Asphalt Inspector Certification Ground Rules and other items

Rocky Mountain Asphalt Education Center

In cooperation with:

COLORADO Department of Transportation

U.S. Department of Transportation Federal Highway Administration

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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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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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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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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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Colorado Asphalt Pavement Association (CAPA)
Rocky Mountain Asphalt Education Center (RMAEC)

CAPA

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**

RMAEC

Cindy Rutkoski — **RMAEC Instructor**

Diane Hammond — **RMAEC Training Coordinator**

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LabCAT Board of Directors

Ken Coulson	Coulson Excavating
Ed Wells	Connell Resources
Craig Wieden	CDOT Staff Materials
Jody Pieper	RME - CDOT R-2
Brian Dobling	Colorado Division Office-FHWA
Craig Vaughn	CMT Technical Services
Tim Webb	RME CDOT R-5
Justin Cupich	Kumar & Associates
Tom Peterson	CAPA

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LabCAT Technical Committee

Vincent Battista	CDOT Asphalt Pavement Services Manager (Co-Chair)
Patrick Kowing	FHWA – Central Federal Lands Division
Johnny Lam	CDOT Asphalt Pavement Program
Cindy Rutkoski	RMAEC Instructor
Ethan Wiechert	Earth Engineering
Tom Clayton	RMAEC (Co-Chair)
Tammy Buck	
Eric Biggers	Martin Marietta
David Fife	United Companies
David Chelgren	Martin Marietta
Mike Gallegos	CDOT R-1 Lab Manager
Lisa Wisner	CDOT R-5 Material
Jeff Cuypers	Brannan Sand and Gravel

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These are the producers and Binder suppliers who makes up CAPA?

Producer / Binder Supplier Members

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

Self Introductions

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

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Questions, need some snacks or beverages….

Before we start

???????

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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.

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How we Define Quality?

QUALITY is defined as "A degree or grade of excellence" *1

*1- The American Heritage Dictionary

For the Road Building Industry, a better definition should be:

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

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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.**

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The parts of TQM

Owners Acceptance (OA)

An 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**

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Owners Acceptance and Process Control

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

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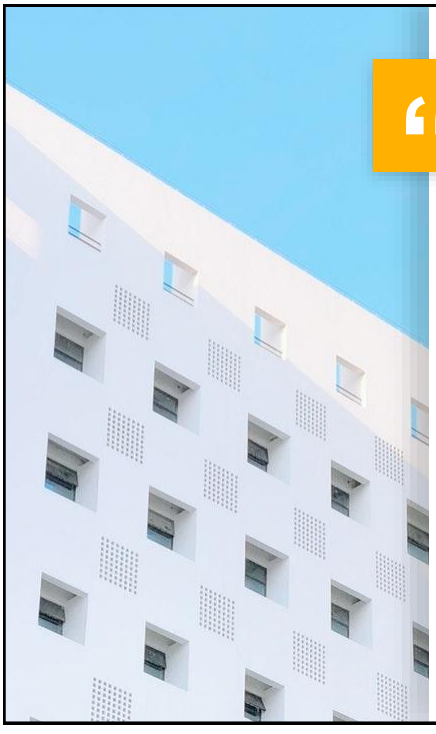

The Independent Assurance Program (IA)

- **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.**

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The Independent Assurance 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.**

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Project Inspection

INSPECTION remains is an essential part of the QA 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.

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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

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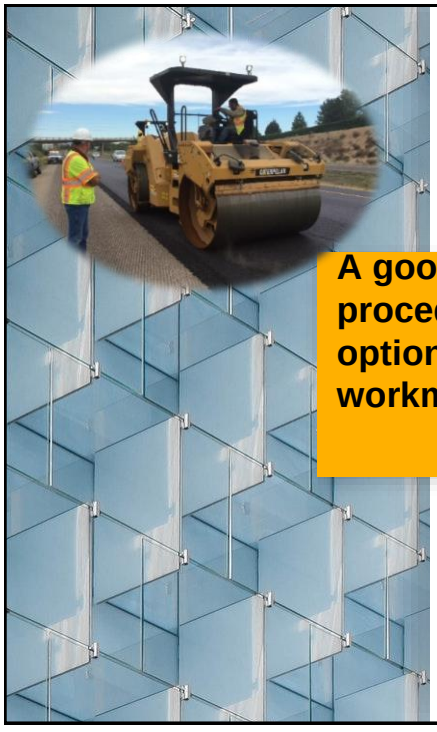

A good OA specifications should include procedures to determine one or more of these options to address defective materials or workmanship:

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Possible **procedures**

- **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**

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If sampling is required, a representative number of samples, typically with a minimum of 3 portions for each sample, 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 and equal amounts of material for samples should be obtained and split between the PC and OA laboratories.

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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.

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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.**

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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***.

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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.**

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

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

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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.

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WHAT INFORMATION SHOULD THE INSPECTORS GATHER FOR PRE-CONSTRUCTION?

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ASPHALT PAVING INSPECTION CAN BE DIVIDED INTO TWO AREAS*

- ☑ Preliminary or Pre-paving Responsibilities
- ☑ Paving Operations
  - We will discuss the particulars for some of the two areas over the next several slides

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PRELIMINARY OR PRE-PAVING RESPONSIBILITIES

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

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

- Projected Start Date
- Start location/CTS
- 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)

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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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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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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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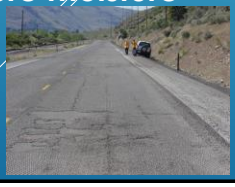
FIELD REVIEW PRIOR TO PLACEMENT

- 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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ASPHALT PAVING MATERIALS

- Prior to observing work, examine the pre-pave meeting minutes. Use these notes to become familiar with work processes to be observed.
- **Compaction Test Section:** The CTS shall be constructed to provide the nominal layer thickness specified. The first 500 tons of Asphalt Paving Materials on the project location shall constitute the CTS. Two sets of random cores shall be taken within the last 200 tons of the CTS. Each set shall consist of seven random cores. The locations of these cores will be such that one set can serve as a duplicate of the other. One set of these cores shall be immediately submitted to the Engineer/Owners representative.
- 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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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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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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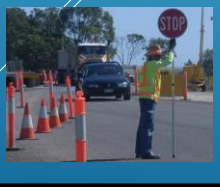
TRAFFIC CONTROL

- 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 place



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☑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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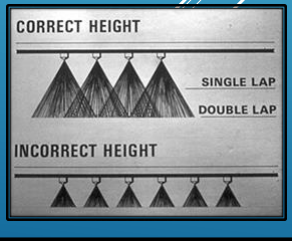
EQUIPMENT CHEC

- Distributor
  - Spray Bar
    - Length
    - Height from surface



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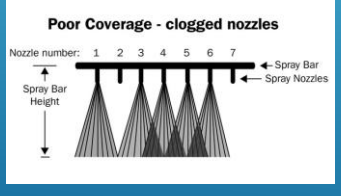
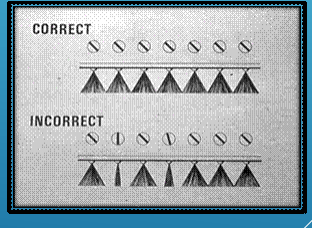
Spray Bar Nozzles

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





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*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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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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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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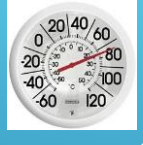
WEATHER REQUIREMENTS

- 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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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.		

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- *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 previous chart.*

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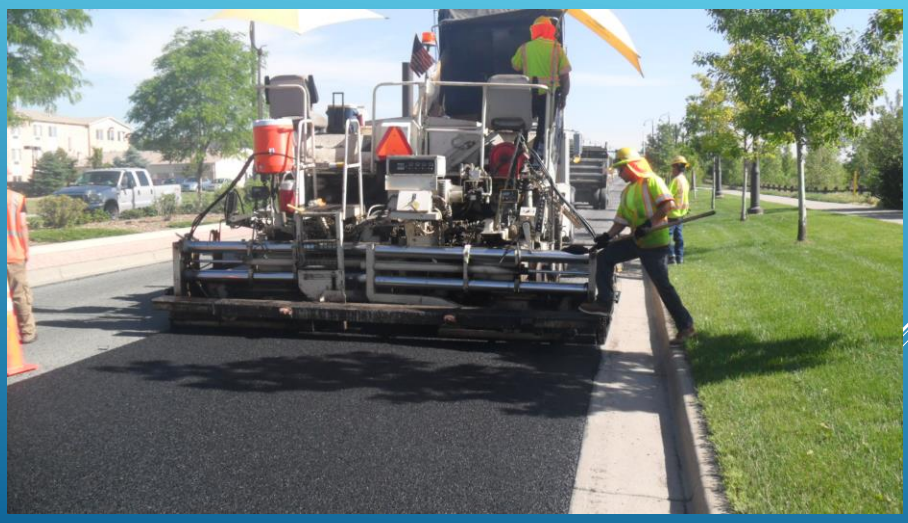
Questions ?



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

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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.

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Contract Documents and Specifications

Provide for:

- 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

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Types of Specifications

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

We will explore each of these in the next few slides

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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.

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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.

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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.

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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.**

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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.

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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.

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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.

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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

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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

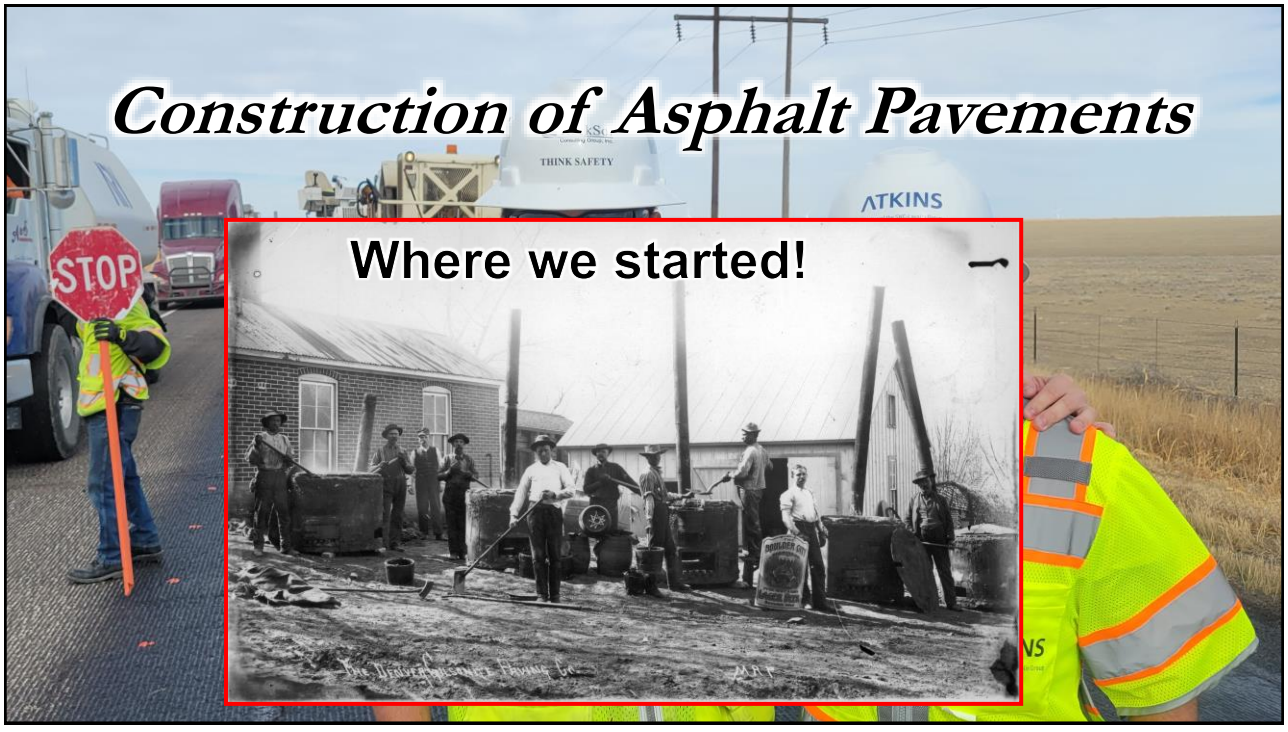
68


Questions ?

