW

TROUBLESHOOTING HMA

Problem	Fluctuating Head of Material	Feeder Screws Overloaded	Finisher Speed Too Fast	Too Much Lead Crown in Screed	Too Little Lead Crown in Screed	Overcorrecting Thickness Control Screws	Excessive Play in Screed Mechanical Connection	Screed Riding on Lift Cylinders	Screed Plates Worn Out or Warped	Screed Plates Not Tight	Cold Screed	Moldboard on Strikeoff Too Low	Running Hopper Empty Between Loads	Feeder Gates Set Incorrectly	Kicker Screws Worn Out or Mou	Scr	Scr	Incor	Cold Mix Temperature	Mix Temperature ure in Mix	tion
Wavy Surface – Short Waves (Ripples)	✔	✔	✔				✔	✔		✔									X	X	X
Wavy Surface – Long Waves	✔	✔				✔	✔	✔												X	
Tearing of Mat – Full Width			✔							✔		✔							X	X	X
Tearing of Mat – Center Streak					✔					✔		✔									
Tearing of Mat – Outside Streaks				✔						✔		✔	✔								
Mat Texture – Nonuniform	✔	✔	✔						✔	✔	✔	✔							X		
Screed Marks									✔												
Screed Not Responding to Correction			✔						✔	✔		✔							X		
Auger Shadows		✔																			
Poor Precompaction			✔							✔											
Poor Longitudinal Joint	✔	✔					✔			✔											
Poor Transverse Joint		✔							✔	✔		✔									
Transverse Cracking (Checking)																			X	X	
Mat Shoving Under Roller																			X	X	
Roller Marks																				X	
Poor Mix Compaction																			X	X	X

Procedure for Using Table
1. Find problem above.
2. Checks indicate causes related to the paver.
   X's indicate other problems to be investigated.



Poor Longitudinal Joints


SPEED LIMIT
55

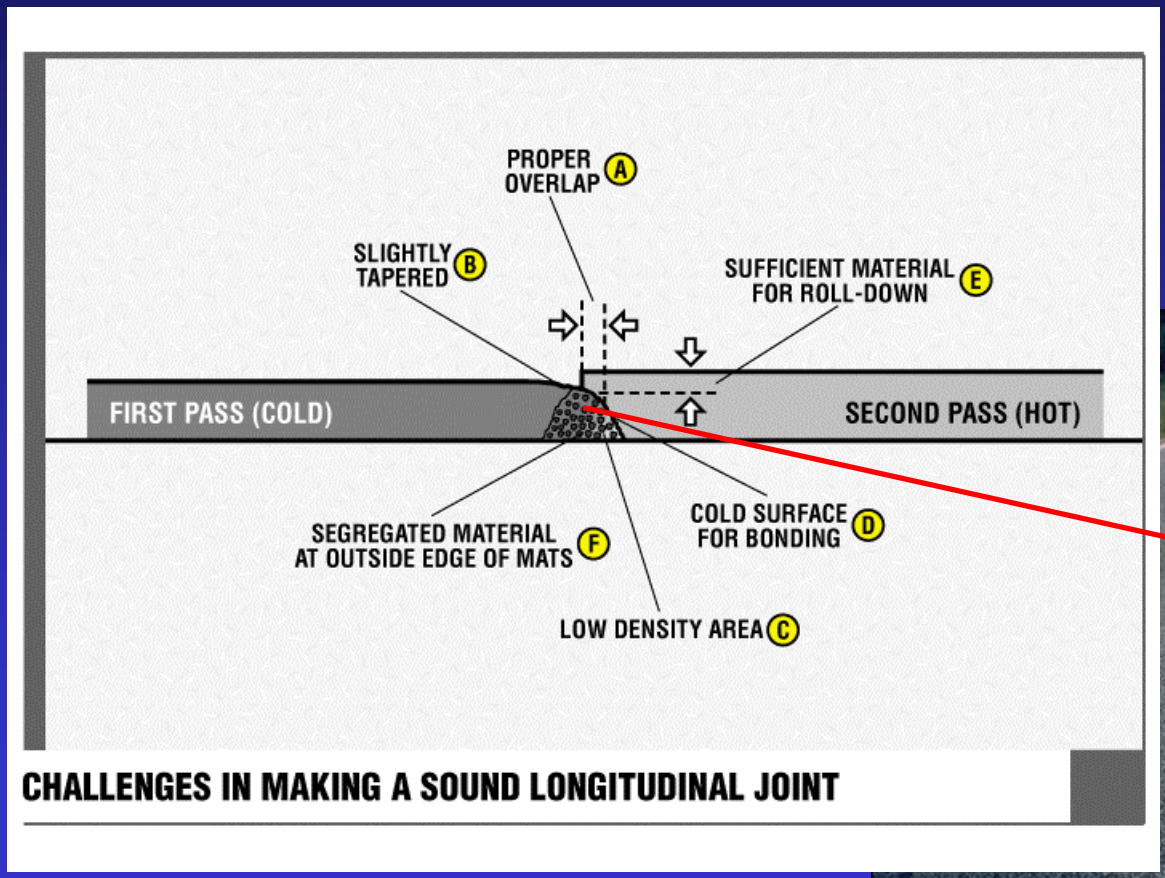
JOINT PROBLEMS

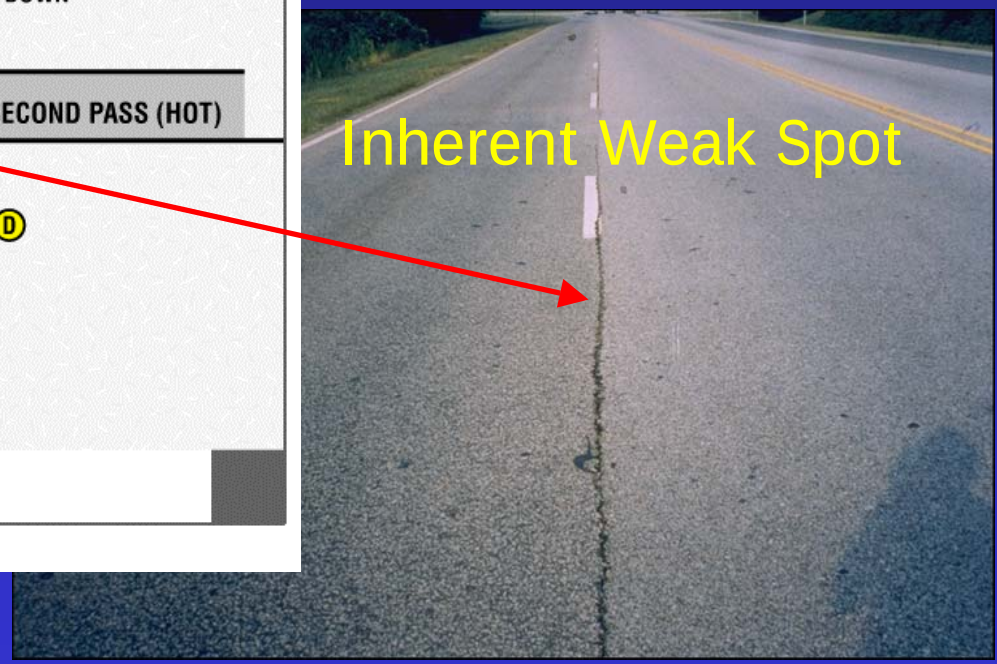
- MIX TENDER; DRY; HARSH
- RAPID COOLING OF MAT
- LACK OF MATERIAL AT THE JOINT
- POOR COMPACTION TECHNIQUES
- SEGREGATION OF HMA

