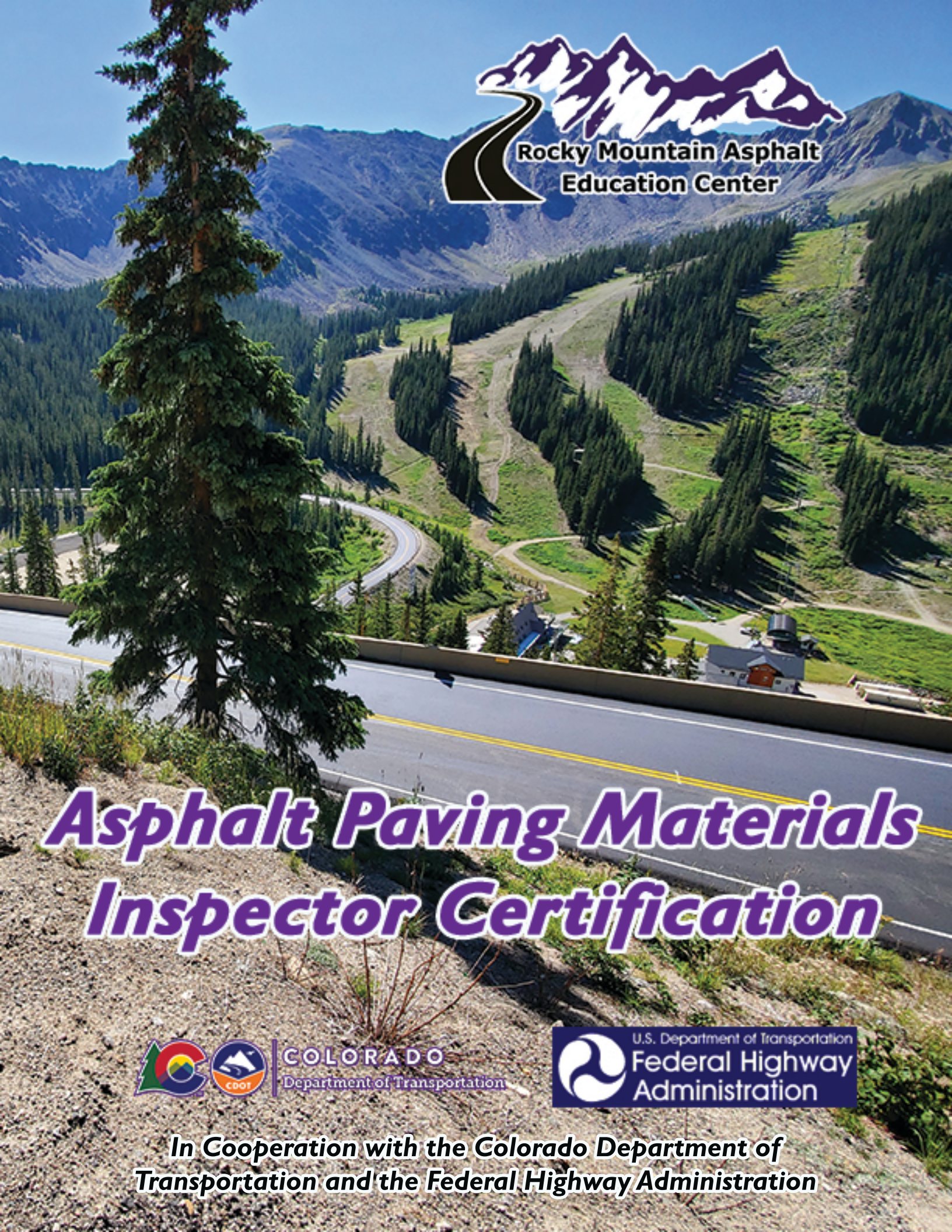
Rocky Mountain Asphalt
Education Center
Asphalt Paving Materials
Inspector Certification
COLORADO
Department of Transportation
CDOT
U.S. Department of Transportation
Federal Highway
Administration
In Cooperation with the Colorado Department of
Transportation and the Federal Highway Administration

Asphalt Inspector Certification Ground Rules and other items

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In cooperation with:

COLORADO Department of Transportation

U.S. Department of Transportation Federal Highway Administration

1

Introductions

- Over the next few slides you will get information about:
  - Ground rules
  - General Information about the facility
  - Handouts you received
  - CAPA & RMAEC Staff
  - The CAPA Membership
  - The schedule for this session
  - Certification Requirements
  - Self Introductions

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2

Ground Rules

- **Relax!**
- **Questions are welcome and encouraged during presentations!**
- **Continuing Education Units (CEU) are available (0.8 per day), contact Diane in the office across the hall during a break if you would like to get a CEU Letter**
- **Please take a moment to Silence Cell Phones!**

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3

General Information

- Coffee & Refreshments
  - To use the pop machine, find the black button above the coin slot, push the button then make your drink selection
- Breaks
- Lunch
- Restrooms
  - Out of the RMAEC facility, turn right down the main hallway in the building, the restrooms will be on the left-hand side of the hallway

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4

Handouts

The Materials provided for you for this session!

- **Printed slide presentations**
- **The Program Critique – The LabCAT Board of Directors an LabCAT Technical committee request you please complete and return the Evaluation/Critique forms at the completion of the session. You may place the completed evaluations in the "Clear In box" on the back wall under the clock, or turn them in with your written exam.**

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5

Colorado Asphalt Pavement Association (CAPA)

Rocky Mountain Asphalt Education Center (RMAEC)

• Tom Peterson, P.E.	CAPA Executive Director
• Tom Clayton, SET	CAPA/ RMAEC Director of Training and Member Services
• Mike Skinner, P.E.	Director of Engineering
• Cindy Rutkoski	Instructor, RMAEC
• Diane Hammond	RMAEC Training Coordinator

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6

Who makes up CAPA?

Producer Members

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7

Inspectors Certification Program Timeline

8:00 – sometime Mid Afternoon- Introduction and Course Presentations

- **Lunch will be served at Approximately 12:00 noon, we will break as soon as the lunch arrives, we complete the section underway then break for 30 minute)**

Examination will be given at the completion of the presentations. 1-hour maximum time limit will be allowed.

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8

This is the list of items to be presented today

- Introduction (This section)
- Inspection - Only the beginning
- Inspectors Responsibilities for Pre-Construction
- Specifications used for asphalt construction
- An overview of the Inspectors Responsibilities
- APM Production Facilities
- Inspectors Responsibilities for Surface Preparation
- APM Materials Transfer
- Methods for Sampling of APM
- Basic Paving Operations
- The Compaction process
- The basics of High-Speed Inertial profiling
- Basic Mat Defects

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9

Inspector Certification Requirements

- Requirements to be certified: Each candidate must take and pass the written examination achieving a minimum of 80% correct
- Written examination specifics.
  - The written test is ***CLOSED*** book!
  - Notes taken during the session ***WILL NOT*** be allowed during the test.
  - This is information you should have a grasp on to do the work as an Inspector

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10

We would like to know who each of you are, it is important to all of us here today!

Self Introductions

- ***Name***
- ***Organization/Agency***
- ***Title/Responsibilities***
- ***Years in the construction field***

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11

Questions,

Before we start ???????

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12

1

Why is it we do, what we do for road construction?

We are required to be certified on Highway projects based on the criteria set forth by:

The Code of Federal Regulations (23 CFR 637B)

CDOT CP-10

- Specifically, all persons and all laboratories conducting tests used in mix design or acceptance must be qualified.
- Laboratories conducting Independent Assurance (IA) inspections for CDOT must be accredited and the people conducting these inspections must be certified.

2

How we Define Quality?

- QUALITY may be defined as "A degree or grade of excellence" *1
- As it relates to transportation, Quality may be defined as:

"Characteristics of a product or process that are required for some desired level of excellence"

*1- The American Heritage Dictionary

3

What is Total Quality Management (TQM)

- Total Quality Management (TQM) is a comprehensive and structured approach to organizational management that seeks to improve the quality of products and services through ongoing refinements in response to continuous feedback.
- TQM requirements may be defined separately for a particular organization or may be in adherence to established standards.

4

Owners Acceptance (OA)

A OA program shall provide for an acceptance program and an independent assurance (IA) program consisting of the following:

The system should include:

- Monitoring the Contractor's Process Control (PC) activity.
- Acceptance sampling and testing
- Inspection

5

Owners Acceptance (OA)

- The acceptance program shall consist of the following:
- Frequency guide schedules for verification sampling and testing which will give general guidance to personnel responsible for the program and allow adaptation to specific project conditions and needs.
- Identification of the specific location in the construction or production operation at which verification sampling and testing is to be accomplished. Identification of the specific attributes to be inspected which reflect the quality of the finished product.
- Process Control (PC) sampling and testing results may be used as part of the acceptance decision provided that:
  - The sampling and testing has been performed by qualified laboratories and qualified sampling and testing personnel.
  - The quality of the material has been validated by the verification testing and sampling. The verification sampling shall be performed on samples that are taken independently of the quality control samples.
- The dispute resolution system may be administered entirely within CDOT

6

Acceptance Program (IA)

The quality control sampling and testing is evaluated by an IA program.

If the results from the quality control sampling and testing are used in the acceptance program, a dispute resolution system. The dispute resolution system shall address the resolution of discrepancies occurring between the verification sampling and testing and the quality control sampling and testing.

7

Acceptance Program (IA)

- The IA program shall evaluate the qualified sampling and testing personnel and the testing equipment. The program shall cover sampling procedures, testing procedures, and testing equipment. Each IA program shall include a schedule of frequency for IA evaluation. The schedule may be established based on either a project basis or a system basis. The frequency can be based on either a unit of production or on a unit of time.

8

Project Inspection

INSPECTION remains is an essential part of the OA process. Inspection by Agency personnel should ensure that the contractor is following the provisions of the submitted and approved PC plan.

Visual inspection must be used, in addition to sampling and testing, to determine conformance with specification requirements for acceptance.

9

Inspection

Sometimes, even if the contractor is following the PC plan, visibly defective workmanship or material may be identified.

The inspector SHOULD be in communication with the contractor as soon as visibly defective materials are observed.

If visibly defective material or workmanship has been discovered, the Inspector should work with the contractor to decide upon an appropriate course of action to remedy the situation.

- The action to remedy will depend on the situation itself and the agencies policies practices

10

Inspection

A good OA specifications should include procedures to determine one or more of these options to address defective materials or workmanship:

- Reworking and resubmission to the acceptance system
- Evaluating the in-place material utilizing additional sampling and testing
- Removal and subsequent replacement of the defective materials

11

Inspection

- If sampling is required, a representative number of samples (typically a minimum of 3) should be taken at agreed upon locations by the Contractor (PC) and owner (OA) to determine the extent of the visibly deficient area.
- A sufficient quantity of material/samples should be obtained and split between the PC and OA laboratories.

12

What is an Owners Acceptance Program?

- **Owners Acceptance in construction** addresses the overall problem of obtaining the quality of the facility to be built in the most efficient, economical, and satisfactory manner possible. Within this broad context, quality assurance involves continued evaluation of the activities of planning, design, development of plans and specifications, advertising and awarding of contracts, construction, and maintenance, and the interactions of these activities.

13

What is an Owners Acceptance Program?

- **A Owners Acceptance Program (OAP) requires that individuals who perform one or more of the actual sampling, testing, and inspection functions for the Agency, Contractor, vendor, or private laboratories, be adequately trained and qualified/certified.**

14

Construction is a *Partnership* between the *Owner/Agency* and the *Contractor*.

- Each agency has its own approach to communication with the contractor

A good partnership is fostered through the interactions of the ***Agency Project Manager/Engineer***, ***Inspector*** and the ***Project Superintendent/Foreman.***

15

Owner/Agency/Contractor Partnership

- **Quality asphalt pavements are as critical to *local government agencies* as they are to state and federal government agencies.**
- **Proper inspection is critical to help ensure quality asphalt pavements**
- **The *Pavement Inspector* is responsible for seeing that quality pavements are obtained, and the job is done in a *safe* manner**
- **Partnering requires an understanding of the specifications, plans and intent of the project.**

16

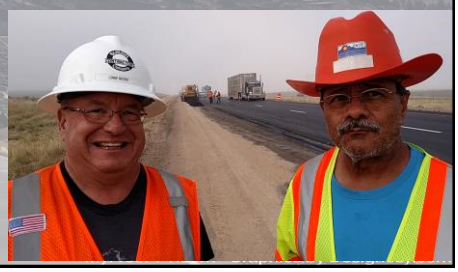
The drivers for the owner:
plans and specifications, contract requirements, quality

The drivers for the contractor:
cost, schedule, production, constructability

18

What is Partnering?

- **Successful partnering should enable long-term integration of the entire project team for the mutual benefit of all, and so it is crucial that the right partners are selected. Partner's project objectives and culture should be aligned, use of parties' resources should be optimized and risks should be allocated to those most able to mitigate them.**



19


• Comments?
• Questions?
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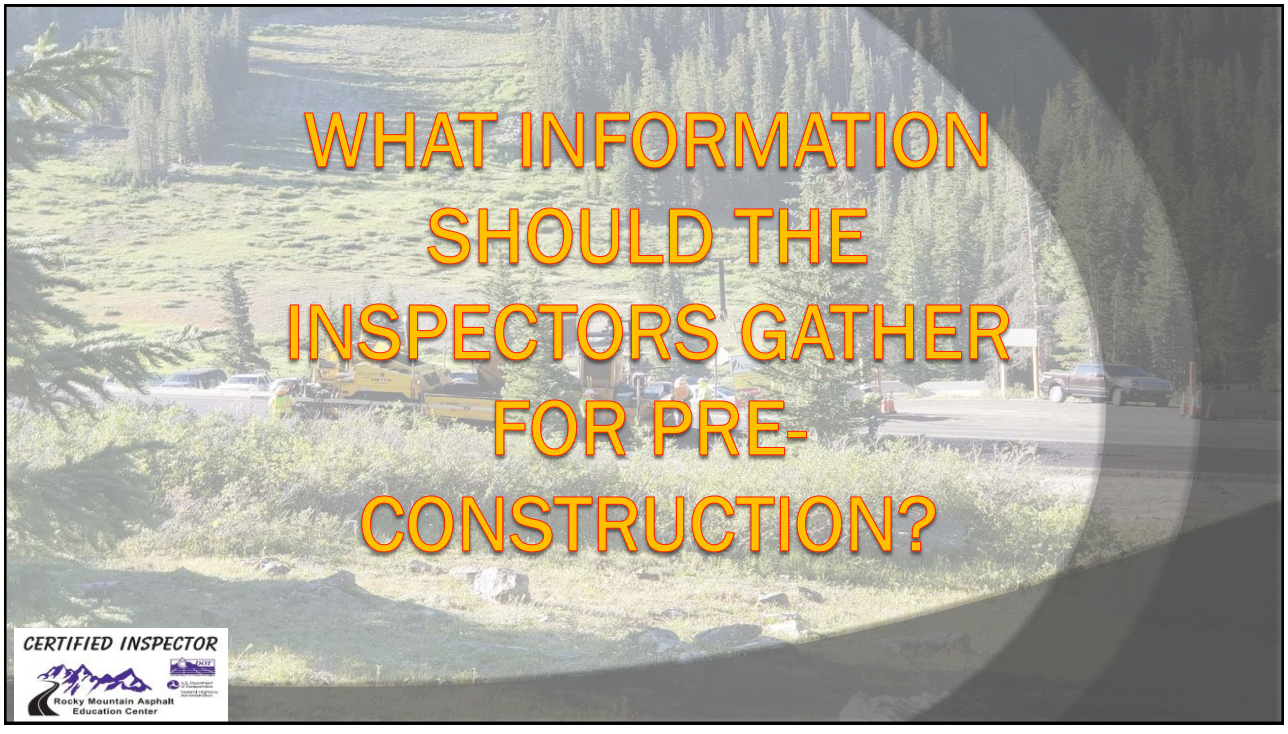
WHAT INFORMATION SHOULD THE INSPECTORS GATHER FOR PRE-CONSTRUCTION?
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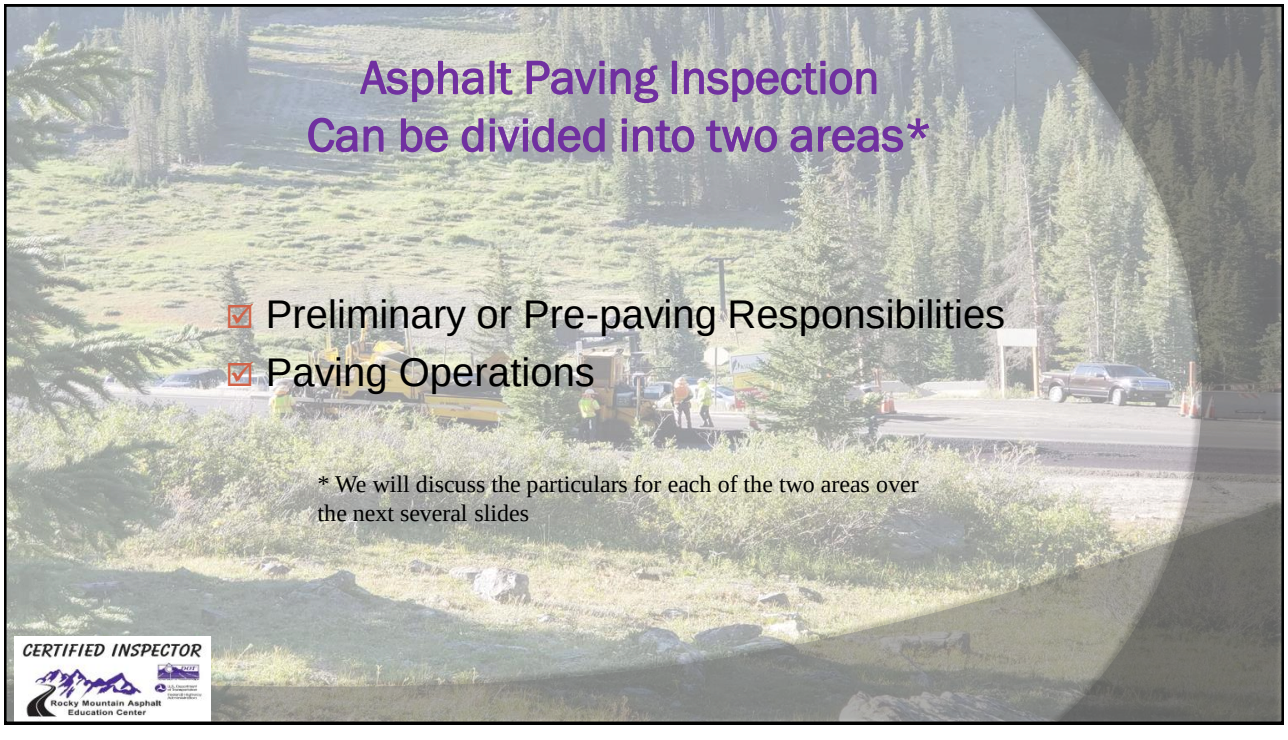
1


Asphalt Paving Inspection
Can be divided into two areas*
☑ Preliminary or Pre-paving Responsibilities
☑ Paving Operations
* We will discuss the particulars for each of the two areas over the next several slides
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2

Preliminary or Pre-paving Responsibilities

✓ Items the inspector needs to handle prior to the beginning of the paving operation.

- Projected Start Date
- Start location
- Document review
- Coordination with the public
- Coordination with the consultants
- Traffic control
- Weather requirements
- Site Safety
- Confirming Dispute Laboratory
- Pre-paving conference
- Field review of paving site
- APM Acceptance method
- Equipment checks
- Tack coat application
- Mix Design Approval (CDOT Form 43)

We will discuss all of these more in the next few slides

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3

What document should the Inspector review?

- **Contract documents, Bid Specifications and Special Provision and any Change Orders**
- **Construction Manuals**
- **Traffic Control Plan**
- **Inspectors Checklist**
  - **It is imperative to know the differences between specifications and "Best Practices"**

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4

Items which should be discussed in the Pre-Paving Conference

- APM Plant Check
  - Where is the plant in relationship top the project?
  - What obstacles may cause delays in product delivery?
- Verification of Job mix formula and all APM that will be supplied to the job site meets specifications
  - Have the mix designs been submitted and approved?
- Verification of the Paving equipment that the contractor proposes to use on the project
- Distribution of Test results and other communications
- Review of the paving procedures and methods the contractor will be using
  - (CDOT has a standard Pre-Paving form as do many other agencies)

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5

Is it important to Coordinate with the Public?

- **Paving plans should address the coordination of paving with businesses, residence and utilities which may be affected by the paving operations**
  - ***Coordination with the public is as simple as the normal construction signage on the roadway!***
    It may be something else, written or other such as an Agency PIO
  - **Utilities should be notified far enough in advance of the paving operation to have all of the facilities adjusted, all cuts completed and patched properly**
  - **Access for business employees should be arranged to accommodate their arrival and departure**
  - **Private residence should also be notified of times of access and egress from their homes**

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6

Field Review prior to placement

- Always wear the required safety gear such as: a safety vest, hard hat, and proper footwear
- Check to make sure surface to receive the APM is ready
  - If milling is specified prior to paving make sure it is milled to the proper depth – surface should not be torn or ripped
  - Dust control during milling operation should be attended to meet environmental regulations
  - Drainage also should be handled after milling to make sure moisture will not remain on the prepared surface prior to paving

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7

Hot-Mix Asphalt Pavements

- Prior to observing work, examine the pre-pave meeting minutes. Use these notes to become familiar with work processes to be observed.
- Discuss procedures established to maintain continuous and effective inspection at all points of work and proper liaison between quarry, plant, and paving operations.
- Verify that plant production has been designed to meet delivery, laydown, and compaction rates (i.e., continuous production with minimal stops and starts). or contractor of your observations
- Inform PIO of the project details for paving

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8

Evaluate:

- Equipment, to determine whether its type, size, and operation comply with the contract requirements, if applicable.
- Backup equipment in case of breakdowns.
- Procedures for checking and maintaining payment records for asphalt and the asphalt mix, and for documenting that all items paid for are actually incorporated into the pavement; pay particular attention to criteria established to define acceptance.
- Diaries, plant and road reports, and other day-to-day records of the operations.
- Use of control charts to control operations.
- Operation of cold-feed proportioning, the dryer, screening, and batching equipment.
- Mixing time.
- Substrata condition ahead of the placement of the hot-mix asphalt (i.e., tack or prime coat, cleaning, patching, absence of raveling, etc.).

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9

Evaluate: (cont)

- Adequacy and effectiveness of the contractor's operations and the CDOT's inspection of the laying operations.
- Continuity in the delivery, laydown, and compaction (minimal stops and starts).
- Temperature of the mix versus required range (plant and laydown).
- Thickness and calculated spread rate.
- Slope pavement (eliminate edge drop-offs for errant vehicles).
- Density results.
- Finished section smoothness, cross-section, and transitions.
- Grade match into manholes, curb and gutter, and water valves.
- Work zone safety and control.
- Uniformity of gradation, asphalt content, and other mix properties.
- Applicable contract warranties.

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10

Traffic Control

- **Traffic Control Plan (TCP)**
  - Identifies type of sign and device to be used
  - Placement of signs and devices
  - Based on Part VI of the MUTCD
    - Who can change the TCP?
      - Traffic control plans should not be changed unless changes are approved by the Engineer in charge/ the agency, the contractor and-or the TCS.
  - Flag person - Flagging requires coordination between two flag persons or more
  - When a sign is not required it should be covered or removed as required
  - Review work hour restrictions
  - Understand the differences between Day and Night paving.
  - Observe the construction zone after all signage is in plac

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11

☑In the following slides, some of the items noted are required by project specification, while some are construction ***"Best Practices"***.
In the end all items will apply to the project and end result

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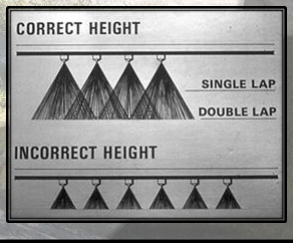
12

Equipment Check

- Distributor
  - Spray Bar
    - Length
    - Height from surface



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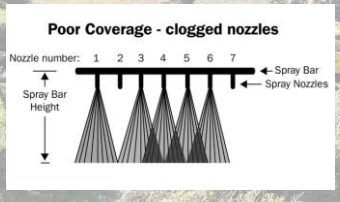
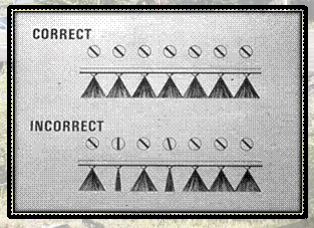
13

Spray Bar Nozzles

- Are they clean and not plugged
- Adjusted to the proper angle for a double or triple overlap
- Application rate checked





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14

*Inspector Best Practice for the distributor

- Record distributor information such as but not limited to;
  - Calibration date of the distributor, if available
  - Travel speed of distributor
  - Application rate desired and placed
  - Type of material being placed

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15

Additional Equipment Checks

- All trucks should be checked for Items that can damage the pavement or are unsafe
  - Fuel and Oil leaks
  - Faulty backup alarms
  - Tarps to protect from dust and wind to keep APM hot
  - APM Release agents

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16

Additional Equipment Check

- Roller Checks
  - Steel Wheel
    - Check drums to see that they are straight
    - Scrapers and Mats
    - Drum water spray system
  - Pneumatic Tire
    - Tire pressure
    - Wheel scrapers and mats
    - Tire temperature
    - Skirts

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17

Weather Requirements

- Temperature
  - CDOT has removed the minimum compaction temperatures. The Specification now reads" The contractor may continue to apply compactive effort as long as they can demonstrate to the owner damage is not occurring"
  - HMA should be discouraged when temperatures are too low
    - WHY? Cold temperatures remove the heat from the mat too quickly
    - The mat may not stick to the intended surface
  - Be aware of any calendar day restrictions
- Precipitation
  - Do not start paving when rain is about to start
  - Do not start paving too soon after a rain when there is free water on the surface to be paved
  - Sprinkles will not harm the mat
- Wind
  - Can cause problems with tack coat application
  - Can cool the mat rapidly so compaction can not be obtained
- Check individual project specification, agency requirements may differ

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18

401.07 Weather Limitations and Placement Temperatures.

Asphalt shall be placed only on properly prepared unfrozen surfaces which are free of water, snow, and ice. The Asphalt shall be placed only when the surface temperatures equals or exceed the temperatures specified in Table 401-3 and the Engineer determines that the weather conditions permit the pavement to be properly placed and compacted.

