

Hauling, Laydown and Compaction

WisDOT/WAPA Asphalt Pavement Project Manager Training

June 2010

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Topics

- Hauling
- Equipment – pavers, MTDs, rollers
- Construction – surface prep, placement and joints
- Compaction
- Surface Requirements
- Quality Management Program

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450.3.1.2 Hauling Vehicles

- Tight, clean and smooth box
- Cover/tarp for box
- No “oil leaks of any magnitude”



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Optional Release Agent

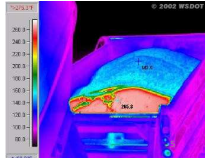
- Light coating
- From Approved List
- Drain after coating, if used



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450.3.2.3 Transporting and Delivering

- Deliver at a temperature within 20°F of recommended temperature (from binder supplier)
 - Typically loaded at between 250°F to 350°F.
- Tarp loads when air temperature is below 65°F or during inclement weather
- Insulate truck beds
- Minimize haul distances

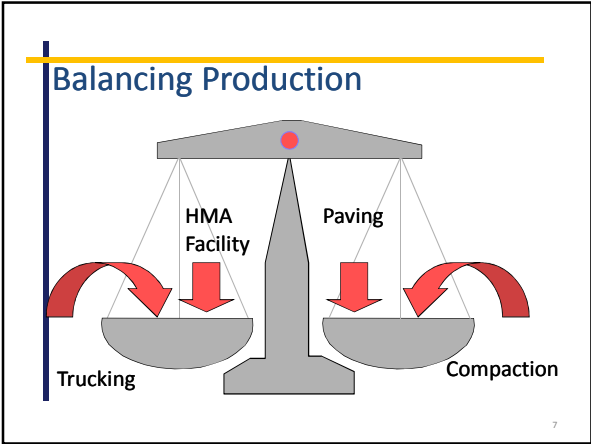


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Delivery

- Delivery is the start of the HMA construction process.
- Like any process, if it is planned properly, it will go smoothly.
- The smoother the process, the better the product.
- Balance plant production and laydown rate.

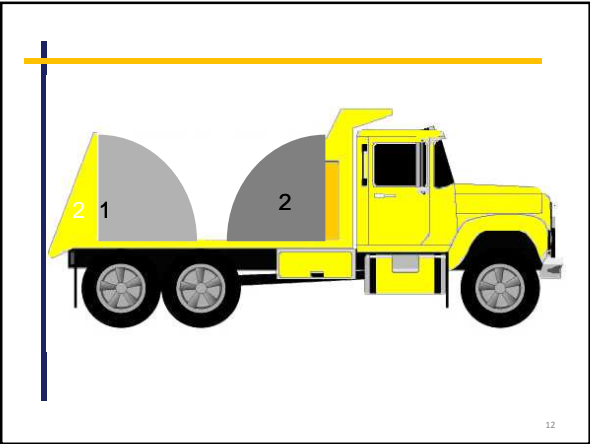
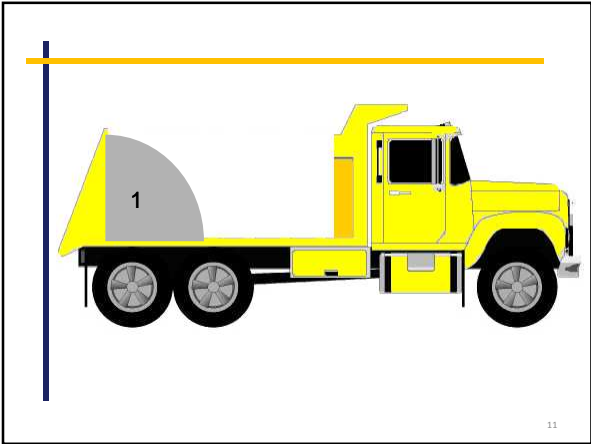
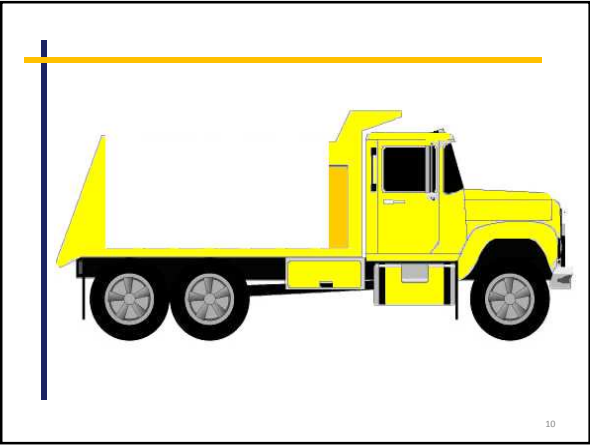
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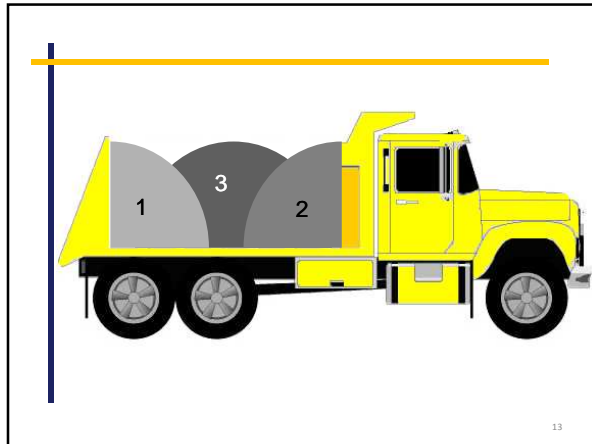