Bad joints require little or no effort!

What is the Problem?

The first pull of the paver generally leaves an area of low density along the unconfined longitudinal edges of the mat.





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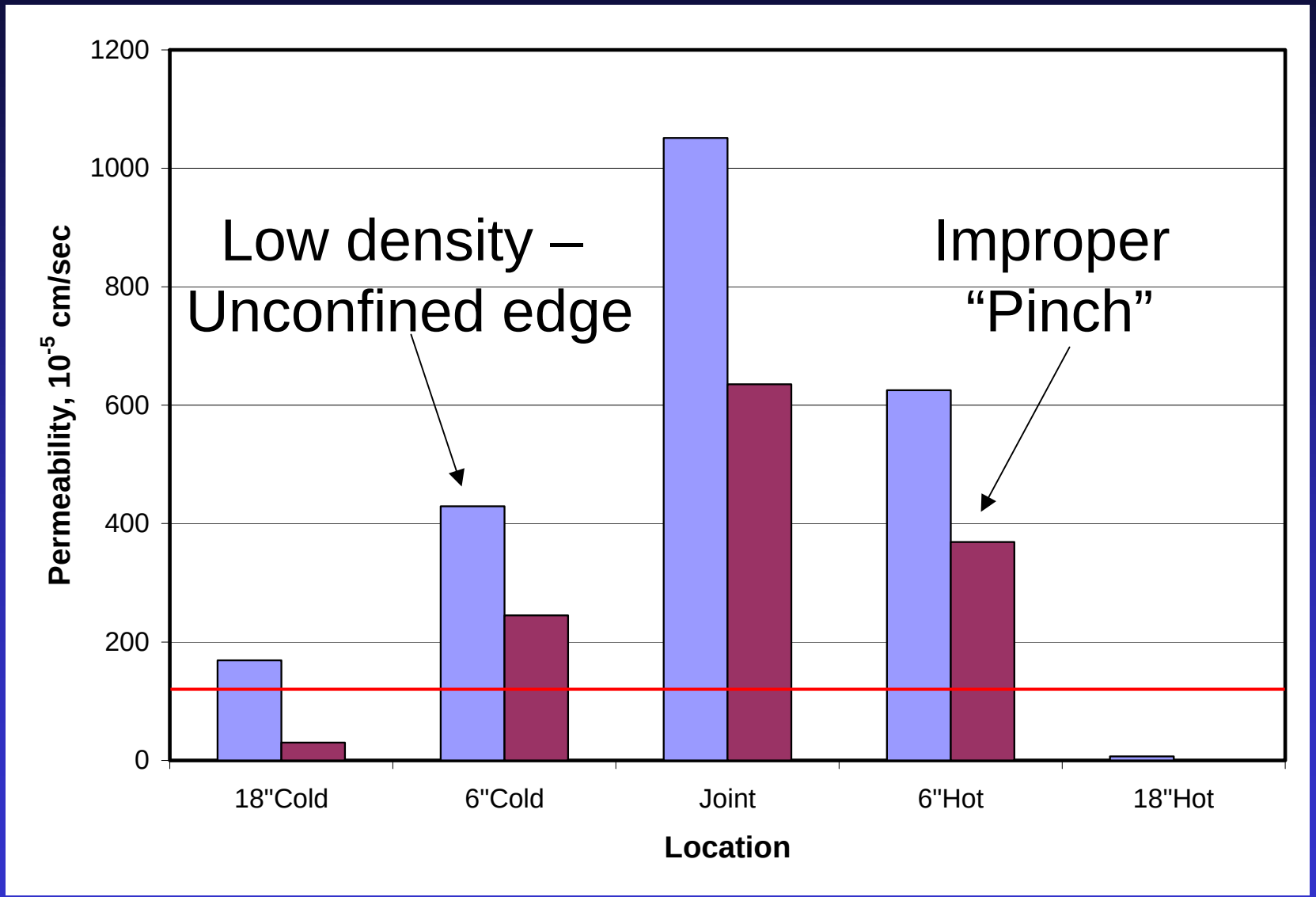
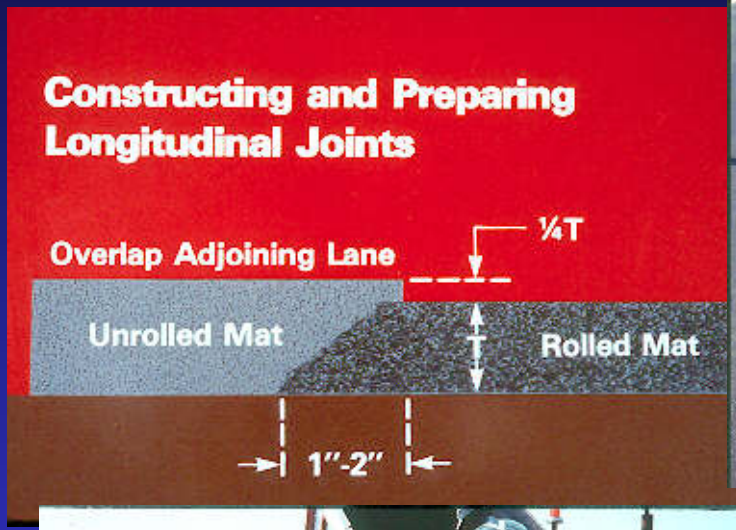
Field Permeability Measurements



Longitudinal Joint Problems

- One of the biggest problems is a “crooked” mat.
  - Impossible to consistently match with the hot mat.