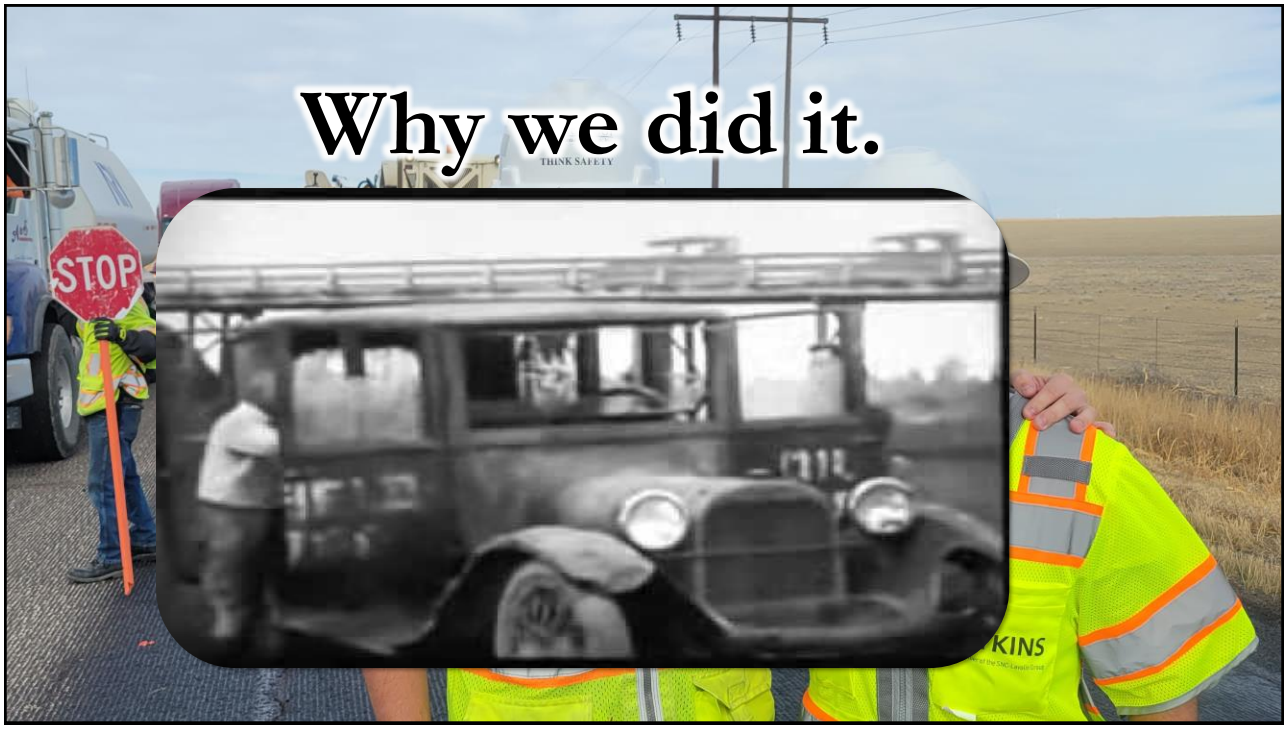
69


The Inspectors Responsibilities for Construction ~ an Overview
STOP
ATKINS

70


Construction of Asphalt Pavements
Where we started!
STOP
THINK SAFETY
ATKINS

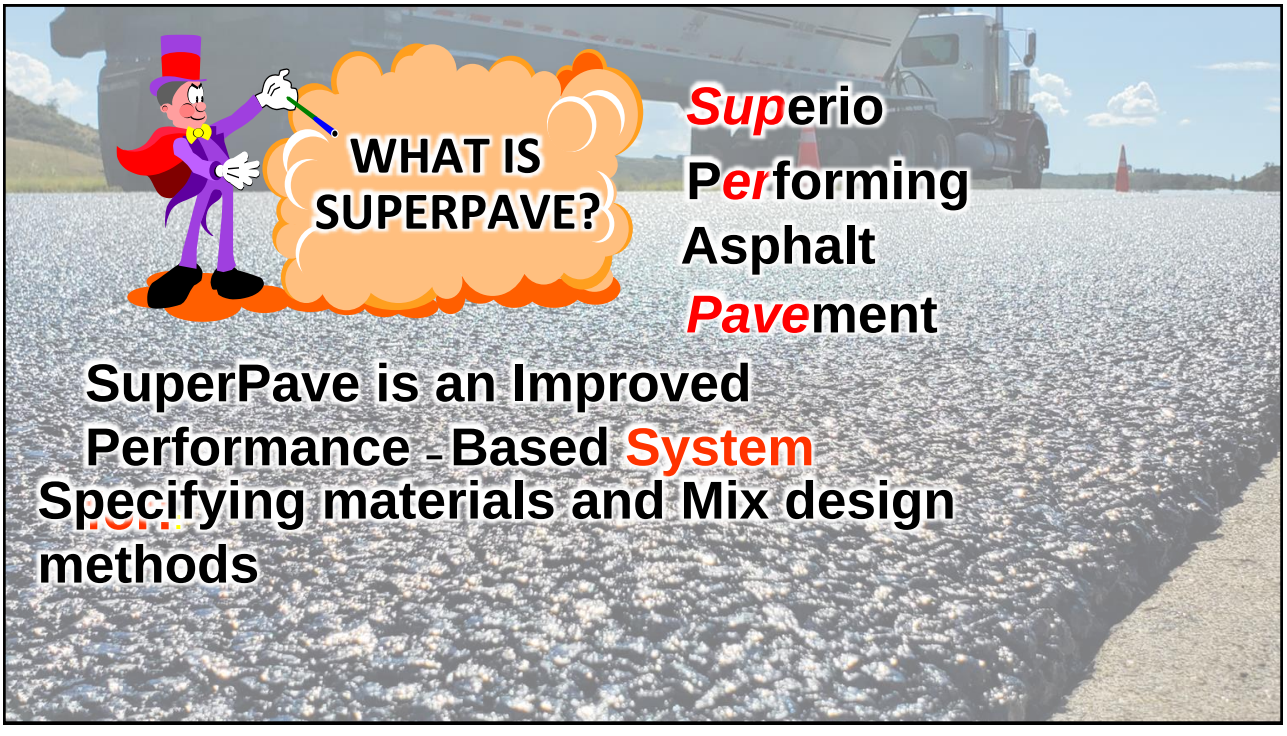
71


Why we did it.
STOP
THINK SAFETY

72


STOP
And today!
ATKINS
ATKINS

73

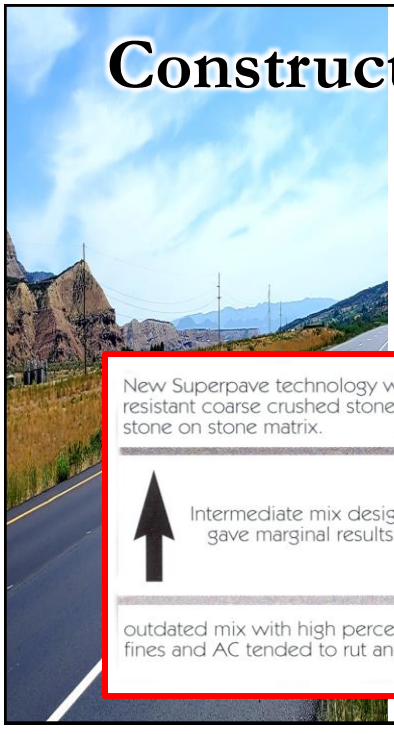

WHAT IS SUPERPAVE?
Superio
Performing
Asphalt
Pavement
SuperPave is an Improved Performance - Based System
Specifying materials and Mix design methods

74

Construction of Asphalt Pavements

75

Construction of Asphalt Pavements



Marshall Mix Technology

Superpave Technology

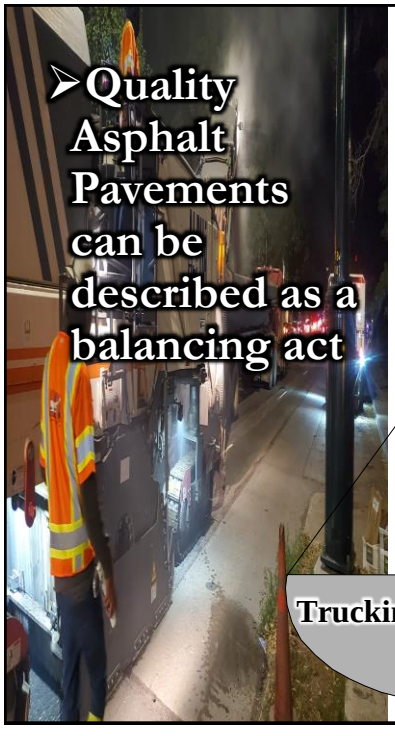
- **Increased rutting resistance**
- **Increased resistance to low temperature thermal cracking**