- ### Factors to Consider
- Production facility output rate
 - Availability and condition of storage silos
 - Number, type and capacity of trucks to be used
 - Time:
 - to lubricate the truck bed before transport
 - waiting time at the production facility
 - to load, weigh and ticket at plant
 - to cover the load (if tarpaulins are used)
 - Haul distance between plant and paving site
 - Average truck speed (traffic, RR crossings, etc.)



- ### Loading Trucks
- Clean, smooth bed
 - No contamination
 - Optional release agent
 - No excess
 - Multiple drops to control segregation





Tarp when needed

- Temperature $\leq 65^{\circ}\text{F}$
- Inclement weather
- Urban projects
- When you need to keep heat in the mix

Before Unloading Trucks

- Inspect and Accept Mix
- Collect Weigh Ticket
 - Is it the right mix for the job?
 - Does it look right?


Visual Mix Inspection

- **Blue Smoke:** check mix temperature (too hot?)
- **Stiff Appearance:** check mix temperature (too cold?)
- **Mix Slumped in Truck:** mix may contain too much asphalt or excessive moisture
- **Lean, Dull Appearance:** mix may contain too little asphalt
- **Mix Containing Lumps or Clods:** excess moisture?
- **Segregation:** evaluate mixture all handling procedures
- **Bleeding:** check release agent (no diesel fuel)
- **Uncoated Particles:** poor mixing, incompatibility?

Truck Drivers

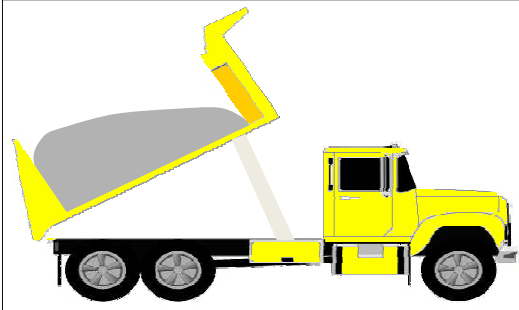
- Part of the team – communicate so they understand roles and responsibilities
- Need to pay attention to people, traffic, surroundings and paver operator instructions

- Back slowly towards paver
 - Straight and centered
- Stop a few inches before paver
- Light touch on the brakes
- Let paver pick up truck
 - Avoid bumps




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Raise truck bed 3-4 ft before releasing gate



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Then release gate and load hopper.



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Truck loading and unloading is key to getting smooth, non-segregated mat.

