SUPERPAVE Construction – Lessons Learned

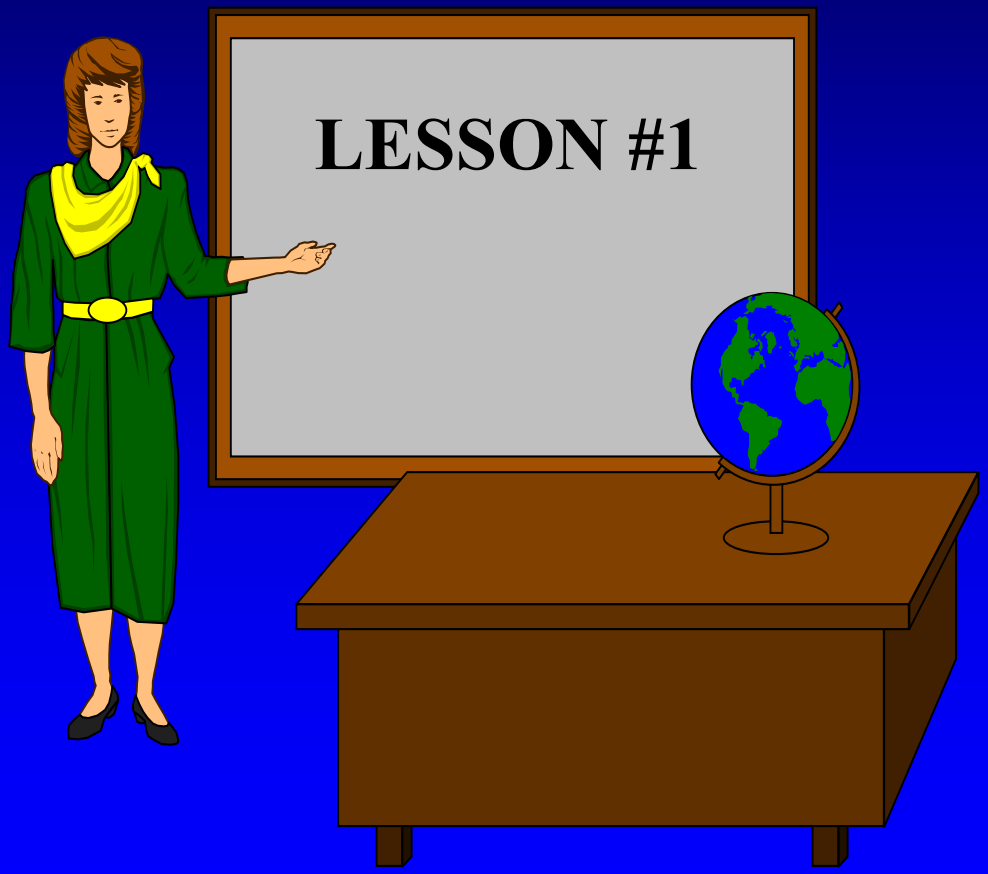
NEAUPG Annual Meeting

Wilkes-Barre, PA

October 23, 2003

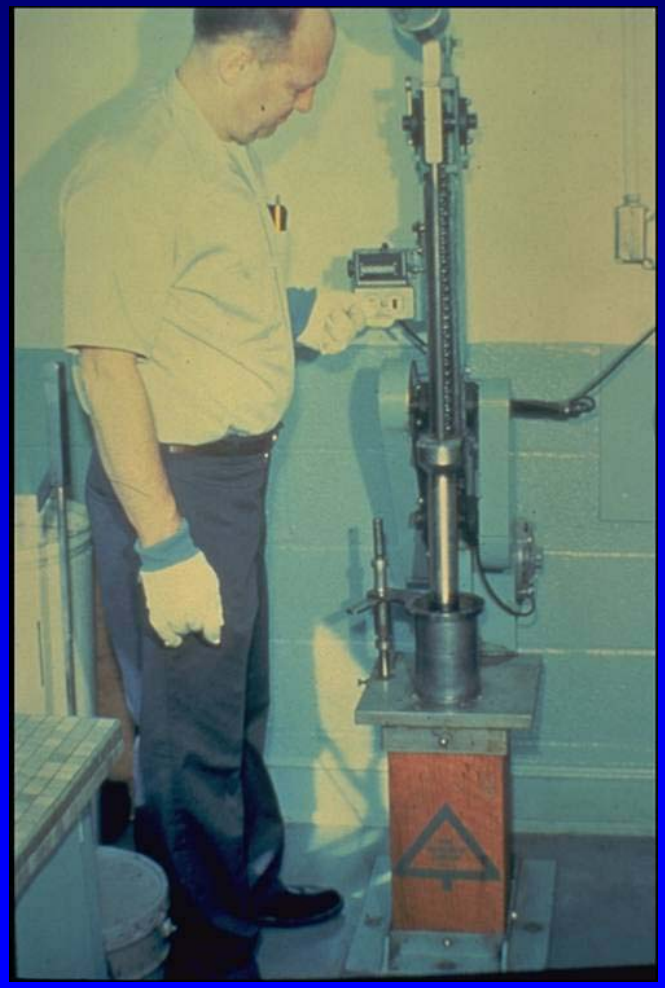
CITGO

SUPERPAVE Construction – Lessons Learned



- Lesson #1
  - What is this Stuff?

Lesson #1 – What is This Stuff?



- Marshall or Hveem Method for 50 years
  - Comfort Zone
  - Agencies developed their own mixes
    - Alphanumeric Code – AABC, Base 1, Base 2, BC, BF, BI, FABC, F-1, HDB, HDS, I-1, I-2, I-5, ID-2, ID-3, J-1, P-401, SC, SF, ST, Type 1, Type 1B, Type 1C, Wearing 1, Wearing 2
    - Secret Code?

Lesson #1 – What is This Stuff?

- Marshall or Hveem Method for 50 years
  - Pendulum went from fine to coarse
- After 50 years of tinkering, these mixes did not always perform well, especially in high stress areas
- Change Was Necessary

Lesson #1 – What is This Stuff?