Constructing Good Joints?

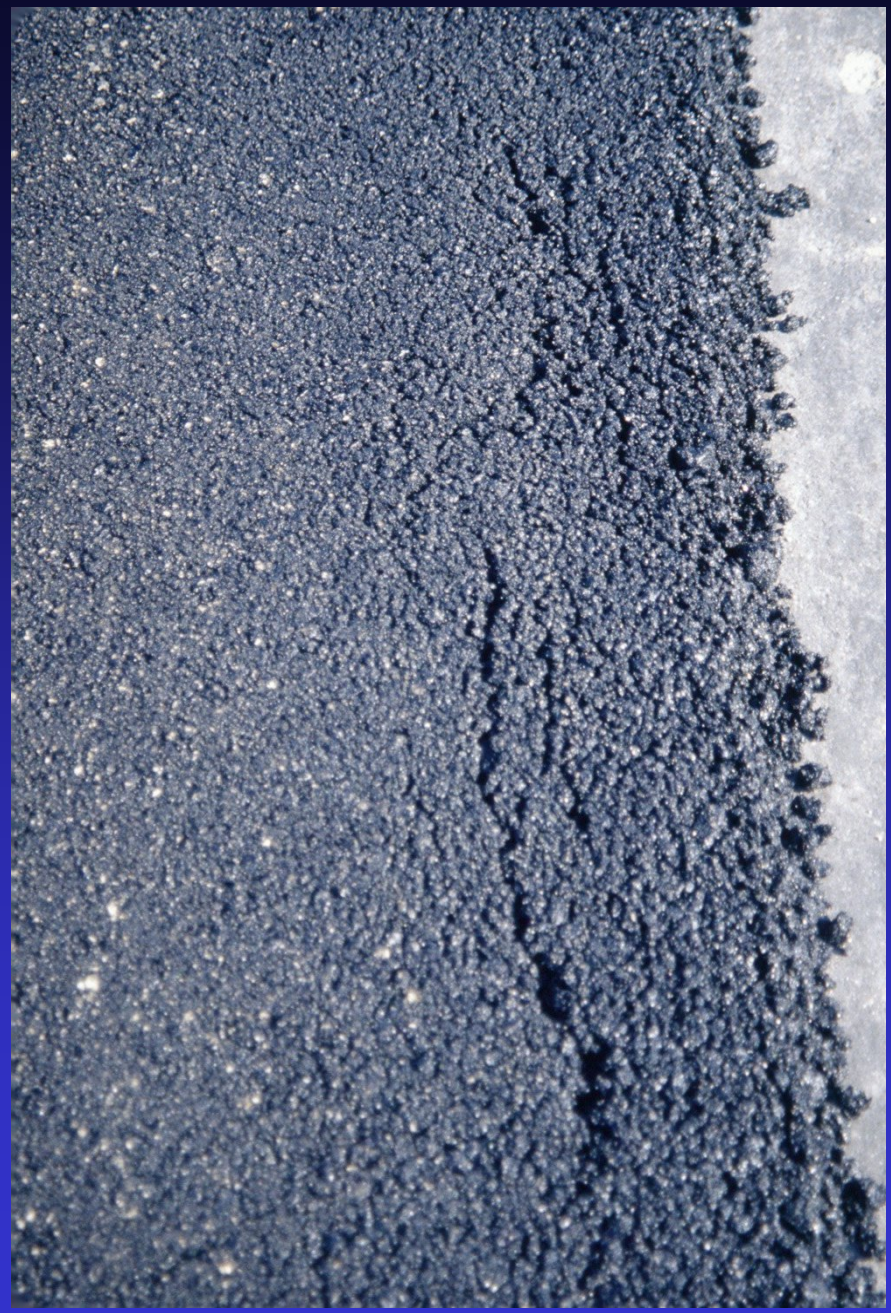


Longitudinal Joint Construction

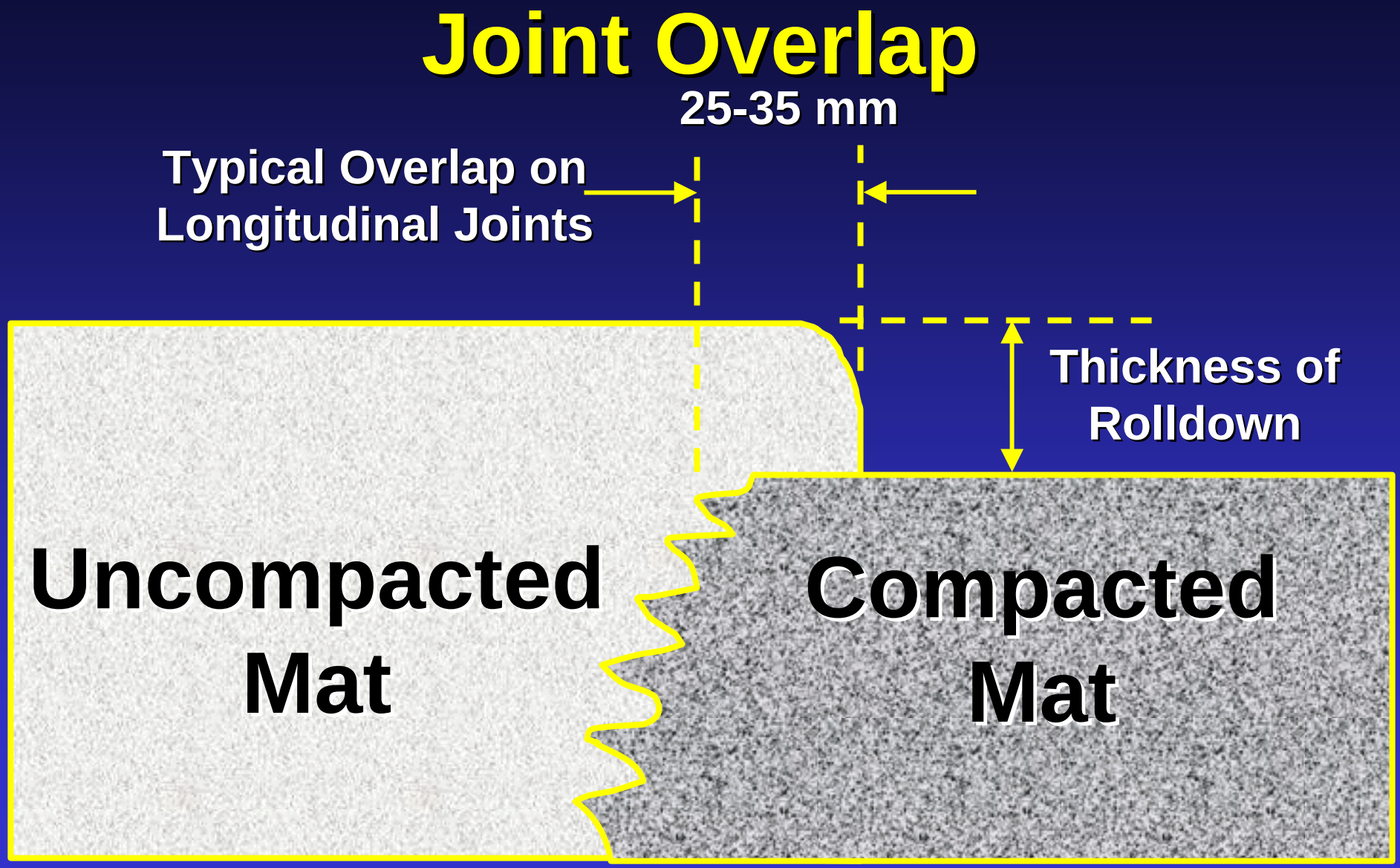
The Basics

- Compaction of the first lane or the unsupported edge
- Proper overlap between the first lane and the second
- Don’t touch the joint
- Proper compaction of the joint

