Asphalt Pavement: The Road to Quality
Paver Operations
Presented by Peter Fredrickson

Training Objectives
- We will cover
- The five factors
- Safe paver operation
- Screed setup and what you need to know about your screed
- Balanced production
- Controlling segregation

Track Drive
- **Advantages**
  - Excellent Traction
  - Excellent Flotation
  - Low Ground Pressure
- **Disadvantages**
  - Higher production cost = higher initial purchase price and higher maintenance cost over the life of the tractor
  - Less mobile

Wheel Drive
- **Advantages**
  - Mobility
  - Lower maintenance costs
  - Familiar steering control
  - Job site speed
  - Less base rock disturbance
- **Disadvantages**
  - May spin on loose surfaces or heavy tack coated surfaces
  - Risk of tire puncture
Pavers Utilizes a Free Floating Screed Principle

That means the screed, which is being towed along by the tractor is lowered and held down onto the mat by its own weight.

It's supported by the quality or stability of the material that it's laying.

Five Factors

- The Factors Affecting Screed Performance
- Methods of Controlling These Factors
- What the Crew Can Do

Factor Number 1

Controlling Mat Thickness
Adjusting the “Angle of Attack”

Angle of Attack

Definition:
Angle made by the screed plate to the mat with which it is paving.
Changing the Angle of Attack - Increasing

Changing the Angle of Attack - Decreasing

Methods of Changing the Angle of Attack
- Manual using Depth Crank
- Automatically using grade sensors or switching tow point manually

Screed Ratio
- Ratio: 1:1
- Pivot Point: 25 mm or 1 inch here
- Changing Line of Pull: 3 mm or 1/8 inch here
What is a Tow Length?

- **Manual Control by use of depth cranks**
  - Tow Point not used

- **Automatic Control using grade sensors**
  - Tow Point adjustable

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**Screed Reaction**

- **Reaction of the Screed Over Five Tow Lengths**

- **The ‘Key’ to Good Angle of Attack Control**
  - Looking Ahead
  - Frequent Depth & Slope Checks
  - Smooth Depth Changes
  - Avoiding Over-Correction
Problems That May Cause Variations in Angle of Attack

1. Over Correction of Hand or Automatic Controls
2. Over Sensitive Automatic Controls
3. Worn Screed Components
4. Poor Screed Maintenance
5. Cold Screed

Factors Determining the Angle of Attack

- Mat Depth
- Screed Weight
- Material Stability
- Screed Plate Depth (front to back)

Other factors which may affect the Angle of Attack:
Mat & screed temperature, material type, nominal aggregate size, varying paving speed and varying head of material

Summary - Angle of Attack

- Know your alignment - read and mark out the job site
- Correct screed set - up procedure at start
- Make frequent depth and slope checks
- Use automatic controls whenever possible
- Allow screed time to react
- Avoid over-correction
- Constantly monitor screed and material temperature

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Factor 2
Head Of Material
Over 90% of all mat faults may be attributed to poor head of material control. A constant flow of material and a consistent head of material is essential for smooth quality paving.

**Varying the Head of Material**
- Increased Depth
- Decreased Density
- Decreased Depth
- Increased Density

**Auger Overload**
What Happened Here?

- A hole in the side of the mat is the first sign of an empty hopper

Head of Material

Control Starts Here

The Auger Assembly

The Receiving Hopper

To be efficient the system should remain full and be running approximately 90% of the paving time

Paving Width and Extensions

Always maintain a consistent head of material, level with the auger shaft is ideal

Have auger/conveyor system running steadily approx. 90% of the time

Keep the conveyors full and hopper at least 1/4 full at all times

Use feed control sensors

Adjust the ratio dials or flow gates to suit width, depth and speed

Summary – Head of Material
FACTOR NUMBER 3

Paving Speed

Paving operation runs most efficiently when no waiting time is required for trucks to arrive with material, and all starts and stops are made quickly and smoothly.