76

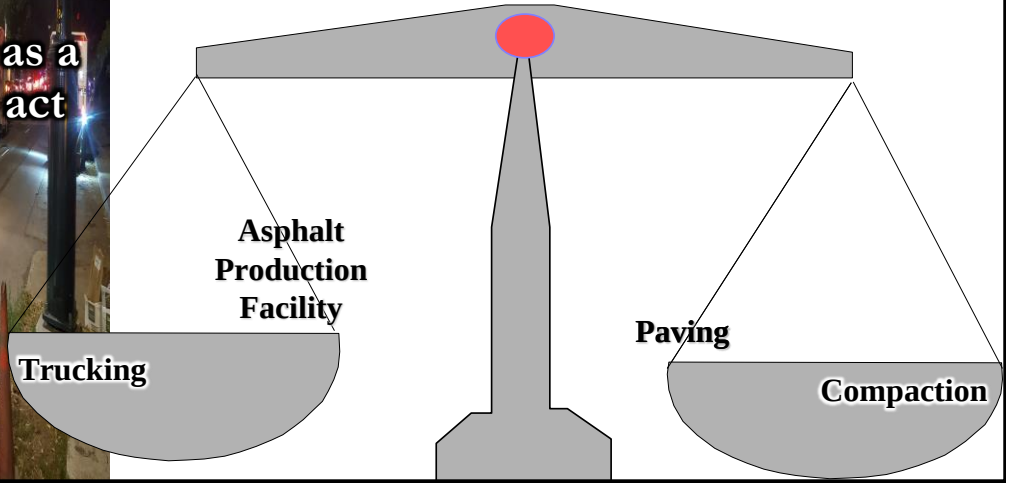
Construction of Asphalt Pavements

- 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***

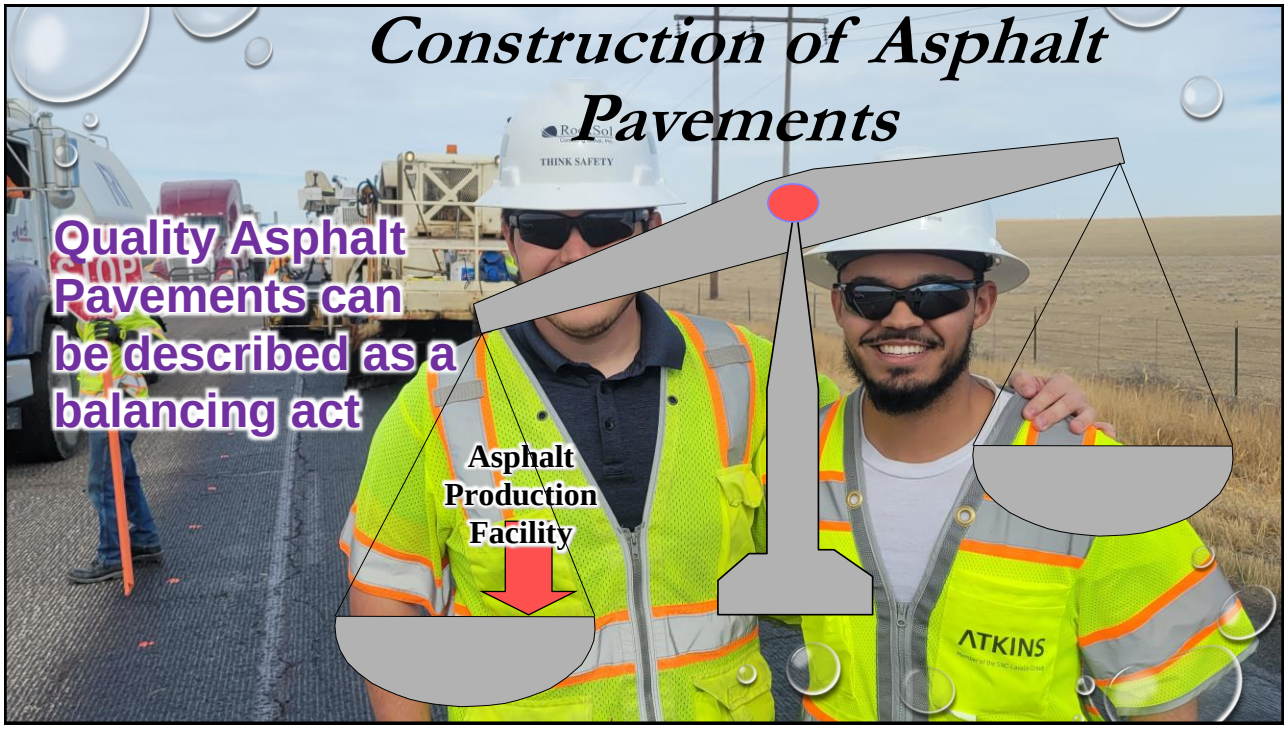
77



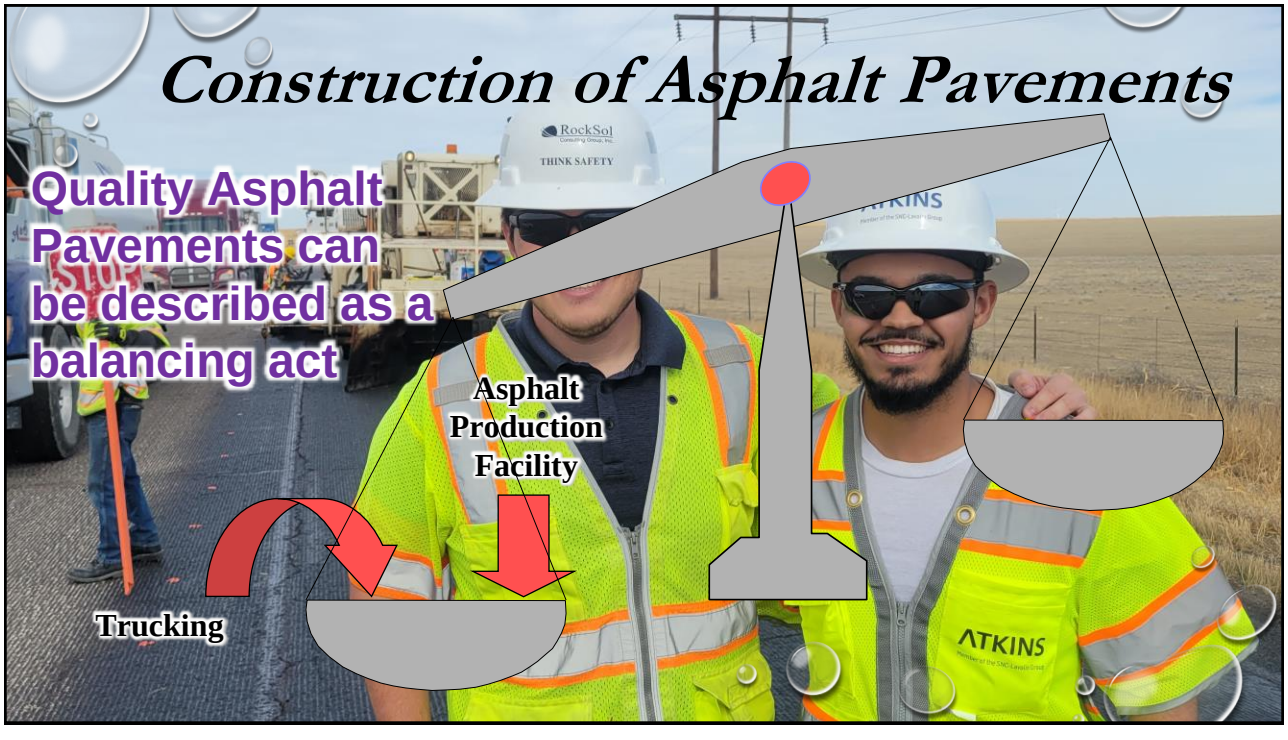
Construction of Asphalt Pavements



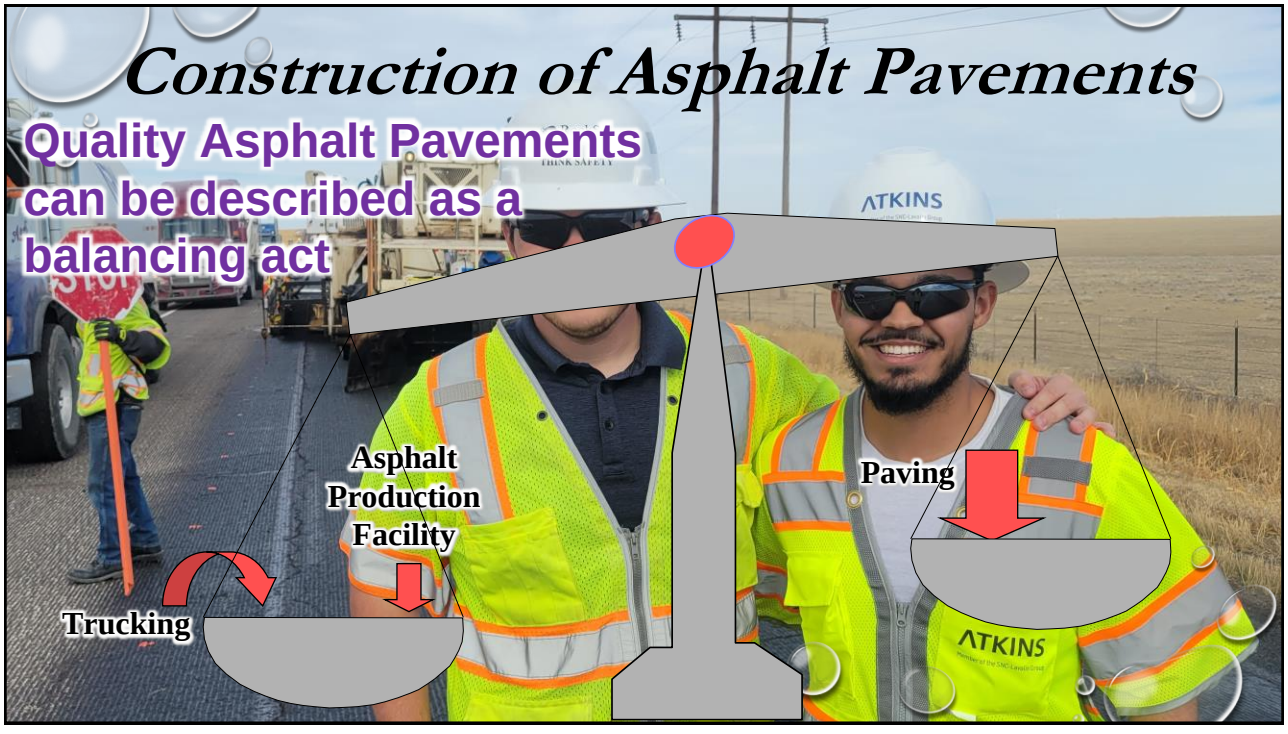
78


Construction of Asphalt Pavements
Quality Asphalt Pavements can be described as a balancing act
Asphalt Production Facility
THINK SAFETY
ATKINS

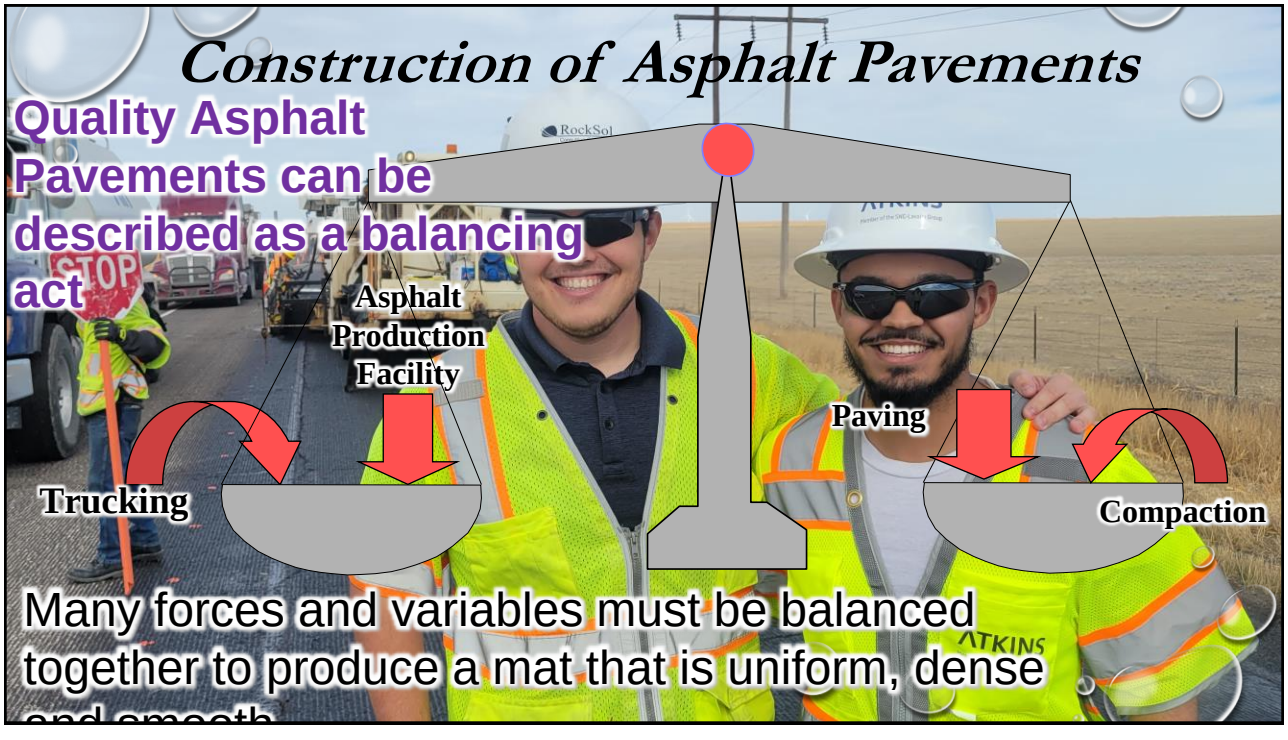
79


Construction of Asphalt Pavements
Quality Asphalt Pavements can be described as a balancing act
Asphalt Production Facility
Trucking
THINK SAFETY
ATKINS

80


Construction of Asphalt Pavements
Quality Asphalt Pavements can be described as a balancing act
Asphalt Production Facility
Paving
Trucking
ATKINS

81


Construction of Asphalt Pavements
Quality Asphalt Pavements can be described as a balancing act
Asphalt Production Facility
Paving
Trucking
Compaction
Many forces and variables must be balanced together to produce a mat that is uniform, dense
ATKINS

82

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 the 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"

83

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

84

85

A BRIEF LOOK AT ASPHALT PRODUCTION FACILITIES

86

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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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

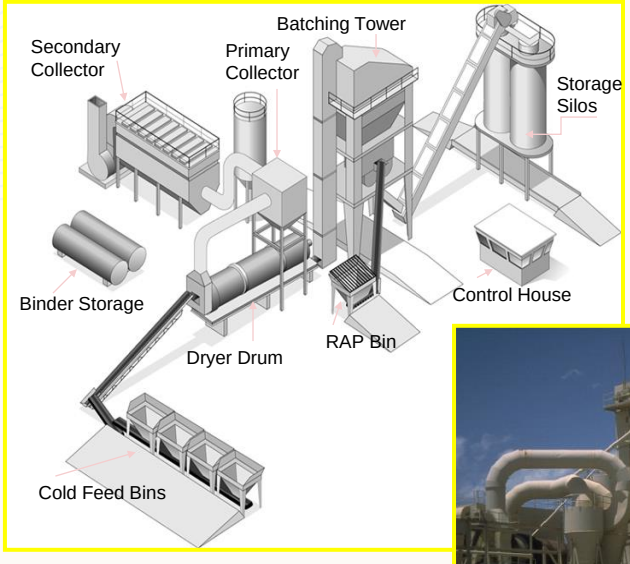
Batch plant

- 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**

89



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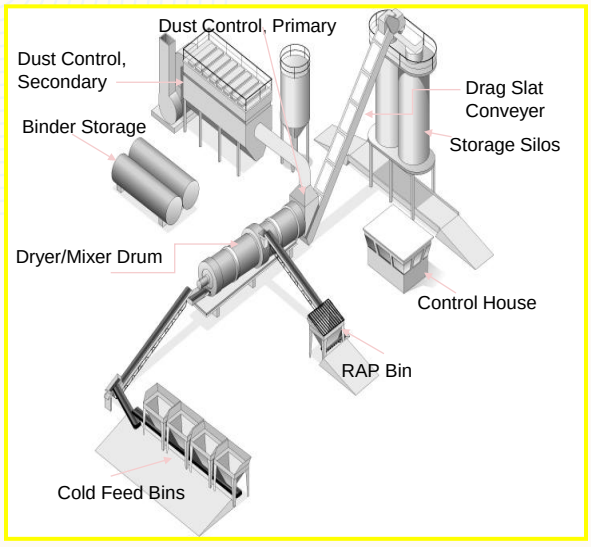
Schematic/Picture of a Batch Plant layout

90



Schematic/ Picture of Continuous Drum Plant

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SYSTEM COMPONENTS OF THE BASIC ASPHALT PRODUCTION PLANTS

Aggregate Handling
Asphalt Handling
Mixing
Discharge

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

Additives
Dust Control
Systems
Control

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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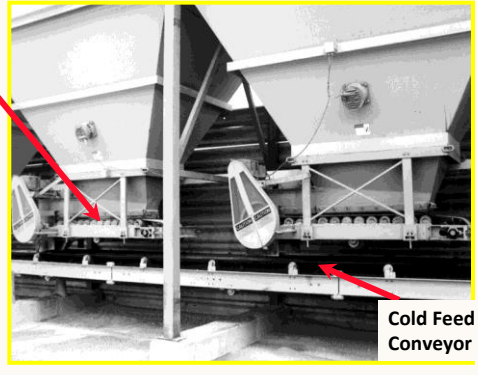
COLD FEED BINS

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

95

Aggregate Handling System ~ Cold Feed Conveyor

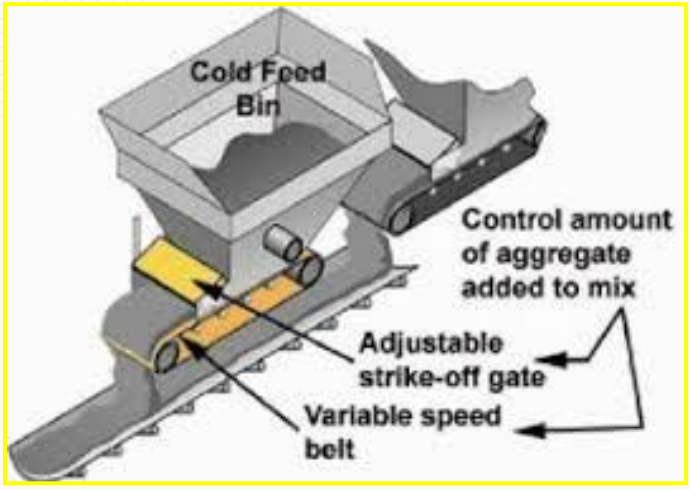


Collects the aggregates from the various cold bins feeders and transports the cold aggregates to the dryer/heating drum

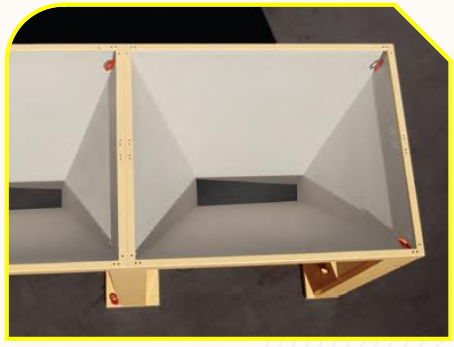
Proportioning flow from each feeder is controlled by a variable speed belt and adjustable feeder gate beneath the cold feed bin

96

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

Composite Belt

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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?

99

Types of Continuous or Drum Mixer Plants

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

100

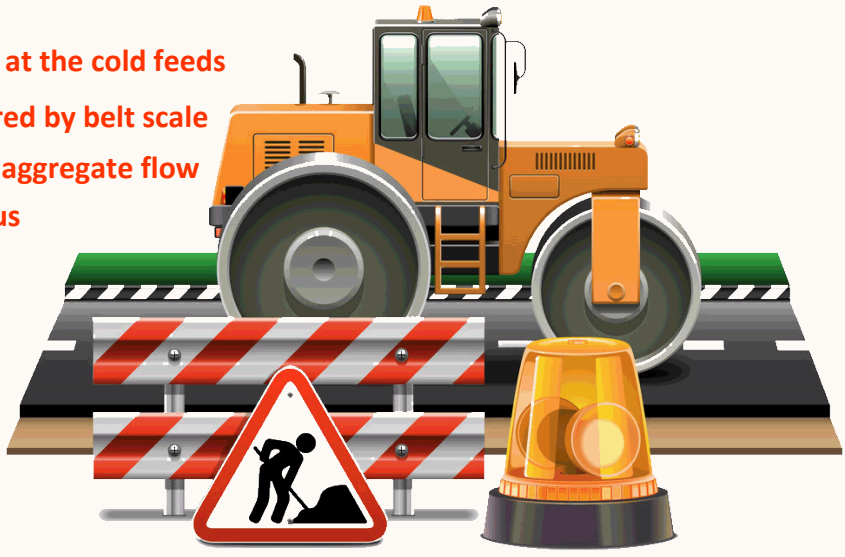
Continuous or Drum Mixer Plants

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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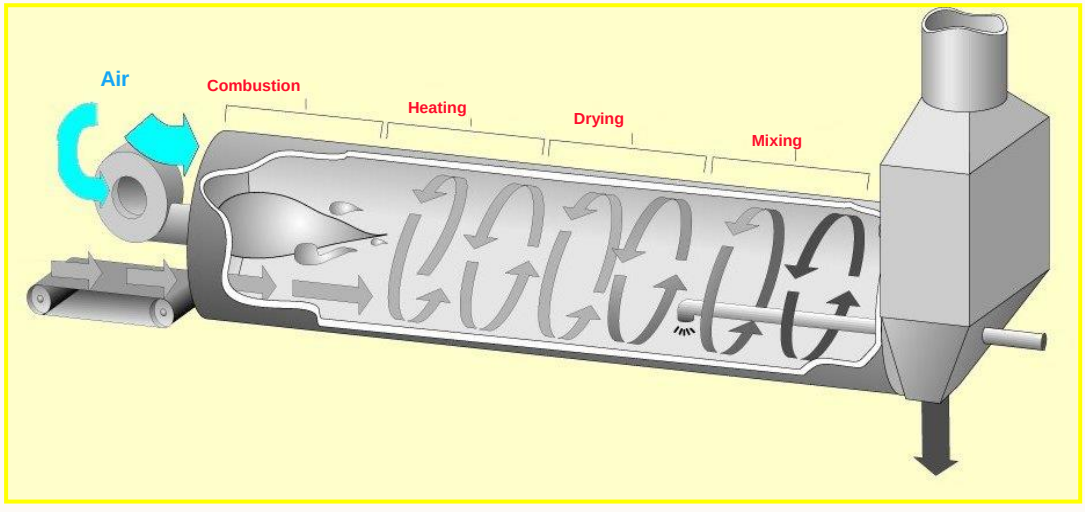
Parallel Flow Drum