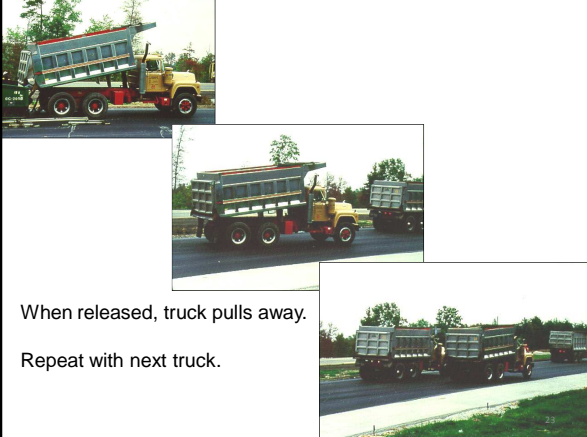
Many things can make or break the operation.



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When released, truck pulls away.

Repeat with next truck.



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Clean truck in designated cleaning area, off the paving area.



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Mix spilled or left in front of paver can cause problems "down the road."

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Material Transfer Device

One of the essentials for a consistent and high quality HMA pavement is to provide for a continuous operation

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MTD Benefits

- Provides additional surge volume for the paver
 - Keeping the paver moving → smoother pavement
- Serves as a buffer between the paver and the haul trucks
 - Avoiding bumps → smoother pavement
- Provides remixing capability
 - Remixing → less segregation

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Bottom dump trucks require pick up device.

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Equipment Overview


- Pavers
- Rollers
- Joint Heaters
- Longitudinal Joint Attachment

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Pavers

Place the HMA to the desired width and thickness and produce satisfactory mat texture.

- Tractor Unit
- Screed
- Reference Control



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Asphalt Pavers

Receiving Hopper



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Asphalt Pavers

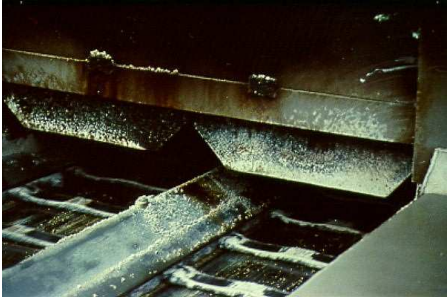
Feed Conveyor



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Asphalt Pavers

Flow Control Gates



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Asphalt Pavers

Distributing Augers



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Asphalt Pavers


Distributing Augers: (~75% height)



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Screed Unit

- Strikes off mix to desired thickness and surface qualities
- Provides initial compaction

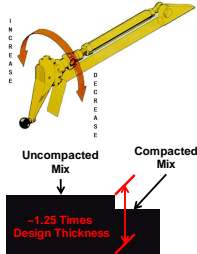


The most important part of the paving machine

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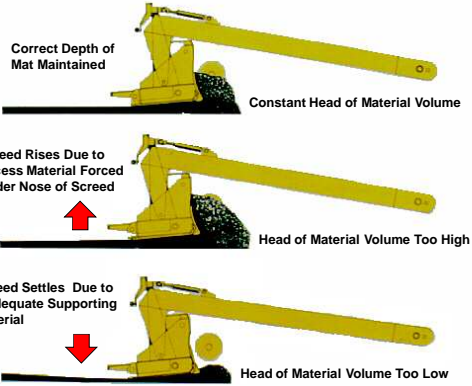
Screed Unit

- The thickness control screws rotate the screed about its pivot point
- The rotation changes the screed's angle of attack, causing the screed to raise or lower
- One full turn of the crank produces ~1/4" change in mat thickness