FACTORS NUMBER 4 & 5

Screed Weight & Material Stability
Factors 4 & 5

When the paver stops: Factor 4 becomes the dominant factor

Factor Affecting the Screed

Balancing the Factors

Angle of Attack + Head of Material = Horizontal Resistance to Paving Speed

Any variation in these three factors will affect this balance and may cause undesired screed reactions
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Feed Systems

Material Flow Path Through the Paver

- Hopper
- Conveyors
- Augers
- Screed
- Fresh Mat

Auger/Conveyor Overview

- Hopper at Least ¼ full
- Conveyors Kept Filled
- Augers Built to Suit Width of Screed - Material Level with Auger Shaft

Components of The Tractor

- Outboard Auger Drive Left and Right Independent Augers
- Set the auger height at least 2 inch's above the mat depth
Components of The Tractor
- Center Drive Left and Right Independent Augers

Components of The Tractor
- Conveyor Chains
- Conveyor Chains/Flow Gates

Proper Flow Gate Position
- Only one feed sensor per side is used with this system
- With this style feed system speeding up the auger also speeds up the conveyor
- Adjust the flow gates to maintain material level at auger shaft height
- For extended paving widths a lower gate position is required
- This allows material time to be augured to the outer edges of the screed without overloading the center

Flow Gates or Ratio Dials
- Gates as installed on older style pavers
Independent auger and conveyor drive systems don’t require flow gates instead ratio dials are used

- Ultrasonic Auger Sensor
- Ultrasonic Conveyor Sensors

**Ratio Dials**

- Ratio dials set the head of material
- Unlike the original ultrasonic feed systems that required moving the sensor to change the pile height.
- Today’s systems allow you to change the pile heights by simply turning the ratio dial.
- When your paving speed changes the ratio dials will need to be adjusted to maintain the proper head of material, auger and conveyor speed.

These Images show the right and wrong way to mount feed sensors

- The feed sensors send out sound waves and need to be positioned properly.
- They don’t know the difference between asphalt or metal parts of the paver.
- If your auger or conveyor stop working the first thing to check is the sensor position.

These Images show the right and wrong way to mount feed sensors

- Sensors may not work properly when subjected to excessive heat.
- Sensors have a working window, mounting them too close or too far away can cause problems.
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- With ratio dials and split drive it is possible to short feed without cutoff plates
- If what you are paving is too wide to pave at full width, dial the auger feed down to off and run just the conveyor in auto.

What happens if we attempt to pave over an uneven base?

We see a condition in the mat known as: **Differential Compaction**

Creating Differential Compaction Through Spillage
Differential Compaction

Mat Profile After Compaction is Greatly Improved Compared to the Original Base Profile

Freshly Placed Mat

15% Compaction From Roller

Milled Surface

Leveling Course

Original Uneven Base

The more layers that are laid: the better the surface finish

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- The main components of the screed
- Main screed with adjustable crown
- Hydraulic extensions with slope
- End gates sometimes called edger plates or wings
- The screed control stations
- Electric, diesel or propane screed plate heaters

Primary Screed Functions

- Lays material to accurate widths, depths and profiles
- Provides pre-compaction to the mat
- Smooths and seals the mat
- Provides the screed operator with a platform so he can control screed position and material flow rate

Mat Profiles

- Flat Surface
- Slope Right or Left
- Wedge Right or Left
- Positive Crown
- Negative Crown or Invert
- Main Line & Shoulder
Profiles
- Flat with extensions at full width

Profiles
- Positive Crown

Profiles
- Positive Crown with Extensions Sloped

Profiles
- Negative Crown / Invert

- This is what limits the % of Negative Crown / invert you can achieve.
**Screed Designs, A Birds Eye View**

- Direction of travel
- Wedge Lock
- Front Mounted Extensions
- Rear Mounted Extensions