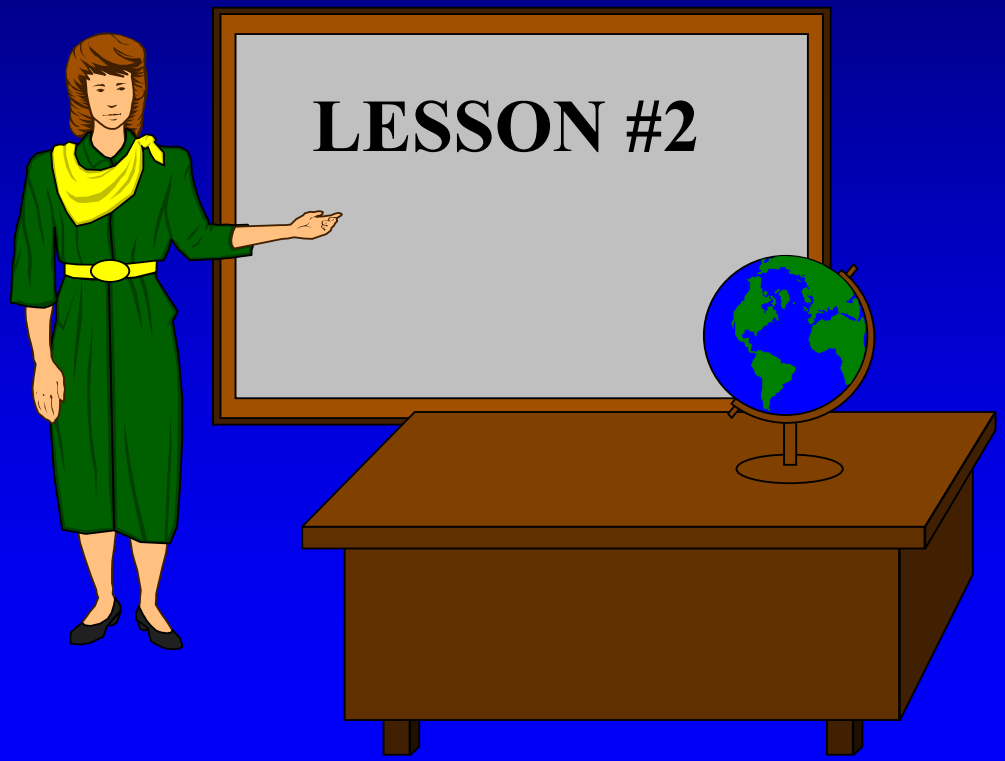
19 mm SUPERPAVE Mix

- New Mix Names – no more secret codes
  - Metric System
  - Nominal Maximum Size Instead of Maximum Aggregate Size
  - Typically Coarser than the Mixes of the Past
    - Potential for more production & laydown problems

Lesson #1 – What is This Stuff?

- New Asphalts – Performance Grade
  - New Secret Code to Learn
    - PG XX-XX
    - No More AC-20?
  - New to Both Suppliers and Contractors
- Is it Modified?
  - Handling
  - Temperatures

SUPERPAVE Construction – Lessons Learned

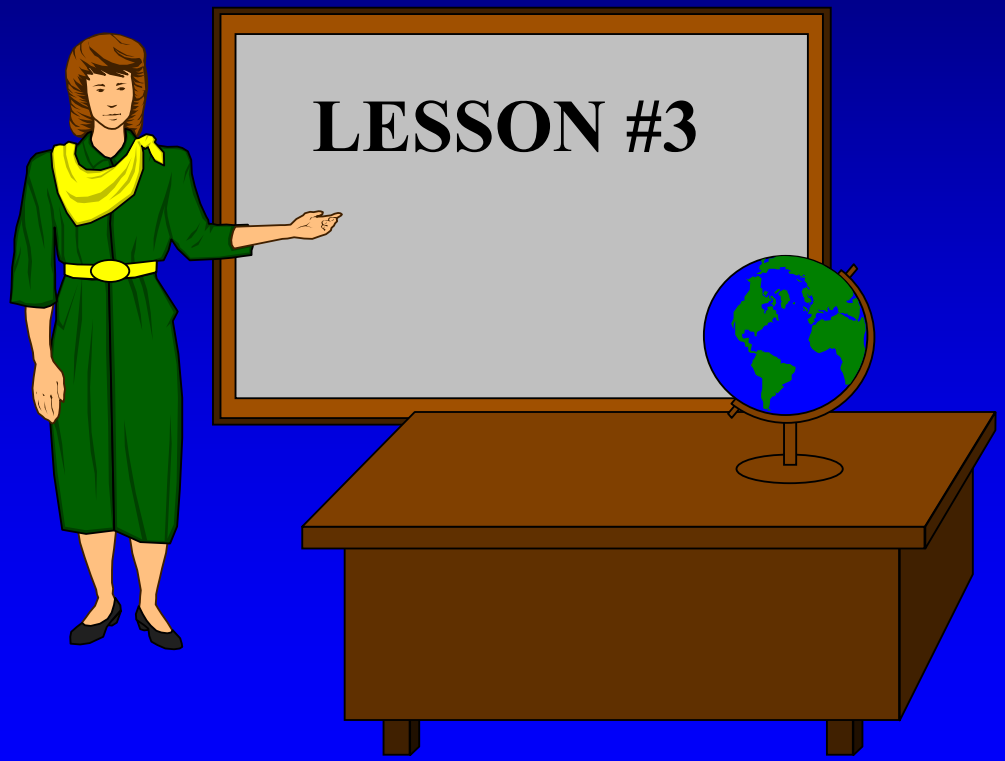


- Lesson #2
  - Training – Leave No One Behind

Lesson #2 – Leave No One Behind

- Information Transferred from Researchers to Material Engineers and Technicians
  - DOTs
  - Contractors
- Laydown Crews Learned by Trial & Error
- Pavement Designers – No Training?
  - Select Mix
  - Select PG Binder
  - Select Thickness