(Not Common Today, but still available and used)



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Continuous or Drum Mixer Plant

Hot Mix Asphalt

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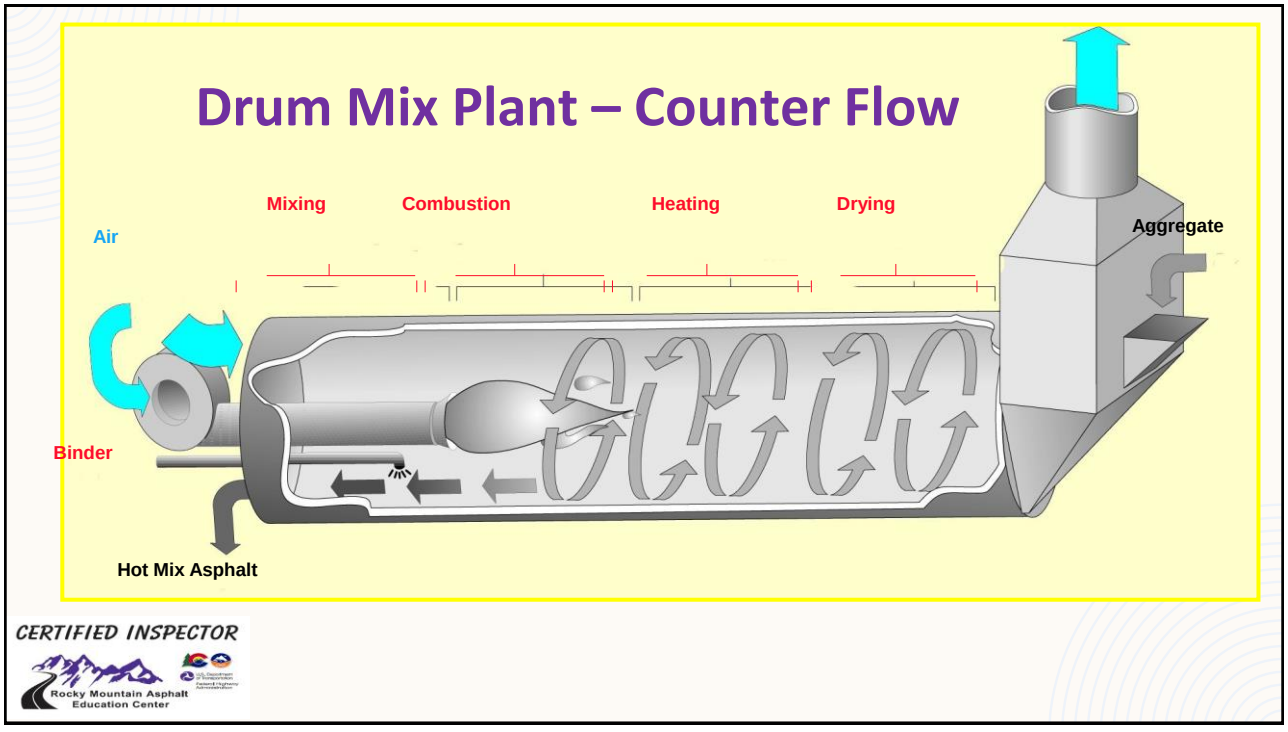
Drum Mix Plant – Counter Flow
Mixing
Combustion
Heating
Drying
Air
Aggregate
Binder
Hot Mix Asphalt
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DRYING
MIXING
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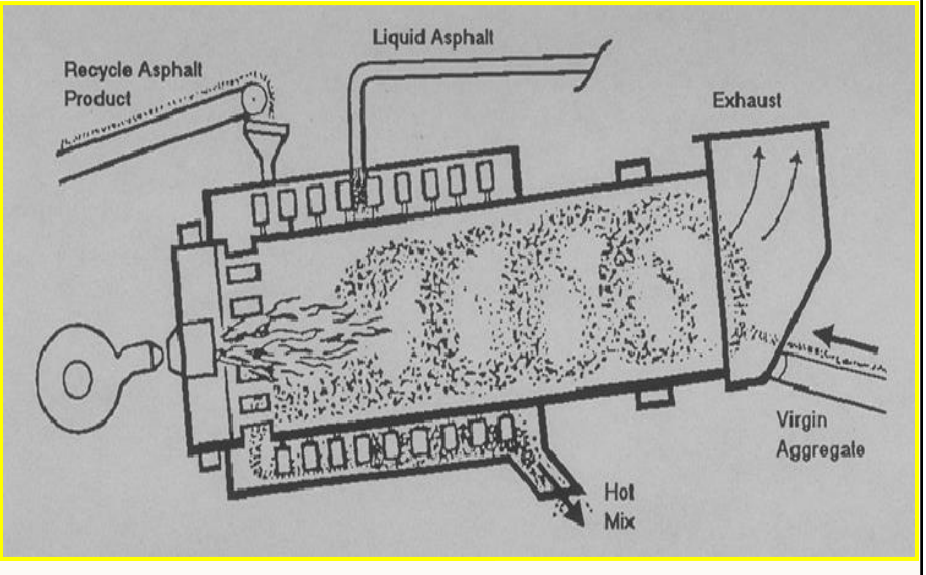
Aggregate Veiling in the Drum

105

AGGREGATE VEILING

107



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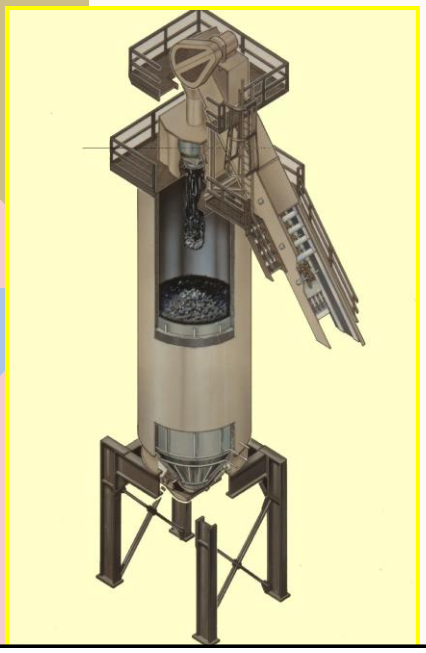
Double Barrel Drum

108

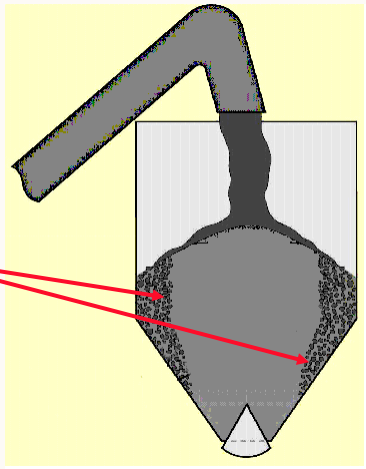
Surge and Storage Silos – Conveyor Systems



109

Surge and Storage Silos – Gob Hopper

Large aggregate rolls to outside causing minor segregation



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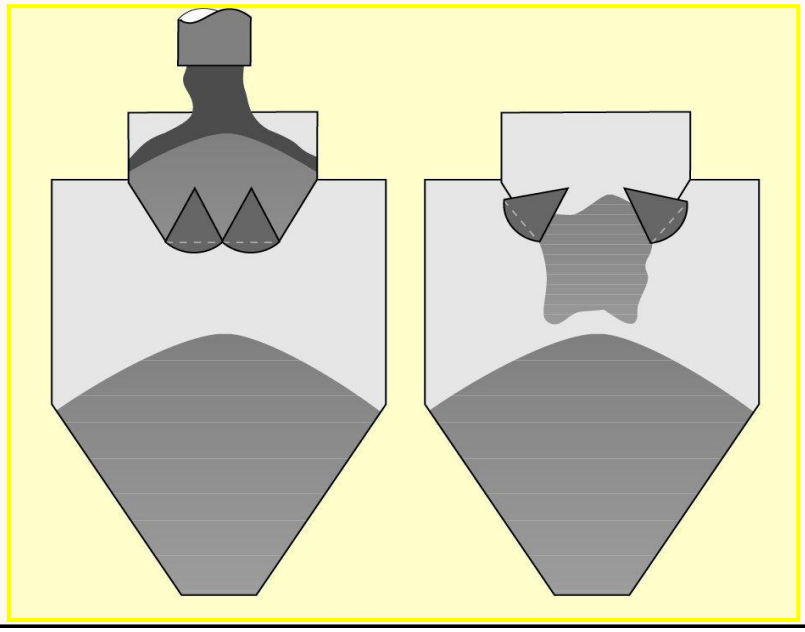
110

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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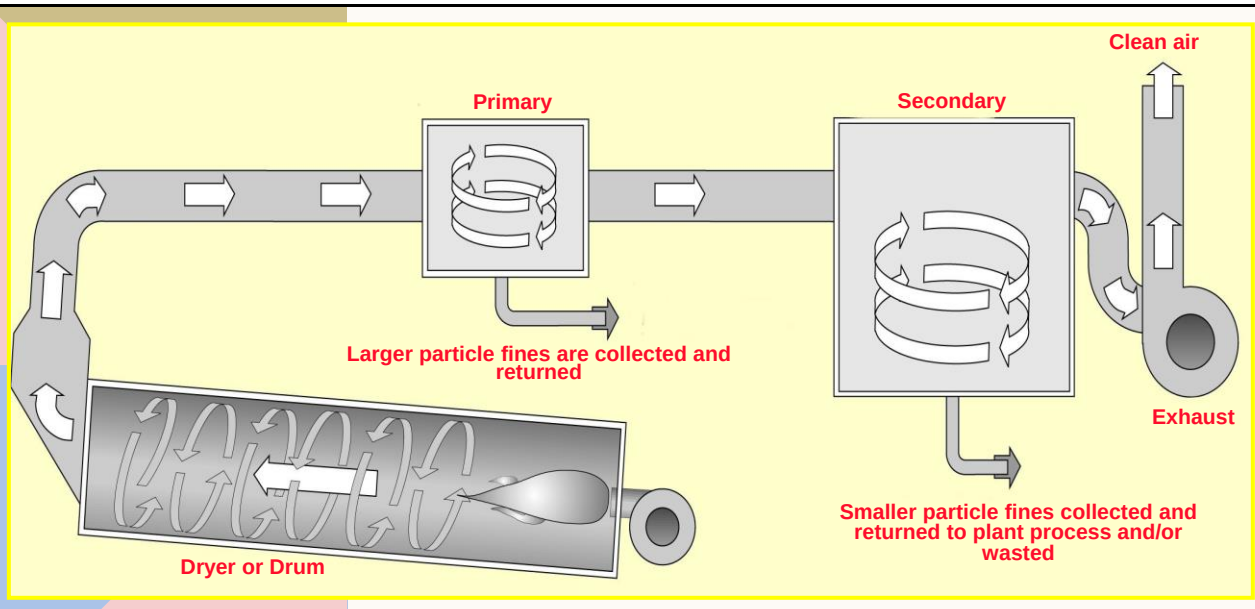
Emission Control Systems

116



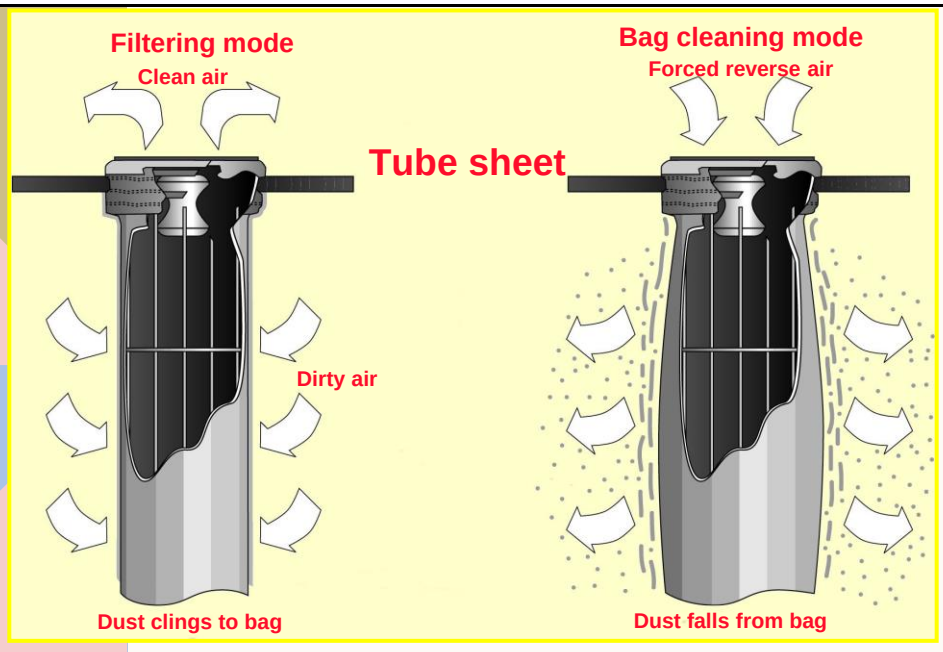
Emissions Control Equipment Primary & Secondary