Table 401-3

PLACEMENT TEMPERATURE LIMITATIONS IN ºF

Compacted Layer Thickness in Inches	Minimum Surface Temperature °F	
	Top Layer	Layers Below the top Layer
<1½	60	50
1½ - < 3	50	40
3 or more	45	35
Note: Ambient temperature is taken in the shade. Surface is defined as the existing base on which the new pavement is to be placed.		

Use common sense when cold weather is apparent. If the forecast is for warmer temperature in the paving window it may be appropriate to allow for paving to begin prior to reaching the specified temperature if the ground temperatures are at or above those specified in the chart above

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19

- ***Use common sense when cold weather is apparent. If the forecast is for warmer temperature in the paving window it may be appropriate to allow for paving to begin prior to reaching the specified temperature if the ground temperatures are at or above those specified in the chart above***

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20

Questions ?

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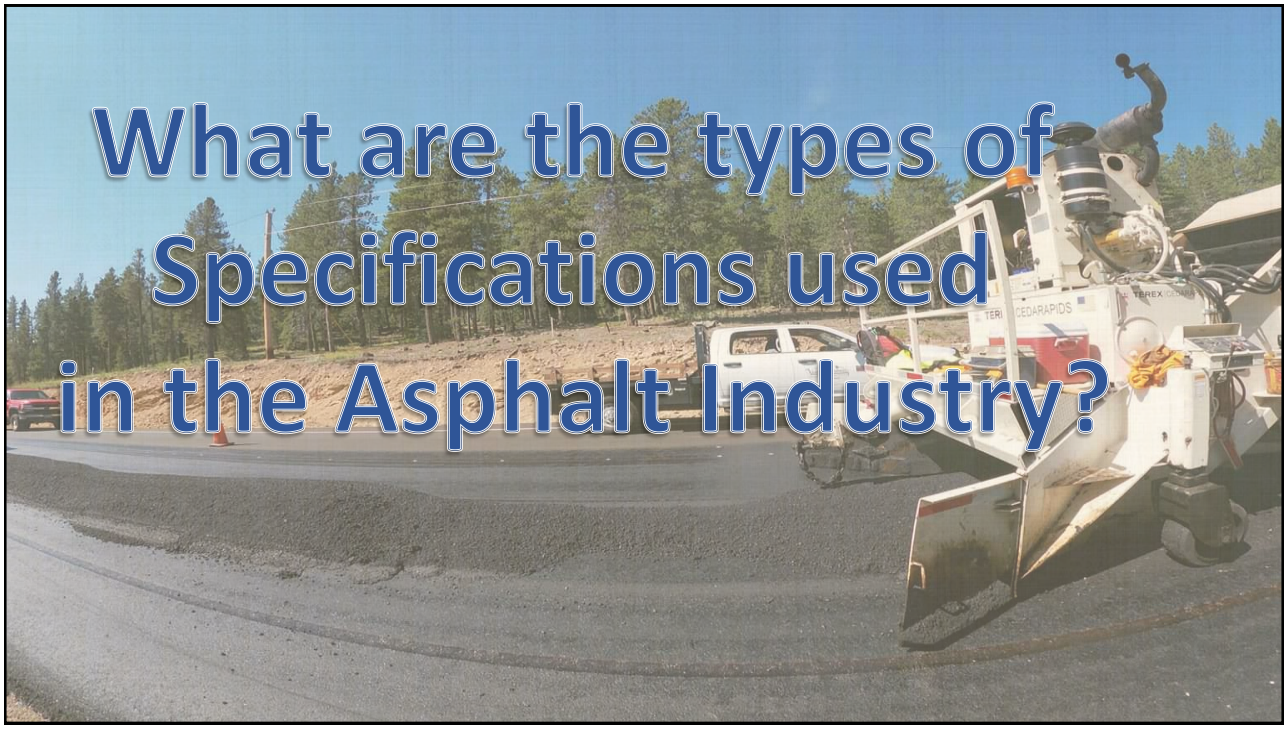
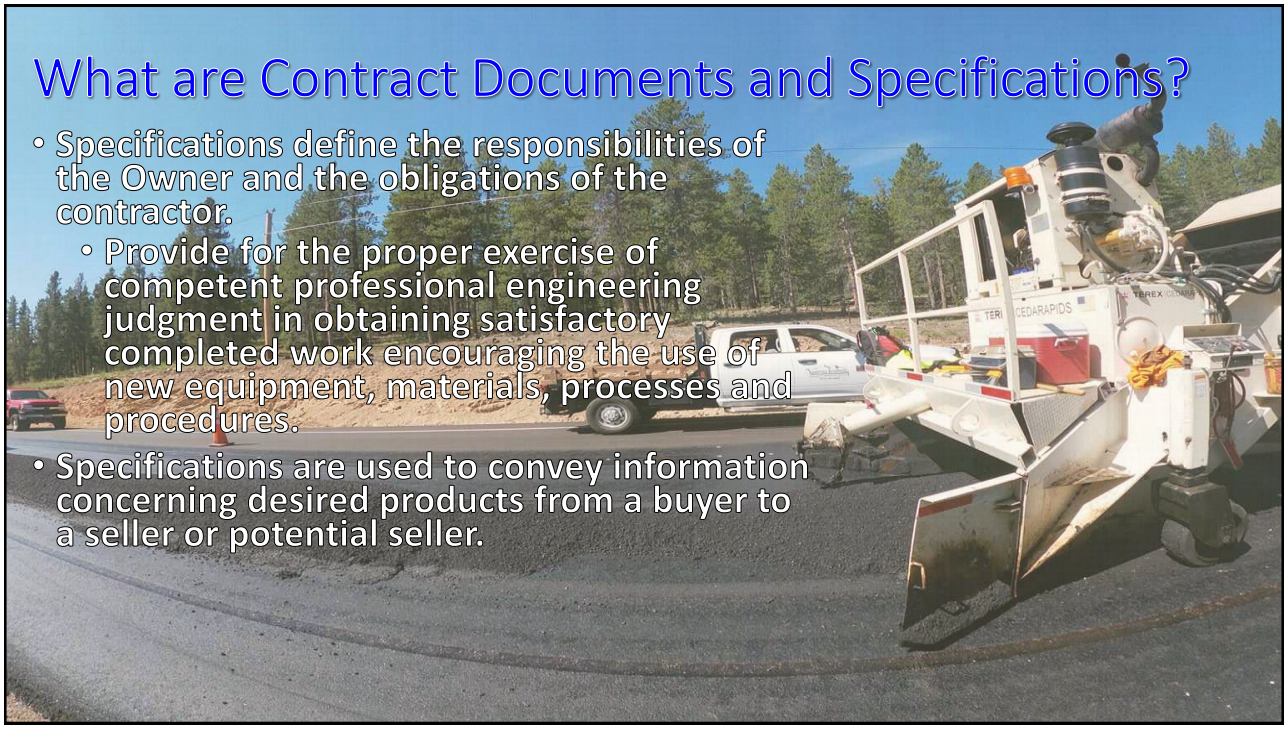
21


What are the types of Specifications used in the Asphalt Industry?

1


What are Contract Documents and Specifications?
• Specifications define the responsibilities of the Owner and the obligations of the contractor.
• Provide for the proper exercise of competent professional engineering judgment in obtaining satisfactory completed work encouraging the use of new equipment, materials, processes and procedures.
• Specifications are used to convey information concerning desired products from a buyer to a seller or potential seller.

2

Contract Documents and Specifications

Provide:

- A basis for competitive bidding
- A basis to describe how and what products will be used on a project
- A means to measure compliance to contracts

3

Types of Specifications

- There are four types of specifications generally recognized in the construction industry:
  - Proprietary product
  - Method
  - End-result
  - Performance

What do most Agencies use?

We will explore each of these in the next few slides

4

Proprietary Product Specification

- Used when a generic description of a desired product or process cannot be easily formulated.
- Usually contains an ***"or equal"*** clause to allow for some measure of competition in providing the product.
- Generally acknowledged that this type limits competition which usually ***results in an increase in cost.***
- Provides very little latitude for innovation.
- Substantial risk for owner for product performance.

5

Method Specification

- Old method of writing construction specifications
- Outlines a specific materials selection process and construction operation to be followed in providing a product.
  - Specified type of material to produce.
  - Type of equipment to be used.
  - How to use the specific equipment.
- Still widely used.
  - Straight forward to write.
  - Implemented with very minimal agency involvement.
- Owner/Agency bears the responsibility of performance.
  - Requires more frequent inspection.
- Greater degree of competition than Proprietary Specs.
- Necessary where end result characteristics cannot be measured.

6

Method Specification

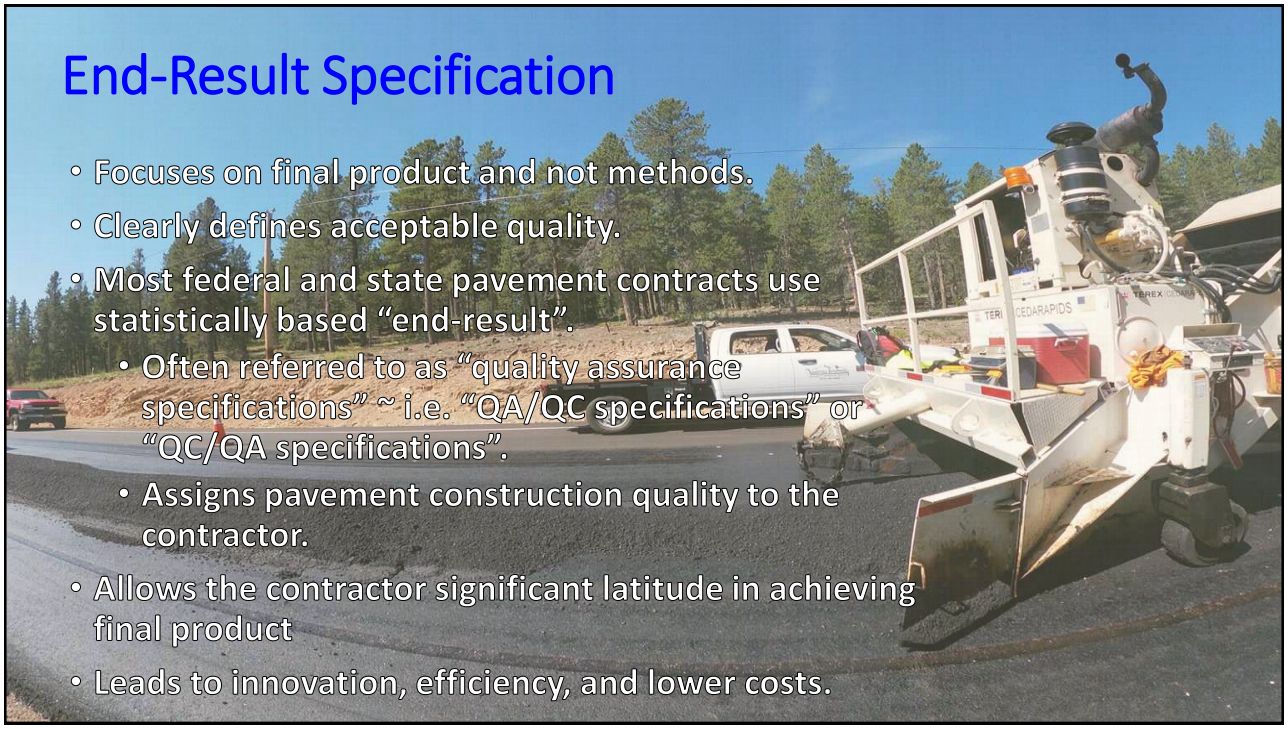
- Disadvantages
  - Tends to stifle contractor innovation.
    - No incentive for contractor to develop better, more efficient construction methods.
  - Not statistically based.
    - 100% compliance is usually not possible.
    - Usually requires "substantial compliance" – vague and undefined.
    - Leads to disputes.
  - Spot checks of material quality.
    - Do not reflect overall material quality – subjectively taken.
    - Not random checks – spot checks have no statistical validity.

7

End-Result Specification

- Final characteristics of the product are stipulated.
  - Desirable that characteristics correlate closely with performance.
- Contractor has freedom in achieving those characteristics.
- Specify range of values (minimum/maximum values) for any given characteristic for conformance to specification.
- Statistical method to estimate overall material quality based on a limited number of random samples.
- Statistical methods will account for sources of variability beyond a contractor's control when comparing field measurements with specification limits.
- Statistical methods clearly define acceptable quality.

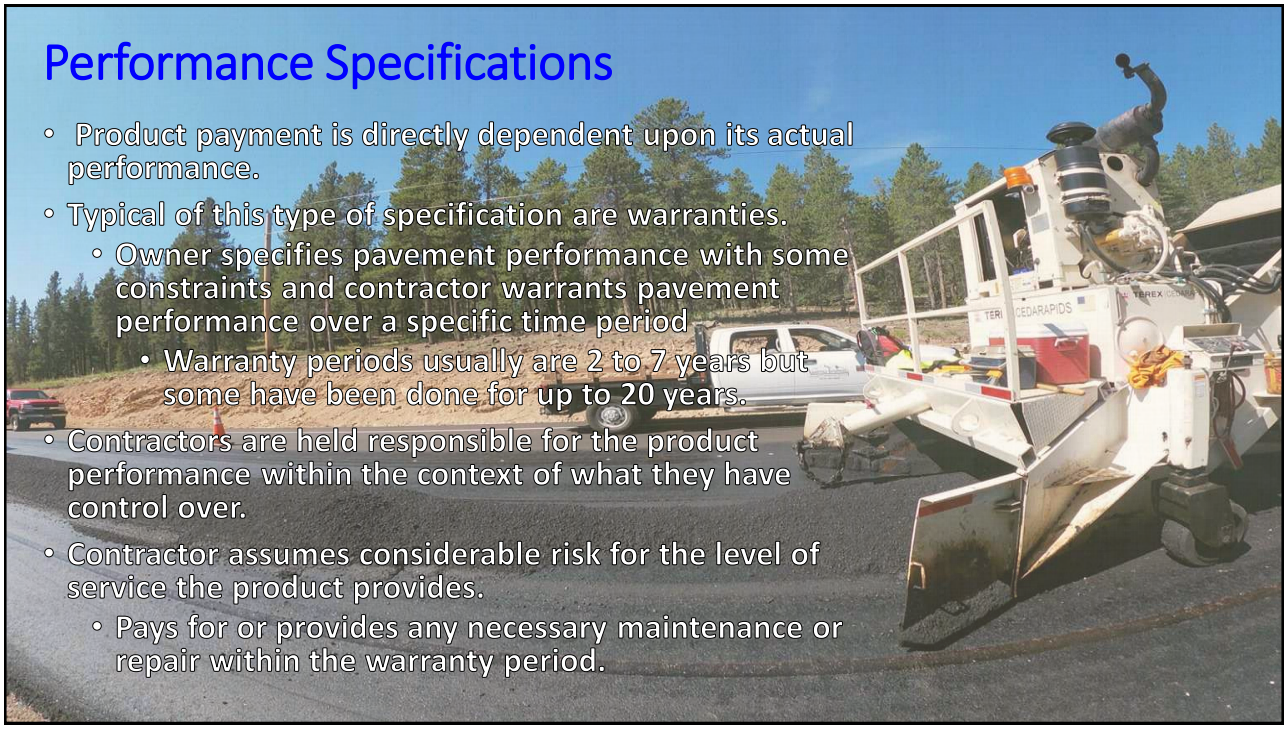
8



End-Result Specification

- Focuses on final product and not methods.
- Clearly defines acceptable quality.
- Most federal and state pavement contracts use statistically based "end-result".
  - Often referred to as "quality assurance specifications" ~ i.e. "QA/QC specifications" or "QC/QA specifications".
  - Assigns pavement construction quality to the contractor.
- Allows the contractor significant latitude in achieving final product
- Leads to innovation, efficiency, and lower costs.

9



Performance Specifications

- Product payment is directly dependent upon its actual performance.
- Typical of this type of specification are warranties.
  - Owner specifies pavement performance with some constraints and contractor warrants pavement performance over a specific time period
    - Warranty periods usually are 2 to 7 years but some have been done for up to 20 years.
- Contractors are held responsible for the product performance within the context of what they have control over.
- Contractor assumes considerable risk for the level of service the product provides.
  - Pays for or provides any necessary maintenance or repair within the warranty period.

10

APM Specifications

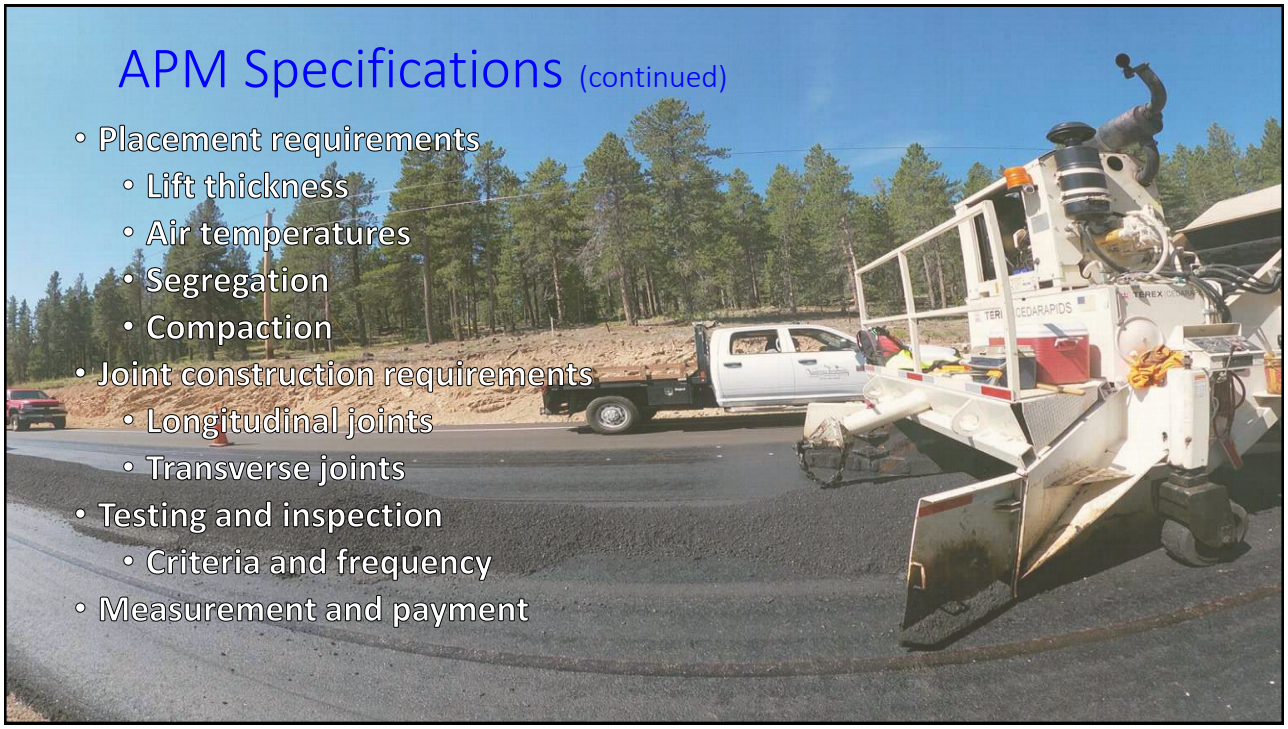
- No matter the type of specification used these are items that should be included in the specifications
  - Design Intent
    - Statement about the general requirements applicable to types of APM and its serviceable life.
  - Materials
    - Requirements for the aggregate to be used in the APM mixture.
      - Uniform quality, clean, hard durable crushed stone, crushed gravel or slag.
      - Aggregate properties, i.e. consensus property requirements.
      - Gradation requirements for Job Mix Formula (JMF).
    - Asphalt Binder Requirements
      - Grades of PG binders and specifications they have to meet for the APM.
      - Tack and Prime requirements.

11

APM Specifications (continued)

- APM Mix design method and plant produced mixture requirements.
  - APM acceptance criteria
- Requirements for mix design approval
- General equipment requirements
  - Plant
  - Hauling or trucking
  - Pavers and grade & slope control
- APM production requirements
  - Production tolerances

12


APM Specifications (continued)
• Placement requirements
• Lift thickness
• Air temperatures
• Segregation
• Compaction
• Joint construction requirements
• Longitudinal joints
• Transverse joints
• Testing and inspection
• Criteria and frequency
• Measurement and payment

13


Questions ?

14

THE INSPECTORS RESPONSIBILITIES FOR CONSTRUCTION ~ OVERVIEW

1

CONSTRUCTION OF ASPHALT PAVEMENTS

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WHY WE DID IT.

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3

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4

Superior

P**er**forming

Asphalt

Pavement

SuperPave is an Improved

Performance – Based System for:

Specifying materials and Mix design methods

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CONSTRUCTION OF ASPHALT PAVEMENTS

- **MARSHALL MIX TECHNOLOGY**
- **SUPERPAVE TECHNOLOGY**
  - **INCREASED RUTTING RESISTANCE**
  - **INCREASED RESISTANCE TO LOW TEMPERATURE THERMAL CRACKING**

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CONSTRUCTION OF ASPHALT PAVEMENTS

- STANDARD SUPERPAVE MIXES REQUIRE (IF NOT WMA)
  - HIGHER MIXING TEMPERATURES REQUIRED BECAUSE:
    - BINDER PROPERTIES HAVE TO BE MET AT HIGHER TEMPERATURES TO ELIMINATE RUTTING
  - HIGHER PAVING TEMPERATURES
    - PG BINDERS STIFFER THAN PREVIOUS AC GRADES
  - THICKER PAVING MATS
    - ***3 TO 1 RATIO TO THE MAXIMUM AGGREGATE SIZE***

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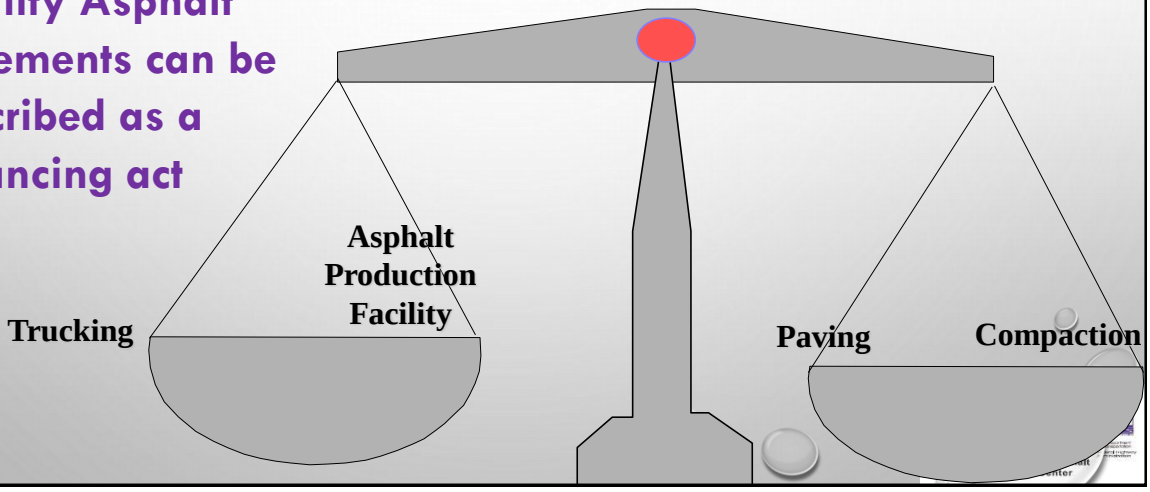
CONSTRUCTION OF ASPHALT PAVEMENTS

Quality Asphalt Pavements can be described as a balancing act



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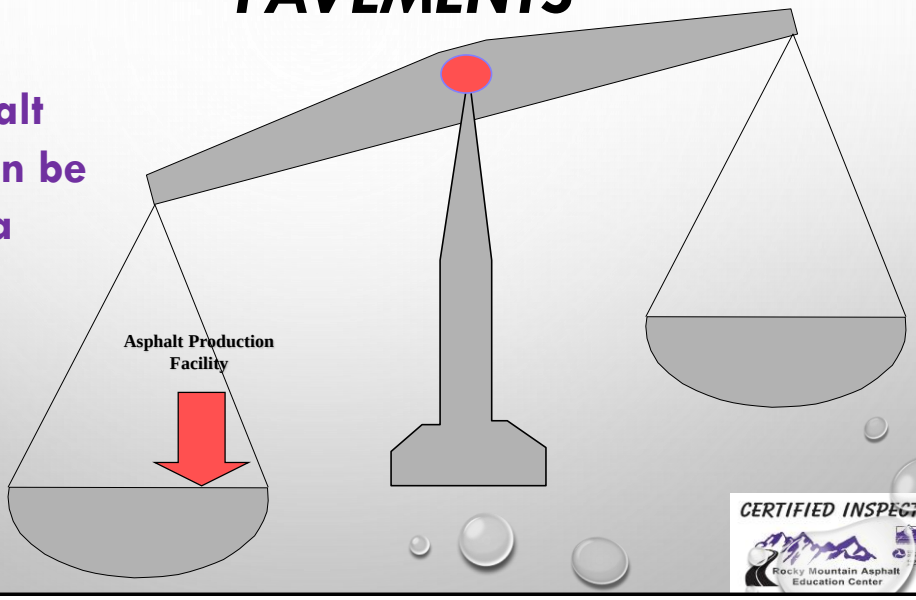
CONSTRUCTION OF ASPHALT PAVEMENTS

Quality Asphalt Pavements can be described as a balancing act



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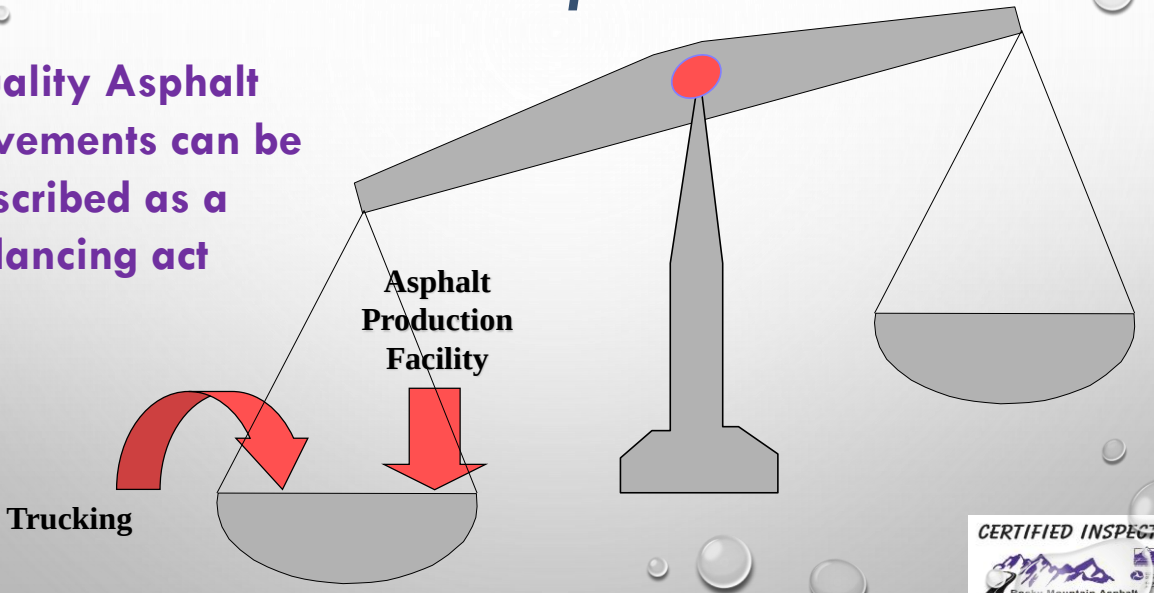
Construction of Asphalt Pavements