SUPERPAVE Construction – Lessons Learned



- Lesson #3
  - SUPERPAVE is Not Forgiving

Lesson #3 – SUPERPAVE is Not Forgiving

- SUPERPAVE Mix Designs are sensitive to material changes caused by the HMA plant
  - Material Breakdown
  - Change in Aggregate Surface Texture
- Allow for Material Breakdown
- Verify the Mix Prior to Starting the Project

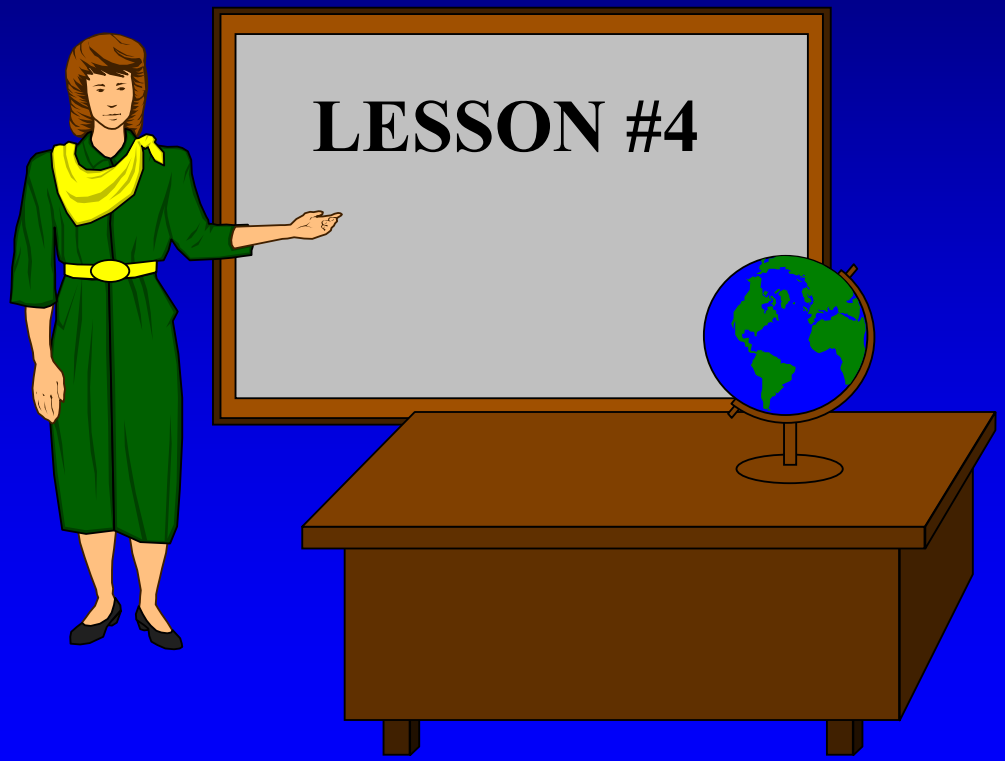
Lesson #3 – SUPERPAVE is Not Forgiving

- Consistent, Quality Aggregate Supply
- Proper Stockpiling and Material Handling
- Good Plant Operations
  - Calibration
  - Dust Return System
  - Maintenance

Lesson #3 – SUPERPAVE is Not Forgiving

- Comfort Zone with Fine Marshall Mixes
- Sloppy Laydown Practices Yield Lousy Results with Coarse SUPERPAVE Mixes
  - Poor Equipment
  - Poor Techniques
    - Lack of Training
    - Poor Attitude
    - Laziness

SUPERPAVE Construction – Lessons Learned



- Lesson #4
  - How Many Bins, Tanks and Silos?

Lesson #4 – How Many Bins, Tanks and Silos?

- SUPERPAVE Mixes are More Sensitive to Gradation Changes - Require Tighter Control
- More Cold Feed Bins Required
  - Marshall - 3 or 4 bins
  - SUPERPAVE - minimum 6

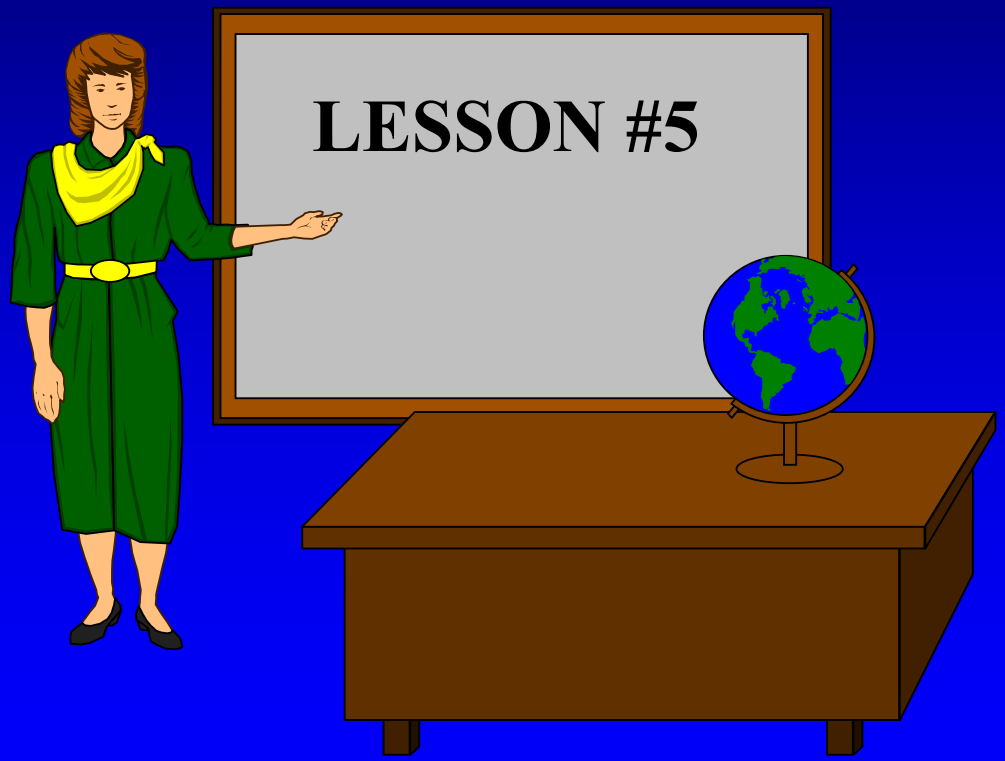
Lesson #4 – How Many Bins, Tanks and Silos?