117

Emissions Control Secondary, Baghouse

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

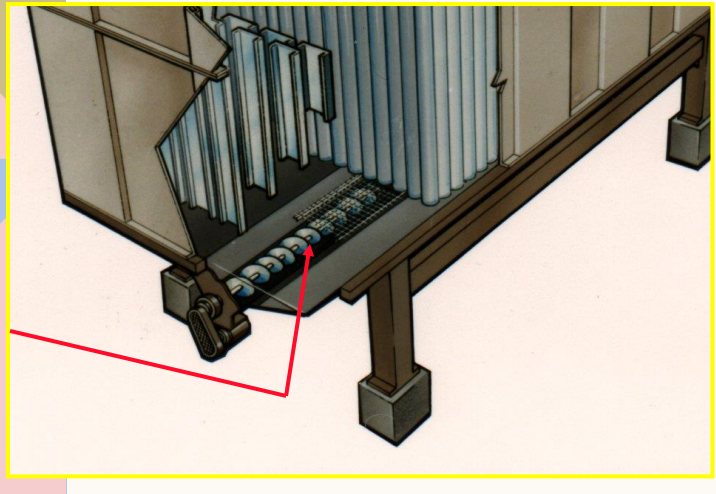
118



Emissions Control Equipment Baghouse Operation

119

Emissions Control Equipment Baghouse Return



120

Emissions Control Equipment

Secondary, Baghouse

121

Todays Plants and System Controls

Modern plants are totally computerized

Capable of multiple job mixes

One person plant operation

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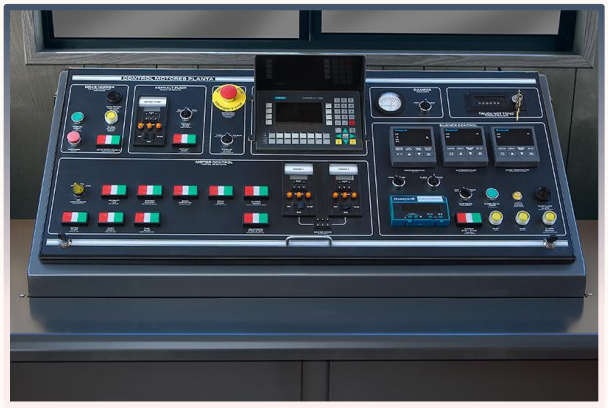

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System Controls – Computerized Drum Plant

123

INSPECTOR BEST PRACTICE

At the beginning of a project visit the plant and document:

- 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

124

QUESTIONS ??

125

Inspectors Responsibilities Construction ~ Material Transfer

126

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

127

What Type of Trucks are Used for Asphalt Delivery?

- **Tandem End Dump**
- **Super Tandem End Dump**
- **Semi End Dump Trailer**
- **Belly 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, may help to keep Asphalt hot**

ASPHALT RELEASE AGENTS USED AND/OR ALLOWED

128

Tandem 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 wheelbase, easiest to maneuver
Disadvantage – limited capacity

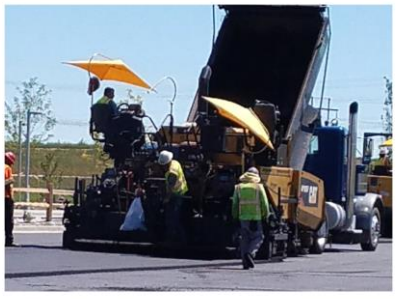
129

Super Tandem End dump

Delivers Asphalt directly to the hopper of the paver
5 or 6 axles
Capacities from 25 to 33 tons (more axles more tons)
Advantages

- **Short wheelbase, easiest to maneuver**
- **Extra Capacity**

130



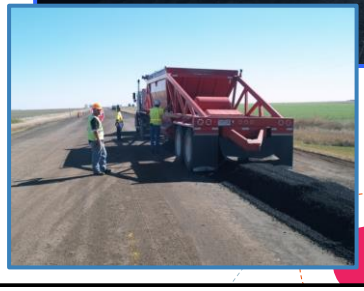
Semi-trailer truck

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

131

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.



132

Horizontal discharge or live bottom truck

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

Capacity - varies

133

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

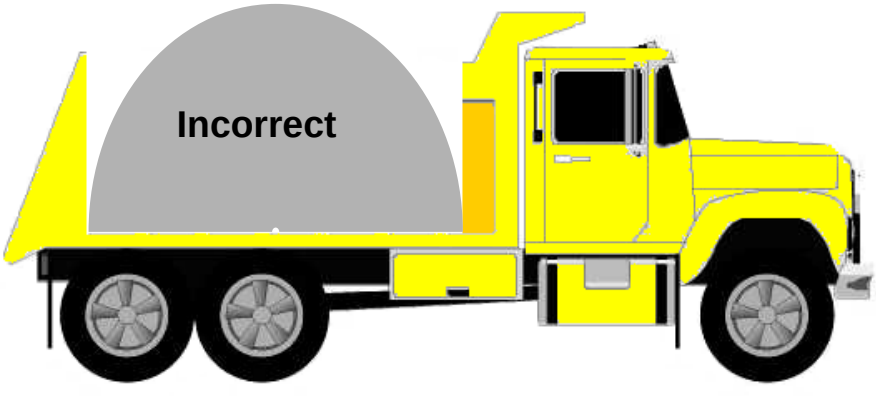
134

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

135

Tandem or Super Tandem Loading "Best Practices"

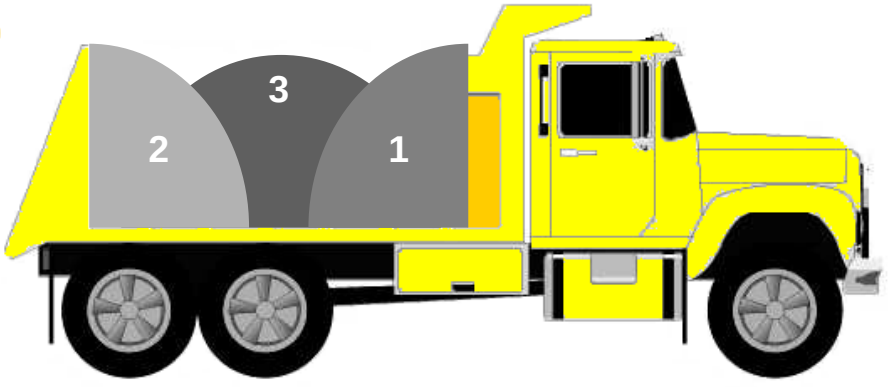


136

Tandem or Super Tandem Loading "Best Practices"

137

Tandem or Super Tandem Loading "Best Practices"

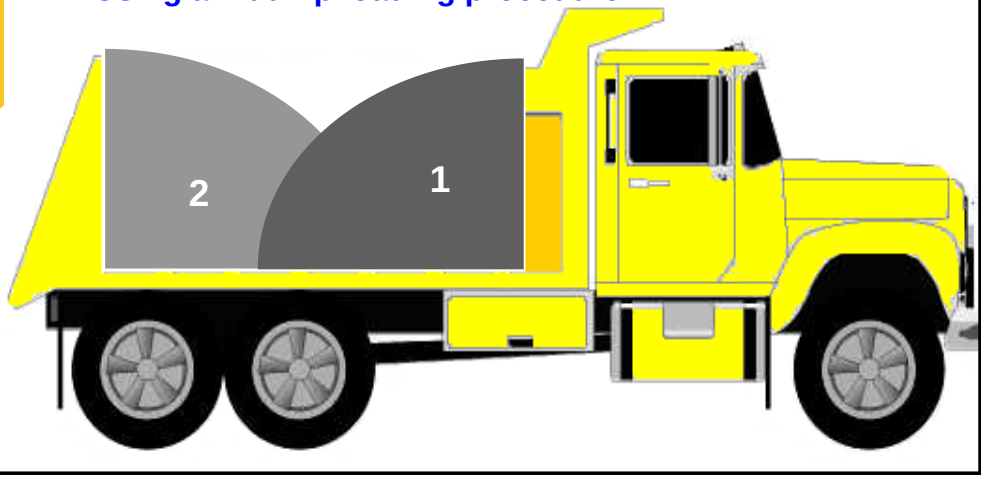


Using a 3-dump loading procedure

138

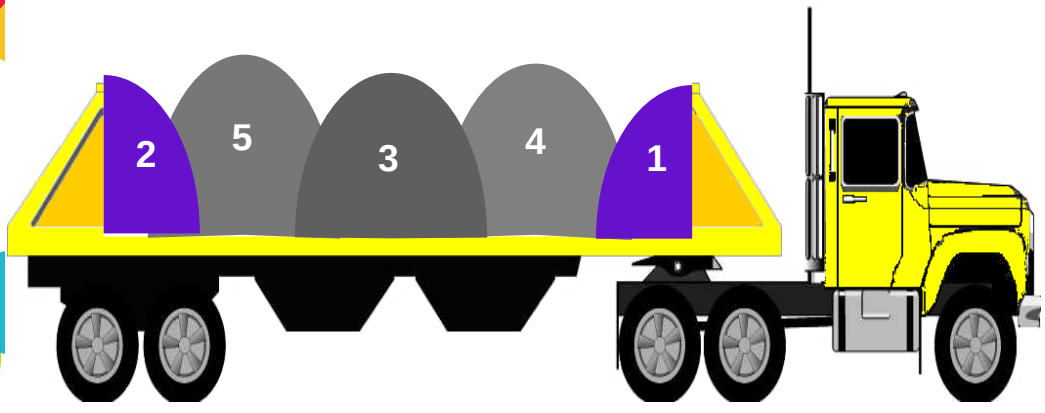
Tandem or Super Tandem Loading "Best Practices"

Using a 2-dump loading procedure



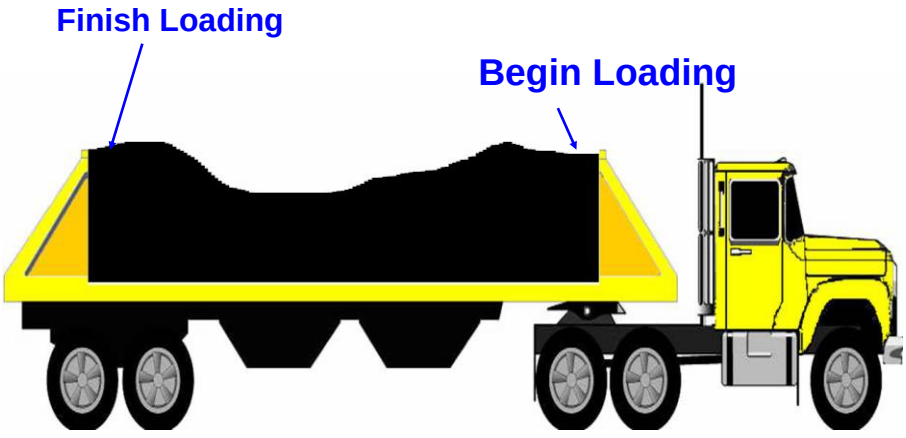
139

Trailer Loading "Best Practices"



140

Trailer Loading (Most Common) "Best Practices"



Continuous loading process

141

- 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 smoothly

Delivery of Asphalt mix to Paver

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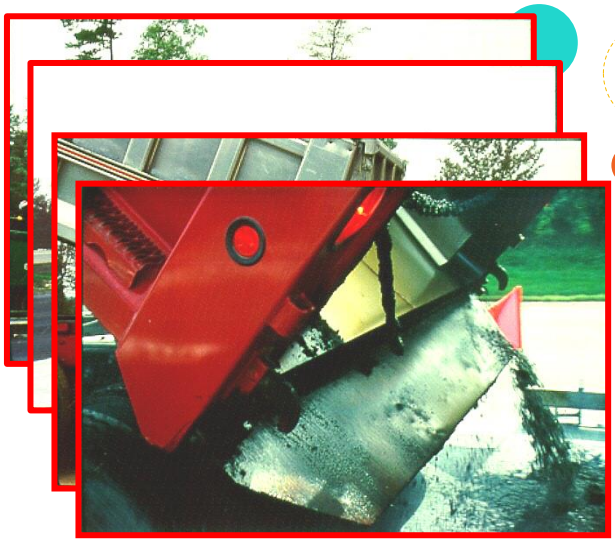
Delivery of APM mix to Paver

- 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

143

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



144

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?

Inspector Best Practice

145

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**

146

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.

147

MTD's

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

148

MTD's

149

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.

150

MTV's

151

MTV's

152

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

153

MTV's

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

154

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.

155

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.

156

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.**

157

158

Inspector's Responsibilities

Construction Observation ~
Sampling Asphalt Paving Mixtures

159

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

160

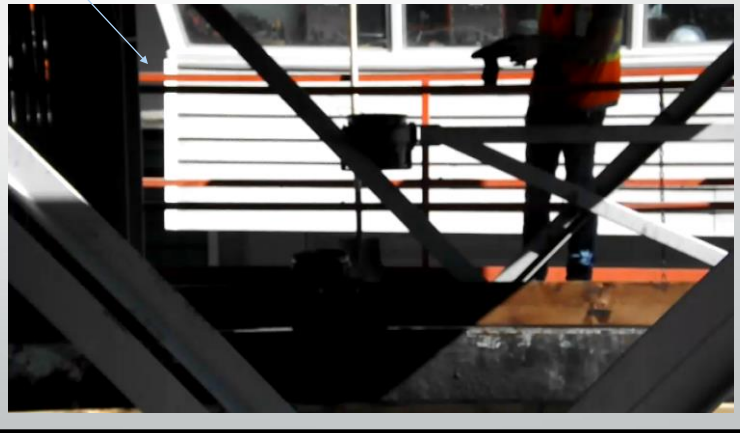
Securing Samples

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

161

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

163

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*

164

165

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*

166

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*

167

168

169

Sampling Asphalt from Behind Paver, before Compaction

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

170

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.*

171

172

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

173

174

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

175

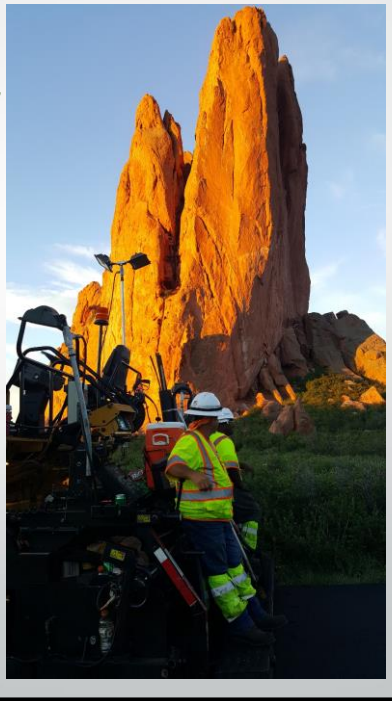
Sample Quantities

As an average:

Project field tests will require a minimum sample size of 65 lbs. for required tests to be performed

176

Questions



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Inspectors Responsibilities

Construction ~ Paving Operations

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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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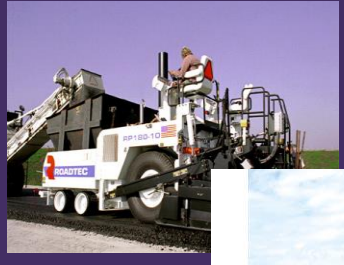
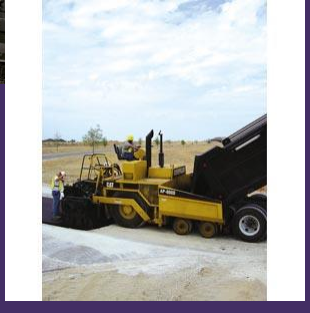
Types of Pavers

- 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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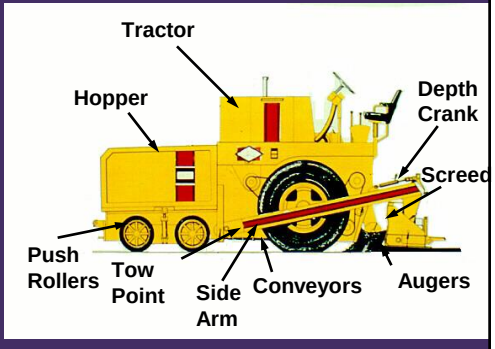
Paver components

- *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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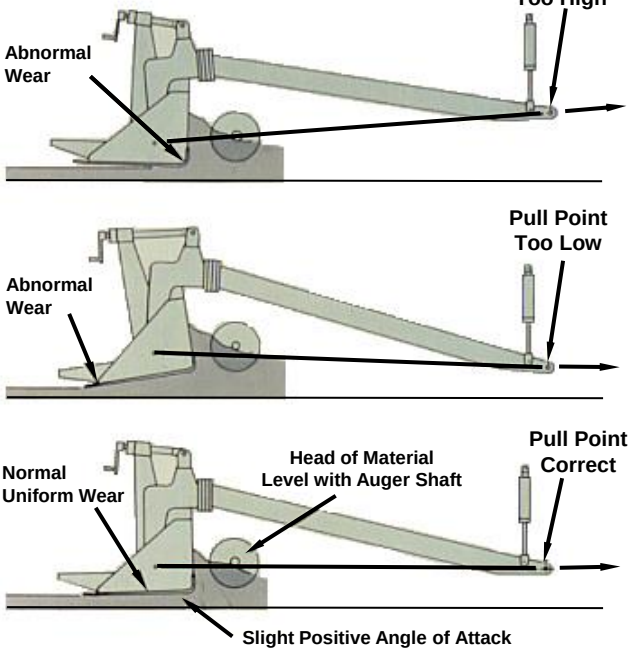
Set the pull point correctly



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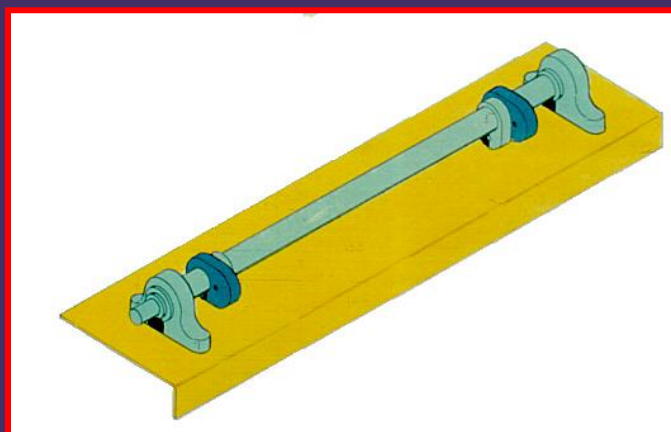
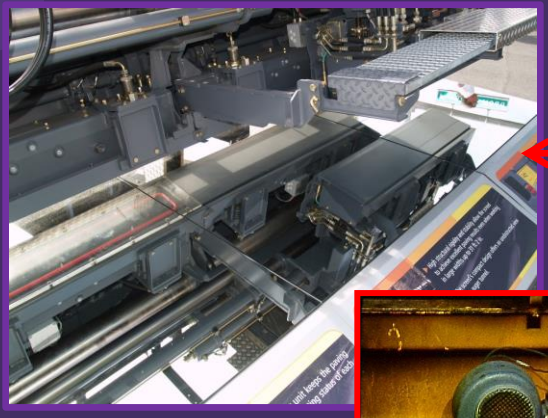
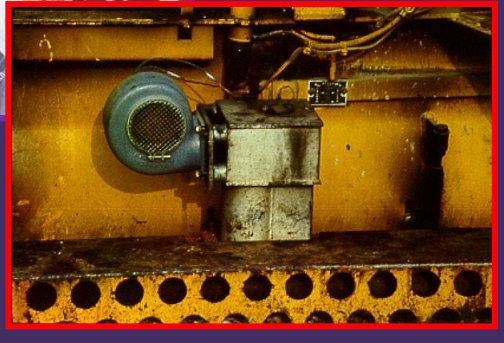


Vibratory Shaft With Weights

183



Screed Heating systems
- Electric
- Diesel Fired



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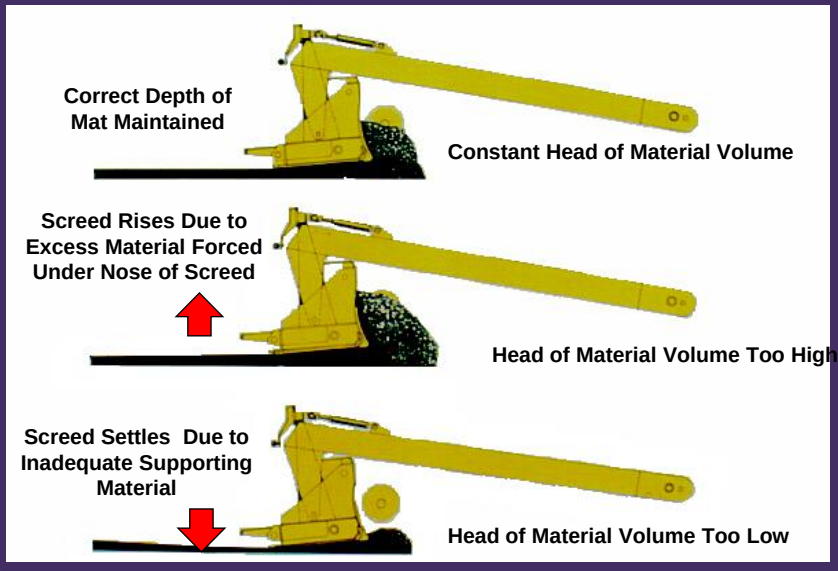
Maintaining the material head is very important



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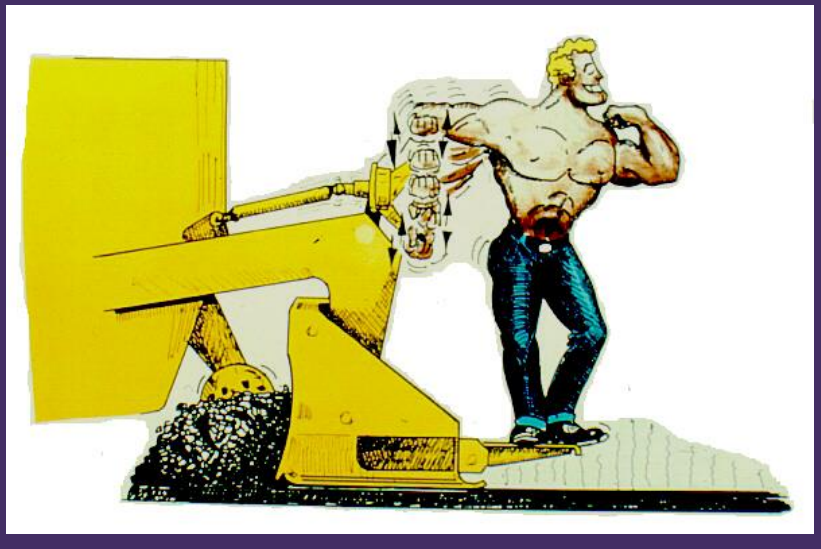
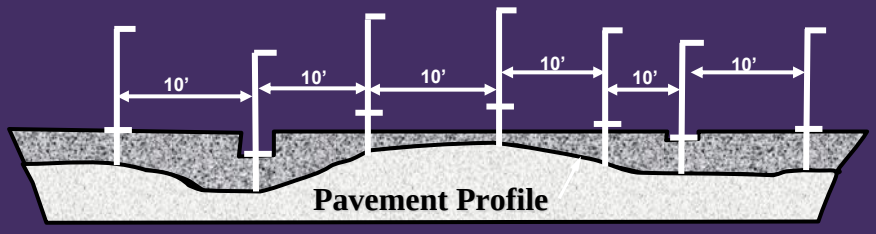
What affects Pavement Smoothness?



188

What will this accomplish?

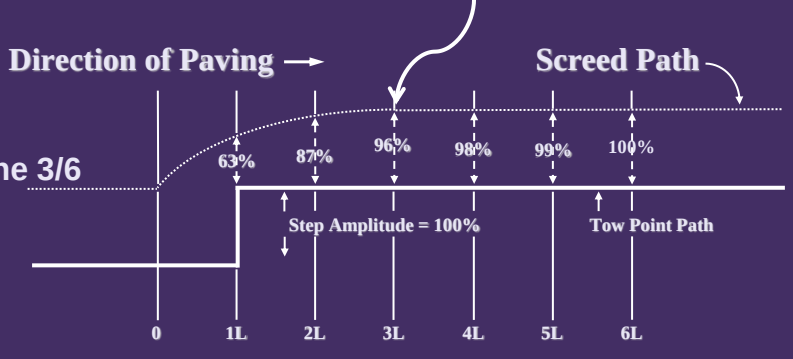


Direction of Paving →

189

How quickly do changes take affect?

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



30/ 60 or the 3/6 Rule

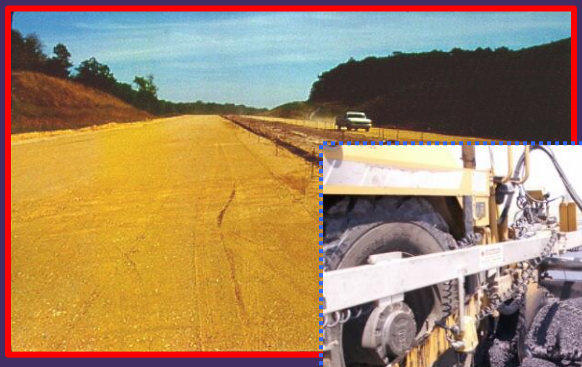
L = Leveling Arm Length (Approximately 10')

Detail of Screed Path

190

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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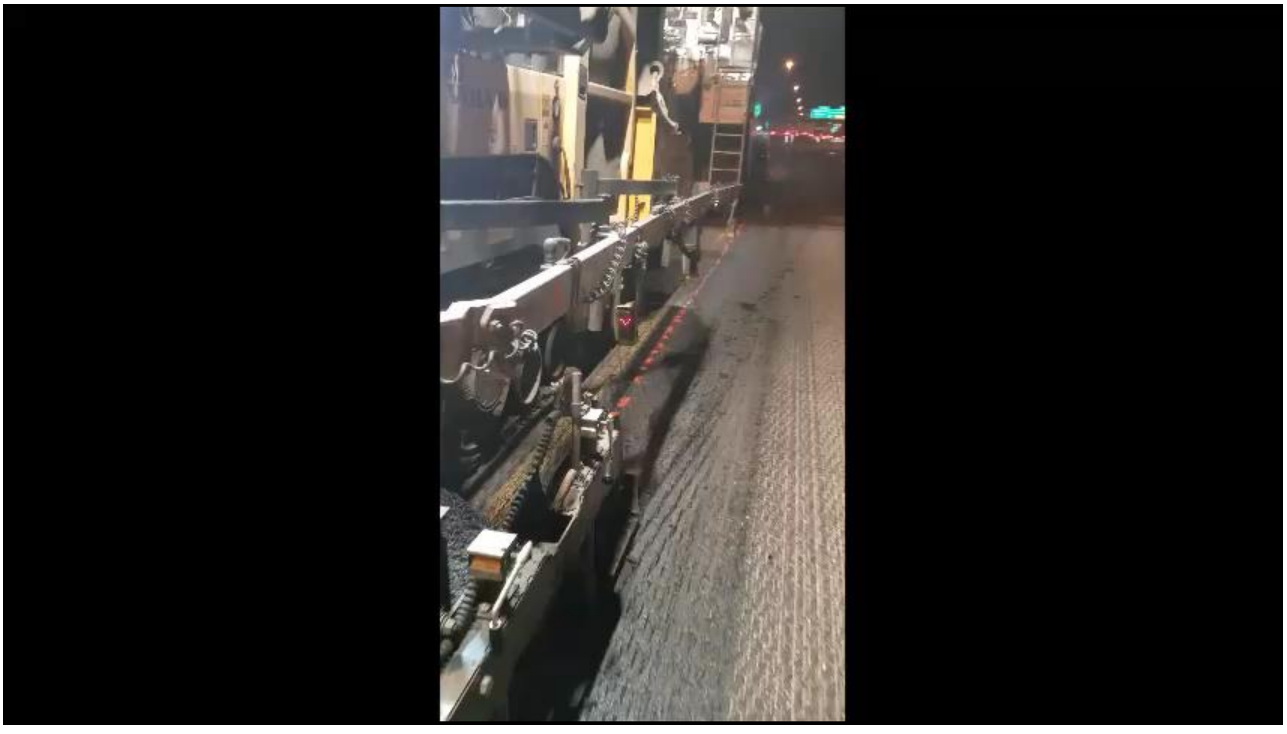

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Automatic Screed Controls

- Joint Matching shoe
  - Short ski that rides directly on the adjacent surface or curb.
  - Most of these sensors today are noncontact 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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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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Paving Operations "Best Practices"

- *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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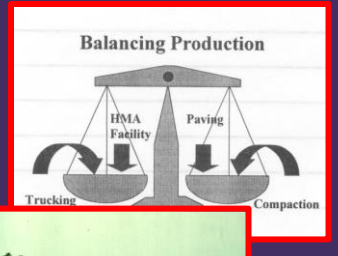
Placement

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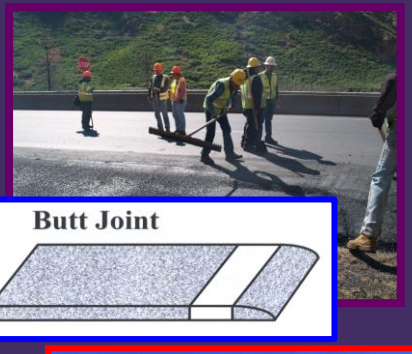
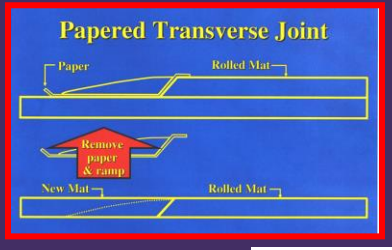
The contractor should try to avoid having the crew picnic between trucks!