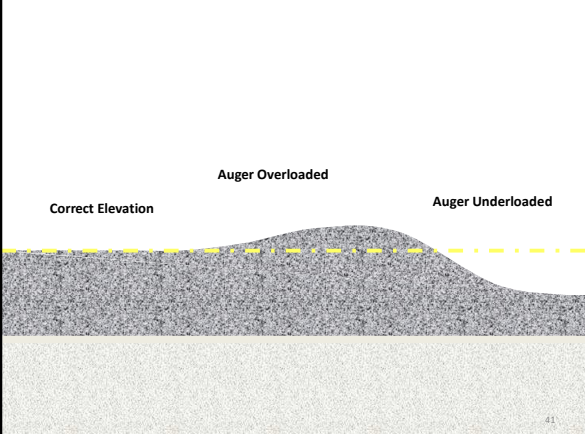


Another way to change mat thickness is to change the height of the tow point

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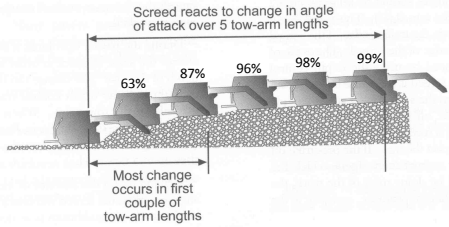
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Screed Reactions


Screed reacts to change in angle of attack over 5 tow-arm lengths



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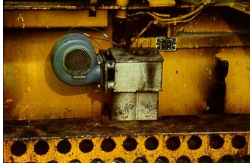
Other Screed Components

- Strike-Off
- Crown Control
- Extensions,
- Cut-Off Shoes
- End Plates
- Screed Vibrator
- Heating System



Heating System


- The screed is equipped with heaters that are used to warm up the screed bottom prior to the start of paving
- If not used, the texture of the mat will appear open and torn
- The heaters should be turned off during actual paving



[Back](#)

Automatic Screed Control


- Electronic adjustment to screed height using sensing and referencing system
- Sensor detects elevation changes, adjusts the height of the tow point
 - Sensing devices:
 - Wand
 - Ultra sonic
 - Laser




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Automatic Screed Control

- Electronic adjustment to screed height using sensing and referencing system
- Reference Systems:
 - Stringline
 - Can provide the smoothest ride
 - Requires survey crews
 - Mobile
 - Long skis (25' to 60')
 - "Construction Friendly"
 - Joint matching shoe
 - Short ski that rides on adjacent surface




Rollers



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Typical Compaction Train

- *Screed*
- *Breakdown Roller*- Vibratory Steel Wheel
- *Intermediate Roller*- Pneumatic Tire Roller or Vibratory Steel Wheel
- *Finish Roller*- Static Steel Wheel Rollers
- *Traffic*



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Vibratory Rollers

- Provide compactive force by a combination of weight and vibration
- Vary in weight
- Vary in size
- Vary in configuration
- Operation modes
- Frequency and amplitude adjustable



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Vibratory Roller

- **Impact spacing** should be between 12 and 14 impacts per foot
- Function of roller speed and frequency



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Pneumatic Roller

- Tires must be inflated to equal pressures
 - 60 to 120 psi Range
 - ~70 psi tender mix
 - ~90 psi stiff mix
- Warm tires before compacting hot mix
- Skirts keep tires warm during the day



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Steel Wheeled Roller

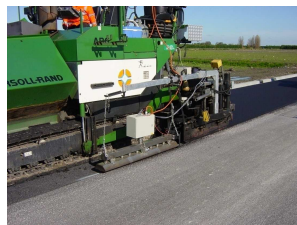
- Vary in size and weight
 - 3 to 14 tons
 - 10 tons typ. for RDWY work
 - 3 to 5 foot diameter wheels



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Joint Heater (STSP 460.015)

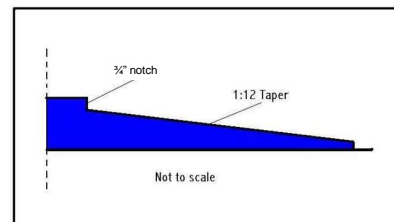
- Reheats adjacent pavement to promote better joint
- Self-contained heating unit
- Uniform distribution of convection heat
- Reheats to:
 - 290-340°F when air ≥ 60°F
 - 240-290°F when air < 60°F



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Longitudinal Joint Attachment