Quality Asphalt Pavements can be described as a balancing act



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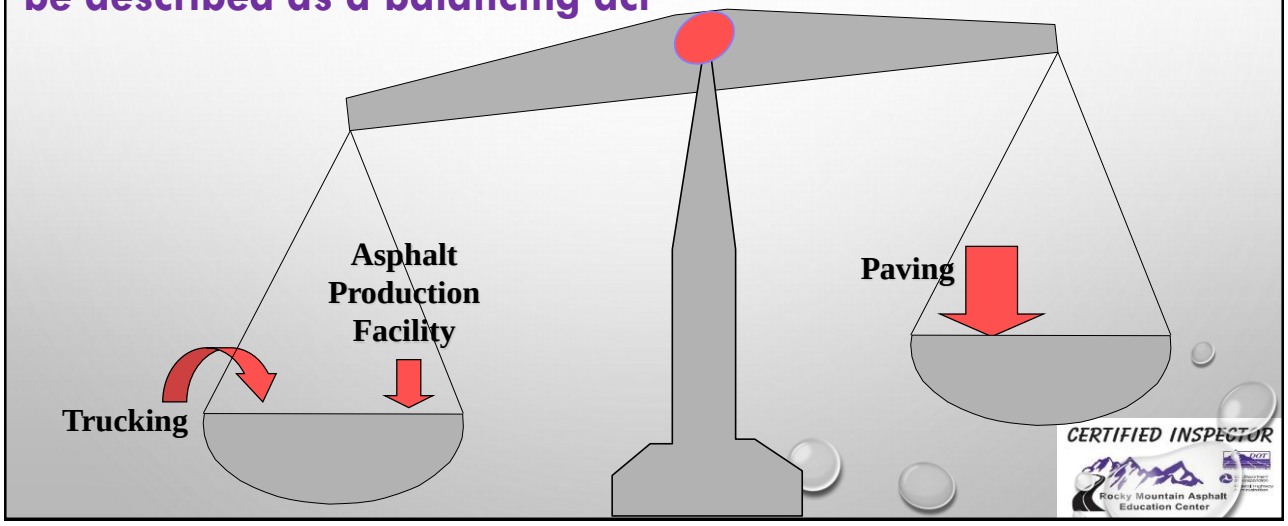
Construction of Asphalt Pavements

Quality Asphalt Pavements can be described as a balancing act



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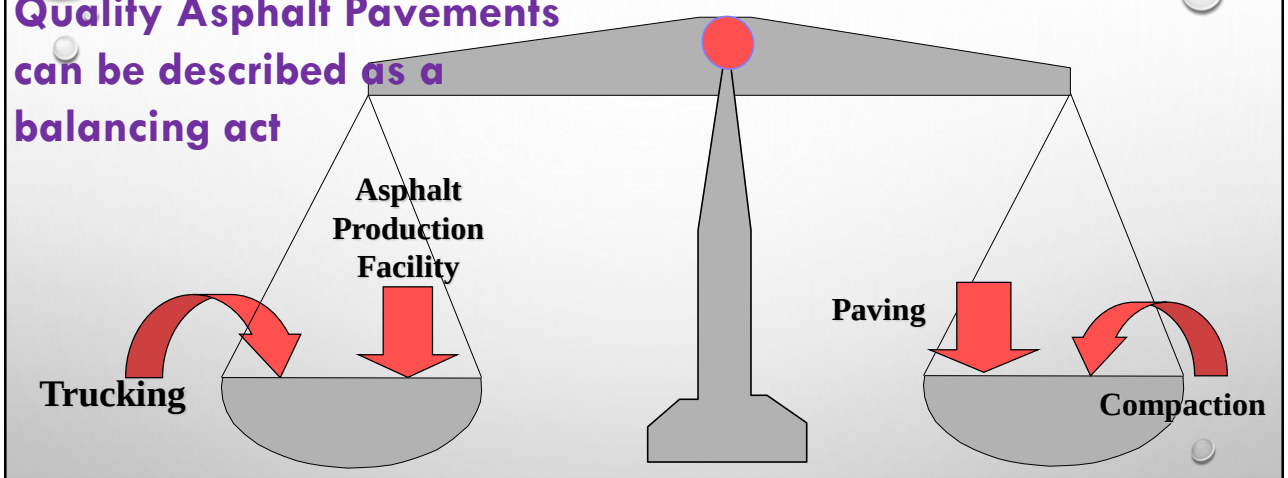
CONSTRUCTION OF ASPHALT PAVEMENTS

Quality Asphalt Pavements can be described as a balancing act



Many forces and variables must be balanced together to produce a mat that is uniform, dense and smooth

12

INSPECTOR BEST PRACTICE

- IN THE ***DAILY*** PROJECT DIARY RECORD,
  - THE ASPHALT PLANT PRODUCTION RATE
  - THE NUMBER OF TRUCKS ASSIGNED TO HAUL ASPHALT TO THE PROJECT
  - PAVER RATE OF TRAVEL
  - NUMBER AND TYPE OF ROLLERS BEING USED ON THE PROJECT
    - CONDITION THE ROLLERS ARE IN (IE STATIC, VIBRATORY, OSCILLATORY, ETC.)
    - LOCATION OF THE ROLLERS FROM THE PAVER AT VARYING TIMES AND TEMPERATURES
    - WEATHER CONDITIONS AT EH TIME THE PATTERN WAS ESTABLISHED
    - IF PROBLEMS ARISE, THEY CAN OFTEN BE TRACKED TO CHANGES IN THESE ITEMS

AN OLD QUOTE: "A PICTURE IS WORTH A THOUSAND WORDS, BUT IT DEPENDS ON WHO'S LOOKING AND WHO'S COUNTING. AN INSPECTOR NEEDS TO BE LOOKING, COUNTING, AND DOCUMENTING THOSE THOUSAND WORDS"

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CONSTRUCTION OF ASPHALT PAVEMENTS

- **QUALITY ASPHALT PAVEMENTS START AT THE GROUND LEVEL**
- **PERFORMANCE OF ASPHALT PAVEMENTS UNDER TRAFFIC ARE DIRECTLY RELATED TO THE CONDITION OF THE SURFACE ON WHICH THEY ARE PLACED**
  - **NATURAL SUBGRADE, AGGREGATE BASE COURSE, EXISTING ASPHALT OR EXISTING PCCP**

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A brief look at Asphalt Production Facilities

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What is the Purpose of an Asphalt Plant?

- *It is To Consistently* produce a *quality* Asphalt mixture that contains the desired proportions of binder and aggregate within the job mix tolerances and specified temperatures
- The facilities must comply with laws, rules, regulations and statutes of….
  - Federal Government
  - State Agencies
  - Counties
  - Cities

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2

What are the basic functions of an Asphalt Plant

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There are 2 Basic types of Asphalt production facilities used in Colorado

- Batch plant
  - Only aware of 3 Batch plants in Colorado
- Continuous (Drum-mixer) plant
  - **This is the most common type of plant used today in Colorado and around the Country**

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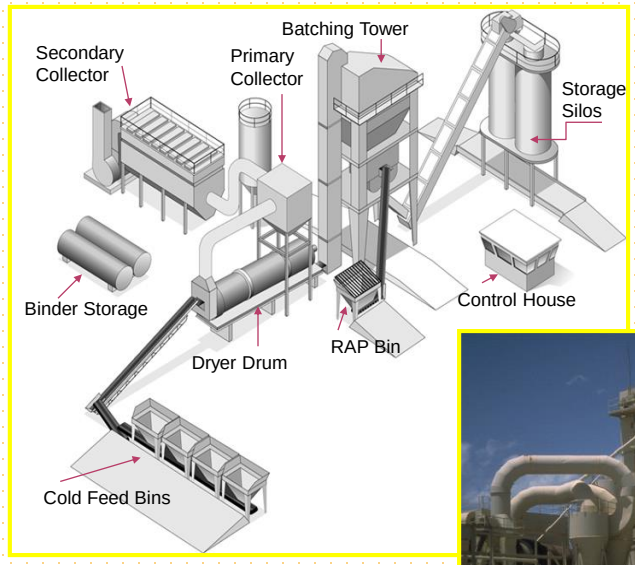

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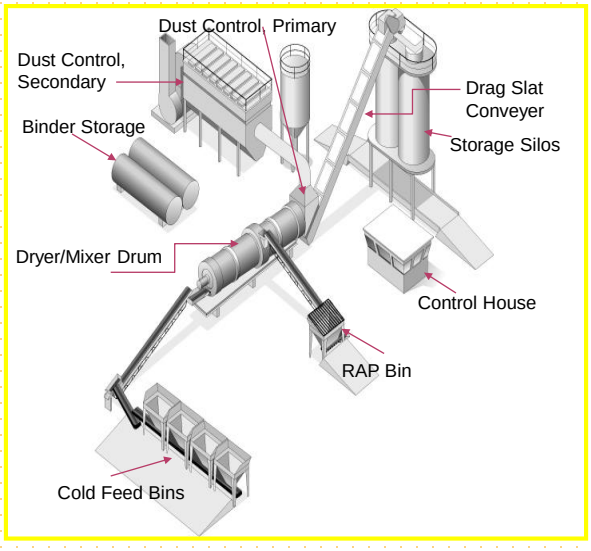
Schematic/Picture of a Batch Plant layout

5



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Schematic/ Picture of Continuous Drum Plant

6

System Components of the Basic Asphalt Production Plants

- Aggregate Handling
- Asphalt Handling
- Mixing
- Discharge
- Additives
- Dust Control
- Systems Control

These are specific to the plant type, (Batch or Continuous Drum Plant)

These components are generic to all plant types

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Aggregate Handling System

Batch Plant

- Aggregate Stockpiles
- Cold Bins
- Cold Feed Conveyor
- Dryer Drum
- Hot Elevator
- Hot Screens
- Hot Bins

Continuous Drum Plant

- Aggregate Stockpiles
- Cold Bins
- Cold Feed Conveyor
- Dryer/ Mixer Drum

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Aggregate Handling System ~ Stockpiles

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Cold Feed Bins

- Composite gradation is controlled by the individual bins containing the various gradations/sizes of aggregate
  - Gradation and quality of aggregate is controlled at the quarry

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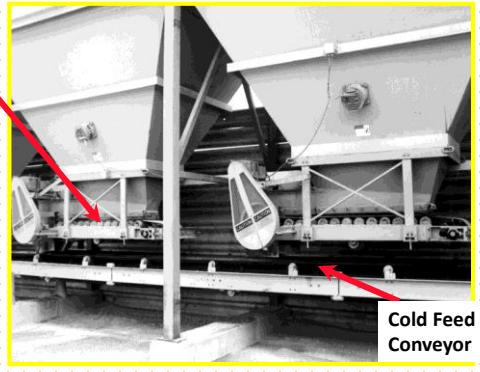
Aggregate Handling System ~ Cold Feed Conveyor

Variable speed feeder belt



- Collects the aggregates from the various cold bins feeders and transports the cold aggregates to the dryer/heating drum
- Proportioning flow from each feeder is controlled by a variable speed belt and adjustable feeder gate beneath the cold feed bin

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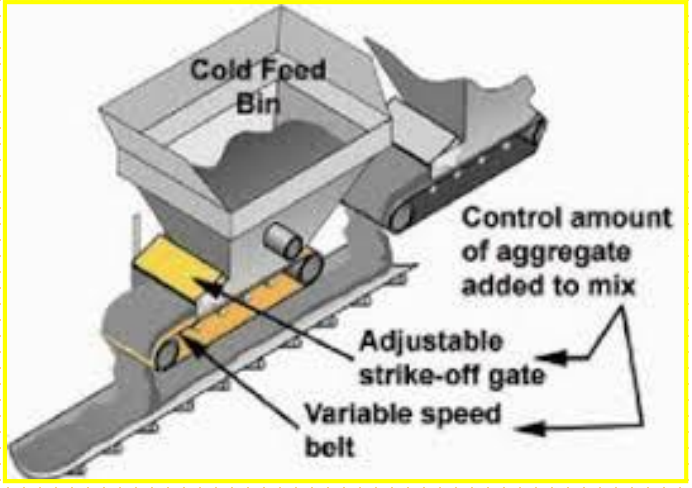
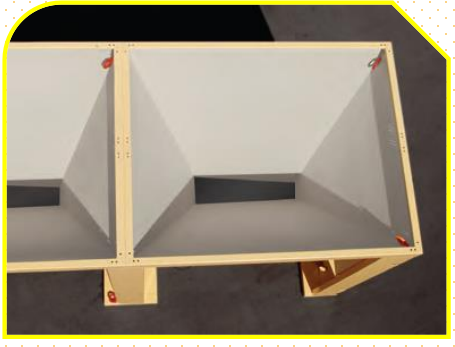
Aggregate Handling System ~ Cold Feed Conveyor



Cold feed bins are designed with steep walls and a self-relieving bottom to encourage smooth material flow.



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Aggregate Handling System ~ Cold Feed Conveyor

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Asphalt Binder and Storage System

- Heated storage tanks
- Pump delivery system
- Binder weigh system

Binder Delivery System ~ Storage Facilities

Heated Storage Tanks

Storage Tank & Delivery Piping Heating System

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What's the difference between horizontal and vertical storage tanks?

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Types of Continuous or Drum Mixer Plants

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- Parallel Flow Drum
- Counter Flow Drum
- Double-Barrel Drum
- Double Drum
- Triple Drum

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Continuous or Drum Mixer Plants

The Gradation is controlled at the cold feeds

Aggregate flow rate measured by belt scale

Binder quantity metered to aggregate flow

Mix production is continuous

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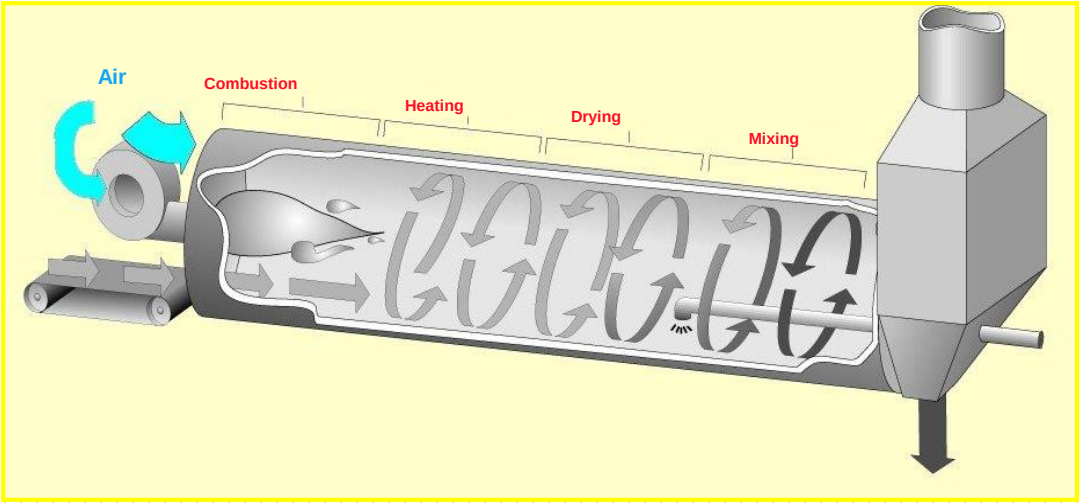
Parallel Flow Drum

(Not Common Today, but still available and used)



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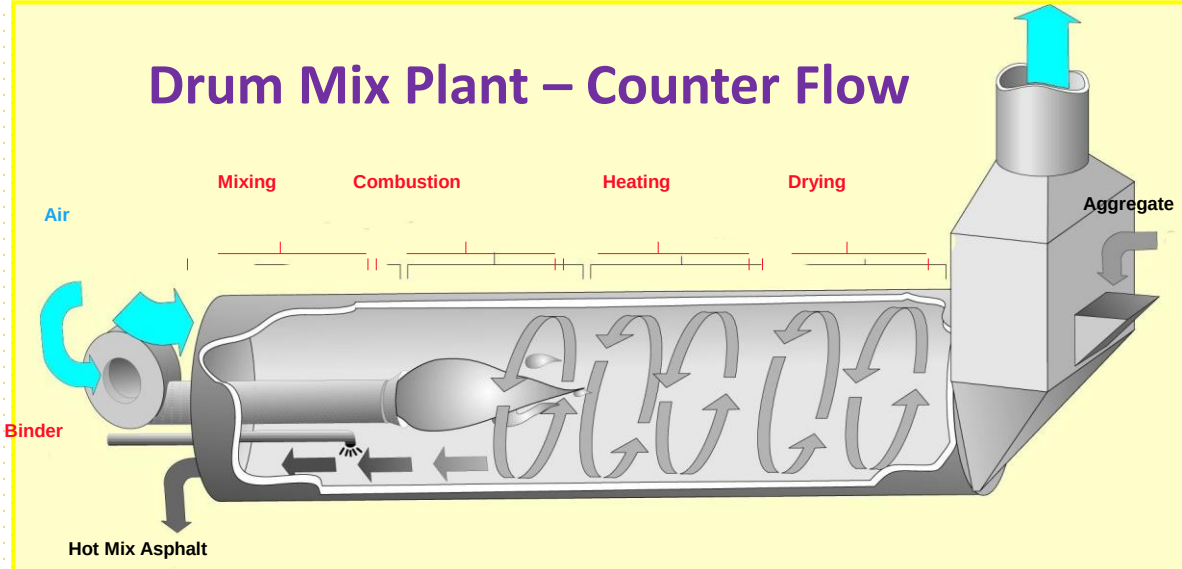
Continuous or Drum Mixer Plant

Hot Mix Asphalt

18

Drum Mix Plant – Counter Flow



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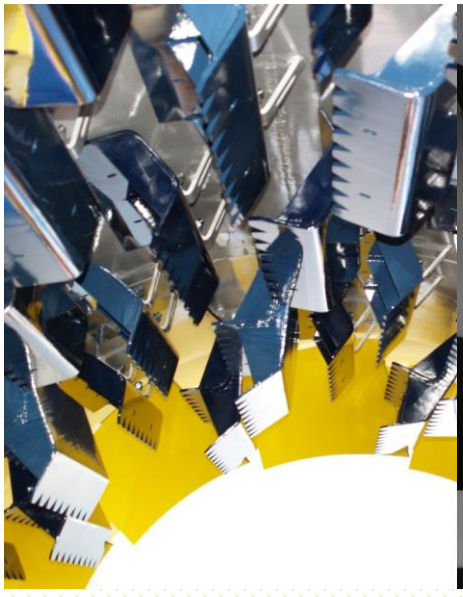

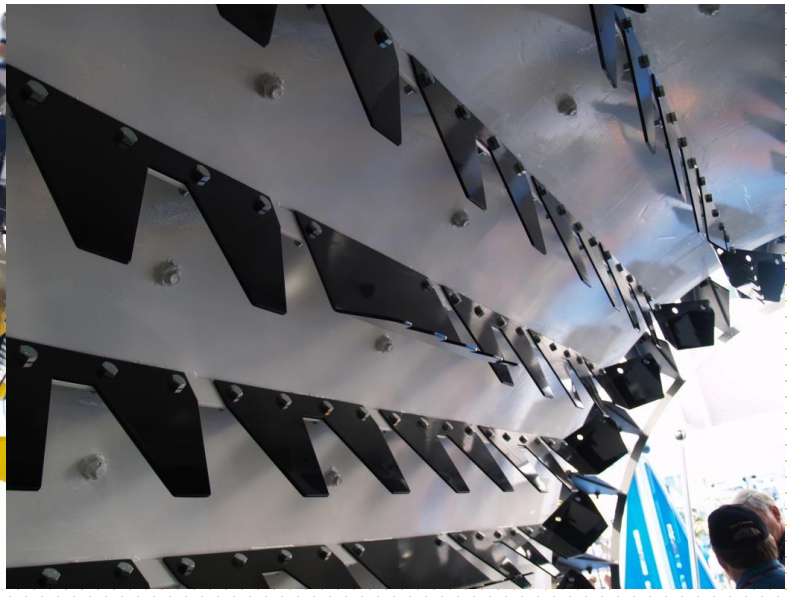

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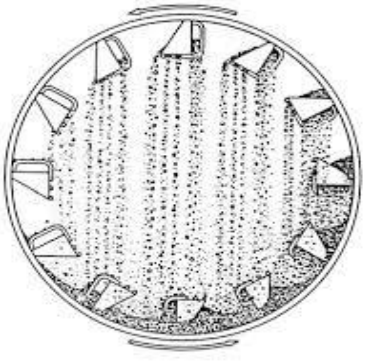
Aggregate veiling

20



Too Slow

Too Fast

Proper rotation speed

Drum Mix Plant – Drum speed and Aggregate Veiling

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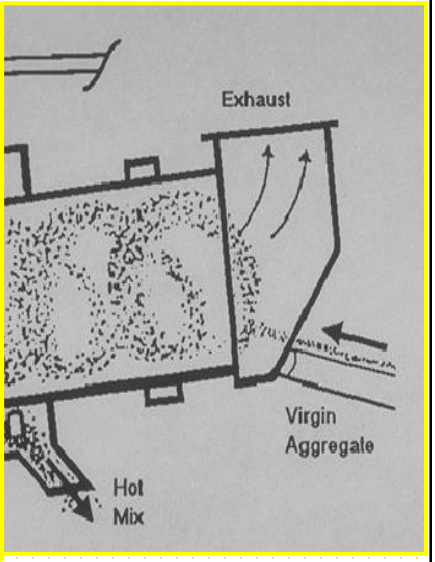

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Double Barrel Drum

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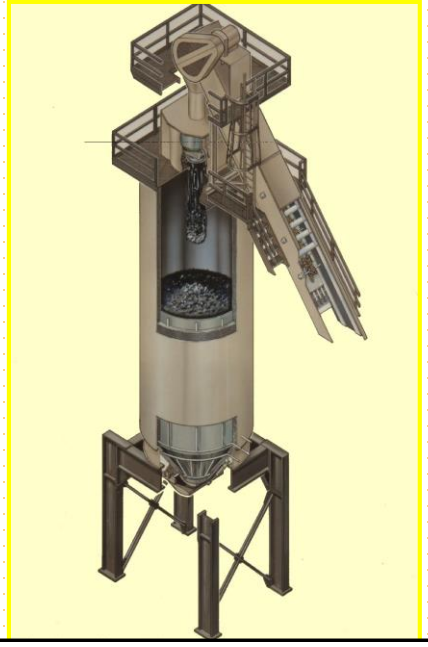
Surge and Storage Silos – Conveyor Systems



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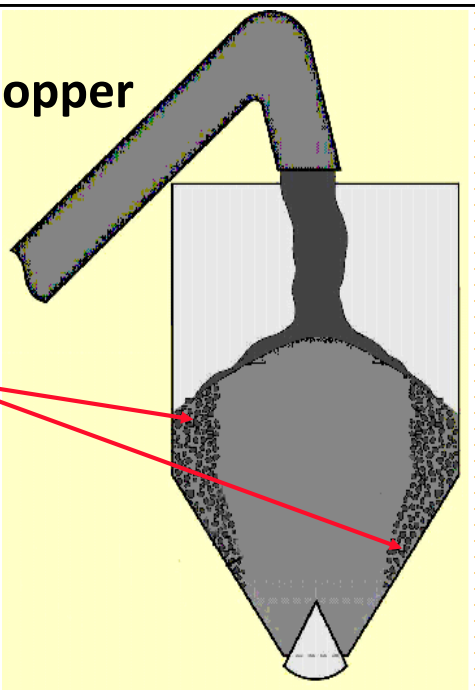
Surge and Storage Silos – Gob Hopper

Large aggregate rolls to outside causing minor segregation



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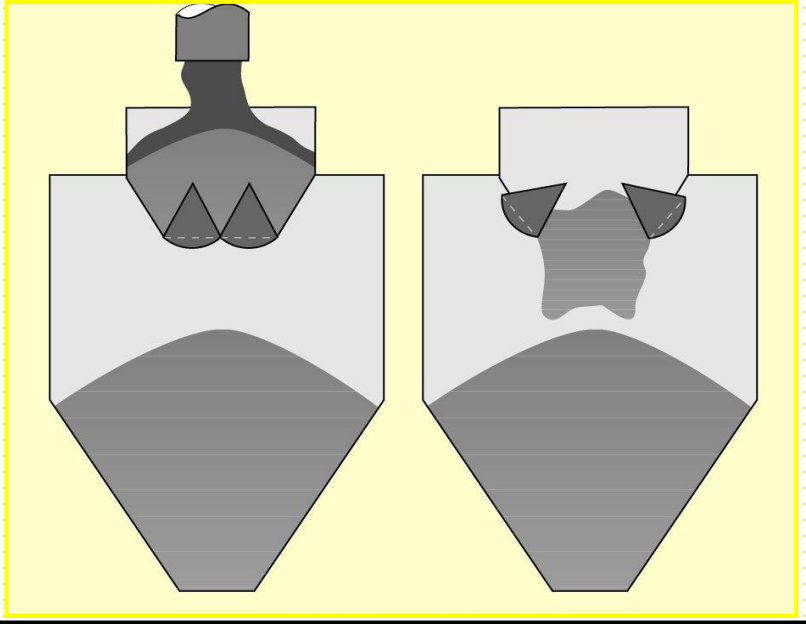
Surge and Storage Silos – Gob Hopper



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Surge and Storage Silos – Loading Doors

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Additive Addition System

Anti-stripping agents
- Hydrated Lime
- Liquid anti-strip

Recycled Asphalt Pavement (RAP)

Fillers, Fibers & other materials

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Additive Addition Systems – Hydrated Lime

•Pugmill – Number of shafts and the mixing length?