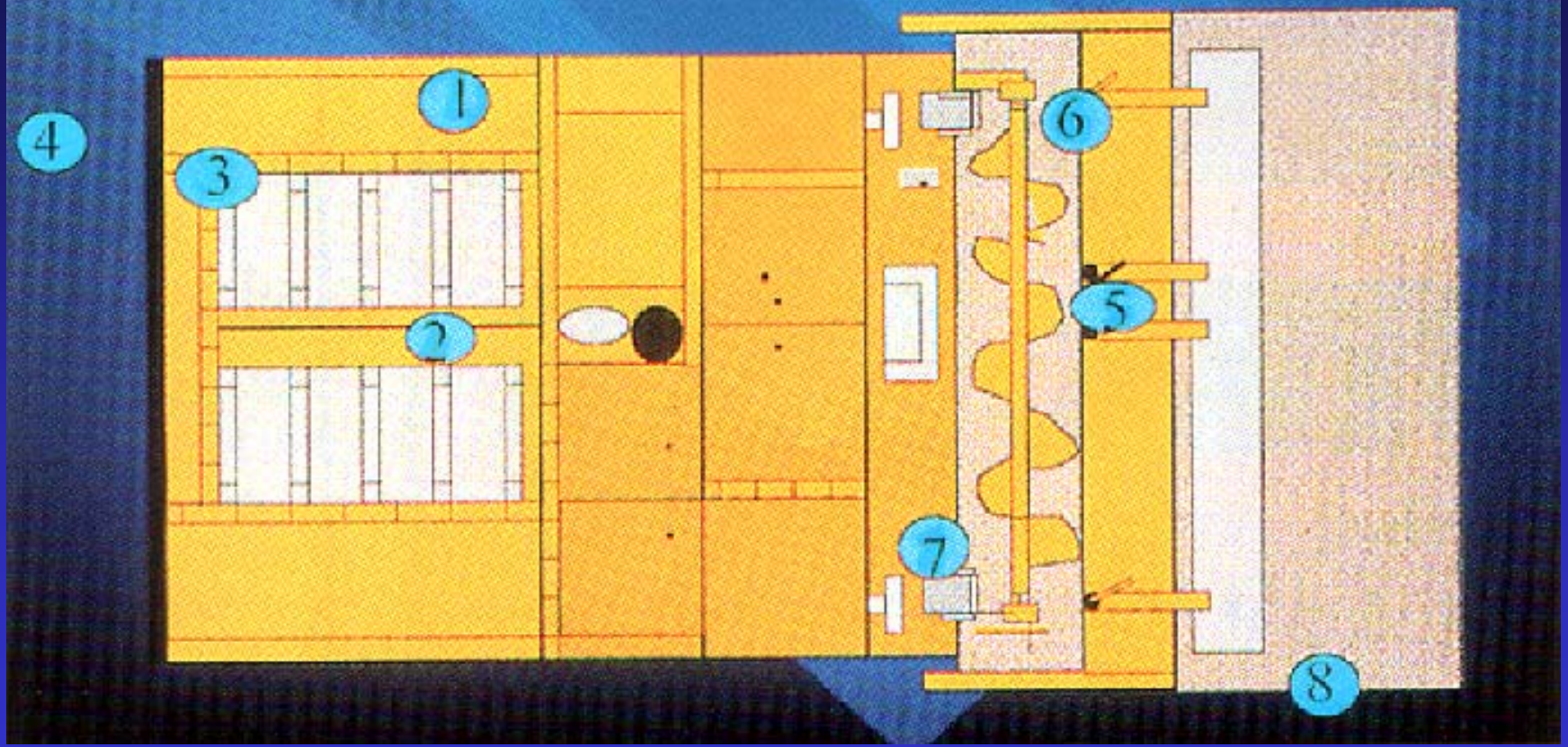

BOMAG



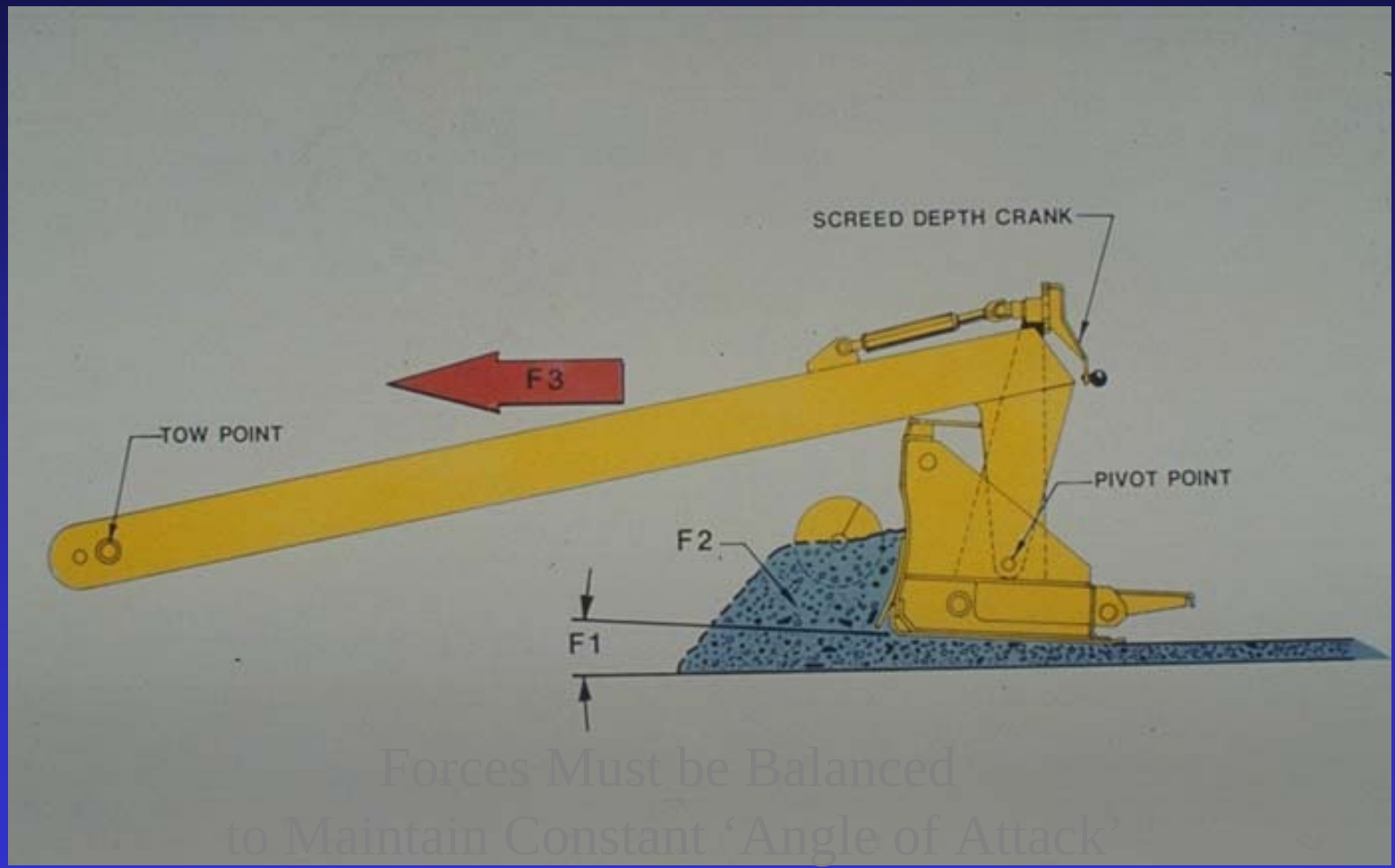
Does this work?

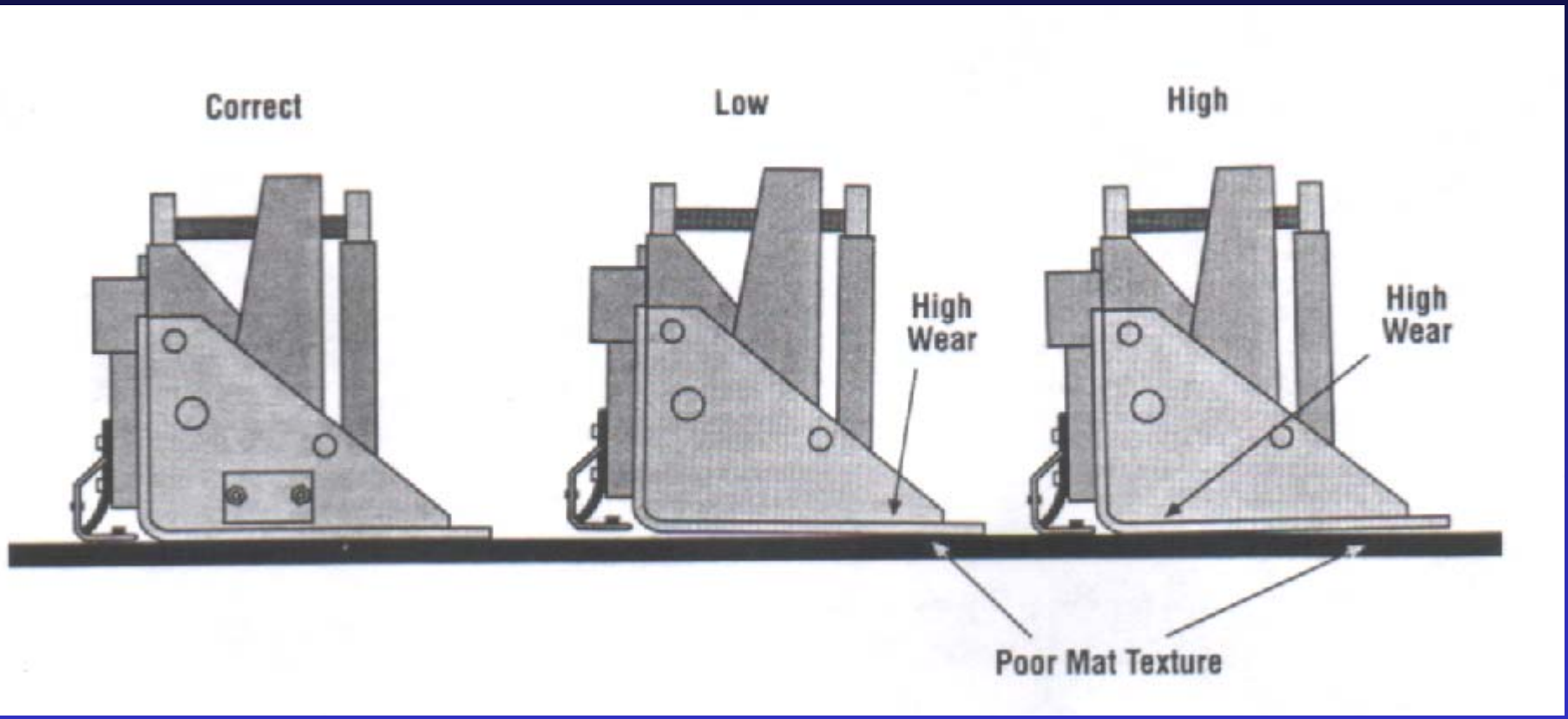

Joint Overlap
25-35 mm
Typical Overlap on
Longitudinal Joints
Thickness of
Rolldown
Uncompacted
Mat
Compacted
Mat