- Not Just AC-20 Anymore – Multiple Asphalt Tanks Required
  - Standard Grade – PG 64-22
  - Bump Grade – PG 70-22
  - PMA – PG 76-22
  - Recycle Mixes – PG 58-28?

Lesson #4 – How Many Bins, Tanks and Silos?

- Storage Silos – limits number of mixes
- Four Mixes - 9.5mm, 12.5mm, 19mm, 25mm
- Four ESAL levels - four asphalt contents
- PG Binders - PG 64-22, PG 70-22
- 32 Mix Designs - 3 Silos
- Try to limit number of mixes per project

SUPERPAVE Construction – Lessons Learned

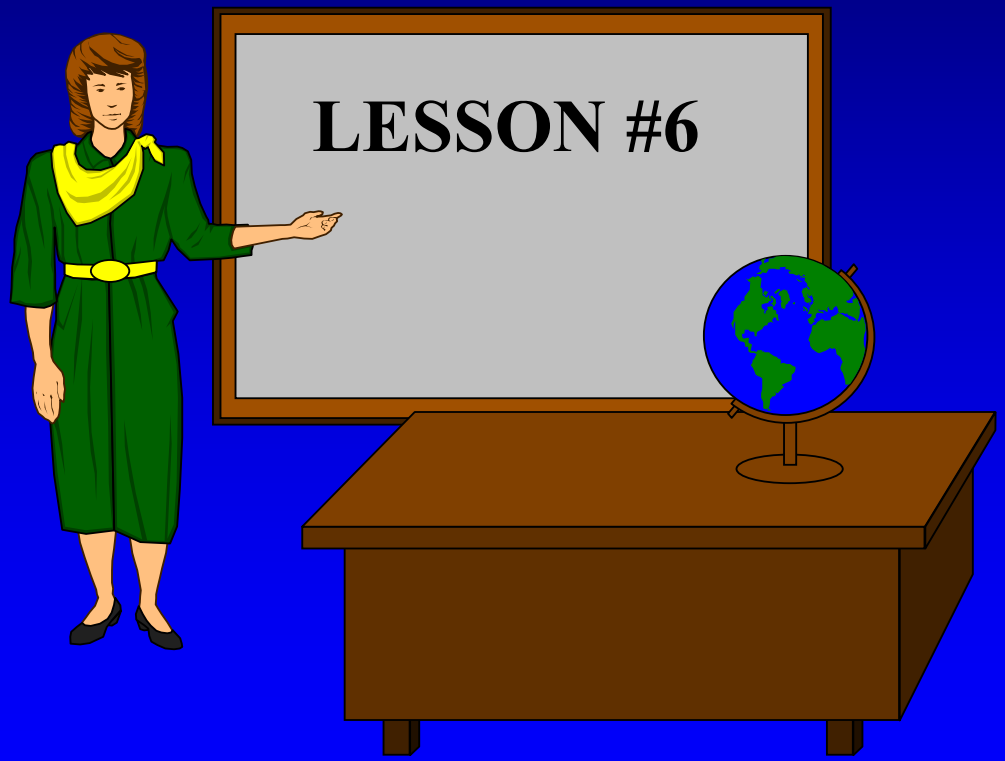


- Lesson #5
  - Back to Basics

Lesson #5 – Back to Basics

- Production & Laydown "Best Practices"
  - Developed While Using Marshall & Hveem Mixes
  - Also Worked With SUPERPAVE
  - MUST be used to Place SUPERPAVE Successfully

SUPERPAVE Construction – Lessons Learned



- Lesson #6
  - Don’t Stop!

Lesson #6 – Don't Stop!

- **Consistent, Non-Stop Movement of HMA Material and the Paver is the Goal**
  - **Mat Texture**
  - **Prevent Segregation**
  - **Smoothness**

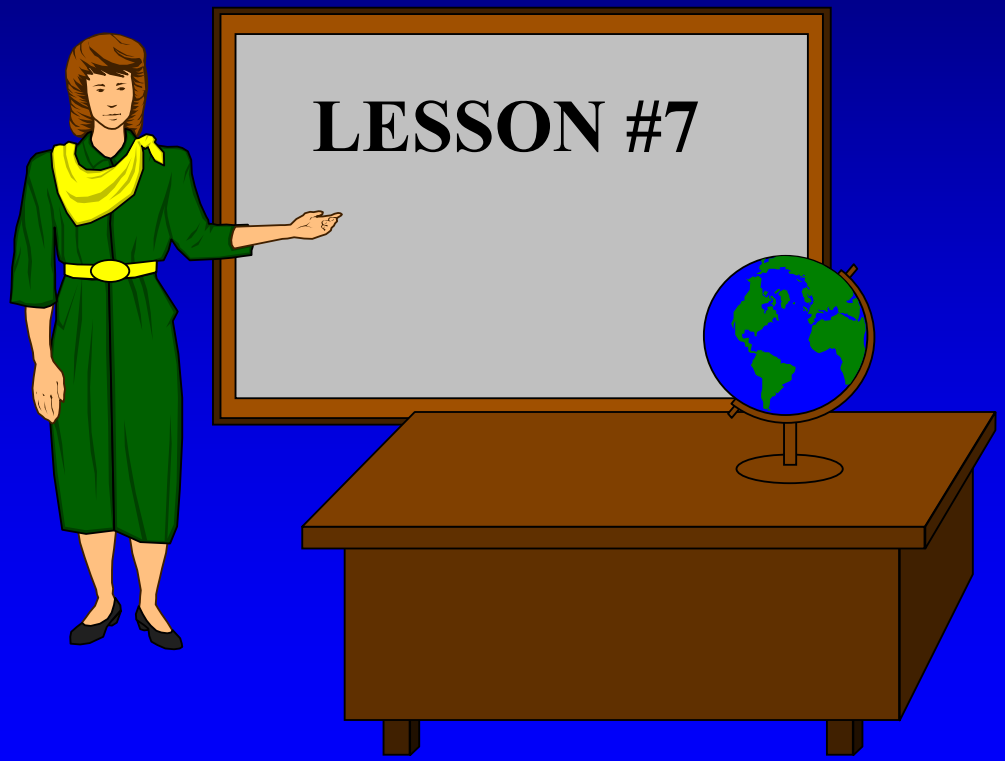
Lesson #6 – Don't Stop!