•How is moisture introduction controlled?

•How is the introduction of lime controlled?

•How is the lime injection confirmed?

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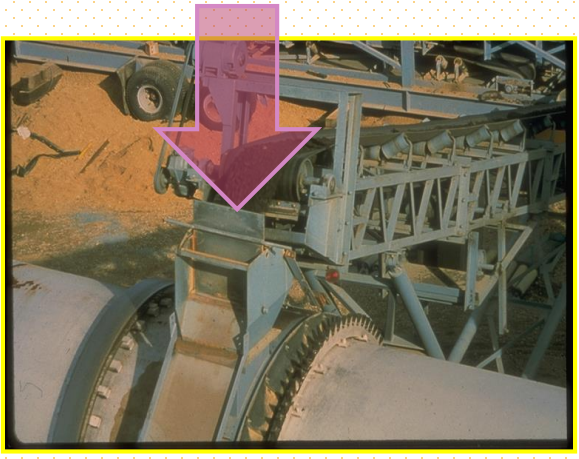
RAP Additive System

RAP Collar



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Primary Control Equipment
Knockout Box
Cyclone Separator
Centrifugal Washer
Secondary Control Equipment
Scrubber
Baghouse
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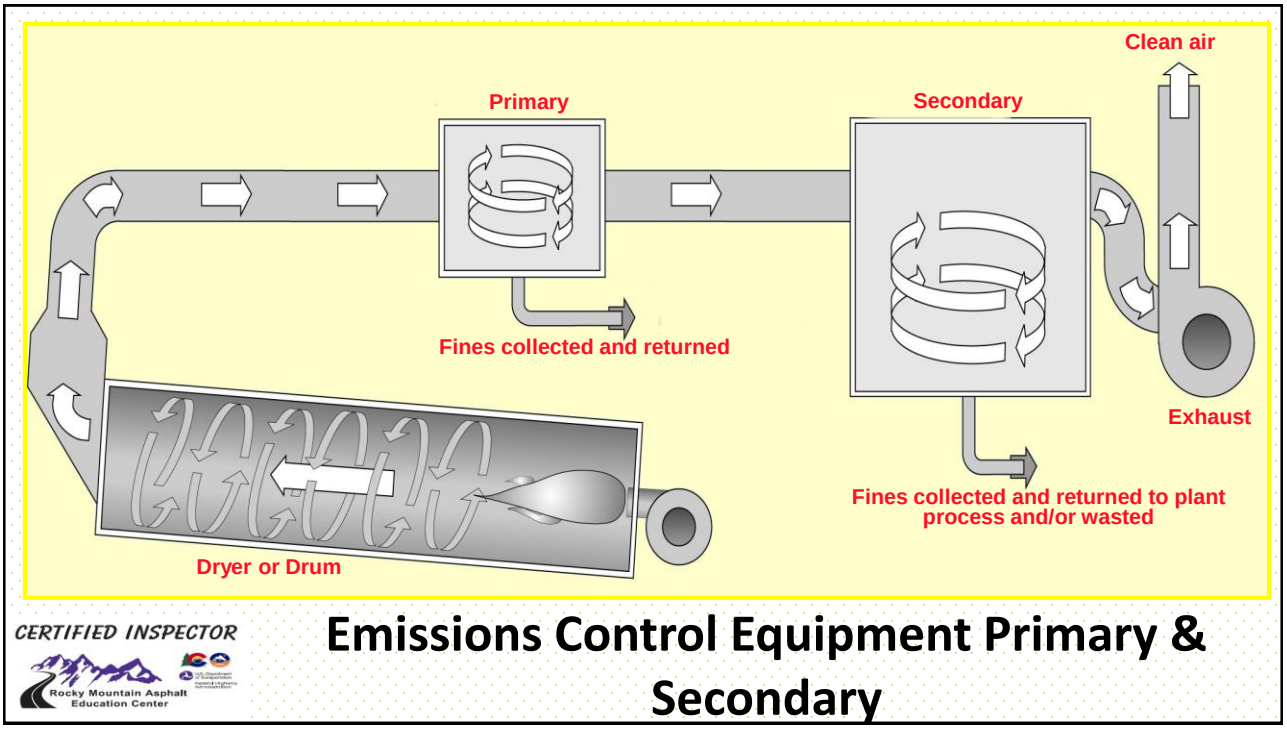
Emission Control Systems

30


Clean air
Primary
Secondary
Fines collected and returned
Exhaust
Fines collected and returned to plant process and/or wasted
Dryer or Drum
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Emissions Control Equipment Primary & Secondary

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Emissions Control Secondary, Baghouse

What is happening with the fines, are they being rejected or returned into the APM?

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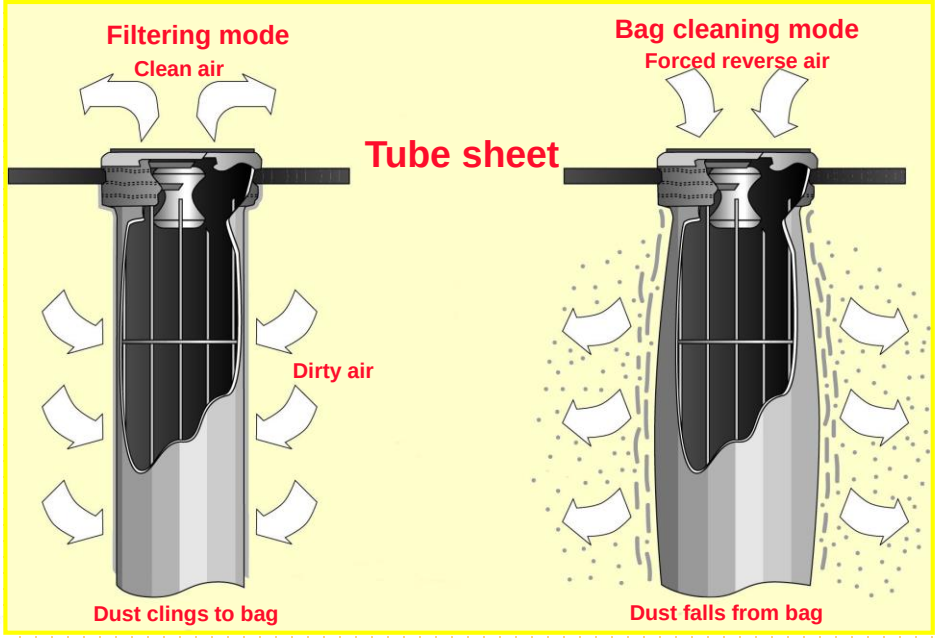

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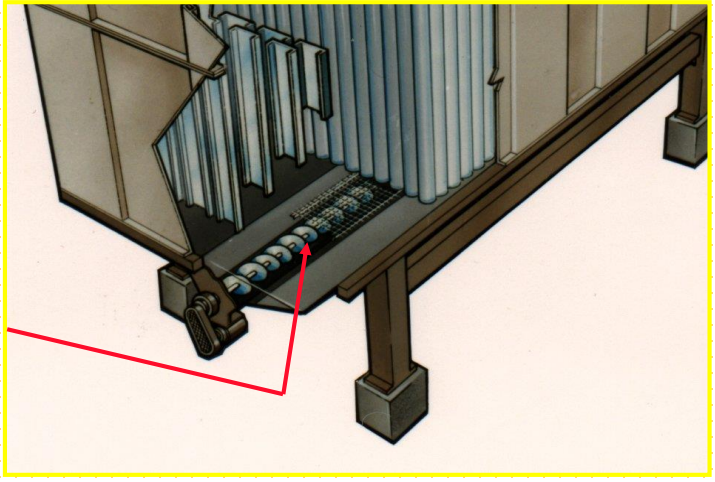
Emissions Control Equipment Baghouse Operation

33

Emissions Control Equipment
Baghouse Return



Dust return screw

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Emissions Control Equipment

Secondary, Baghouse

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System Controls

Modern plants total computerized

Capable of multiple job mixes

One person plant operation

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System Controls – Computerized Drum Plant

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Inspector Best Practice

- <u>At the beginning of a project visit the plant and document:</u>
  - The aggregate stockpiles, note the construction methods and height of the piles. Is cross contamination being observed?
  - The cold feed bins, how many, number being used, calibration data, loading order (fines on bottom, coarse aggregate on top?)
  - Plant type, single drum, double drum, etc
  - Production capacity of the plant, Ton per hour?
  - Binder storage, capacity, No. of tanks present, type of tanks, Vertical or horizontal, temperature control
  - APM storage, No. of silos, storage time, gob hopper operation
  - Emissions control type, bag house, wet scrubber, etc
  - Visit the control house, talk with the operator to get information

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Questions ??

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Inspectors Responsibilities

Construction ~ Surface Preparation

1

Surface Preparation

Introduction

- **Construction of quality APM pavements begins with the proper preparation of the surface to be paved, whether the surface is made of soil, crushed stone, existing hot mix asphalt pavement or portland cement concrete pavement.**

2

Surface Preparation (Continued)

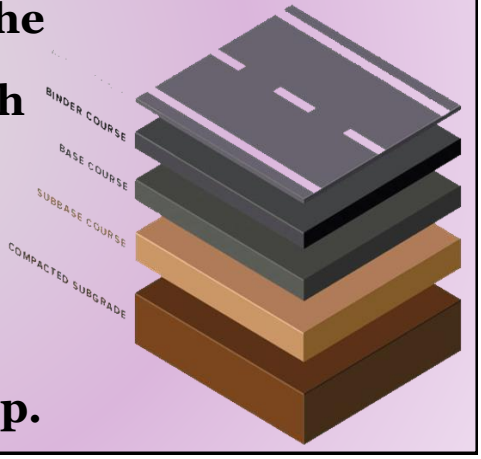
Each surface has different procedures for preparation, all must demonstrate the same characteristics before the placement of APM

- **Structurally sound**
- **Well drained**
- **Properly graded**
- **Clean and dry (Natural soils must have moisture present for compaction)**
- **Primed or Tacked (Depending on the surface)**
- **Compaction Testing (Depending on the surface)**
- **Proof roll (Depending on the surface)**

3

Surface Preparation (Continued)

- **The ability to achieve *Structurally sound, Well drained, Properly graded, Clean and dry* in the surface to be paved depends on the condition of the pre-existing materials, and the extent to which the surface lends itself to rehabilitation or demolition.**
- **Roadways that exhibit structural failure as a result of increased traffic loads will need to be reconstructed from the ground up.**



4

Roadway Subgrade Preparation

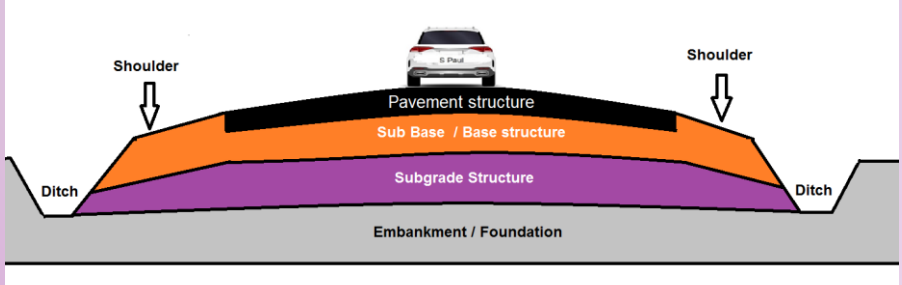
What do I need to look for?

- **Is there a soils report available?**
  - Analyze the soils present for potential problems during construction, if possible, and make note of soils which were described in the design report for the roadway, wet subgrade soils, or potentially expansive soils which should have been addressed in the original preparation
- **If no soils report is available how can you analyze the soils?**
  - Verify if possible, compaction testing and a proof roll of the soils have been completed
- **The inspector should know what the tolerances are for the project being inspected for subgrade, ABC, and APM**
- **The Inspector is required to document the actual measurements and actual deviations from planned depths. (Each project should have similar tolerances)**

5

Roadway Subgrade Preparation Soil Subgrade (Continued)

- **The Contractor should make corrections/repairs to the subgrade after the proof roll in areas which exhibited movement under the single axle loads.** (The limits should have been discussed in the Pre-paving meeting)
- **If placement is delayed, what should be done when paving is scheduled?**



Typical Cross Section of Roadway

6

Inspector Best Practice

- When observing a Proof Roll the inspector should attempt to obtain these things:
  - Weight ticket for the axel of the truck being used
  - Deflection in each lane, walk with the water truck in each lane
  - Mark areas which exhibit excessive deflection
  - Document in the project diary proof roll information such as; the date and time the proof roll was observed, general condition of the area being observed, areas where less than satisfactory subgrade is observed, methods used to repair unacceptable subgrade
  - When appropriate, recommend the use of the patching quantities in the project contract to repair soft and yielding areas

7

Expansive or Collapsing Subgrade soils

- **Expansive soils are ones that swell in volume when subjected to moisture. These generally are found on the front range of Colorado**
- **Collapsing soils are ones which will collapse in volume under loading. This can occur in a dry state or many happen rapidly with the introduction of moisture. These are more common on the western slope of Colorado**
- **Both of these soil types will perform if properly treated and constructed. If they are not treated there may be major problems. VERIFY for the presence of these type soils, and if mitigation is anticipated or completed**

8

Roadway Preparation (Existing Portland Cement Concrete)

- **Review the method to be used to reduce or eliminate the possibility of reflective cracking from the existing PCC into the APM overlay.**
- **Observe the method designated, and verify the materials being used are as specified**

9

Roadway Preparation (Existing APM, Overlay, NO MILLING)

- **The Inspector should verify the distressed pavement areas have been or are being removed, obtain a map of previously identified areas, and field verify**

The Inspector should verify the removal of materials which are considered unacceptable to support the pavement, i.e. soft, wet or other wise in need of corrections.

During removal if additional areas of distressed pavement are observed notify the project Engineer

10

Roadway Preparation Existing APM, with a milled surface Overlay

- ***At a minimum, the Inspector should observe the milling of the existing layer to assure the required depth is being removed.***

- ***The Inspector should verify the distressed pavement areas have been or are being removed, by obtaining a map of previously identified areas, and field verify***

11

Roadway Preparation Existing APM, Overlay, with Milling (continued)

- ***If the overlay area is designated for a leveling or correction course, observe the placement of the layer assuring the materials being placed are as designated by project specification or submittals***
  - ***Verify compactive effort is being applied using ONLY a rubber tire roller***
- ***Ensure the contractor has made all attempts to protect the area prior to placement of APM from traffic or elements if possible***
- ***Observe cleaning and proper tacking prior to placement of the new APM layer***

12

Inspector Best Practice

- Drive milled surfaces each day when they are open to traffic. During these trips observe the following:
  - **The presence of loose materials and the possibility of potential "blow outs" which should be attended to immediately**
  - **Scabbing, if the surface has a large amount of scabbing, the RE or Project manager should be contacted about adjusting the depth of milling**

"If you find defects you can get them repaired and take the credit for the discovery. If you don't find it, someone else will (your supervisor, traveling public or the news media) and you will get the blame. You will then have to get it fixed and get in trouble"

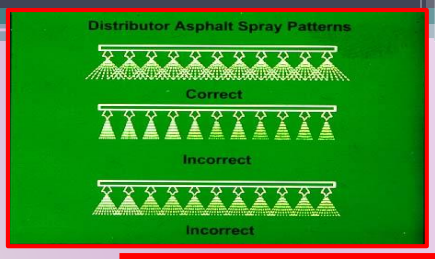
13

Prime Coat, General Practices

- ***Prime coats are not a substitute for proper subgrade or base course prep. Prime coats are generally readily available.***
  - ***When cutbacks were used it was standard practice***
  - ***With the reduction in cutback usage the practice of priming the subgrade has been reduced***
- ***Typical primes today are emulsions***
  - ***Application rates – 0.1 to 0.3 gal/sq yd/in depth***

14

Tack Coat, General Practices



- *Purpose is to bond new APM to old pavement*
- *Surface to receive the tack coat must be cleaned and dry*
- *Surface must be covered uniformly*
  - *Single, Double or Triple overlap?*
- *Make sure proper grade of tack coat is used*
- *Make sure proper application rate is applied*
  - *Record beginning and ending distributor tank readings to determine the rate of application*
- *After application make sure there are no bare spots*
- *Do not apply more tack than can be covered in a day*
- *When using emulsions make sure it "breaks" (brown to black color change) prior to placing the APM*

15

16

1

What is Materials Transfer?

- **Materials transfer is the process of moving material from one point to another.**
  - **There are many methods to accomplish this, they include**
    - **Trucking**
    - **Materials Transfer Devices**
    - **Materials Transfer Vehicles**

2

What Type of Trucks are Used for Asphalt Delivery?

- **End Dump**
- **Semi Trailer**
- **Rear Dump**
- **Conveyor Dump**
- **All trucks should be checked for Items that can damage the pavement or are unsafe**
  - **Fuel and Oil leaks**
  - **Faulty backup alarms**
  - **Tarps to protect from dust and wind to keep Asphalt hot**
  - ***ASPHALT RELEASE AGENTS USED AND/OR ALLOWED***

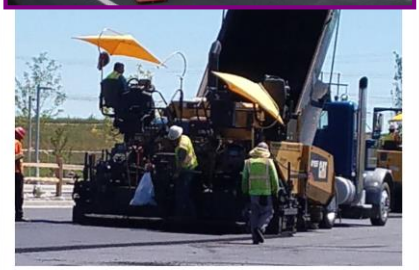
3

End dump

- **Delivers Asphalt directly to the hopper of the paver**
- **3 to 6 axles**
- **Capacities from 11 to 18 tons (more axles more tons)**
- **Advantage – shortest wheel base, easiest to maneuver**
- **Disadvantage – limited capacity**

4

Semi-trailer truck

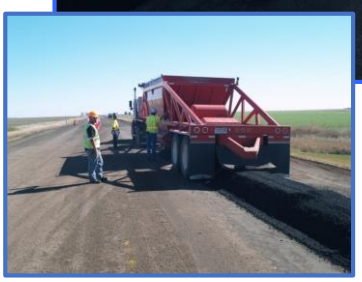


- Capacity – 18 to 23 tons
- Advantage – capacity
- Disadvantage
  - requires more maneuvering skills
  - overhead obstructions
  - greater segregation potential during loading
  - truck bed weighing on paver

5

Bottom or Belly dump truck

- Delivers load from beneath, into a windrow
- Capacity – 18 to 23 tons
- No truck contact with paver
- Requires that the windrow be correctly sized to insure consistent mix supply to the paver
- Requires some type of delivery device to the paver
  - Pickup elevator or mobile transfer vehicle



6

Horizontal discharge or live bottom truck

- Conveyor belt or slat conveyor discharges mix from back without raising bed – directly to paver
- Capacity - varies

7

Haul trucks conditions

- All truck beds must be kept clean and free from foreign materials
- Beds should be smooth and free from major dents or depressions where release agents and Asphalt can accumulate
- Should be equipped with load tarps
  - Maintains Asphalt temperatures
  - Protects Asphalt during inclement weather

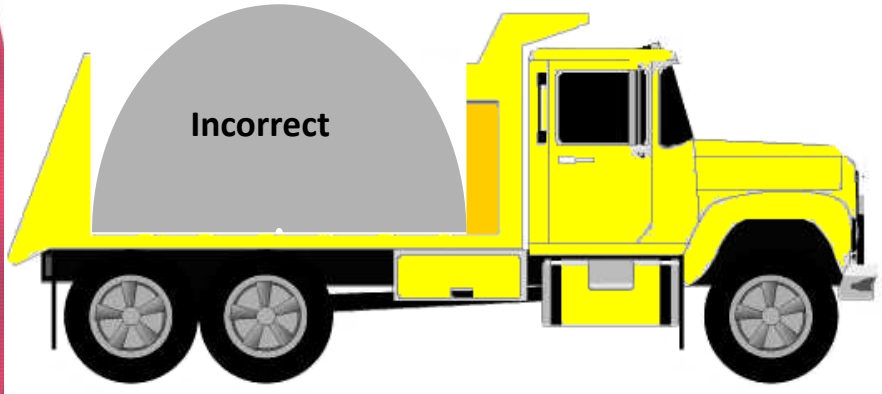
8

Truck Loading Procedures

- **Should not be overloaded - illegal**
- **Proper loading techniques can help to eliminate segregation problems**
  - **If improper loading is observed- note in the project notes and discuss the procedure with the project engineer and/or contractor**

9

Truck Loading "Best Practices"



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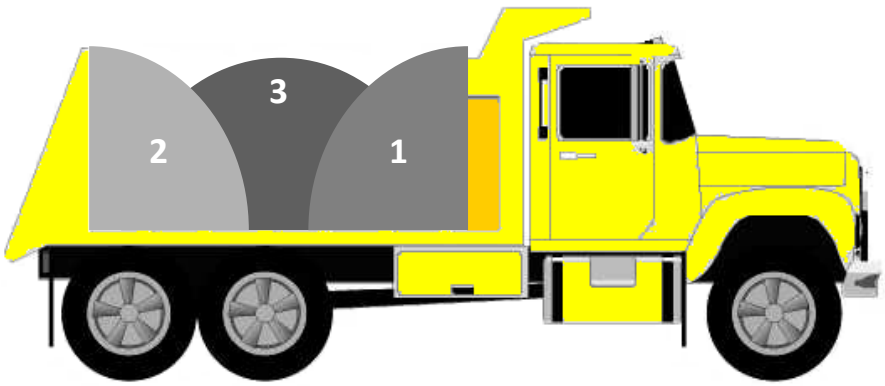
Truck Loading "Best Practices"

11

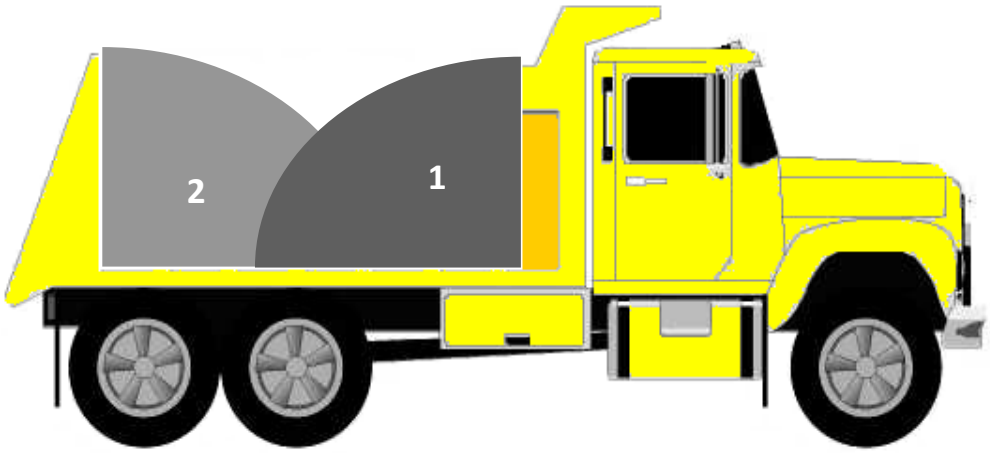
Truck Loading "Best Practices"



Using a 3-dump loading procedure

12

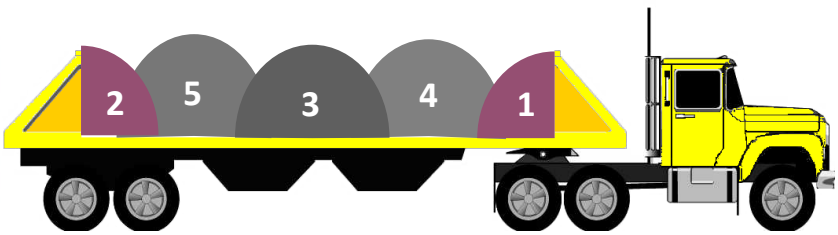
Truck Loading “Best Practices”



Using a 2-dump loading procedure

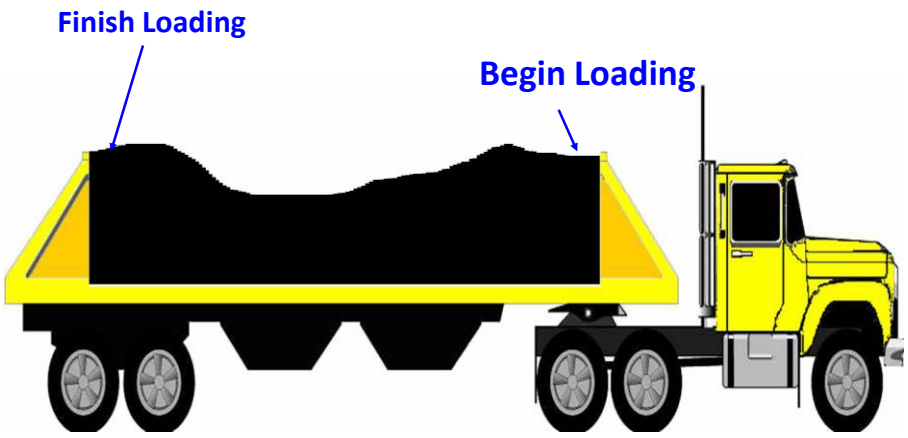
13

Truck Loading “Best Practices”



14

Truck Loading "Best Practices"



Continuous loading process

15

Delivery of Asphalt mix to Paver

- **Once the truck is loaded and ticketed is should proceed directly to the paving project**
- **Park in designated areas minimizing tracking the prime or tack coat**
- **Once in line to dump in the hopper of the paver it should be far enough ahead so not to interfere with paving operations, but close enough to get to the paver and keep the operation moving <u>smoothly</u>**

16

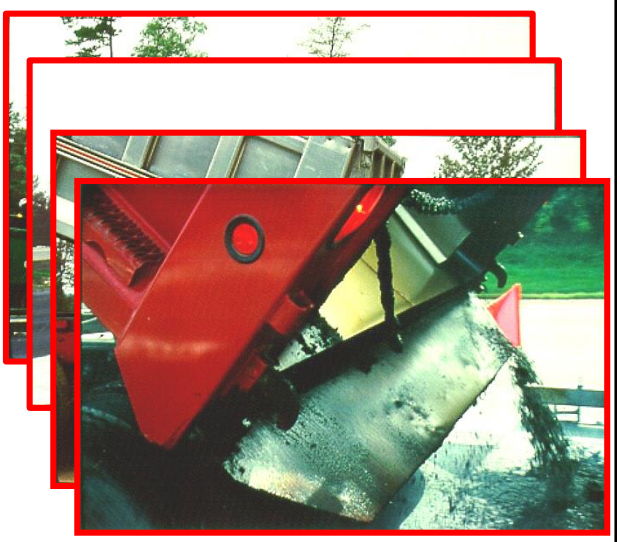
Delivery of APM mix to Paver

- **Truck drivers should always follow the direction of the dump man**
- **Truck should never bump into paver!!!!**
- **Proper procedure for dumping the mix into the hopper is to raise the truck bed slightly and allow the mix to slide against the tailgate – then open the tailgate**
- **After the hopper is filled, the truck bed is raised slowly continually charging the hopper and maintaining a <u>smooth</u> operation**

17

Delivery of APM mix to Paver

- **Once the truck is empty the bed is lowered before the truck pulls away from the paver**
  - **Allows the truck apron to clear the hopper guards**
- **After clearing the paver the truck departs to the clean up area**
  - **To clean the apron and tailgate**
  - **Designated cleaning area is not the paving site**



18

Inspector Best Practice

- Document the types of trucks being used each day APM is being placed. Information should include:
  - The number of trucks on the haul.
  - Truck types, Tandem, trailer, belly dump, or live bottom
  - Release agent being used. Ask the drivers what they are spraying and who is supplying the release agent (Them or the asphalt supplier, if private haulers are being used)
  - Know what the truck loading procedure is. This could be observed during the visit to the plant early in the project
  - What is the paver loading procedure. Are the trucks “bumping” the paver? Is the driver “charging” the tailgate prior to releasing the mix into the hopper?
  - Is there a truck “clean out” site available. Is it being used? If not what procedures are being used to clean trucks after dumping?