SEGREGATION…8 AREAS TO WATCH



Forces On Screed



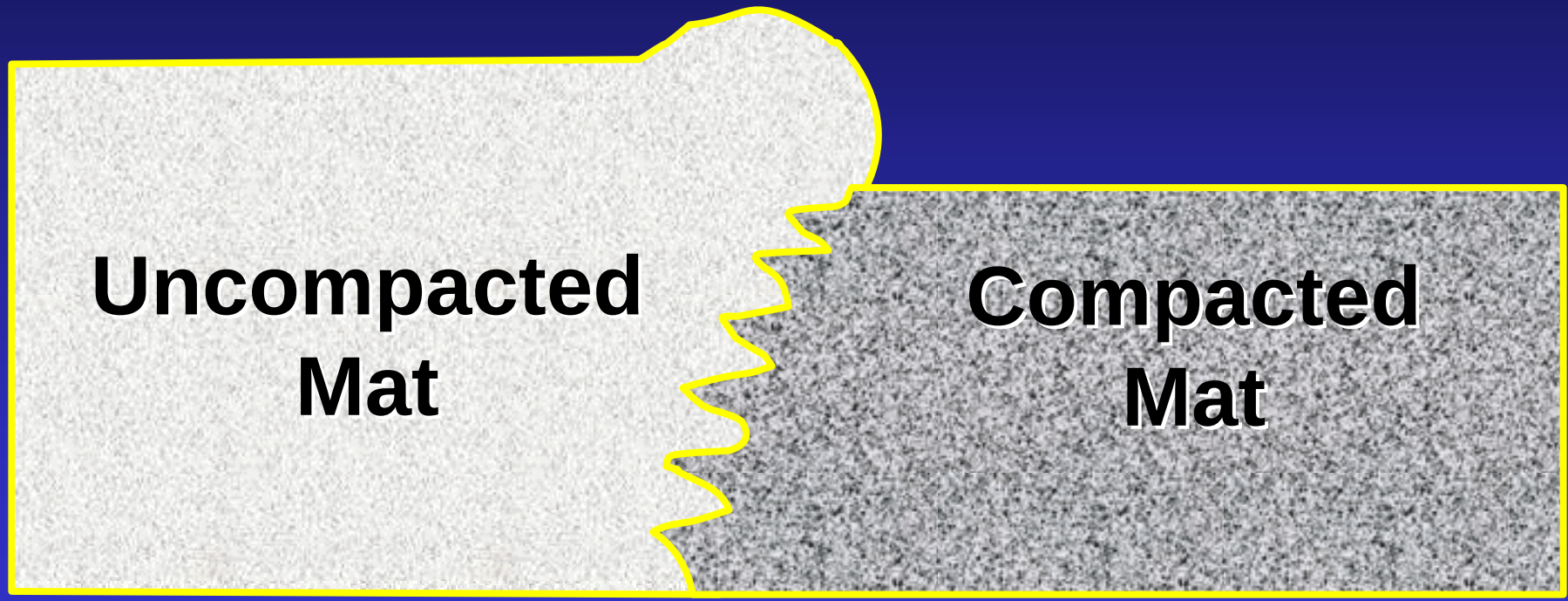

Correct
Low
High
High Wear
High Wear
Poor Mat Texture

Without Auger Extensions

SCREED MARKS

- EXTENSIONS SET TOO HIGH OR LOW
- EXTENSIONS STARVED FOR MIX
- LACK OF MIX VIBRATION
- WORN AUGERS AND/OR PLATE
- OVER SENSITIVE AUTOMATIC CONTROL
- TURNING PAVER TOO SHARPLY
- CHECKING/TEARING UNDER SCREED

Mix “Bumped Back” to Joint



Don’t Touch The Joint!

Joint Without Luting

Longitudinal Joint Solutions

- Quality workmanship is the 1st step.

- Hot joint construction
  - Echelon paving
- Rolling methods
  - Rolling from hot side, cold side, pinch, etc.
- Construction methods and materials
  - Tapered joints (3:1, 12:1 w/ notch, etc.)
  - Cutting wheel
  - Edge restraining device
  - Joint adhesive

Longitudinal Joint Solutions

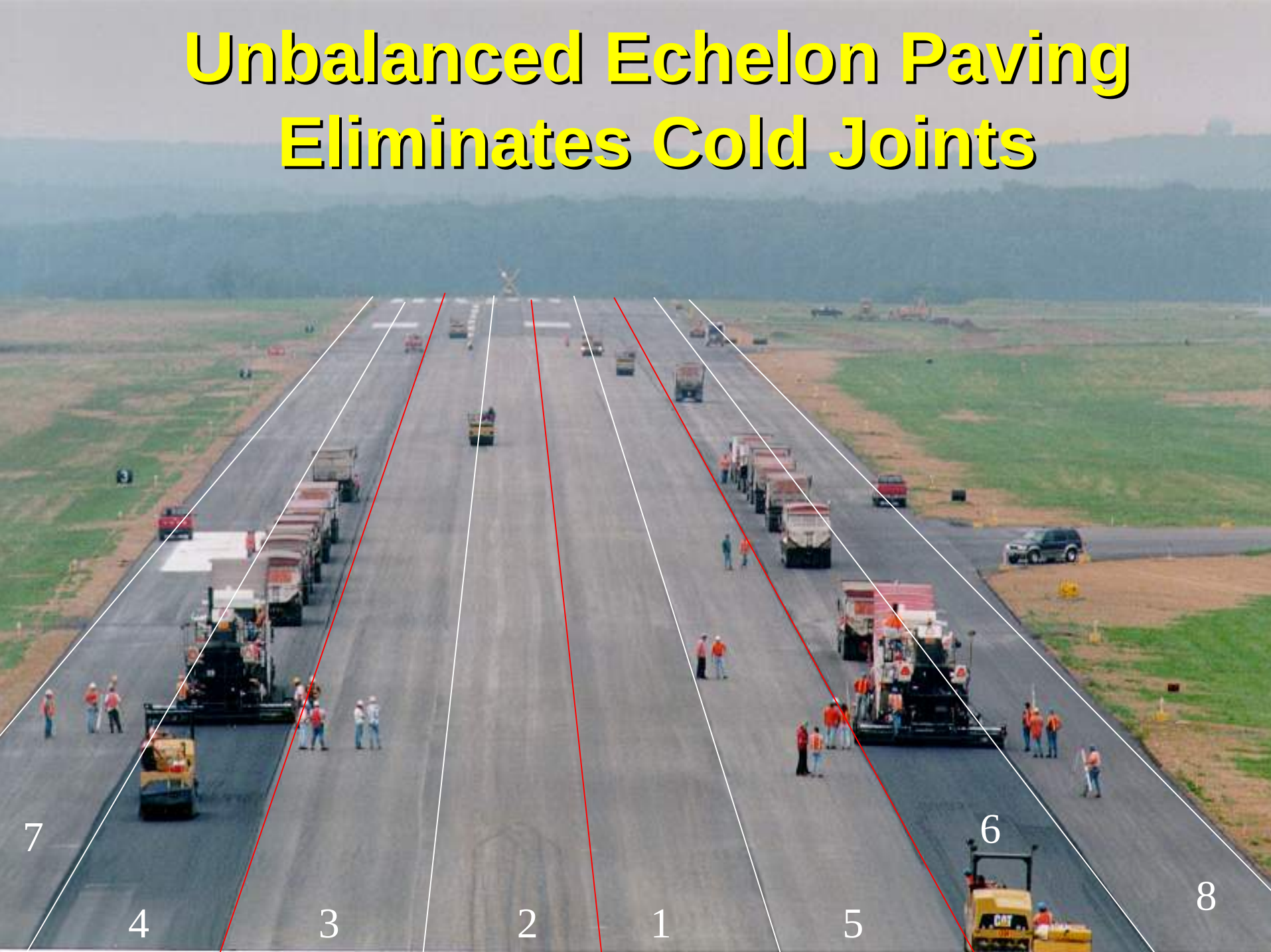
- Echelon Paving
  - Hot joint construction is likely to provide greater joint density.