- Match Paver Speed to Delivery Rate of HMA to the Job
  - 250 tph delivery - 12' lane, 2.00" lift
    - 250 tph x 9 sy/ton = 2250 sy/hr
    - 2250 sy/hr x 9 sf/sy = 20,250 sf/hr
    - 20,250 sf/hr / 12' width = 1688 ft/hr
    - 1688 ft/hr / 60 min/hr = 28 ft/min
  - 400 tph requires 45 ft/min

Lesson #6 – Don't Stop!

- Plan for Easy, Quick Entry and Exit from Paver for Delivery Trucks
  - Train Truck Drivers in Proper Procedures
    - Trucks Lined Up in Front of Paver With Beds Raised
    - Paver Bumps Truck
    - No Cleanout in Front of Paver
      - Designate a location on the project site
  - Traffic Control

SUPERPAVE Construction – Lessons Learned



- Lesson #7
  - No Jail Breaks!

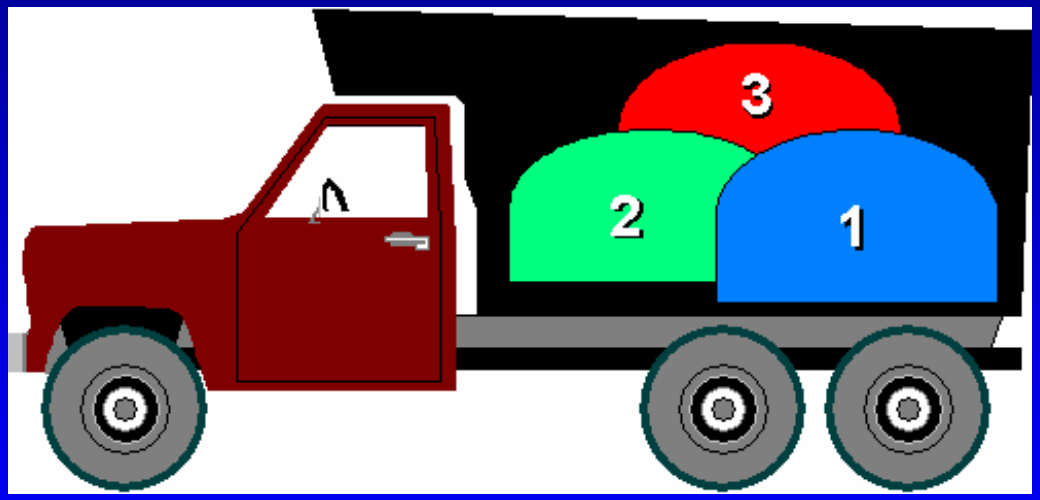
Lesson #7 – No Jail Breaks!

- Keep HMA Confined in a Mass From the Plant to the Pavement
- Larger Aggregate Particles Will "Break & Run" At Any Time Prior to Passing Under The Screed If You Allow It – <u>SEGREGATION</u>

Lesson #7 – No Jail Breaks!

- Segregation in HMA Plant
  - No Obstructions in Drum
  - Drag Conveyor Operation
  - Storage - Batcher and Silo Gates

Lesson #7 – No Jail Breaks!



- Truck Loading Procedure
  - Prevent "Break & Run" From Silo Into Truck Bed
  - 3 Drops
    - Use Tailgate, Front of Dump Body, and First Two Drops as Confinement

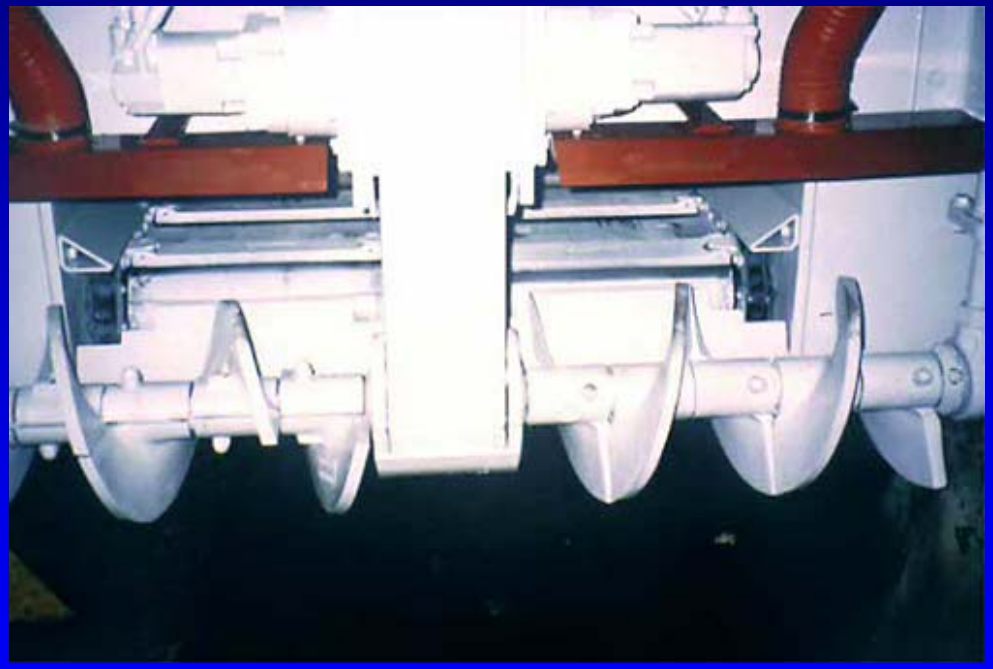
Lesson #7 – No Jail Breaks!