19

An alternative to direct delivery to the paver from trucks are “Materials Transfer Vehicles” (MTV) or “Material Transfer devices” (MTD)

- **Elevator type**

- **Transfer machine**

- **Transfer Machine**

20

MTD's

MTD's: Non self-propelled transfer device that is normally pushed by the paver. Accepts material from either the ground (windrow) or conventional trucks and feeds material to the hopper of the paver.

21

MTD's

Is the materials being picked up adequately?
Is the MTD leaving excessive materials on the grade?

22

MTD's

23

MTV's

MTV's: Self-propelled vehicle with a fixed on-board storage capacity. Accepts material from the ground (windrow) or from conventional trucks and transfers material to the paver hopper.

24

MTV's

25

MTV's

26

MTV's

MTV's are raising the standards for pavement smoothness, How?.

Continuous Non-Stop operation of the paving Train

No Truck to Paver contact

27

MTV's

MTV's: Raising the standards for eliminating aggregate and temperature segregation.

28

QUALITY PAVING WITH MTV's:

Remember that the MTV does not need to be physically tied to the paver. To make better use of the MTV, use it to unload trucks where safest (away from overpasses and power lines) and shuttle back to the paver to keep the hopper insert charged.

Use the MTV pivoting conveyor to allow offset paving. This can help to keep haul trucks off of tack and away from string lines.

29

QUALITY PAVING WITH MTV's:

At the beginning of the day, take the first truck from the plant and move it back to third or fourth in line. Then take the second and third loads from the plant and run them straight through the MTV and into the paver. This will preheat the metal surfaces of the MTV and will insure the paver starts with hot material in the hopper.

A good rule of thumb is that any base that will support a rubber-tired paver will support most MTV's.

30

QUALITY PAVING WITH MTV's:

Above all, use the MTV to promote quality paving practices:

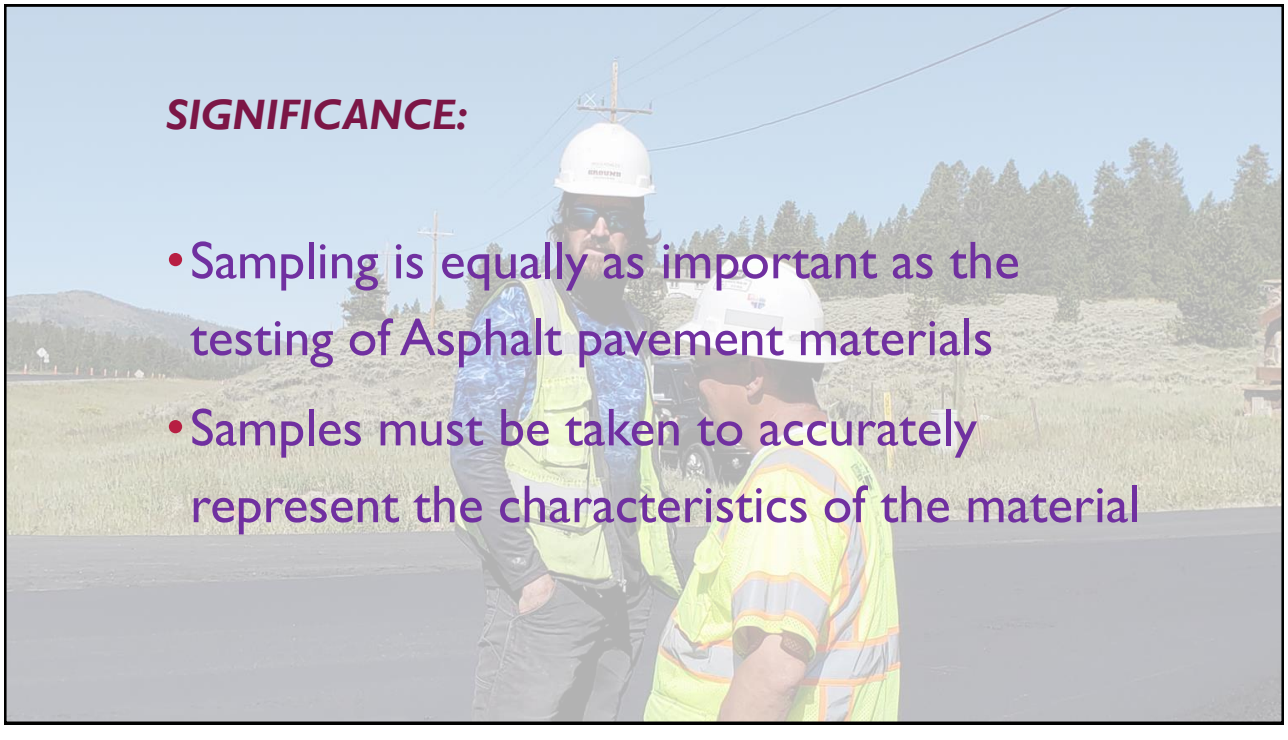
* Constant, uniform head of material.
* Eliminate spillage in front of the paver.
* Use constant paver speed to enhance a good roller pattern so as to always achieve proper densities.

31

32


Inspector's Responsibilities
Construction Observation ~
Sampling Asphalt Paving Mixtures

1


SIGNIFICANCE:
• Sampling is equally as important as the testing of Asphalt pavement materials
• Samples must be taken to accurately represent the characteristics of the material

2

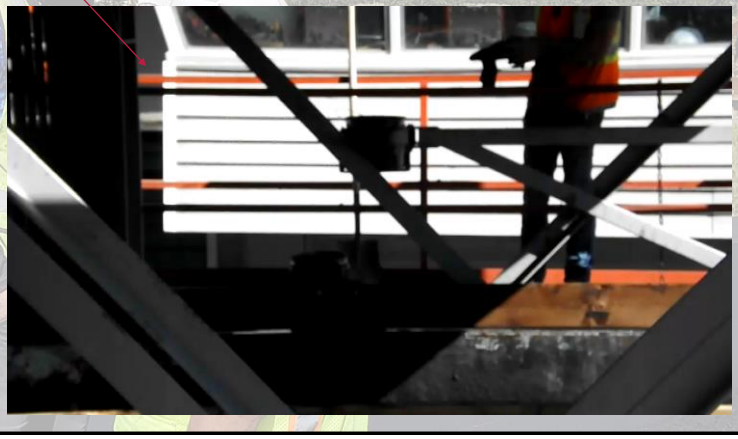
SECURING SAMPLES

- *Samples for acceptance or assurance testing shall be sampled by the contractor and witnessed by an authorized representative of the Agency*

3

SAMPLING ASPHALT

- ***sampling tube (Swing Arm)***
- ***point of delivery***
- ***behind paver***
  - *Prior to Compaction*
  - *After Compaction*



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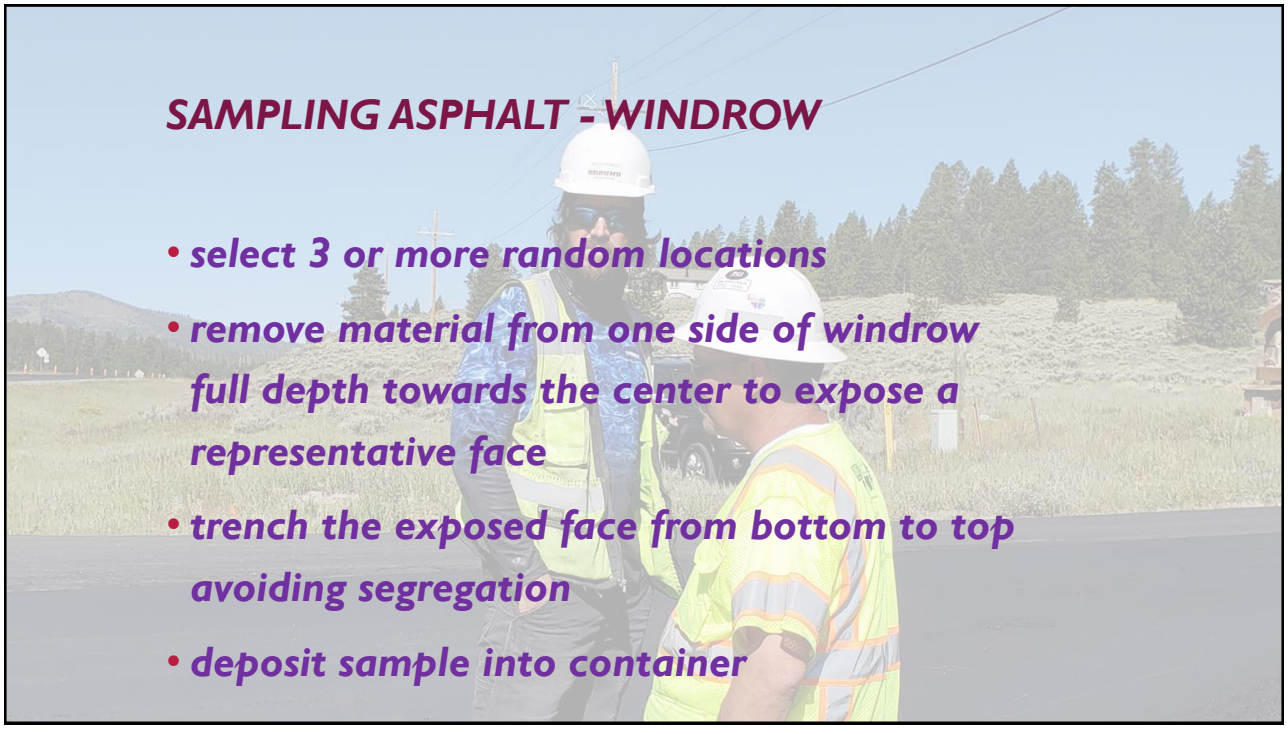
SAMPLING ASPHALT AT THE POINT OF DELIVERY
• Locations
• Windrow
• Paving machine spreading screws (auger chamber)
• Mat behind paver

5


SAMPLING ASPHALT - WINDROW
• select 3 or more random locations
• remove material from one side of windrow full depth towards the center to expose a representative face
• trench the exposed face from bottom to top avoiding segregation
• deposit sample into container

6

7

SAMPLING ASPHALT - SPREADING SCREWS (AUGER CHAMBER)

- observe augers
- augers should be in operation at least 80 % of the time
- Auger chamber area should be at least 2/3 filled with the Asphalt mixture

8

SAMPLING ASPHALT AT THE AUGER CHAMBER

- obtain the portions ahead of the augers
- insert scoop into mixture
- remove portion, avoiding loss of material
- obtain at least 3 equal portions and transfer to a suitable container
- combine all portions
- cover container with tight fitting lid

9

10

11

SAMPLING ASPHALT FROM BEHIND PAVER, BEFORE COMPACTION

- Apparatus
  - small flat scoop with sides or sampling device
  - container, with tight fitting lid, of suitable capacity

12

SAMPLING ASPHALT FROM BEHIND PAVER BEFORE COMPACTION (CONTINUED)

- use a random method to determine sampling locations
- obtain at least 3 approximately equal size increments immediately behind paving machine
- increments shall be the full depth of lift
- templates which are placed before mixture is spread will be helpful.

13

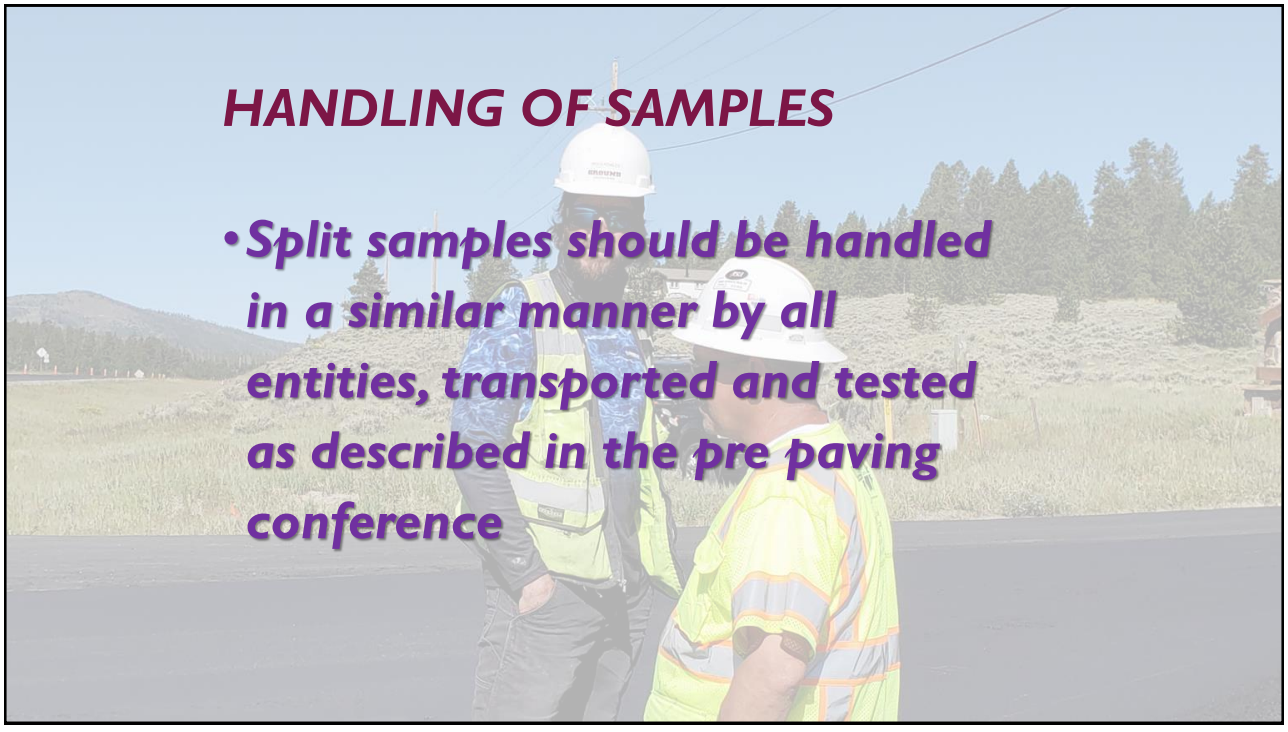
14

SAMPLING FROM ROADWAY AFTER COMPACTION

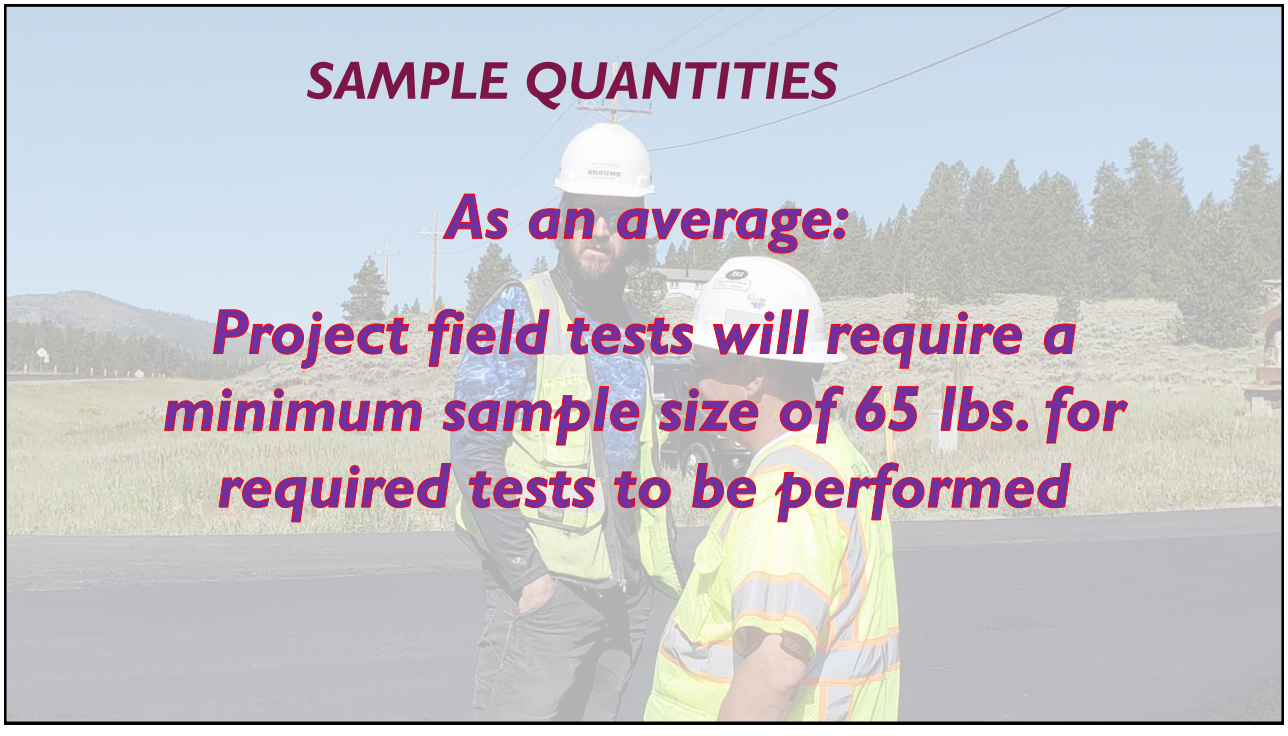
- **select the units to be sampled by a random method**
- **obtain at least 3 approx. equal samples for the full depth of material, taking care to exclude any underlying material**
- **each increment shall be obtained by coring, sawing or other methods in such a manner to ensure a minimum disturbance of the material**

17

18

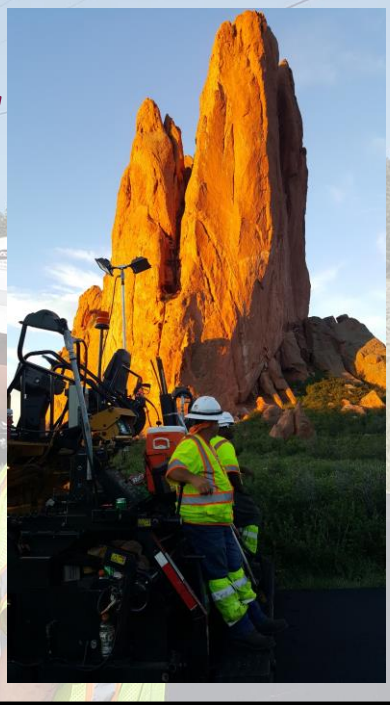

HANDLING OF SAMPLES
•Split samples should be handled in a similar manner by all entities, transported and tested as described in the pre paving conference

19


SAMPLE QUANTITIES
As an average:
Project field tests will require a minimum sample size of 65 lbs. for required tests to be performed

20

Questions



21

Inspectors Responsibilities

Construction ~ Paving Operations

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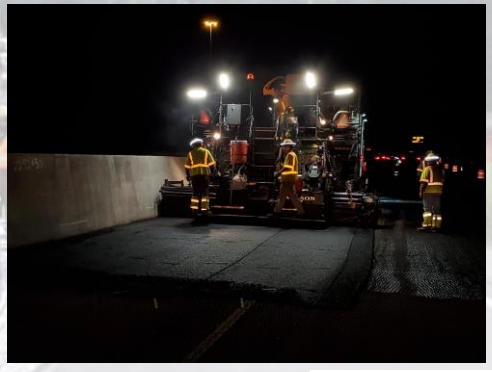
1

Placement of Asphalt mixture

- *Asphalt mixtures are placed with a paving machine (paver)*
- *The paver places the Asphalt to the desired width, thickness and a satisfactory mat texture*



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2

Types of Pavers

- Type of pavers
  - Rubber tire
    - Move around more readily
    - Faster travel speeds
  - Track type
    - Spreads weight over a larger area
    - More effective paving grades

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3

Paver components

- *Tractor unit – provides all the power for the paver and carries the mix from the hopper to the screed*
  - *Hopper*
  - *Flow control gates*
  - *Auger*
- *Screed – towed by the tractor, spreads the mixture to a specified thickness, initial density and smoothness*
- *Grade and slope controls*

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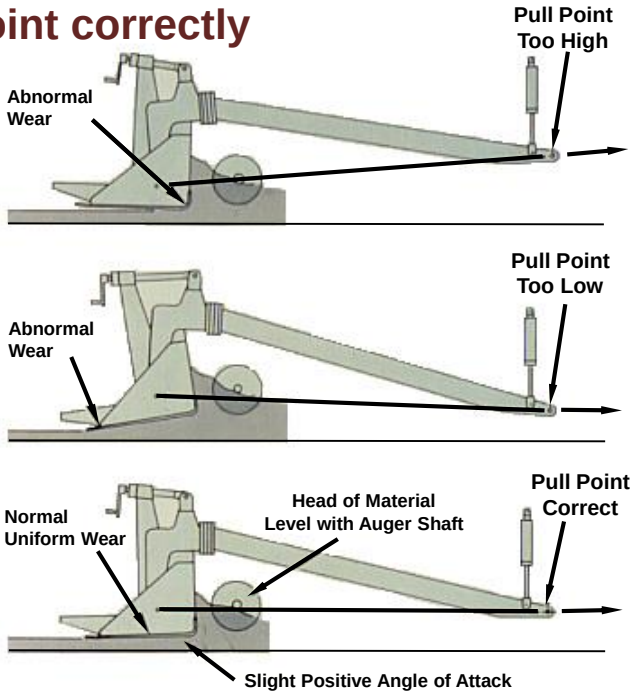
4

Set the pull point correctly



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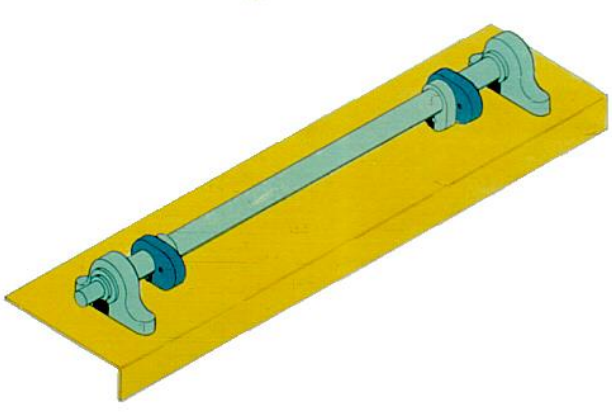

Vibratory Shaft With Weights

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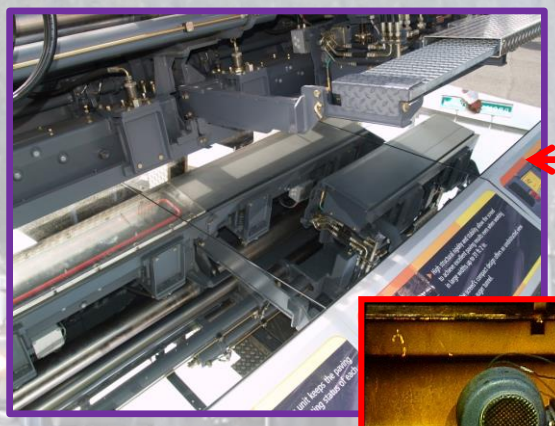
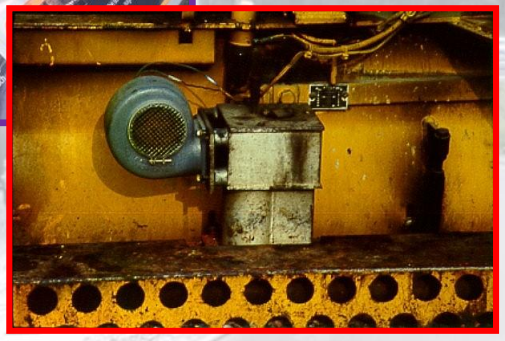
7



Screed Heating systems
•Electric
•Diesel Fired



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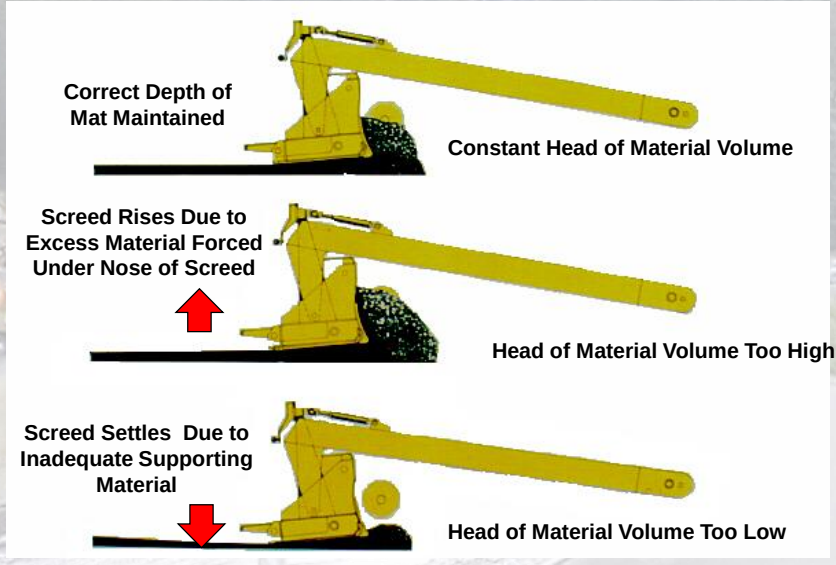
8

Maintaining the material head is very important



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9

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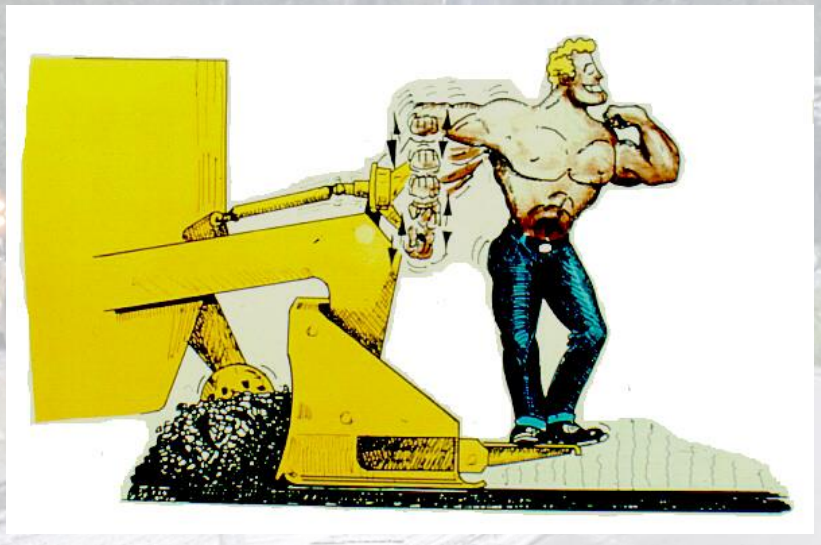
10

What affects Pavement Smoothness?