Hot Joint

150 wide Runway Covered in

8 passes @ 18.75 Feet wide

Unbalanced Echelon Paving Eliminates Cold Joints



Other Solutions?

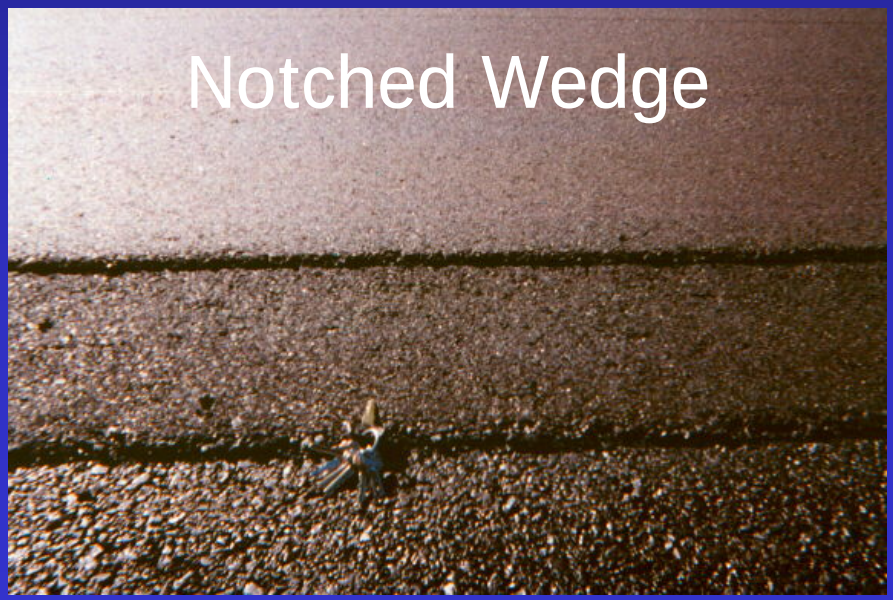
Roll from hot side w/ 150 mm overlap

Roll from cold side w/ 150 mm overlap

Roll from hot side w/ 150 mm pinch

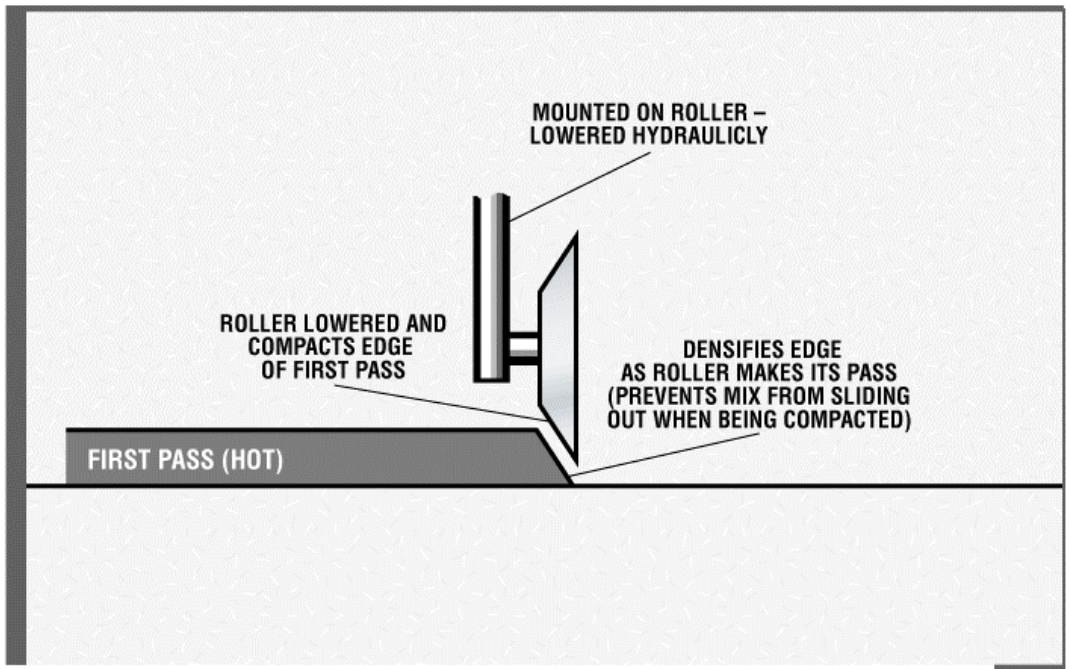
Notched Wedge Joint


Template


Notched Wedge

Roller

Edge Restraining Device



EDGE COMPACTOR

Success dependant roller operator following pavement edge

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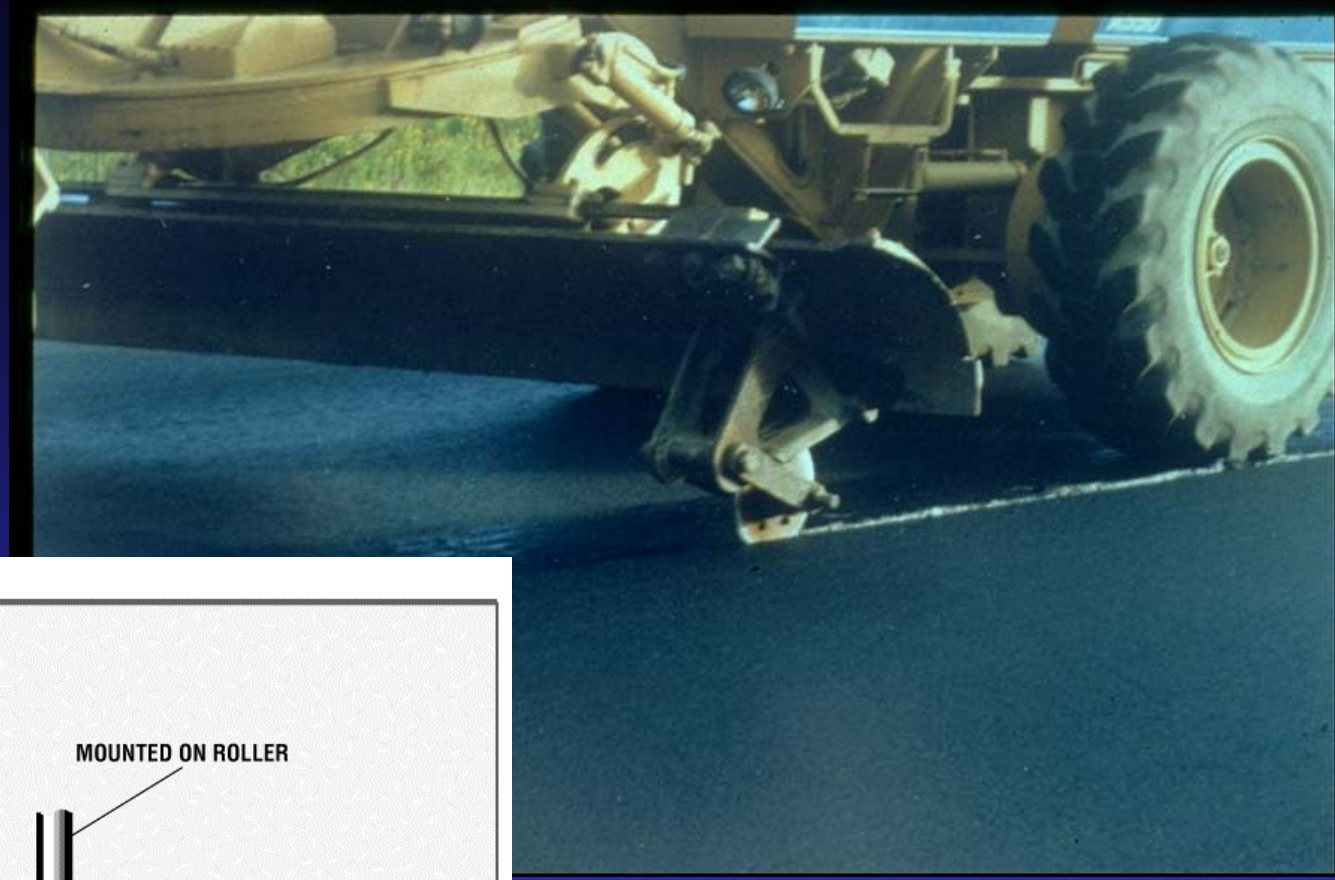