- **Truck Unloading Procedure**
  - **Raise Dump Bed & Place Mix Against Tailgate Before Opening It**
  - **Dump HMA into Paver as a Mass**
    - **Don't Dribble – Prevent "Break & Run" From Truck into Paver**
- **Train Truck Drivers in Proper Procedures**

Lesson #7 – No Jail Breaks!

- Paver Hopper Operation
  - Keep Hopper Deck Covered With HMA At All Times
  - Hopper Wings Dumped Only Into Half-Full Hopper Deck
- Prevent End-of-Load Segregation

Lesson #7 – No Jail Breaks!

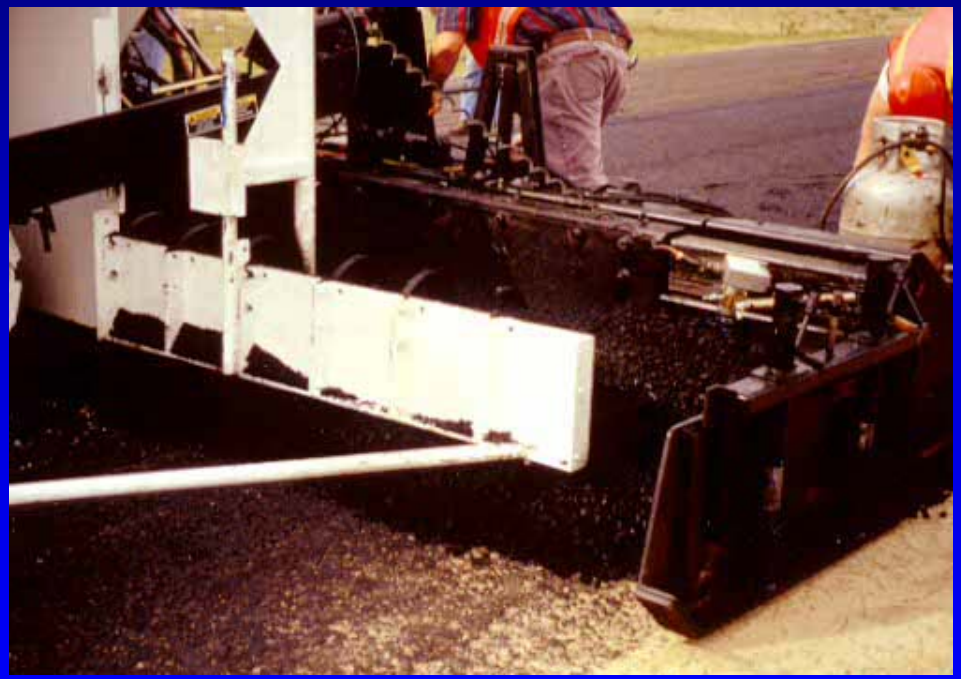


- Paver Feeder Operation
  - Prevent “Break & Run” of Coarse Aggregate Under Feeder Gear Box
    - Diverter Plates
    - Reverse Augers

Lesson #7 – No Jail Breaks!

- Paver Feeder Operation
  - Flow Gates Set for Consistent Feeder Operation
  - Maintain Constant Head of Material

Lesson #7 – No Jail Breaks!

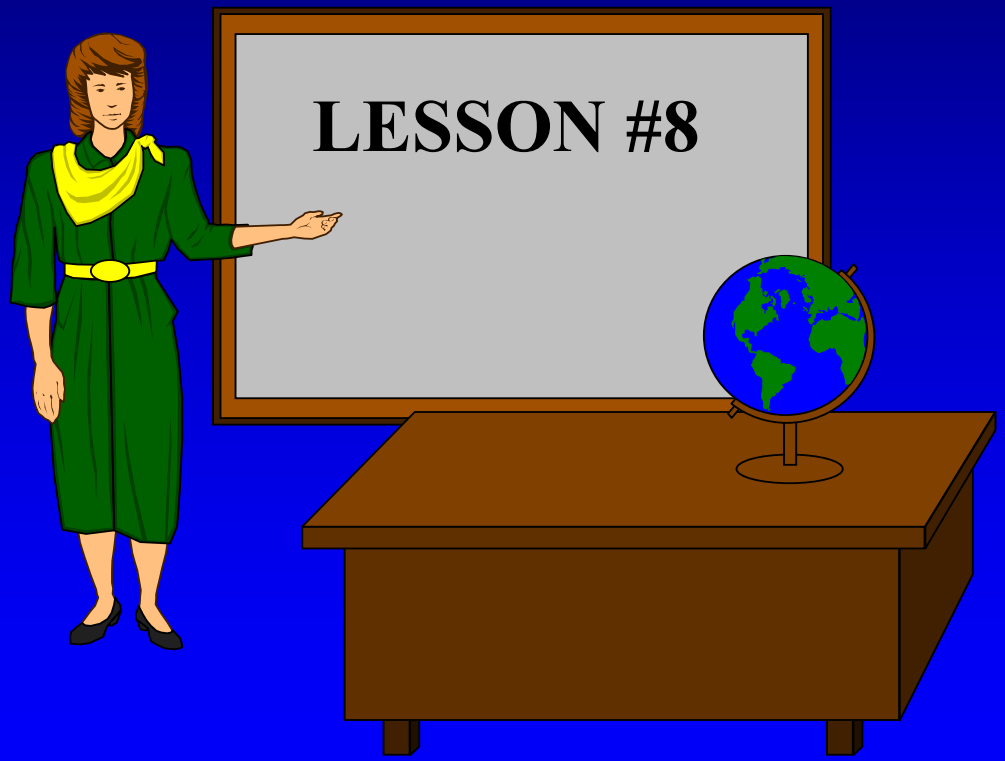


- Paver Feeder Operation
  - Move Mix as a Confined Mass to End Gate
    - Auger Extensions
    - Auger Tunnel Extensions

Lesson #7 – No Jail Breaks!