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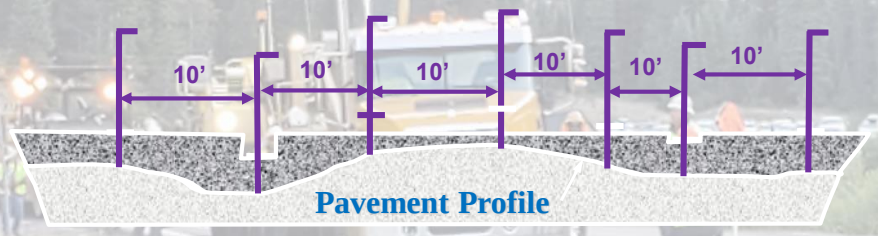
11

What will this accomplish?



Direction of Paving →

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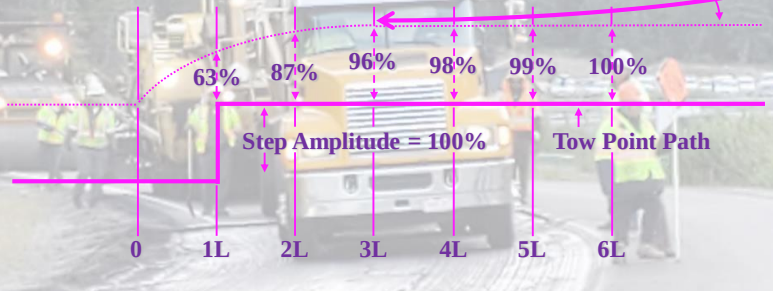
12

How quickly do changes take affect?

No additional changes should be made until at least this point (96% Change)

Direction of Paving →

Screed Path



L = Leveling Arm Length (Approximately 10’)

Detail of Screed Path

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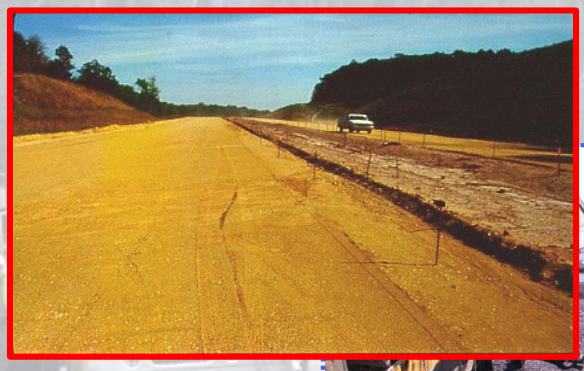
13

Automatic Screed Controls

- *String line – longest grade reference*
  - *Advantage*
    - *Predetermined grade can be matched very accurately*
  - *Disadvantage*
    - *Survey crew has to set grade controls, difficult to use on horizontal curves and easily disturbed*



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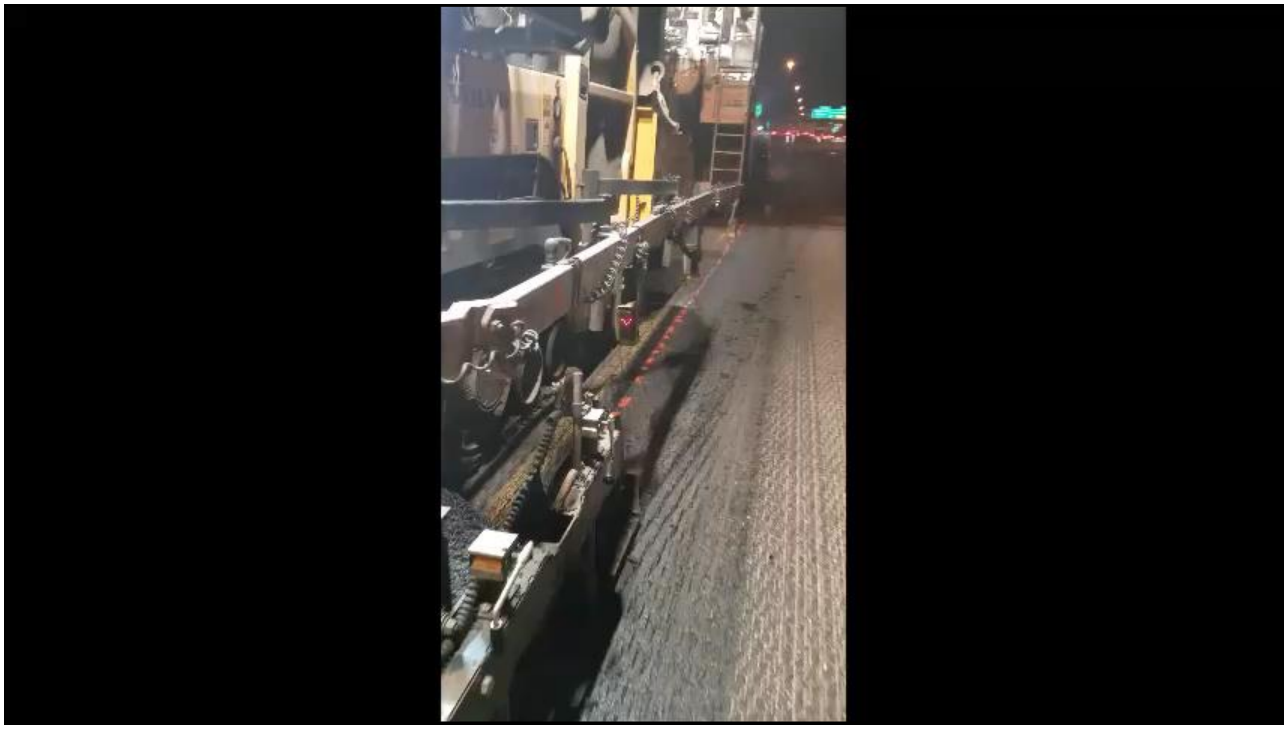

16

Automatic Screed Controls

- *Joint Matching shoe*
  - *Short ski that rides directly on the adjacent surface or curb, Most of these sensors today are non contact sonar type sensors*

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Inspector Best Practice

A Check document daily:

- *The auger rate of rotation (40 rpm?)*
- *The auger time in rotation verses idle time. The auger should be rotating at least 80 % of the time*
- *Head of material in auger chamber. This should be ½ to 2/3 full*
- *Are auger extensions installed if the screed is extended more than 2 feet?*
- *Is the screed vibrator functioning? What is the limit dial set to?*
- *Grade control. What type is being used. Is it functioning properly?*
- *Introduce yourself to the Paving foreman, superintendent, paver operator and screed person. Don't be afraid to ask questions about the operation of the paver*

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18

Paving Operations "Best Practices"

High quality pavements do not just happen, they are a result of thorough preparation, **good communication** and ***inspector's*** **attention to detail**

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19

Paving Operations "Best Practices"

Placement

- *Trucks should not back into paver – paver should pull into truck*
- *Loading paver with mix make sure it is not dumped outside the hopper – paver should not run over spilled mix*
- *Dumping wings on hopper can be a potential source of mix segregation*
- *Check overall quality of mat*
  - *Should have a smooth and uniform surface*
  - *Check for segregation by a non-uniform surface texture*
- *Check depth of placement*
  - *Mat consolidates 20% to 25% during compaction*

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Paving Operations "Best Practices"

- *ANY change in mat placement depth should be made gradually*
- *Before paving adjacent lanes the surface should be tacked as well as the longitudinal joint*
- *When paving the adjacent lane the paver should slightly overlap the first lane to form a tight joint*
- *Joint hand work should be kept to a minimum*
- *Grade and cross slope control*
  - *Ski should travel in a straight line*
  - *Cross-slope should be set at beginning and should not require changing during the paving operation*

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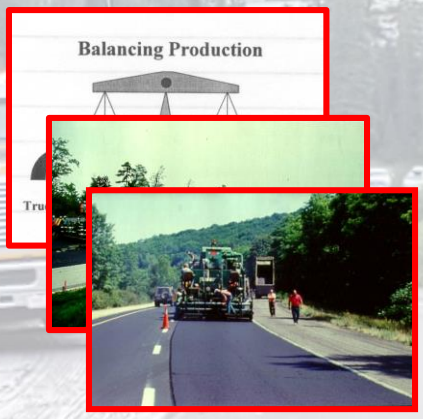
Placement

- *Quality Asphalt pavement – laydown operation*
  - *Requires balance between paving operations*
  - *Continued delivery of Asphalt mix*
  - *Continuous non-stop operation of the paver*



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22

The contractor should try to avoid having the crew picnic between trucks!

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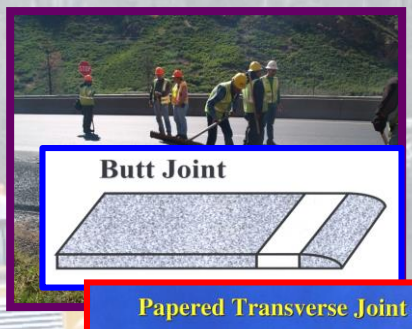
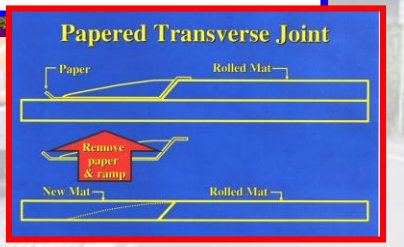
Transverse Joints

- *Transverse joint – constructed across the pavement whenever paving is being suspended (end of day's operation)*
- *Butt joint most common.*
- *Tapers should be a minimum of 20:1 for all transverse joints*





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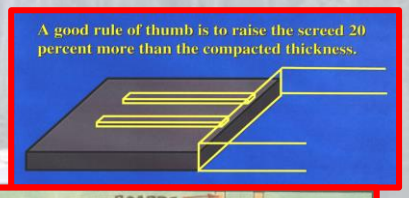
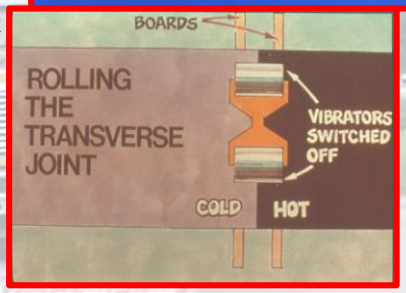
Transverse Joints

- *Butt joint*
  - *Beginning of paving raise screed +/- 20 to 25% more than compacted thickness*
- *Roll joint parallel to joint for even transition from previous days paving*





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25

Longitudinal Joints

- *Straight consistent longitudinal joints*
  - *Should only be bumped not raked*
  - *Overlap 1 inch to 1.25 inches*
- *Curves require smooth consistent arcs*
- *Joint Density may be included as an incentive/disincentive pay item*

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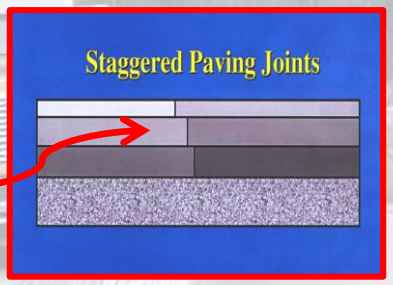
Longitudinal Joints

- *Multiple layer Asphalt pavement longitudinal joints*
  - *Staggered so a single vertical joint does not run the full depth of pavement*
  - *Overlap should be greater than 6 in.*
  - *Location of the joint is critical to long term life*
  - *Joints should not be located on a skip line*



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27

Inspector Best Practice

- *Document daily:*
  - *The transverse joint construction and "night" joint construction*
  - *Measure the surface tolerance of the last transverse joint, should be with in 3/16" in 10'*
  - *Measure the surface tolerance of the longitudinal joint no more than 3/16" in 10', measure in 3 locations*
  - *Measure the location of the longitudinal joint relative to the wheel path and previous lifts*
  - *Measure the transverse cross slope. This should be with in ±0.1% of requirements in the plans*

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28


Questions
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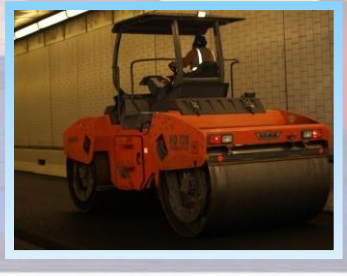
29

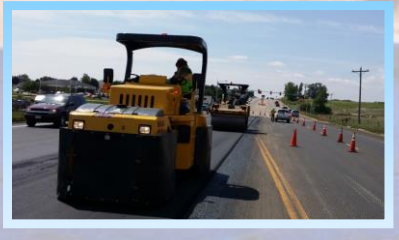
Inspectors Responsibilities

Construction ~ Compaction

1

Asphalt Compaction





2

Asphalt Mat Compaction

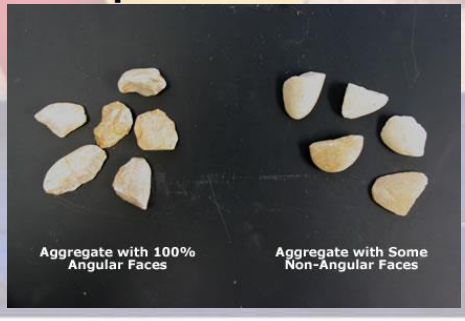
- Compaction densifies *(rearrangement of particles)* the pavement so it will maintain its shape and have the required strength for traffic loads.
- Rolling of the mat must achieve density, smoothness and surface texture
- It is the single most important factor that affects the ultimate performance of a Asphalt pavement
- Adequate compaction increases the fatigue life, decreases permanent deformation (rutting), reduces oxidation, decreases moisture damage, increases strength and stability

3

Aggregate Angularity will effect the compaction process

Angular Aggregate
High Internal Friction
– high strength
– difficult to compact

Rounded Aggregate
Low Internal Friction
– lower strength
– easy to compact



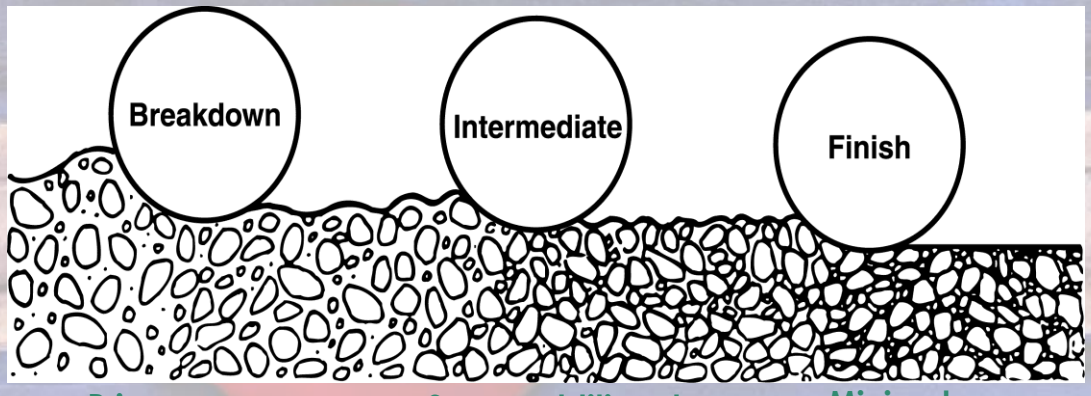
4

Superpave Mix Designs

- More coarse- & gap-graded aggregates
- Fully crushed aggregate, less natural sand
- Modified asphalt
- Higher density required at a given asphalt content

5

There are 3 Phases of Compaction



- Primary compaction
- Aggregate movement

- Some additional compaction
- Binder movement

- Minimal additional compaction
- Smooth surface

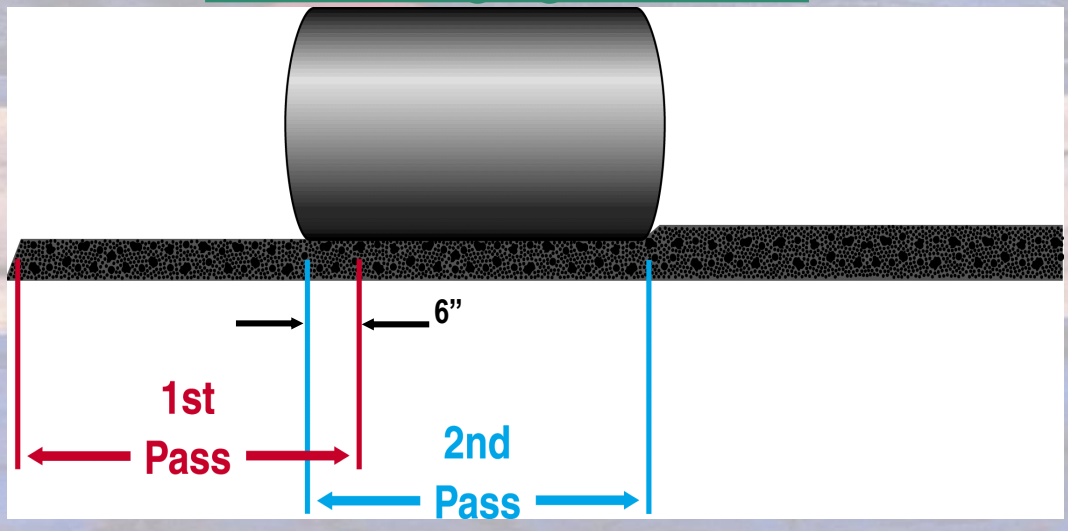
6

Initial Phase of Compaction

- Breakdown
  - Breakdown usually accomplished with a steel wheel roller
  - Density should be near ±90% when completed
  - Vibratory mode when mat is ≥2”
  - Static mode when mat is < 2”

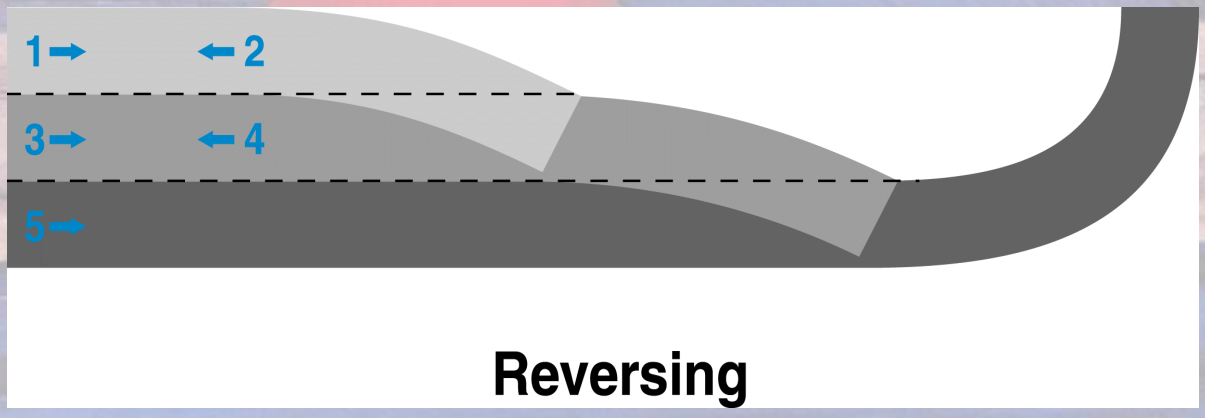
7

What are the recommended overlaps when changing directions



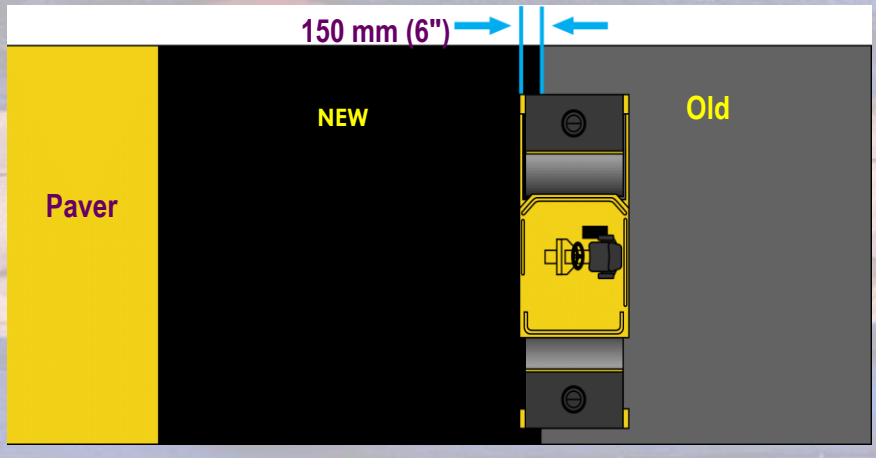
8

"Best Practice" when Reversing Direction



9

Transverse Joint Construction



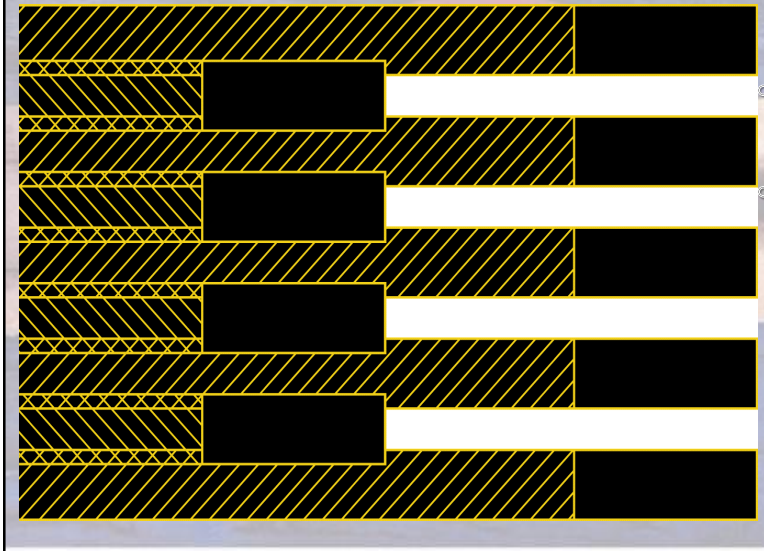
10

Phases of Compaction

- Intermediate
  - Usually accomplished with a pneumatic tire roller
  - Achieves 2%-3% of the required mat compaction
- Leveling course
  - Should always be done with a pneumatic roller

11

Pneumatic Rolling



- Overlap at least 3" on each side-by-side pass
- For best results, keep tires hot at all times

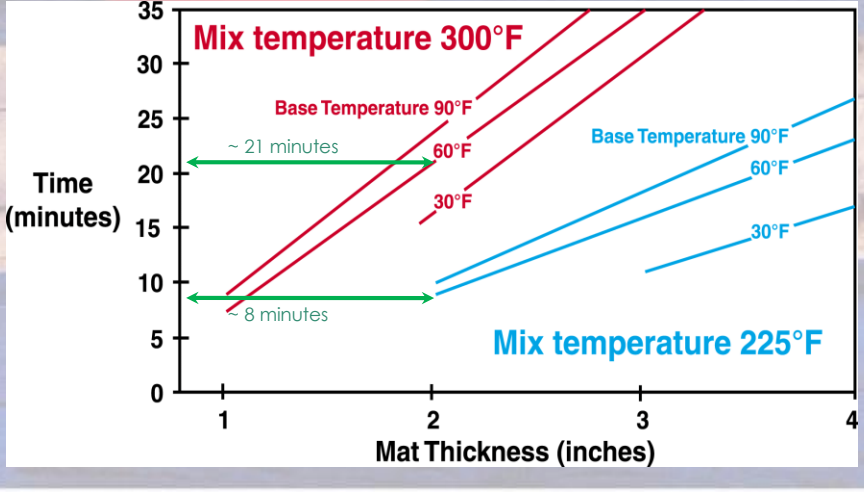
13

Phases of Compaction

- **Finish**
  - *Usually accomplished with a steel wheel roller*
  - *Achieves the last 1%-2% of the required mat compaction to meet specificaton*
  - *Removes roller marks from the finished mat*

14

Illustration of Time Available to Compact



15

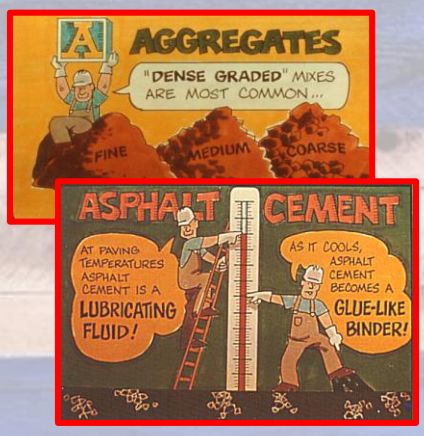
Recommended Compactors

- Breakdown: vibratory double drum (DD)
  pneumatic tired roller (PTR)
- Intermediate: pneumatic tired roller
  vibratory double drum
  vibratory or static
- Finish: vibratory double drum static

16

Compaction of Asphalt Pavements

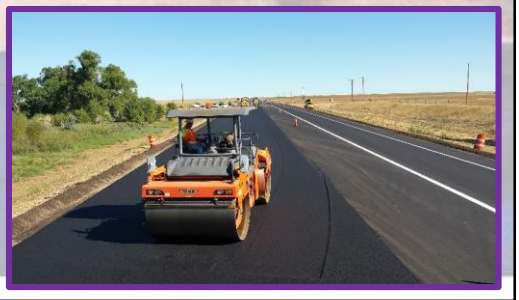
- Factors which may affect compaction
  - Aggregates
  - Binder type
  - Mix properties
  - Environmental conditions
    - Layer thickness
    - Air and base temperatures
    - Laydown temperatures
    - Wind velocity