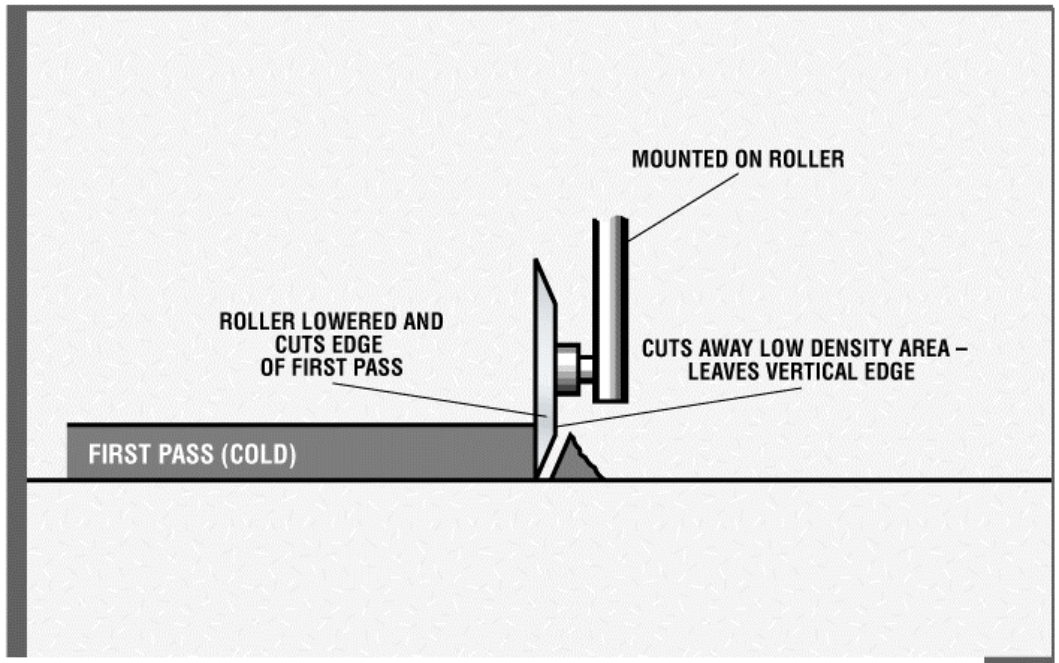
Cutting Wheel





CUTTING WHEEL

Can be mounted on roller or motor grader

Rubberized Joint Adhesive

Conclusions

- Workmanship is critical to quality
- Variety of techniques can be effective depending upon the application
  - Notched Wedge Joint appears to offer promise in improving quality while being safer and increasing productivity
  - Rubberized Adhesive is very effective
  - Rolling from the hot side and rolling 150 mm off the hot side are the most effective traditional techniques

Thanks!

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