200

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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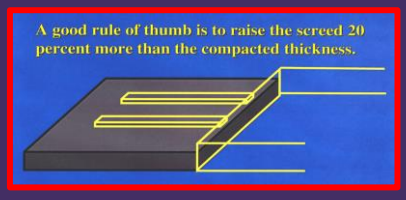
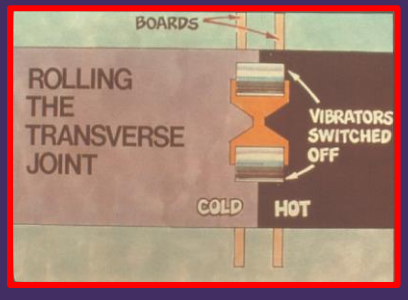
Transverse Joints

- 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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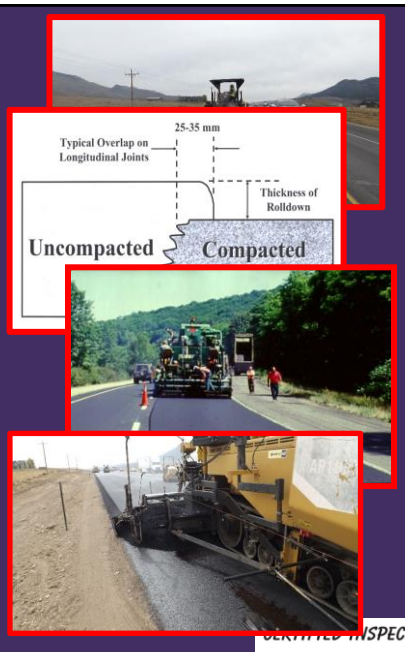
Longitudinal Joints

- Straight consistent longitudinal joints
  - Should only be bumped not raked
  - Overlap 1 inch to 1.25 inches (25 to 35mm)
- Curves require smooth consistent arcs
- Joint Density will be included as an incentive/disincentive pay item for CDOT projects



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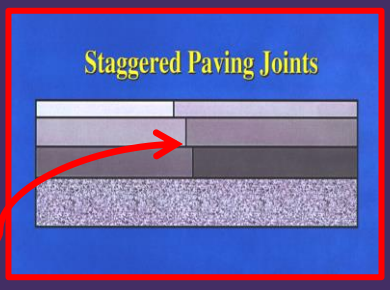
Longitudinal Joints

- *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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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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Inspectors Responsibilities

Construction ~ Compaction

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ASPHALT COMPACTION

208

WHAT IS 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

209

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

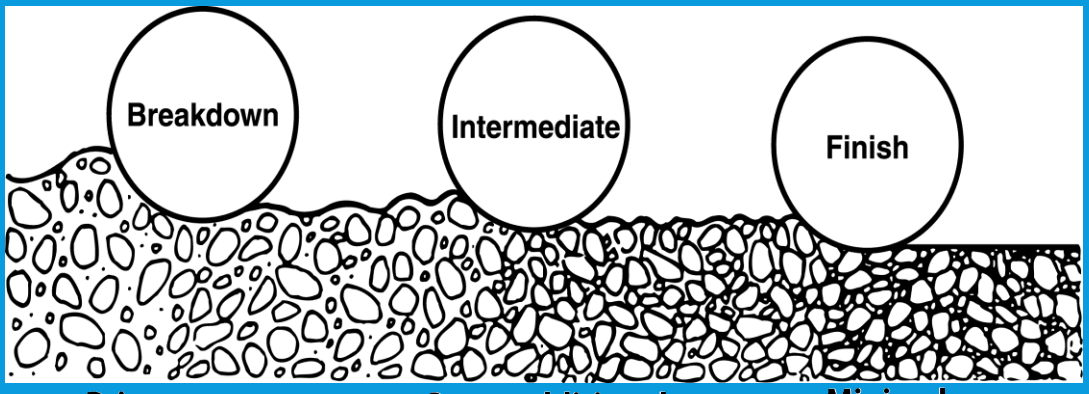
210

SUPERPAVE MIX DESIGNS

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

211

THERE ARE THREE PHASES OF COMPACTION



- Primary compaction
- Aggregate movement

- Some additional compaction
- Binder movement

- Minimal additional compaction
- Smooth surface

212

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"*

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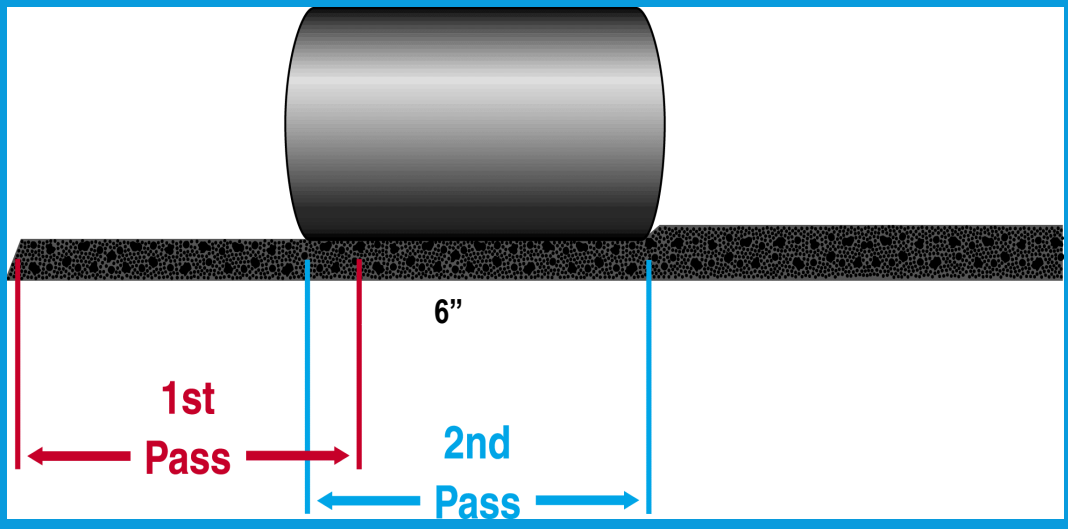
WHAT ARE THE RECOMMENDED OVERLAPS WHEN CHANGING DIRECTIONS



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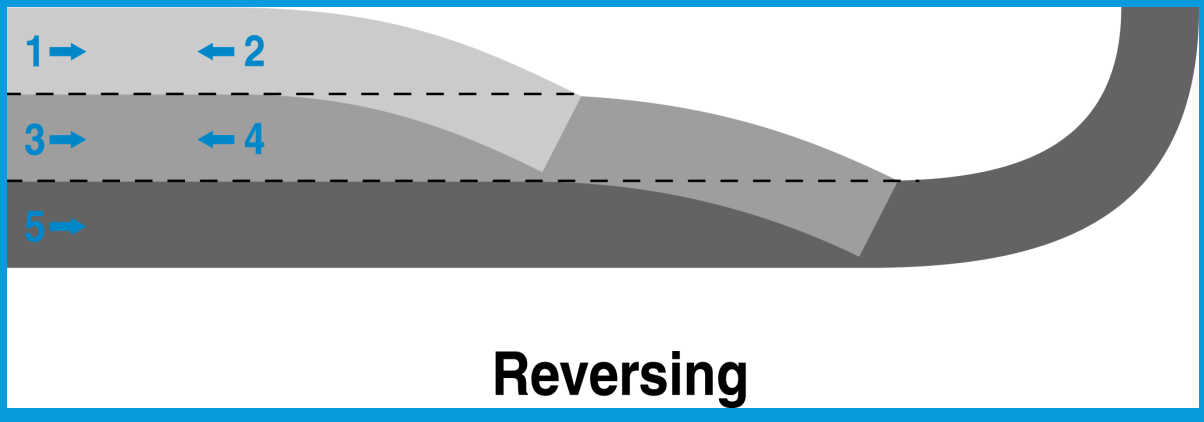
“BEST PRACTICE” WHEN REVERSING DIRECTION



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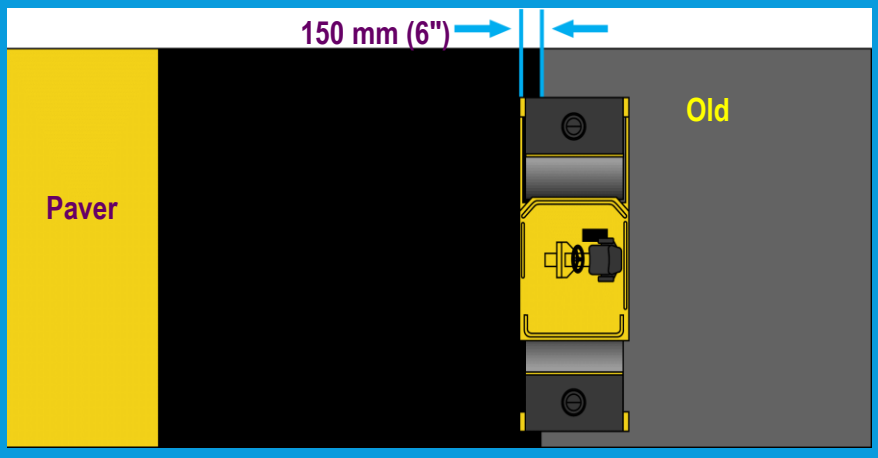
TRANSVERSE JOINT CONSTRUCTION



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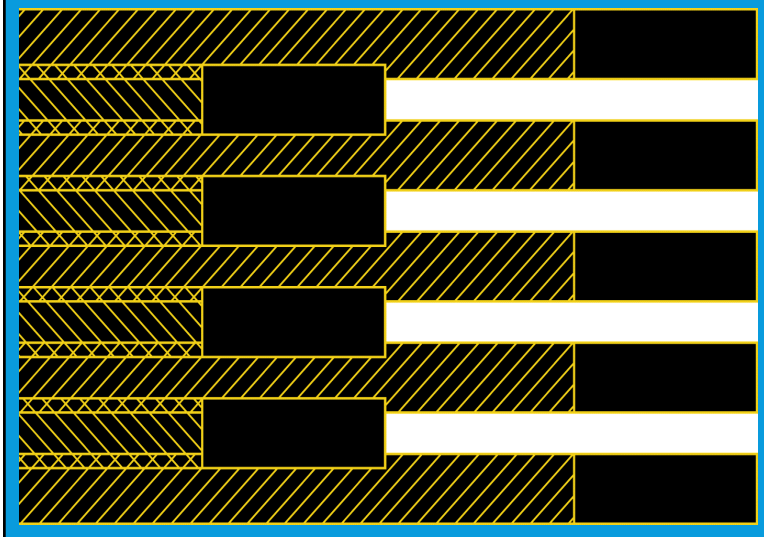
SECOND PHASE OF COMPACTION

- **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

217

PNEUMATIC COMPACTION (ROLLING)



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

218

THIRD PHASE OF COMPACTION

- Finish Rolling
  - Usually accomplished with a steel wheel roller
  - Should achieve the last 1%-2% of the required mat compaction to meet specification.
  - Primary purpose is to remove the roller marks from the finished mat

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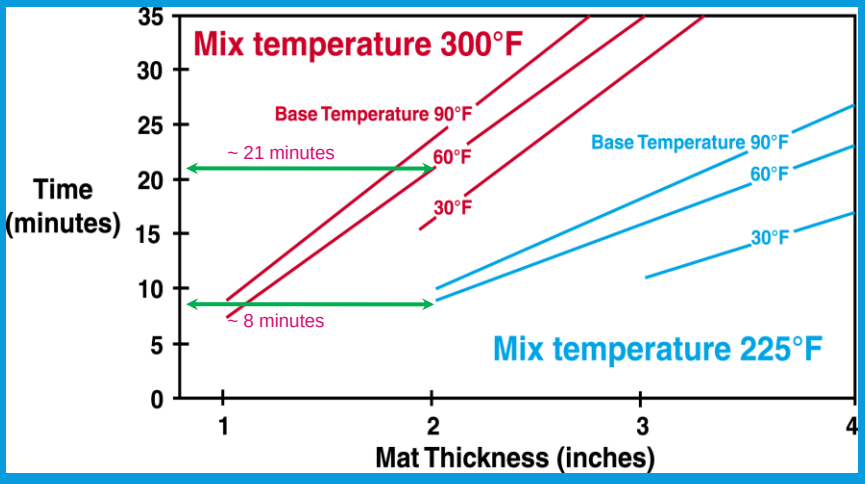
HOW MUCH TIME IS AVAILABLE TO APPLY THE THREE PHASES OF COMPACTION?