- Used to produce notched wedge joint
- Attaches to paver



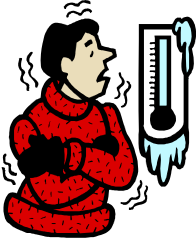
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Construction

- Spreading and Finishing Mixture
 - Segregation
 - Mid-Lane Segregation
 - Longitudinal Joints
- Laydown
 - General Requirements
 - Base Conditions and Correction – in Overlay module
 - Tack Coat – in Overlay module
 - Layer Thickness

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Temperature Restrictions




- Temperature must be $\geq 36^{\circ}\text{F}$
- May place lower layer and base at lower temperatures with engineer's approval
- Do not place over frozen subgrade.

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Date Restrictions

- Do not place between October 15 and May 1 without engineer's approval.
- Contractor request = Contractor's risk; restore damage or defects
- Department convenience = Department responsible for damage or defects



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Layer Thicknesses

NMAS	Min Layer Thickness (in)	Max Lower Layer Thickness (in)	Max Upper Layer Thickness (in)
37.5 mm	3.5	5	4.5
25.0 mm	3.25	5	4
19.0 mm	2.25	4	3
12.5 mm	1.75	3	2.5
9.5 mm	1.5	3	2

SMA's use 12.5 or 9.5 mm and have no max lower layer thickness.

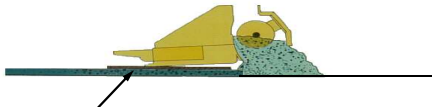
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Laydown – Paver Operation Best Practices


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Starting Off




Starting Blocks

A good rule of thumb is to raise the screed 1/4" to 1/2" more for each 1" of compacted thickness.



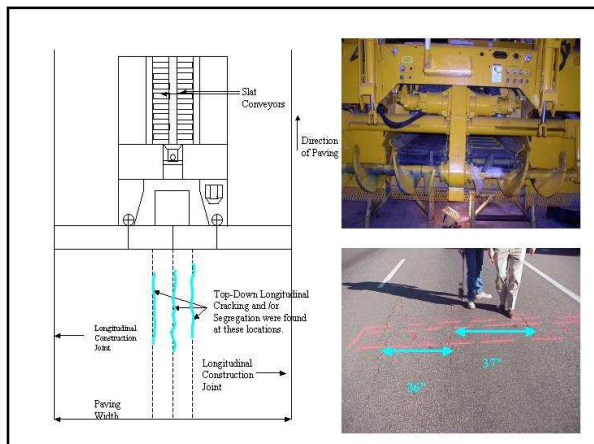
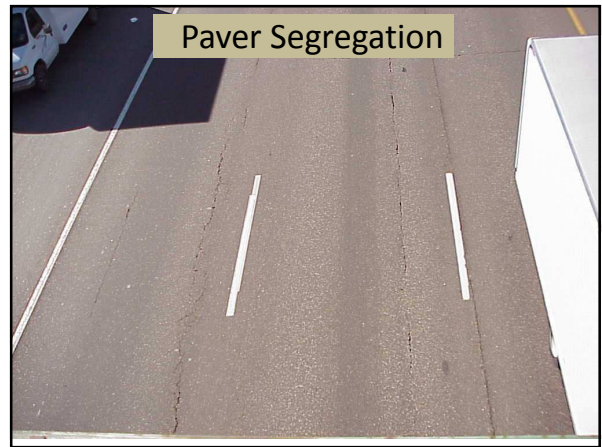
Paver Operations




- Keep the paver moving steadily forward
- Maintain proper, constant flow of material
 - Proper flow gate setting to keep slat conveyors running most of the time
- Keep constant head of material at the augers
- Don't dump the hopper wings
 - Fold only enough to keep mix hot while waiting and only when hopper is fairly full.