- **Material Transfer Vehicle**
  - **Reduces Truck-Dumping Issues**
  - **Remixing Reduces Silo And Truck-Loading Segregation**
  - **If Paver Hopper Insert Is Kept Full – Reduces Segregation Caused By Hopper Operation**
  - **Does NOT Correct Poor Practices Behind the Hopper**

SUPERPAVE Construction – Lessons Learned



- Lesson #8
  - It's Not Easy to Be Dense

Lesson #8 - It's Not Easy to be Dense

- Coarse-Graded SUPERPAVE Mixes Typically Harder to Compact than Marshall Mixes
- Major Adjustment for Agencies and Contractors Using Poor Marshall Density Specifications
  - 10% - 12% in-place air voids typical
  - Worked for fine-graded Marshall mixes
  - Permeability problems for SP mixes

Lesson #8 - It's Not Easy to be Dense

- **Factors Affecting Compaction**
  - Lift Thickness (Design)
  - Mix Temperature (Contractor)
  - Compactive Effort (Contractor)
  - Strength of Underlying Material (Design)
    - Cannot achieve density when paving over structurally unsound material
    - Weak Subgrade
    - Roadway Shoulders

Compaction of Superpave Mixes

Approximate Density Measurement	**91% - 92% of M.T.D.**	**92% of M.T.D.**	**94% - 97% of M.T.D.**

Temperature Zones	320° - 240°	240° - 170°	170° - 150°
Distance	**200 feet**	**200 feet**	**150 feet**

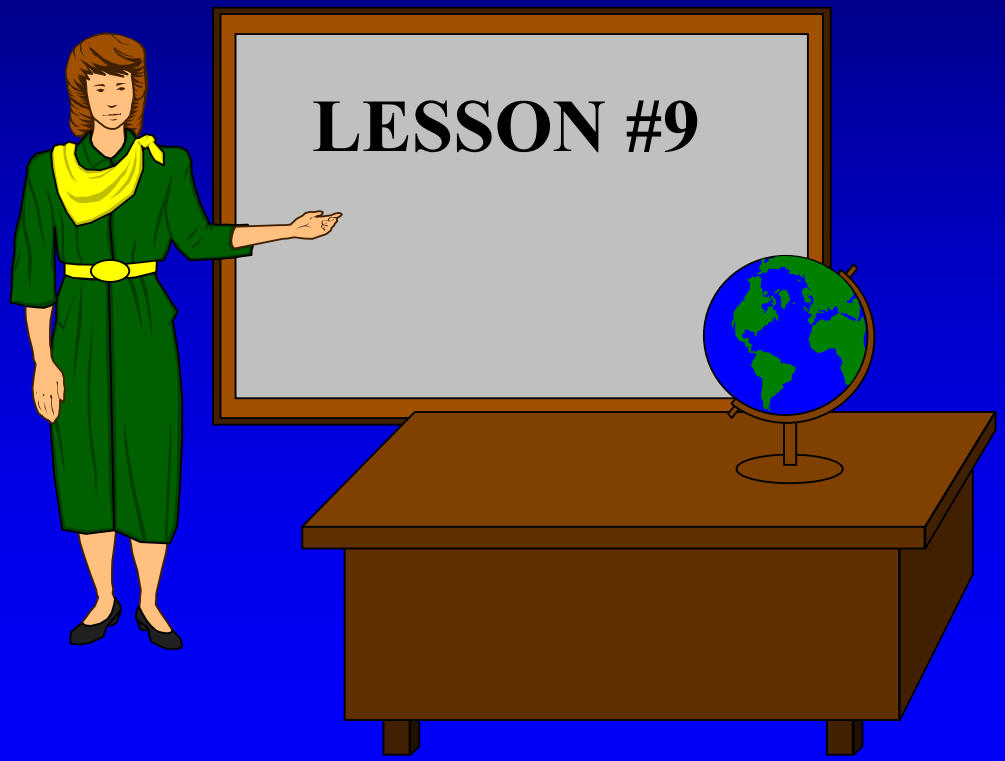
Lesson #8 - It's Not Easy to be Dense

- ***All SUPERPAVE Coarse Mixes DO NOT HAVE A Tender Zone!!!***
- **Tender Mix VS. Tender Zone**
- **Only 1/3 of SUPERPAVE coarse mixes have shown a Tender Zone**
- **Build a Test Strip**

Lesson #8 - It's Not Easy to be Dense

- Use Enough Rollers to Achieve Density
  - Three or Four?
  - Width
  - High Frequency
  - Rubber tired?
- Keep Front Roller Close to Paver - ***If Mix Temperature is Appropriate***
- Use an Infrared Temperature Gun

SUPERPAVE Construction – Lessons Learned



- Lesson #9
  - Good Equipment is a Must!

Lesson #9 – Good Equipment is a Must!

- HMA Plant Must be in Good Condition and Calibrated to Produce Quality SUPERPAVE Mixes Consistently
- Calibrate Quarterly
  - Truck Scales
  - Belt Scales
  - Asphalt Pump Meter
  - Thermocouples