**Setting Up the Screed**

1. Lower screed to reference
2. Center tow points
3. Null screed (Cranks are relaxed)
4. Turn cranks two turns CW or CCW depending on your brand of paver (increase AOA)
5. Pave & readjust slowly to correct depth

**Know where the screed gauges are and what they are for**

- Extension Slope
- Crown
- Extension Height

**How fast should I pave?**
Factors Affecting the Selection of Paving Speed

- Material supply to the hopper
- Size of the mixing plant
- Distance from plant to paver
- Number and size of trucks
- Mat dimensions
- Rolling and compaction rates

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How does a screed achieve Pre-Compaction?

The Compaction Factor

- Percentage of Maximum Theoretical Density – Allow Approximately 25% or ¼ inch per inch paved.

Achieving Pre-Compaction
Typical Screed Weights

Screed weight is an important factor in the pre-compaction of the mat, here are some weights of 10' screeds:

- Front Mounted Extensions: 6500 – 8000 lbs
- Rear Mounted Extensions: 8000 – 8800 lbs

Mat Quality

- Also Begins With a Properly Set Screed

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Lead Crown

- Evenly Position Tow Points
- Drop The Screed Onto An Even Surface Null Depth Screws
- Pick The Screed Up Set It on The Safety Supports
- Use a String Line or Straight Edge, Check the Lead Crown to Tail Crown Relationship
- If Adjustment is Required, You Need to Know How to Separate the Lead Crown From the Tail

Checking Lead Crown

- Center Tow point
- On an Even Surface Null Depth Screws
Safety

- Before putting any part of your body under a screed, make sure it is safety supported.
- If you are working with a wheel paver, place blocks under the screed to avoid injury in the event of a tire failure.
- Use caution to prevent burning yourself if the screed has been preheated.

Checking Lead Crown

- Using Nylon String Pulled Fiddle String Tight

Checking Main Screed Lead Crown at The Center

- Set the tail to flat
- Then check the lead; this screed has an inverted lead crown

Release Pins Or Remove The Bolts That Tie The Crown Together

- After resetting lead crown, this screed had a 1/32" gap between the nut and the string at the front and the back was flat.
Lead Crown

- Lead crown adjustment may be necessary several times over the life of the screed plate
- Set the lead crown to the manufacturer's recommendation (Not all Screeds Require lead Crown)
- Excess lead crown will greatly reduce the screed plate life
- An inverted lead crown can cause an open texture in the center of the mat
- Too much lead crown can cause an invert at the longitudinal joints

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- Next Check Extensions for Parallel

Extensions Parallel to the Main

- Checking a rear extension screed for parallel
- As you run the extension out it must stay level or you will not be able to pave flat

Extensions Parallel to the Main

- Checking at the rear of the extension by checking both front and back you can see if you have any twist in the plate
- A twist can cause an uneven texture in the mat
Now Check to see that the Extension Slope is set properly

- Some screeds will allow you to slope beyond flat
- In this case knowing that your slope gauge is set properly is very important
- Other screeds require the inside of the extension to have a slight preset slope to compensate for deflection
- Be careful not to overdue this adjustment, just like lead crown it can cause an invert at the longitudinal joints

Strike Off Plates

- This screed needs the slope stop adjusted
- If left like this it wont pave flat

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- Safe Paver Operation

    - Always start with the manufacturers recommendation

    - When paving the front (attitude) of the screed should be 1/8 inch to 1/4 inch higher then the back

    - If the screed is riding on its nose and you are doing everything else correctly, it could be that the strike off plate needs to come down a little

    - What ever you need the back of the screed to do is what you need to do with the strike off plate

    - In other words raising it will raise the tail and lowering it will lower the tail

Safe Paver Operation

- Operator needs to be qualified, familiar with manuals and instructions
- Do a walk around inspection before starting
Safe Paver Operation