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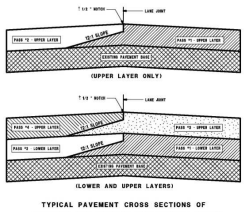


- ### Mid-Lane Longitudinal Cracking
- 2008 Construction Note Number 5
 - Perform nuclear density tests in center 18 inches of paved lane
 - Compare to tests in rest of the lane
 - Consistent differences of 4 pcf indicate potential for distress
 - Discuss changes to correct situation
 - Paver manufacturers have developed retrofit kits and paver modifications.
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Placing Mixture

Longitudinal Joint

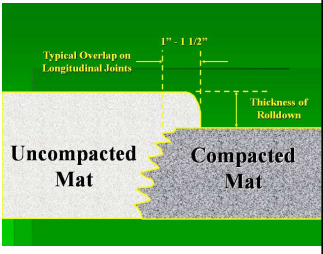


TYPICAL PAVEMENT CROSS SECTIONS OF TAPERED AND NOTCHED LONGITUDINAL JOINTS

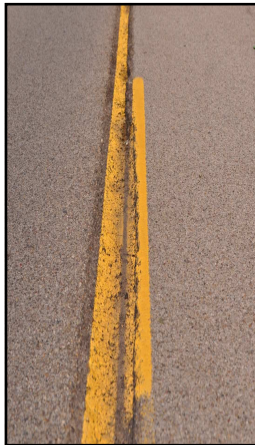
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Longitudinal Joints

- Key is proper overlap of mix between the new and old mat.
- Proper overlap provides just enough material on top of the joint to allow compaction without having extra mix.



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Joint Compaction

- Weakest link
- Allow water and air penetration
 - Stripping
 - Delaminations
 - Hardening/Cracking
- Avoid if possible!
- Many approaches
- Attention to detail

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Drive a straight line!



Maintain proper overlap.
Allow for roll down.



Bump the joint, don't rake.



Scattering Causes Low Joint Density

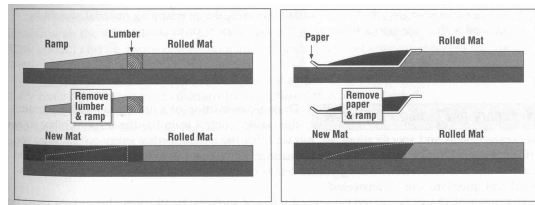
Transverse Joints

- Constructed across the pavement whenever paving is being suspended.
- Run the paver in normal fashion right up to where the transverse joint is being constructed.
- Do not run the paver dry right at the joint. Keep a full head of material in front of the screed to the end.



Placing Mixture

Transverse Joints



Handwork

- Tying into the existing pavement requires skill to ensure a smooth transition
- There will almost always be some handwork necessary to complete the joint
- When handworking mix:
 - “leave the mix high” to allow compaction
 - Handworked mix is looser than paver-laid mix
 - Leave high about 1/4” to 1/2” per 1” of mix laid
- Compact this immediately
 - Handworking (and the time to do it) results in a cooler mix

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WisDOT Project Manager Perspective



- Review Mix Design Information
- Ensure that each load of mix is satisfactory
- Collect Truck Tickets
- Observe paving operation
 - Identify / notify operational concerns
- Check Pavement Thickness
- Project Diary Entry
- Pay Item Measurement

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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

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Factors Affecting Compaction

- Mix Properties
 - Aggregate gradation, shape and texture
 - Binder stiffness and content
 - Mix temperature
- Environmental Conditions
 - Air and surface temperature
 - Wind
 - Humidity



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Factors Affecting Compaction



- Layer Thickness
- Joints
- Segregation
- Equipment
 - Enough
 - Speed
 - Type

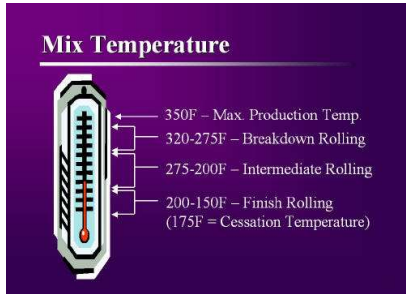
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Temperature is critical



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Mix Temperatures (Pre-Warm Mix)



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Roller Patterns

- Uniform compaction depends upon getting the same number of roller passes over each area of the mat.
- This means that a pattern must be developed that covers the entire mat with an equal number of roller passes from each type of roller.