17

Rolling the Mat

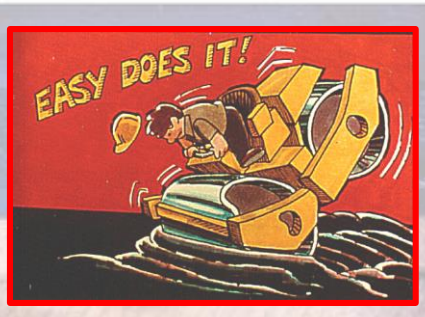
- Watch each roller operation
- Set the rolling pattern
  - Should be determined at the start of the paving
    - All rollers to be used on the project should be used in the development of the roller pattern
    - Pattern should be followed through out the project and checked on a daily basis



18

Rolling the Mat

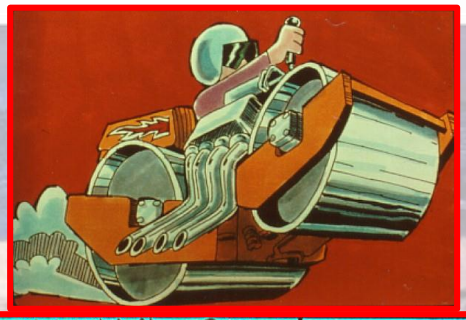
- Rollers should slow gradually come to a full stop, then slowly start in the reverse direction –
  - This is the only stop the roller should be allowed on the new pavement
  - When stopping to change direction roller should make a slight turn
- Rollers should never be stopped on a fresh mat or sudden change in direction made

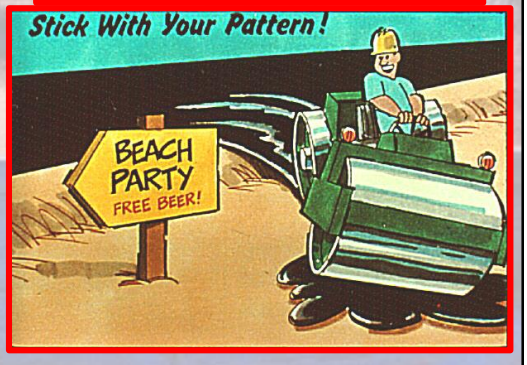


19

Rolling the Mat

- Rollers should proceed in as straight line as possible – turning should be done smoothly and gradually
- Speed of roller should be about walking speed
  - Rollers should not be operated any faster than 2-3 mph
- Roller should not roll off the edge of pavement but stick to roller pattern
- On super elevation sections rolling should start on the low side





20

Rolling the Mat

- Each pass should overlap the previous pass by 6 to 12 inches
- Longitudinal joints are always rolled first regardless of their location
- Routine checking of mat density should be done

21

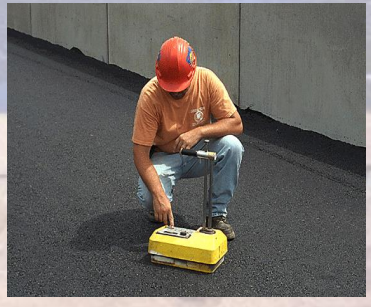
Inspector Best Practice

- *Document the roller pattern during construction of the test strip and then weekly there after, include the following information as a minimum:*
  - *The number of rollers, type and model number of each*
  - *Passes made by each roller. Condition roller is utilizing during rolling. IE. Static or vibratory*
  - *Distance of each roller behind the paver*
  - *Check the Temperature of the mix at placement time and temperatures during the phases of rolling*
  - *When the rollers begin rolling, how soon after the APM is placed. This will vary with seasons*
  - *Approximate air temperature and wind speed*

22

Nuclear Density Measurements

- Nuclear gauges are commonly used to assist the contractor in setting up the roller patterns
- Measurements often times used for quality control
- Measurements can be used to help the contractor adjust the roller pattern when mix or site conditions change



23

Coring

- Cores commonly used to determine density of compacted Asphalt for quality assurance and payment
- Core density is generally different from nuclear density **(Cores are generally higher in density than nuclear gauge)**, but a correlation can be made between the two test method results

24

Questions ????

25

Understanding Inertial Profiling and the CDOT specifications for MRI

The Information being presented is based on:
Revisions of Sections 105- 89
Hot Mix Asphalt Pavement Smoothness
and
Revisions of Sections 105-90 and 601

1

A bit of history on High Speed Profiling

- Over the next few slides we will present some information on the process of obtaining data for roadway smoothness

6

What is Smoothness / Roughness or Ride Quality?

- Ride Quality depends on:
  1. Human response to vibration of vehicle.
  2. Vehicle response to the road.
  3. Road roughness transferred through the vehicle limitations.

7

How do Vehicles Respond to the Road?

- **Since the early 1970's auto companies have spent considerable effort to study the vehicle vibrations, they are:**
  - **heave, waddle, shake, chatter, jitter, porpoise, tire nibble, etc.**
- **Two major motions which ultimately effect the movement of a vehicle are;**
  - **body bounce**
  - **axle hop.**

8

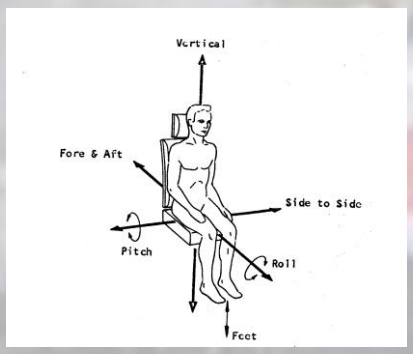
Human Response

- **The U.S. auto companies in the 1970's contracted with a University to research the human movements in a vehicle.**
- **The research determined many things by using the services of University students.**
- **The data included the human response to vibration.**

9

Human Response to Vibration

The automobile industry estimated ride by measuring the human response at several interfaces:



Seat/buttock
Seat/back
Floor/feet
Steering Wheel/Hand

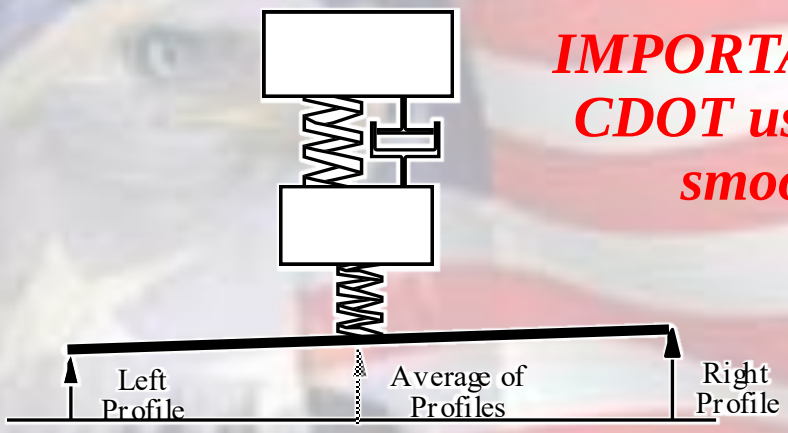
10

How does a Vehicle Response to the Road

- The vehicle exaggerates some road features and isolates you from others.
- Each vehicle responds to the roughness of the road differently.
- Some features in the road are more significant to vehicle response than others.

11

What is different when profiling in Colorado?



1/2 Car = 1/4 Car using averaged profile input

IMPORTANT NOTE: CDOT uses MRI for smoothness

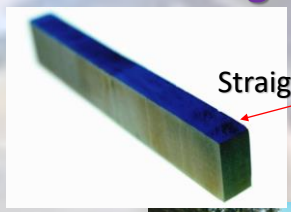
14

What is different when using Mean Roughness Index (MRI)?

- The MRI (Mean Roughness Index) is calculated from profile elevations in the Left Wheel Path and the Right Wheel Path
- The profiles are averaged point by point to create an overall "average" profile
- The IRI algorithm is applied to the resulting profile.
- This is a good way to isolate Localized Roughness

15

There are many different Smoothness Measuring Devices



Straight Edge

High Speed Inertial Profiler

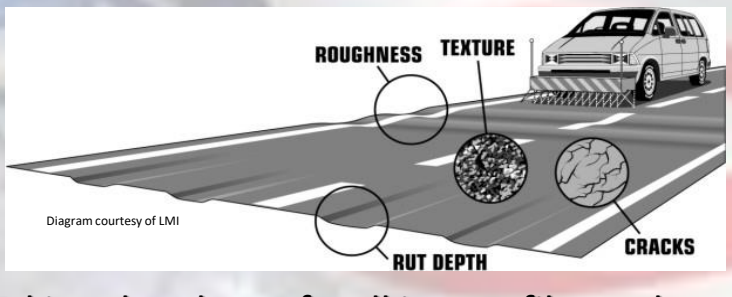
Walking Profilographs

Lightweight Inertial Profiler

Pave set system

16

Why Inertial Profilers?



- Taking the place of walking profilographs
- Using Laser and Inertia Technology
- Faster response time
- Roughness and Rut Depth are the most common uses for inertial profilers

18

How do we build the smoothest roads?

By thinking about the end first

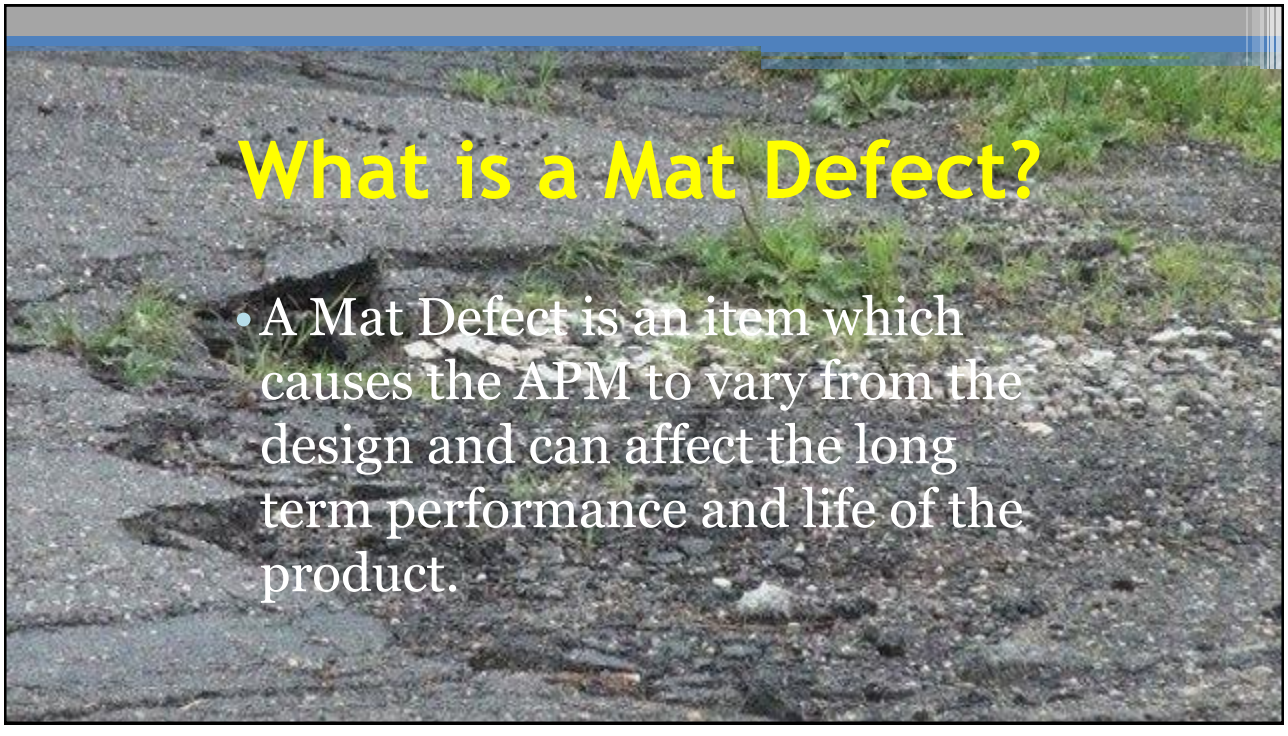
29

- Questions?

30


What are Mat Defects?

1


What is a Mat Defect?
A Mat Defect is an item which causes the APM to vary from the design and can affect the long term performance and life of the product.

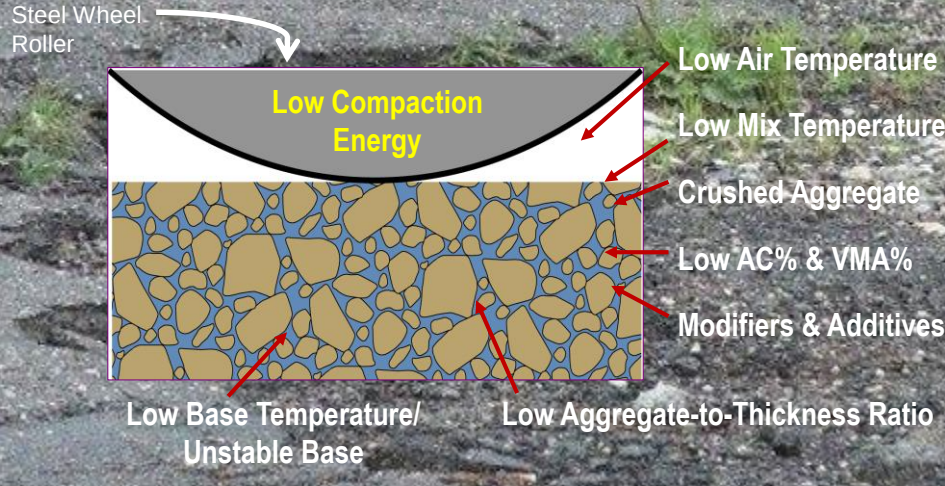
2

What is a Mat Defect?

- While there are many things that can cause an asphalt paving mat to be defective, we will over the next few slides take a quick look at some of the possible defects

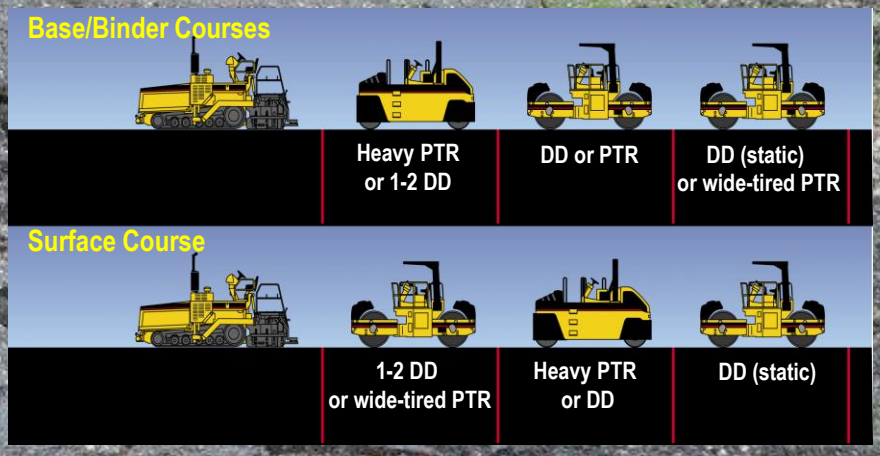
3

Some Factors which might Contribute to Harsh Mixtures



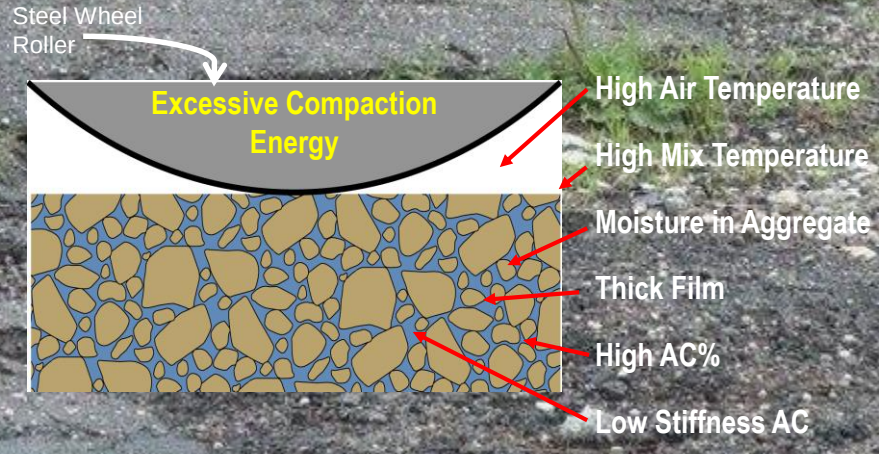
4

The recommend processes for compacting a Harsh Mixture



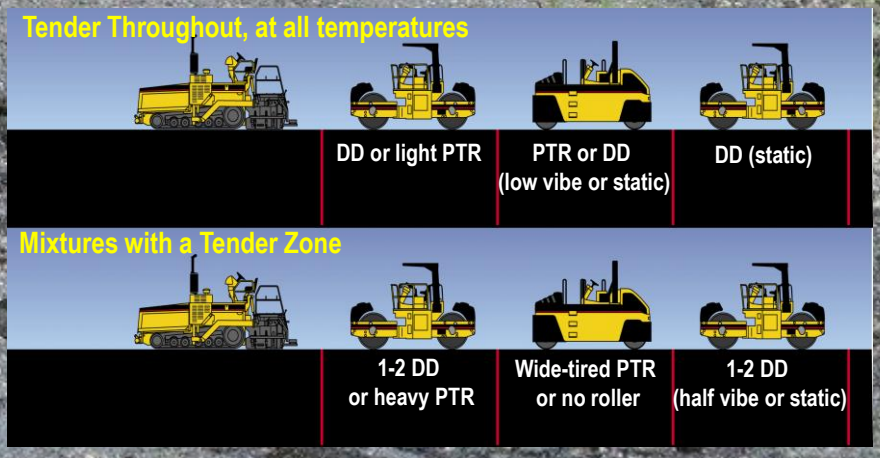
5

Some factors which might Contribute to Tender Mixes



6

The recommend process for compacting a Tender Mixture



7

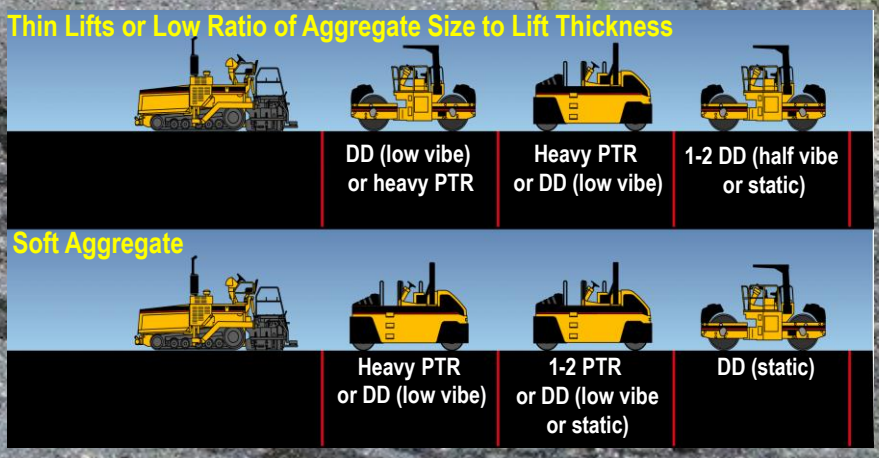
What are characteristics of Fragile Mixes?

Limestone

- Soft aggregate (limestone, dolomite) can be crushed during compaction
- Brittle aggregate can be fractured if too much force is used
- Damage more likely if aggregate-to-thickness ratio is 2 or less

8

Recommend process for compacting a Fragile Mix



9

Compaction Issues - Fatigue Cracks

Possible causes:

- **Improper design or compaction of base aggregate**
- **Excessive compaction of thin asphalt layer (density too high, air voids too low)**

10

Compaction Issues – Rutting or settlement

Possible causes:

- **Inadequate subgrade or aggregate base compaction**
- **Inadequate asphalt compaction (density too low, air voids too high)**

11

Compaction Issues – Longitudinal Joint Cracking

Possible causes:

- Insufficient material at joint during paving
- Improper joint compaction

12

Compaction Issues - Tire Marks

Possible causes:

- Ballast or tire pressure too high
- Rolling too hot
- Finish rolling too cool
- Thick lift, tender mat
- Tire too narrow
- Taking the picture while they are still working the mat
- A pneumatic roller will not cause impact marks even if it is a vibratory Pneumatic roller!

13

Compaction Issues - Asphalt Sticking to the rubber tire roller

Possible causes:

- Tires too cool
- Modifiers in cement
- Nonstick emulsion ineffective

14

Compaction Issues – Impact Marks

Possible causes:

- Vibrating too cool
- Vibrating on too high an amplitude
- Finish rolling too cool
- Finish roller too light
- A pneumatic roller will not cause impact marks even if it is a vibratory Pneumatic roller!

15

Compaction Issues – Crushing/Fracturing Agg.

Possible causes:

- Vibrating with too high an amplitude or frequency
- Roller too heavy
- Vibrating too cool
- Full width of drum not in contact with hot mat

16

Inspector Best Practice

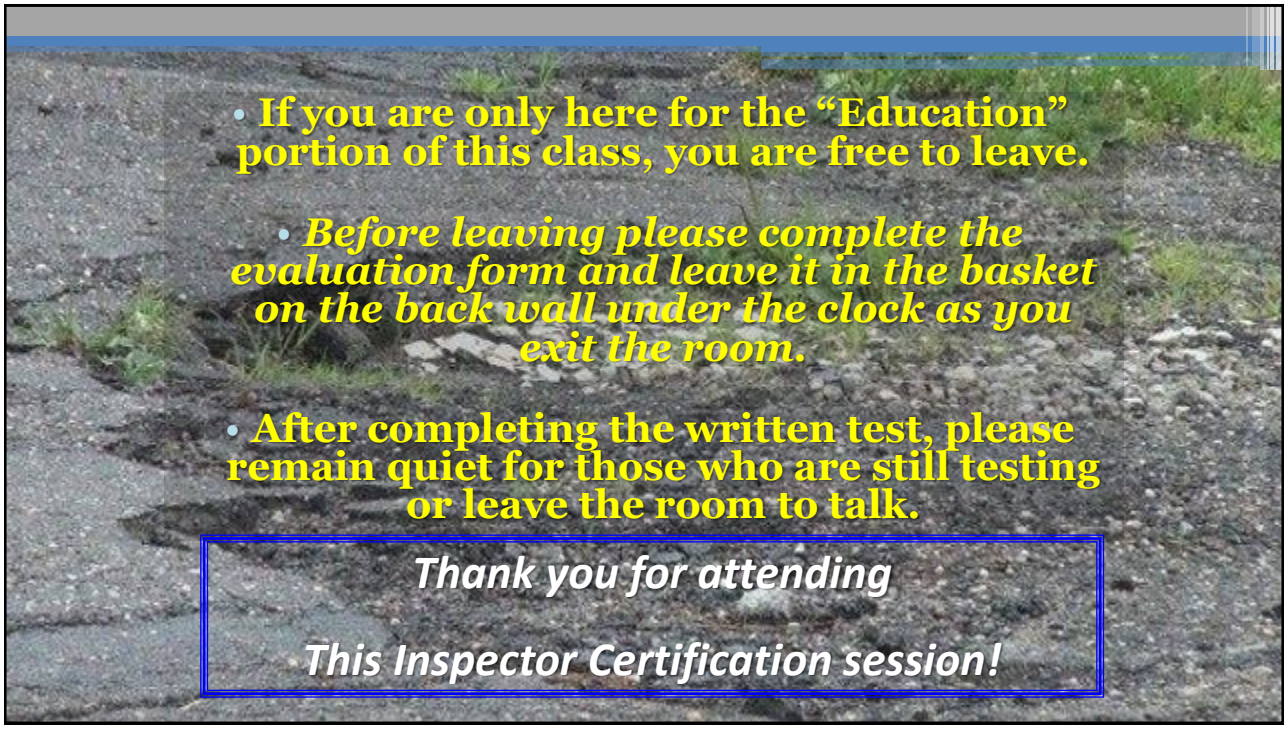
- Drive the project each day and note any findings such as:
  - The location of the Longitudinal joint relative to the wheel path, stripes, and subsequent lifts to be placed
  - How straight is the Longitudinal joint?
  - Is the transverse joint transition smooth or bumpy
  - How does the project ride. If you can feel bumps and vibration, so can the motoring public (A lot of praise is given to a inspector who identifies a problem early and works with the contractor to correct the problem, but very little sympathy is given to an inspector who misses problem for days at a time)
  - Driving the project during a rain or just after a rain fall is an ideal time to identify surface defects
  - Driving the project at dusk or dawn is an ideal time to identify surface defects
  - If possible, have a digital camera with you at all times (see the earlier quote)

Night Paving

- Drive the project during the day, every day after paving has occurred
  - You will be able to see things in the daylight you did not see at night
  - Your supervisor and the public are driving these roads during the day

18

20


• If you are only here for the "Education" portion of this class, you are free to leave.
• Before leaving please complete the evaluation form and leave it in the basket on the back wall under the clock as you exit the room.
• After completing the written test, please remain quiet for those who are still testing or leave the room to talk.
Thank you for attending
This Inspector Certification session!