- Operator needs to be qualified, familiar with controls and instruments
- Do a walk-around inspection before starting
- Wear protective equipment, no loose clothing or jewelry
- Be prepared for:
  - Traffic
  - Obstructions
  - Limited visibility
- Know the width of the paver and attachments
- Be careful operating on slopes

Night Paving Can Be Especially Dangerous

- You HAVE to be able to be seen

Discuss Potential Dangers Before Each Shift

- Always look out for each other

Safe Paver Operation

- Paver is the center of activity
- Be careful of pinch points
- Stay away from moving parts
- Keep workers out of the path of backing trucks
- Enter and exit paver away from traffic
- Use steps and railings, don’t jump on or off the paver
Balanced Production

Factors in balancing production:
1. HMA plant production rate
Factors in balancing production:
- HMA plant production rate
- Distance from plant to paving site
- Number of trucks
- Truck cycle time
- Paver speed
- Net width and thickness
Balanced Production

Factors in balancing production:
- IfMA plant production rate
- Distance from plant to paving site
- Number of trucks
- Trucks cycle time
- Pavement speed
- Mat width and thickness
- Number of rollers

Planning should also account for transitions (loading, taping, waiting time, load transfer, cleaning).

Balanced Production

- Stick to the plan
- If you know your balanced paving speed should be 35 FPM
- Don’t pave 60 FPM because of a hiccup at the start of the day
- All you will do is allow those first trucks to bunch up and return close together on the next round

Mat Quality?

All it took to fix this issue was focusing on the basics
- If the screed person takes care in setting up and adjusting the screed it will leave no transition lines or blemishes in the mat surface.
Center Line Streaking

- Any paver with a center drive auger box may cause center line streaking when using certain materials.
- Adjustment must be made to the tractor and the screed to eliminate these marks.

What's wrong with this picture?

MTV-windrow paving

Other Types of Material Transfer Vehicles
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Topic 6

- 2D Grade and Slope Control

Automatic Grade Control

- Don't confuse grade control with slope control
- Controlling grade = controlling elevation or mat thickness

Automatic Slope Control

- Don't confuse Slope Control With Grade Control
- Always Remember Slope Doesn't Care About Yield

Ways to Control Grade

- Using a single sonic tracker mounted to the end gate
Ways to Control Grade

- Averaging with a drag ski

- Using a Sonic Averaging ski

Laser Systems
Control from a laser reference

Sonic Systems
Control from a physical reference

Slope Systems
Control from a gravitational reference

2D Non Contact Controls

- Laser Control
Segregation Issues

Two types of segregation:
1. Aggregate segregation: Caused by aggregate separating from fines
2. Temperature segregation: Improper HMA cooling causes temperature segregation

Segregation causes rough surfaces, low density, poor durability, and other problems

Raising the Truck Bed

- Raising the truck bed partially before opening gate
- Raise bed fully while about 5% of load is still in the truck
- Keeping the mix in a main center segregation

Centerline Segregation

- Centerline segregation results in a dip down the center of the pavement
- Possible causes:
  - Overmixed aggregate
  - Aggregate running the dryer
  - Worn-reoding aggregate
  - Improperly activated spreader

Preventing Segregation

- Minimize segregation by using proper techniques to load pave
- This picture shows some preventive segregation
- This picture shows the end result of improper segregation
- This picture shows the correct way to load pave
Material Segregation In The Hopper

- The Best Practice Is To Not Raise The Hopper At All
- If You Are Going To Raise The Hopper Between Loads, Do it Before The Hopper Is Empty, You Should Never Be Able To See The Conveyor Chains

Summary

1. Select a speed which balances the material delivery to site and Avoid varying speeds
2. Keep the paver moving, keep stops to a minimum
3. Don’t out pace the rollers
4. Use smooth rapid start and stop techniques
5. Prevent truck to paver contact by using an MTV
6. It takes time to make a level change – Don’t rush or over correct
7. Always maintain a consistent head of material, level with the auger shaft is ideal

Thank You