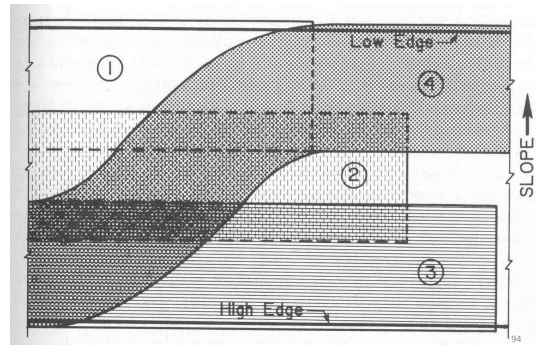
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Roller Patterns

- Overlap between two successive passes should be at least 6 inches
- The roller should be turned slightly to the side when reversing directions or stopping
- Roller passes should end at different points to prevent developing a hump that spans the entire transverse length of the mat.
- Do not roll over a designed crown in the road
- When compacting a longitudinal joint, the first roller pass should be entirely on the hot mat about 0.5 - 1 ft. away from the joint
- Joints should be compacted with the roller operating parallel to the joint

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Roller Patterns



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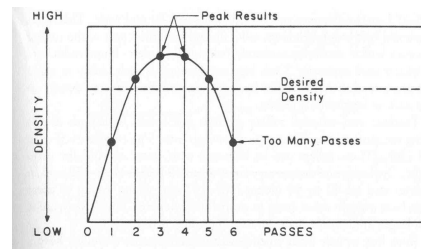
Roller Speeds

Type of Roller	Breakdown	Intermediate	Finish
Static Steel Wheel	2.0 - 3.5 mph	2.5 - 4.0 mph	3.0 - 5.0 mph
Pneumatic	2.0 - 3.5 mph	2.5 - 4.0 mph	4.0 - 7.0 mph
Vibratory Steel Wheel	2.0 - 3.0 mph	2.5 - 3.5 mph	not used

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Roller Patterns

Test Strip



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Checking Density With Nuclear Gauge

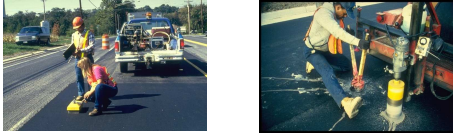


TABLE 400-3 MINIMUM REQUIRED DENSITY⁽¹⁾

LOCATION	LAYER	PERCENT OF TARGET MAXIMUM DENSITY		
		MIXTURE TYPE		
		E-0.3, E-1, and E-3	E-10, E-30, and E-30x	SMA
TRAFFIC LANES ⁽²⁾	LOWER	91.5 ⁽³⁾	92.0 ⁽³⁾	94.0
	UPPER	91.5	92.0	94.0
SIDE ROADS, CROSSOVERS, TURN LANES, AND RAMP ⁽²⁾	LOWER	91.5 ⁽³⁾	92.0 ⁽³⁾	94.0
	UPPER	91.5	92.0	94.0
SHOULDER AND APPURTENANCES	LOWER	89.5	89.5	91.0
	UPPER	90.5	90.5	91.0

⁽¹⁾ The table values are for average for density. If any individual density test result falls below 87% of the target maximum density, the engineer may investigate the acceptability of that material.

⁽²⁾ Includes parking lanes as determined by the engineer.

⁽³⁾ Minimum reduced by 2 percent for < 3 million ESALs and one percent for > 3 million ESALs, for that lower layer constructed directly on crushed aggregate or recycled base courses.

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Compaction



- Things to look for:
 - Proper rolling pattern
 - Proper rolling temperature
 - Proper mat thicknesses

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Mat Inspection

- Cracking (checking)
- Tearing
- Wavy Mat
- Segregation
- Bleeding
- Fat spots
- Slippage
- Broken aggregates
- Roller marks



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WisDOT Project Manager Perspective



- Project HMA Technician
 - HTCP Certified
- Project Manager
 - Documentation
 - QMP Density
 - QMP Ride
 - Diary Notes

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