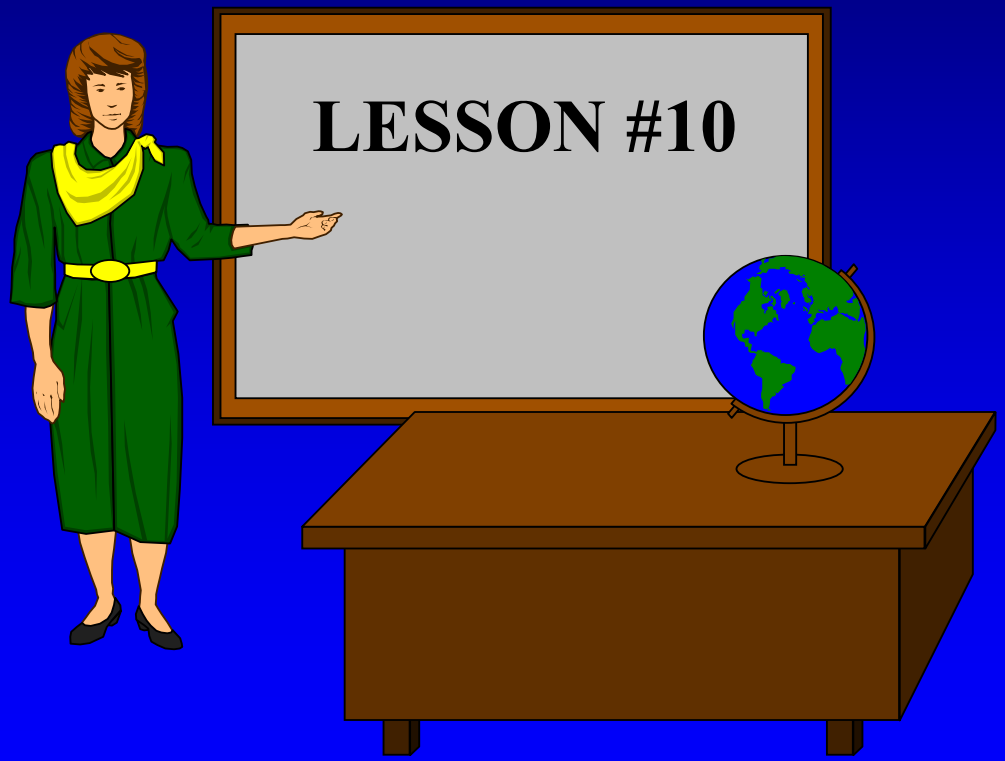
Lesson #9 – Good Equipment is a Must!

- Paver in Poor Condition Cannot Place a Quality Pavement
- A Paver in Perfect Mechanical Condition May Still Place a Lousy HMA Pavement
  - Paver Adjustments
    - Feeder Gates
    - Feeder Controls
      - Head of Material
      - Feeder Speed
    - Screed & Extensions
    - Electronic Grade Control

Lesson #9 – Good Equipment is a Must!

- Compaction Equipment Must be in Good Condition and Well-Maintained
  - Engine RPM
  - Hydrostatic System
    - Smooth travel movement
    - Vibratory system
  - Drums
    - Smooth
    - Round
  - Water Spray

SUPERPAVE Construction – Lessons Learned



- Lesson #10
  - Quality Starts at The Top

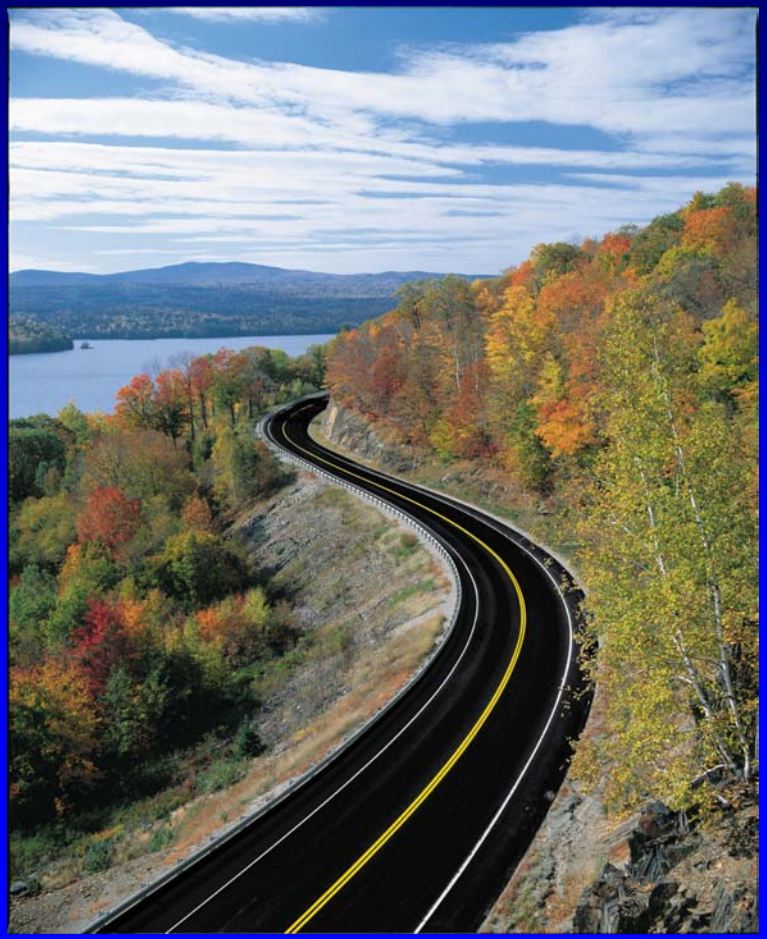
Lesson #10 – Quality Starts at the Top

- Commitment to Quality Must Start With Upper Level Management
- Management Must Clearly Communicate Expectation of Quality to All Employees

Lesson #10 – Quality Starts at the Top

- Management Must Provide Necessary Resources to Perform Quality Work
  - People
    - Motivated
    - Celebrate Success
  - Training
  - Equipment
  - Materials

SUPERPAVE Construction – Lessons Learned (Summary)



- 1) What is This Stuff?
- 2) Training – Leave No One Behind
- 3) SUPERPAVE is Not Forgiving
- 4) How Many Bins, Tanks and Silos?
- 5) Back to Basics
- 6) Don't Stop!
- 7) No Jail Breaks!
- 8) It's Not Easy to Be Dense
- 9) Good Equipment is a Must
- 10) Quality Starts at the Top

SUPERPAVE Construction – Lessons Learned (Summary)

- **Pressures to Meet Production Targets Should Not Make Us Forget or Set Aside the Lessons Learned**