21

Rocky Mountain Asphalt Education Center

Asphalt Inspectors Checklist:

- ☐ **PREPAVING CONFERENCE SCHEDULED/HELD?**
- ☐ **PLANS/SPECIFICATIONS OBTAINED?**
- ☐ **ASPHALT PLANT INSPECTION COMPLETED (IF APPLICABLE)?**
- ☐ **APPROVED MIX DESIGNS OBTAINED?**
- ☐ **TRAFFIC CONTROL PLAN SUBMITTED (IF REQUIRED)?**
- ☐ **SUBGRADE PREPARATION COMPLETED**
  1. Grading complete and compaction tests performed?
  2. Soft/Yielding spots identified?
  3. Corrections made if necessary?
  4. Proof Roll observed or completed?
  5. Grade and alignment verified for proper asphalt placement depths?
  6. Subgrade conditions acceptable (Not frozen/wet or soft)?
  7. Approved?
- ☐ **OVERLAYS**
  1. Areas identified which need repair?
  2. Patching or other repairs completed?
  3. Crack sealing completed?
  4. Surface clean, dry, and ready for placement of new asphalt?
- ☐ **PAVING OPERATIONS**
  1. Traffic control in place?
  2. Weather conditions acceptable for placement of Asphalt Paving Materials (APM), Ambient and surface temperature?
  3. Area of placement identified and approximate quantities of placement known?
  4. Random sampling/testing information available and ready for use?
  - ☐ **PLACEMENT**
    a) Is the Paving equipment clean, warmed and suitable to begin placement?
    b) Is the screed “True” and in proper working condition?
    c) Equipped with full width augers?
    d) Equipped with full width vibratory screed?
    e) Automatic grade controls in place or available?
    f) Automation screed sensor in place and operable to keep mix at 2/3^{rds} full?
    g) Material Transfer Vehicle (MTV) available?
    h) Is the material being delivered to the site as approved?
    i) Is the material being delivered to the site in appropriate truck transports?
    j) Material being delivered at the proper and required temperatures?
    k) Truck transports “releasing or breaking” the loads prior to opening the tail gates for end dump trucks or trailers?
    l) Is the hopper being kept at least half full at all times?
    m) Is material filled to the end of the auger extensions?
    n) Is the mat being placed with an acceptable finish without segregation?
    o) Is the material being placed at the specified thickness?

☐ **LONGITUDINAL JOINT CONSTRUCTION**

a) Are the joint being located in the correct location relative to lane lines?

b) Is the contractor attacking (Compacting the joints while the material is hot) to get a good joint seal and compaction?

☐ **Transverse Joints**

a) Is the joint matched and smooth?

☐ **COMPACTION EQUIPMENT**

1. Does the equipment appear to be in proper operating condition, ie: Are the COCO mats in place and capable of keeping the drums/wheels clean? Is the water system operating with all sprayers operating? Does the contractor have a release agent to use on the rubber tires (not a petroleum product)?
2. Rubber tire pressure checked and at the right pressure?
3. Are the vibrators working properly on the steel wheel rollers?
4. Has the compaction test section area been identified?
5. Contractor beginning rolling while temperatures are acceptable, and completing rolling with in the acceptable range?
6. Roller pattern established and compaction test section complete?
7. Rollers traveling at an appropriate speed (less than 3 mph)?
8. Rollers not stopped and idling on a newly placed mat?

☐ **DENSITY TESTING**

1. Compaction tests being performed, recorded and contractor/QA/Agency notified of results?
2. Compaction test submitted for approval, reviewed by a licensed engineer and submitted to the owner/agency in a timely manner?

Colorado Asphalt Pavement Association

A Guideline for Asphalt Paving Materials (APM) Pre-Paving Conference Agenda

11/2016

Colorado Asphalt Pavement Association

This document was developed by the Colorado Asphalt Pavement Association (CAPA). It is intended to be used as a resource in the design and construction of Asphalt Pavements in Colorado. CAPA can not accept any responsibility for the inappropriate use of these documents. Engineering judgment and experience must be used to properly utilize the principles and guidelines contained in this document, taking into account available equipment, local materials and conditions. All reasonable care has been taken in the preparation of this guideline; however, the Colorado Asphalt Pavement Association and Colorado Department of Transportation can not accept any responsibility for the consequences of any inaccuracies which it may contain.

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The following is an agenda which can be used for a Asphalt Paving Materials Pre-Paving Meeting. The guideline can be used to facilitate a productive and meaningful pre-paving meeting. This guideline presents a minimum set of topics that should be discussed during the meeting; however, not all topics will be covered for every project. Prior to its use, thoroughly read the Agenda's content and consider the special needs of the particular project.

ASPHALT PAVING MATERIALS -PRE-PAVING CONFERENCE AGENDA			*Rev. 09-23-16*
The items in the following agenda are minimum requirements that should be covered during the conference. The agenda may be used as is or as a base to develop a customized agenda. **Checked boxes adjacent to names of attendees are to be on the project distribution list.**			
Project Number:		☐Owners Rep:	
Project Code (SA):		Project Engineer:	
Location:		Contractor:	
Date:		Superintendent:	
Time:		Foreman:	
I. Attendance Roster			
☐Name:		Office Number:	
Representing:		Fax Number:	
Responsibilities:		Cell Number:	
City, State, Zip:		E-Mail Address:	
☐Name:		Office Number:	
Representing:		Fax Number:	
Street Address:		Cell Number:	
City, State, Zip:		E-Mail Address:	
☐Name:		Office Number:	
Representing:		Fax Number:	
Street Address:		Cell Number:	
City, State, Zip:		E-Mail Address:	
☐Name:		Office Number:	
Representing:		Fax Number:	
Street Address:		Cell Number:	
City, State, Zip:		E-Mail Address:	

II. PROJECT ORGANIZATION AND STATUS			
A. OWNER/AGENCY Personnel:			
1. Person in Charge at Paving Site:☐			
Name/Title:		Fax Number:	
Office Number:		Home Number:	
Mobile Number:		E-Mail Address:	
2. Alternate Contact (when personal identified in A.1 is not present):☐			
Name/Title:		Fax Number:	
Office Number:		Home Number:	
Mobile Number:		E-Mail Address:	
3. Quality Assurance Supervisor:			
Name/Title:		Fax Number:	
Office Number:		Home Number:	
Mobile Number:		E-Mail Address:	
4. Tester/Duties:☐			
Name/Title:		Fax Number:	
Office Number:		Home Number:	
Mobile Number:		E-Mail Address:	
5. Inspector/Duties:☐			
Name/Title:		Fax Number:	
Office Number:		Home Number:	
Mobile Number:		E-Mail Address:	
Comments: Discuss the Escalation Process for Paving Items (i.e. what is the chain of command and how/when issues are elevated to the next level in an effort to improve communication and decision making).			

B. Contractor Personnel:			
1. Quality Control Supervisor:			
Name/Title:		Fax Number:	
Office Number:		Home Number:	
Mobile Number:		E-Mail Address:	
2. Personnel to Notify at Paving Site			
Name/Title:		Fax Number:	
Office Number:		Home Number:	
Mobile Number:		E-Mail Address:	
3. Other:			
Name/Title:		Fax Number:	
Office Number:		Home Number:	
Mobile Number:		E-Mail Address:	
Comments: Discuss the Escalation Process for Paving Items (i.e. what is the chain of command and how/when issues are elevated to the next level in an effort to improve communication and decision making).			

II. PROJECT ORGANIZATION AND STATUS
C. Testing Information:
1. Is (Are) the mix design(s) approved by the Owner/Agency? (CDOT Form 43) (MGPEC Form 20)
2. Test locations determined by?
3. Frequency of tests to be performed? Refer to table 106-1 of section 106.05 of the Standard Specifications for minimum sampling and testing for Asphalt Paving Materials (APM). ☐ Check Testing has been completed. Which daily Rice value will be used for compaction verification? (Field Lab or Region Lab)
4. Are Quality Assurance tests to be performed in addition to Quality control tests? (All jobs including “M” projects greater than $150,000 require testing) ➢ If Yes, how often and who will be responsible to schedule the QA tests?
5. Turnaround time of QA and QC test results. ➢ Preliminary test results shall be distributed immediately upon completion. ➢ Final test results shall be distributed immediately upon completion.
No change shall be made in the ingredients comprising the approved mix design without prior written approval of the Project Engineer. This includes asphalt binder suppliers.

III. SCHEDULING
A. Materials:
Materials will be available for sampling on:
B. Asphalt Plant:
The asphalt plant will be ready to be checked on: ➢ What is the location of the plant to be used? ➢ What is the back up plan if the designated plant breaks down? ➢ Type of Release Agent available?
C Scales and Certified Weigher:
1. Has a copy of the scale certification been submitted? ☐Yes ☐No Comments: ➢ Has a copy of the weigher certification been submitted? ☐Yes ☐ No Comments:
2. Weigh tickets shall contain information required by the owner. Comments:
3. Are truck weigh tickets required to be delivered on site? How will the weight tickets be collected? Comments:
4. The Contractor shall provide a list of the haul vehicles and required information per specification (CDOT subsection 109.01)
5. Random checks of the scales are required in the Standard Specifications (CDOT 109.01)
D. Paving Equipment:
The paving equipment will be set up and ready to be checked on:
E. Paving Sequence:
1. The Contractor will commence paving on:
2. How many days per week does the Contractor intend to work?
3. The Contractor proposes to work the following hours:
4. Where will paving start?
5. What paving sequence will the Contractor follow?
F. Quality Control Plan. A quality control plan shall provide information to control the quality of the following:
1. Segregation: ➢ Submitted: ☐ Date Submitted ➢ Approved: ☐ Date Approved
2. Longitudinal Joint Construction: ➢ Submitted: ☐ Date Submitted ➢ Approved: ☐ Date Approved
3. Transverse Joint Construction: ➢ Submitted: ☐ Date Submitted ➢ Approved: ☐ Date Approved

4. Smoothness:
   - This Project is Category 1 ☐ Category 2 ☐ Category 3 ☐ Category 4 ☐
   - This Project is Profiler (MRI) ☐

5. Will an on-site Pre-Placement (Tailgate) meeting occur prior to the beginning of placement to discuss "Best Practices" (See Attached) ☐ Yes ☐ No

6. Who will be the 3rd party, independent testing lab for dispute resolution?
   a. Asphalt Mix Dispute Lab (per CP 17)?
      - ☐ Submitted in writing prior to Pre-Pave Conference.

   b. Roadway Smoothness Profiling?
      - ☐ Submitted in writing prior to Pre-Pave Conference.

7. Other project specific "Special Provisions":

IV. PREPARATION

A. Method of Approving Pavement Surface? (IE: Soil Subgrade, ABC, Milled Surface, ETC.)

Milled surface will be ready for inspection on what date?
Comments:

B. Has the Subgrade or Underlying Pavement Surface Been Approved for Paving?

- Yes ☐
- No ☐

Is the milled surface approved?

- Yes ☐
- No ☐
- NA ☐

- By whom was the pavement surface approved?

C. Tack Coat:

1. Material type
2. Application Rate?
3. How will the Contractor protect the tacked surface after placement, and prior to the placement of the APM?

Comment: The Inspector/Tester will verify all surfaces to accept a new layer of APM will have the proper amount and coverage of tack placed.

V. PRODUCTION AND PLACEMENT
A. Compaction Test Section:
The following procedures should be observed and documented:
1. The Contractor must establish a roller pattern and carefully record the following information:
a. Type, size, amplitude, frequency, and speed of roller:
b. Tire pressure for rubber tire rollers and if the pass for vibratory rollers is vibratory or static:
c. Surface temperature of mixture behind the lay-down machine and subsequent temperatures and densities after each roller pass:
d. Sequence and distance from lay-down machine for each roller and total number of passes of each roller to obtain specified density:

2. When the Compaction Test Section has been completed, the Contractor shall furnish a complete copy of this data to the person in charge (II.A.1) before continuing to pave. Comments:

3. When a successful Compaction Test Section has been completed, the Contractor is required to maintain the roller pattern established during the Compaction Test Section for the balance of the Hot Bituminous Pavement construction (i.e., the Contractor must use the same number and type of rollers and operate them at the same speed, frequency, amplitude and in the same position, relative to the lay-down machine, as was performed during the Compaction Test Section. If Contractor wants to perform minor* changes to the roller pattern that was established during the Compaction Test Section, the Contractor must Perform a Roller Pass Study to demonstrate that the density is obtained with the new roller pattern before proceeding with the paving operation.

Comments:

* The Project Team needs to agree to "minor" at prepave. Minor changes may include items such as: type of roller; numbers of rollers; distance from paver; number of roller passes; and temperatures.

4. The Contractor is responsible for compaction testing of the Compaction Test Section. Comments:

5. Cores are required to calibrate the nuclear density gauge. The Contractor can continue to pave under the following conditions:

- The period that the Contractor continues to pave without test results from cores shall not exceed one working day.
- Construction proceeds at the Contractor's risk.
- What method will be used to bulk core samples?

Traditional Method (CP-44, Method "B") ☐ QC ☐ QA

Core Dry ☐ QC ☐ QA

Comments:

6. A new Compaction Test Section or roller pass study will be required whenever there is a major* change in the compaction process.

Comments:

* The Project Team needs to agree to "major" at prepave. Major changes may include items such as: New Mix Design; change in lift thickness; or other items that could affect the nuclear density gauge correlations.

7. Striping plan: subcontractor or Contractor to install striping?

- When will striping occur?
- What material will be used?
- Have Materials Data Sheets been submitted? Approved? If Not when?
- Has the striping plan been submitted? Approved? If Not when?

VI. TRAFFIC CONTROL
A. Method of Handling Traffic:
Has the Method of Handling Traffic been submitted for the Asphalt Paving Materials Pavement placement operation? If not, when will it be submitted? Is the traffic control plan approved?

VII. FOLLOW UP ITEMS

Items discussed during the meeting, which shall need follow up.

Item for follow up	Who will follow up	Date of completion or response
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

SUGGESTED BEST PRACTICES FOR MINIMIZING SEGREGATION

1. *Aggregate Stockpiles:*
   - ❑ Build in Layers
   - ❑ Avoid any procedure that will allow the aggregate to be pushed or dumped over the side of a stockpile
   - ❑ Separate to prevent intermingling
   - ❑ Aggregate Handling:
     - Loader operator works full face of stockpile
     - Install dividers on the "cold feed" bins to prevent the material from flowing into an adjacent bin
     - DO NOT pile the aggregate so high it flows over the dividers

2. *Loading the Surge Silo: (if the plant has a "batcher or "Gob Hopper" at the top of the silo)*
   - ❑ Adjust the conveying devises to deposit the material in the center of the batcher or gob hopper
   - ❑ Keep the gates on the batcher or gob hopper closed unless dropping a load of mix
   - ❑ Close the gate on the batcher or gob hopper before it is empty to prevent the material from dribbling into the silo

3. *Loading Trucks:*
   - ❑ Keep the gates on the bottom of the silo closed so the material does not dribble into the trucks
   - ❑ Take care to center the trucks (left to right) when loading
   - ❑ Load trucks in multiple drops with the first drop at the rear, second at the front and then alternate dumps
   - ❑ If the mix is prone to segregation, you should avoid loading the trucks by "slowly" driving forward while dropping the mix from the silo

4. *Dumping Trucks:*
   - ❑ To provide as surge of material to the paver, when using end dump type trucks, the box should be raised until the mix moves to the rear of the bed charging the tail gate prior to releasing the load
   - ❑ If any mix is spilled on the roadway, in front of the paver while dumping the truck, the spilled mix should be removed from the roadway before the paver moves forward across the mixture on the grade

5. *Laydown Operations:*
    - ❑ Only dump the wings on the paver hopper at the end of the paving day and utilize this material in the night taper joint or waste the material
    - ❑ To provide consistent flow of material to the screed and avoid gradual deceleration/ acceleration, the paver should be started and stopped quickly at normal operating speed
    - ❑ Keep the hopper more than half full at all times and maintain the height within 1 inch the entire paving day
    - ❑ The auger height should be adjusted so the bottom of the auger is at least two (2) inches above the finished surface of the Asphalt Paving Materials (APM) mat
    - ❑ Adjust the feed sensors to keep the material near the center of the auger at all times
    - ❑ Correctly adjust the lead and tail crown of the screed so that the surface of the APM behind the paver is uniform in appearance and texture
    - ❑ Install or verify the material management kits are installed and functioning properly. This includes the "kick back" paddles under the gear box and outer edges of the auger
    - ❑ Adjust the flow control; gates at the rear of the hopper so that:
        - The slat conveyors run continuously
        - The amount of material being presented to the augers allows for them to run almost continually, (minimum of 80% of the time)
6. *Windrow Elevators:*
    - ❑ When using pickup machines, they should be adjusted so that all of the APM is removed from the surface

7. *Troubleshooting:*
    - ❑ If segregation is observed behind the paver, check the trucks as they arrive and are dumping to see if the mix in the truck is segregated
    - ❑ The risk of causing thermal segregation is increased when paving in cooler temperatures

SUGGESTED BEST PRACTICES FOR PAVEMENT SMOOTHNESS

PAVER OPERATIONS – BEST PRACTICES and INNOVATIONS

Keep the hopper full: If you are not using a hopper insert leave as much surge as possible between truck exchanges and do not run the hopper empty. This will minimize "truck fans" by allowing hot, uniform material from the next truck to blend with mix from the previous dump. Keeping your mat as thermally uniform as possible will result in better densities.

Controlled hopper wing cycling: The wings are where the large, cooler stone tends to collect if not properly reintroduced back to the mix. Regular cycling, where allowed by spec, will reduce large buildups of this segregated material. Don't wait until you are "out of material" to cycle the wings.

Use a hopper insert: If you are using pick up machines and windrow paving use a hopper insert. It will reduce or eliminate segregation.

Keep a constant head of material at the spreading augers: A consistent flow of material to the spreading augers will prevent them from spinning too fast or too slow, which can cause longitudinal segregation. As a rule of thumb a proper head of material is ½ up the spreading auger. Constant changes in the head of material make waves in the mat. If allowed to rotate too fast, longitudinal stripes will occur in line with the reversing augers; too low a rate and the larger stone will drop and collect at the bearing support

Time the conveying and spreading systems: Ensure the ratio pots or flow gates are set to deliver enough material to the spreading augers to keep them running continuously. Set your sonic feeds and leave them there.

Keep your paver speed steady: Drag race paving may be entertaining but stops and starts cause the head of material to rise and fall changing the mat thickness. This not only affects ride but can detrimentally affect density.

Correct lead crown setting and proper strike off adjustment: Equipment fine-tuning issues will help eliminate longitudinal segregation. String line your screed before every job and introduce the correct amount of lead crown; usually 1/8 - 1/4 inches. Make sure your strike offs are correctly aligned. Refer to your owner's manual for the recommended procedure.

Correct spread auger length: Once you have the job planned out if you need to build up the spreading augers then DO IT. Trying to compensate for spreading augers that are too short by running them faster will only result in segregation. This only gets worse with more gap graded mixes. If you have a 20' screed and the job calls for wide paving then BUILD UP THE SCREED; use the auger extensions, wide mat grade supports and the outboard bearing supports. The finished jobs will more then compensate for the time involved in the build up. Then plan the layout so you can maximize the use of the built up screed.

Use Thermal guns: Equip your paver operator and roller hands with thermal (infrared) handheld thermometers and use them to monitor changes in the mat temperature. Establishment of a thermal range during the test strip process gives you a working range to be used through out the paving project.

Don't broadcast material across the mat: This just gives the appearance of a segregation problem. Don't rake material off the joint onto the new mat. Don't walk on the fresh mat.

Train your personnel: Not only in the operation of the equipment but in the art of reading mat defects. The sooner these defects are identified the sooner remedial action can be taken. Remember when the only tool you have is a hammer every problem looks like a nail.

Pave predominately uphill: On steep grades in mountainous terrain, pave uphill when possible. Control of material and speed of equipment is easier to maintain when paving uphill. Paving downhill may be problematic with paver and roller speeds. This may cause "ripples" in the mat that are difficult to remove. The mat may shove and tear more when operations proceed downhill, requiring patching or other undesired corrective work. QC should be onsite to monitor densities when steep grades require a change in the roller pattern.

NOTE: It is not intended to change the direction of the paving operation in rolling terrain. If the roadway grade is predominately in the uphill or downhill direction on mountain passes or other significant elevation changes, paving uphill provides a better product.

JOB SET UP – BEST PRACTICES

Partnering
All personnel involved in the construction planning and design need to meet before the job so we can all "be on the same page" and resolve possible problems before they arise.

Pre Paving Planning Meeting
Meet with your crew every day to review the plan for the day's construction and expectations. Plan the truck route, plan the job layout, and assign people to required tasks.

Communication
Constant communication with all the elements of the paving process from design engineers to the lute man. This keeps all phases of the job on schedule and free of "Uh Ohs".

Mix Selection
Insure the mix is of an adequate design for both strength and workability. Mind your temperatures.

Machine Maintenance
Not only does well maintained iron contribute to a more pleasant work environment it shows your people that you care enough about them to give them the best tools. It provides for a safer work environment and a more productive and profitable organization.

Smoothness-Thickness-Yield
The inspectors and field personnel need to be aware of the paving fundamental that yield, minimum thickness, and smoothness can not be obtained at the same time.

Crew Training
Not only in the operation of the equipment but in the art of reading mat defects. The sooner these defects are identified the sooner remedial action can be taken. Remember when the only tool you have is a hammer every problem looks like a nail.

Know the Consequences
Of improperly operating the machines, improper principles and techniques of paving, rolling and trucking of poor safety awareness. Designate a "job site safety man" know the way to emergency medical care.

BEST PRACTICES FOR LONGITUDINAL JOINT CONSTRUCTION

1. **BE CONSISTANT:** Decide on a plan and stick with it.

2. **COMMIT TO A GOOD JOINT:** Quality contractors build quality joints.

3. **MAINTAIN A PROPER TAPER**: Tapers range from near vertical to 12:1. Regardless of what taper is used, keep it consistent. Vertical edges and notches as vertical as possible. Keep edges confined as long as possible. Maintain a Proper "Head of Material"

4. **MAINTAIN PROPER OVERLAP:** Keep overlap consistent typically from 0-1.5 inches. Place proper amount of Asphalt Paving Materials (APM) at the joint: Too little will allow water to enter the joint. Too much will cause a ridge which will carry water and interfere with compaction. **DO NOT RAKE THE JOINT!** If raking to correct improper amount of material, just bump the joint, DO NOT BROADCAST loose material across the mat.

5. **USE PROPER ROLLING TECHNIQUES!**

BEST PRACTICES FOR BREAK DOWN ROLLER OPERATORS

1. Communicate – with paving crew and foreman for job requirements prior to the arrival of asphalt.

2. Confirm maintenance and water system checks – done on a daily basis to rollers.

3. Determine lift thickness – base or surface riding course.

4. Be aware of material temperature – at delivery to paver and behind screed.

5. Determine rolling drum mode – vibratory or static.

6. Make required amplitude adjustments both roller drums – depending on mix design, material thickness, and temperature zone.

7. Optimize water system controls – to avoid material pick-up and eliminate excessive water usage.

8. Establish proper rolling pattern – determined by paving width, roller drum width, unsupported edges, and drum overlap.

9. Determine rolling speed – to achieve proper impact spacing and meet smoothness requirements.

10. Monitor rolling temperature – and work within optimum temperature zones.

11. Make required rolling coverages – to achieve density requirements.

12. Adjust rolling operations – to satisfy density, smoothness, and production rates.

13. Maintain consistency throughout the entire shift.

BEST PRACTICES FOR FINISH ROLLER OPERATION

1. Communicate – with paving crew, foreman and breakdown roller operator for job requirements.

2. Confirm maintenance and water system checks – done on a daily basis to rollers.

3. Be aware of material temperature – avoid "tender zone."

4. Determine rolling drum mode – vibratory or static depending upon requirements to achieve density and smoothness.

5. Optimize water system controls – to avoid material pick-up and eliminate excessive water usage.

6. Establish proper rolling pattern, – determined by paving width, roller drum width, unsupported edges, and drum overlap.

7. Coordinate final rolling process with QA / QC personnel.

8. Monitor rolling temperature – and work within optimum temperature zones.

9. Make required rolling coverage's – to achieve density requirements and to remove drum edge marks.

10. Maintain consistency throughout the entire shift.

BEST PRACTICES FOR PAVER OPERATORS

Safety operates the paver using "Best Practices" procedures, to produce the highest-quality pavement possible.

1. Select a paving speed that balances delivery, paver capacity and the compaction process and pave with few if any extended stops.

2. Work with screed operator in establishing and maintaining the head of material within a plus or minus one-inch tolerance.

3. Steer the paver holding to a pre-determined reference.

4. Direct the truck driver to raise bed and exit when empty.

5. Utilize rapid, but smooth start and stops to help prevent end-of-load roughness (if stopping is necessary.)

6. Observe APM being discharged into paver hopper or insert for changes in characteristics of the mix.

7. Monitor paver for unusual noise or vibration (notify the proper person to take corrective actions).

8. Work with dump person to make sure truck does not bump paver, or let hopper run low.

9. Work as a team member.

Teamwork Agreement

We, the undersigned partners in Colorado transportation construction, agree to work together as a cohesive, cooperative team to safely deliver quality projects to the public on time and within budget, providing an opportunity for well-managed, competent contractors to make a reasonable profit.

Teamwork Objectives:

- Claims mitigated and resolved promptly
- Safer projects
- Increased job satisfaction
- Reduced delays
- Higher quality
- Reduced total project costs

Teamwork Values

What we value, we do. Each project has its own culture and its norms or "way of doing business." The following is a list of partnering values; attributes of the way we want to do business as partners. As project leaders, the RE's and PM's job is to instill these values into the project and to identify and overcome any barriers that interfere with their achievement.

- Fairness
- Cooperation
- Trust
- Open and honest communication
- Teamwork
- Joint problem solving
- Working for mutual gain
- Rapid dispute resolution at the field level

Required Core Project Goals**:**

- Safe, On Budget, On Time, Quality Met

Recommended Project Specific Goals:

Project specific goals and mutually agreed upon individual goals may be added to your core project goals. Some recommended project-specific goals are listed below for consideration. The RE and PM should discuss with each other what types of goals are important to ensure that the project is not just good, but great!

- Environmental commitments met • Third party coordination
- Disputes resolved • Public relations
- Teamwork/communication • Minimize public impact
- Partnering maintenance • Having fun
- Public image • Job satisfaction

We have identified the following teamwork success factors and commit ourselves to their continuous improvement.

#1 Follow up and measure progress
#2 Train and empower the field staff
#3 Get stakeholders to participate and buy-in
#4 Partner at the strategic/program level
#5 Ensure decision making and risk management occurs
#6 Recognize and award effort

Best Practices for Operator Safety

- Unload and operate equipment only if qualified
- Inspect equipment before use
- Test backup alarm and other safety devices
- Know blind spots and swing radius
- Use seatbelts
- Use 3 points of contact entering and exiting equipment
- Look for over moving equipment and vehicles
- Wipe up grease and fluids on walking/working surfaces

Work Zone Safety Tips

10. Obey Road Crew Flaggers and Speed Limits
9. Look Out for Workers and Flag Persons
8. Don’t Tailgate!!! Keep a Safe Distance.
7. AVOID Changing Lanes in a Work Zone.
6. Minimize Distractions.
5. Stay Alert!!!
4. Be Patient!! Remember Road Improvements Benefit You!
3. Keep up with the Traffic Flow.
2. Expect the Unexpected, Work Zones Can Change!
1. Remember - Dads, Sons, Brothers, Moms, Sisters, and Daughters Work HERE!!!!!