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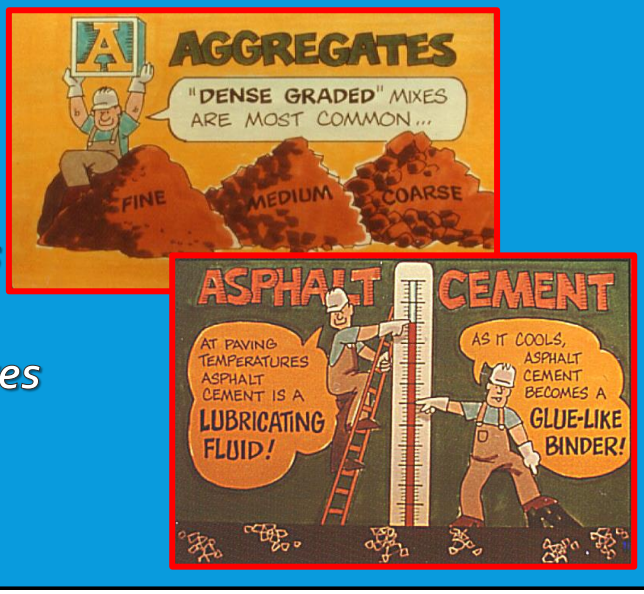
TYPICALLY RECOMMENDED COMPACTORS

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

221

FACTORS WHICH MAY AFFECT THE COMPACTION OF ASPHALT PAVEMENTS

- Aggregates
- Binder type
- Mix properties
- Environmental conditions
  - Layer thickness
  - Air and base temperatures
  - Laydown temperatures
  - Wind velocity



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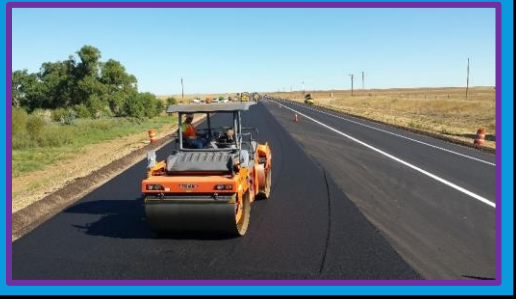
SETTING A ROLLER PATTERN

- 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



223

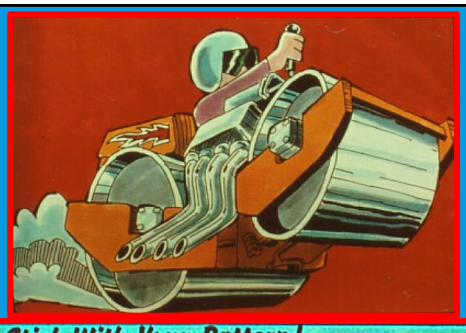
"BEST PRACTICE DURING THE COMPACTION PROCESS

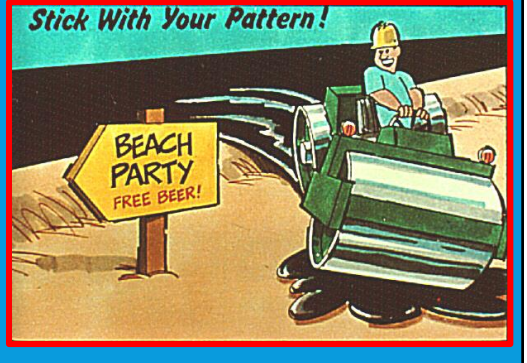
- Rollers should slow gradually come to a full stop, then slowly start in the reverse direction –
  - This is the only stop the roller should be allowed on the new pavement
  - When stopping to change direction roller should make a slight turn
- Rollers should never be stopped on a fresh mat or sudden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

224

APPLYING COMPACTIVE EFFORT

- 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





225

APPLYING COMPACTIVE EFFORT

- 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

226

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

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CONFIRMING COMPACTIVE EFFORT

- 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

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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*
- Two cores shall be taken within the locations used for Nuclear density tests, based on the stratified random sampling process.

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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

231

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

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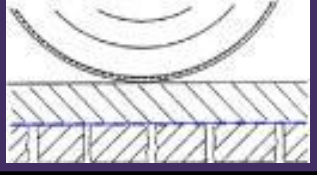
What is Smoothness / Roughness or Ride Quality?

- 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.



237

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.**

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The Human Response to the movement of a vehicle

- 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.

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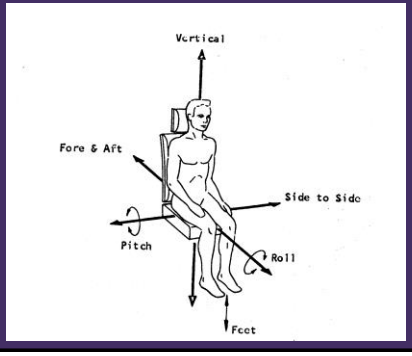
The Human Response to Vibration

The automobile industry estimated ride by measuring the human response at several interfaces. These are the four most identified points of discomfort:



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

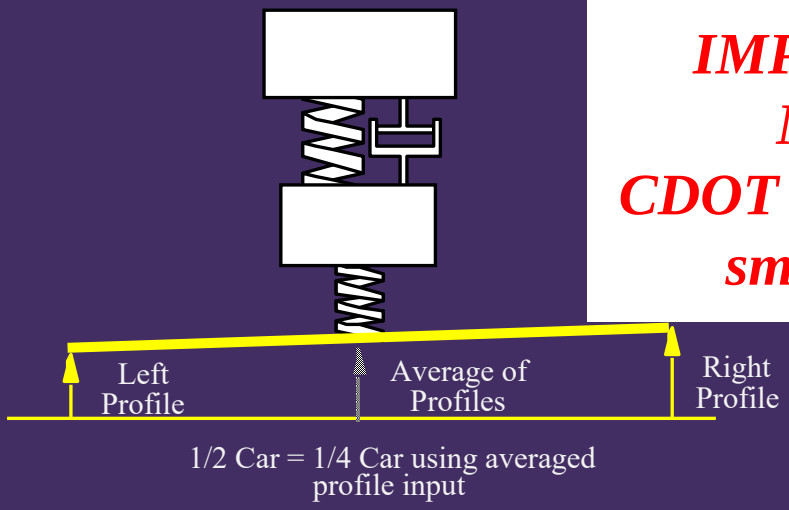
240

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.

241

What is different when profiling in Colorado?



IMPORTANT NOTE:
CDOT uses MRI for smoothness

244

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**

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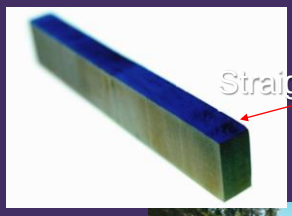
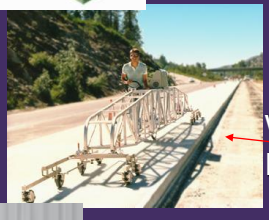
There are many different Smoothness Measuring Devices

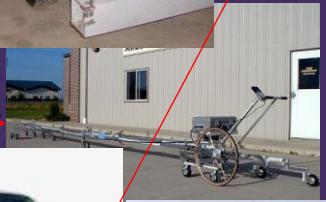


Straight Edge

High Speed Inertial Profiler



Walking Profilographs



Lightweight Inertial Profiler

Pave set system

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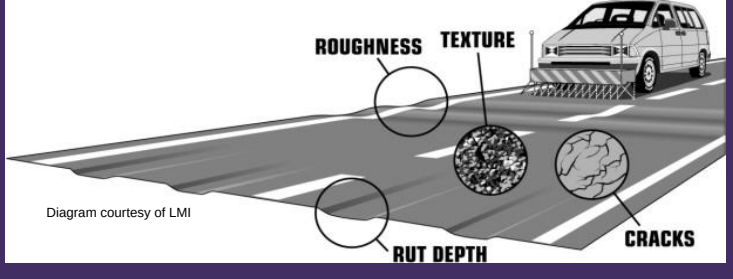
Why HS Inertial Profilers?



- 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

248

How do we build the smoothest roads?

By thinking about the end first

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- Questions?

March 2008

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What are Mat Defects?

261

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.

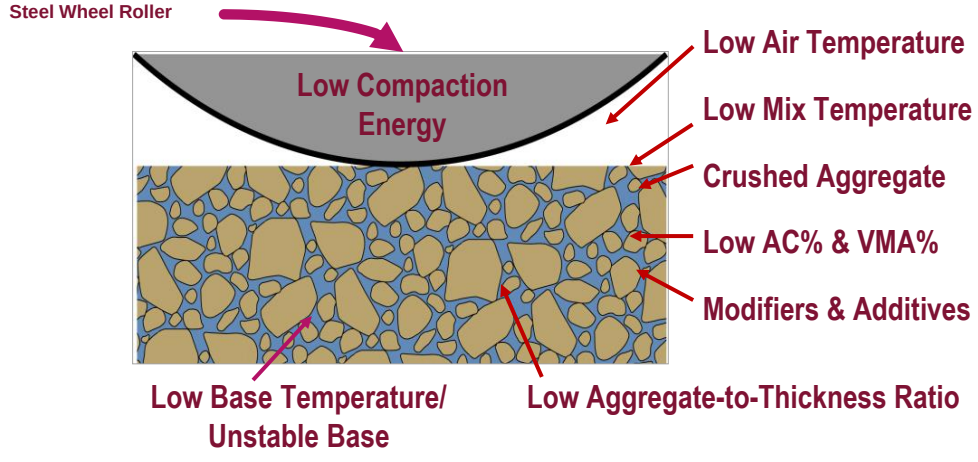
262

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.

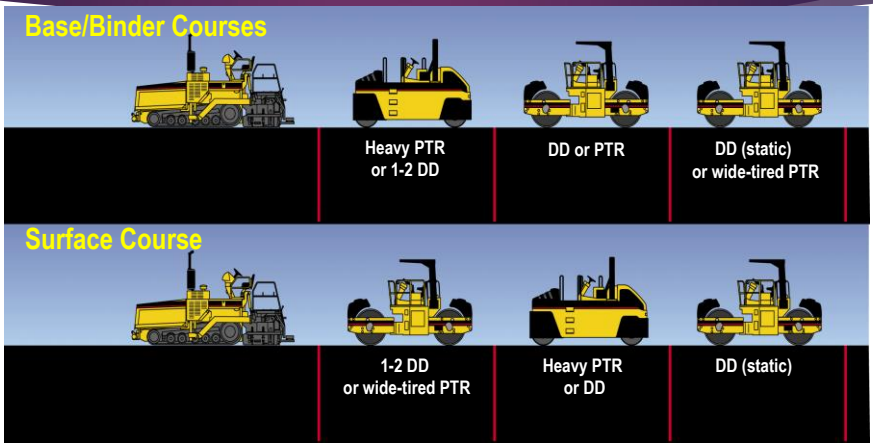
263

Some Factors which might Contribute to Harsh Mixtures



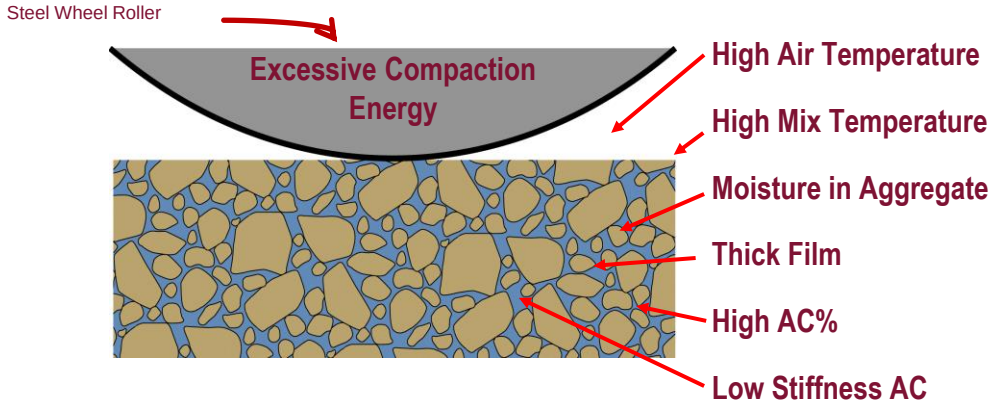
264

The recommend processes for compacting a Harsh Mixture



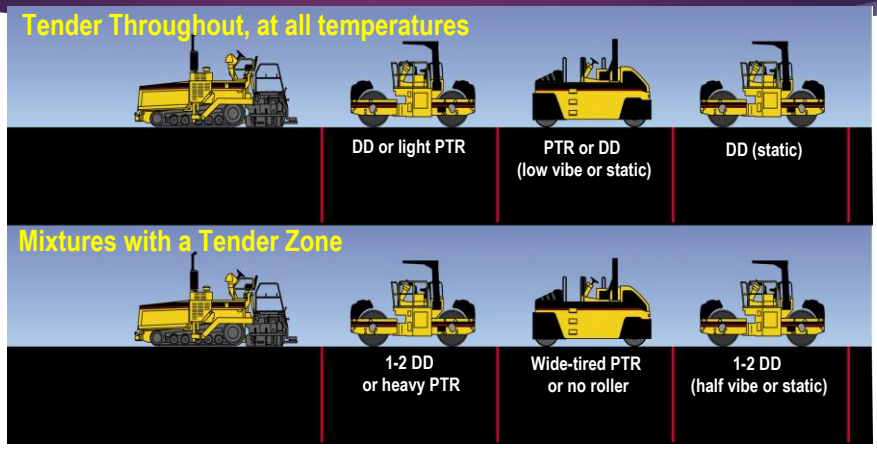
265

Some factors which might Contribute to Tender Mixes



266

The recommend process for compacting a Tender Mixture



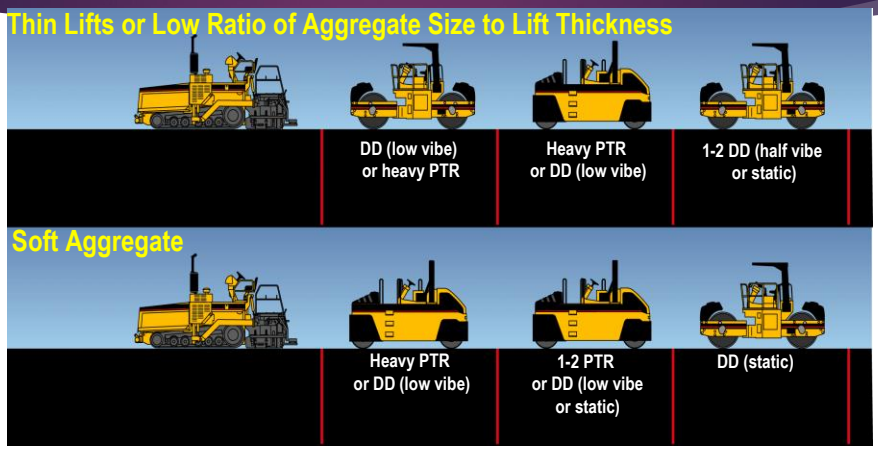
267

What are characteristics of Fragile Mixes?

- 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

268

Recommend process for compacting a Fragile Mix



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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)**

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Compaction Issues – Rutting or settlement

Possible causes:

- Inadequate subgrade or aggregate base compaction
-

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Compaction Issues – Longitudinal Joint Cracking

Possible causes:

- Insufficient material at joint during paving
- Improper joint compaction

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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!

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Compaction Issues – Asphalt Sticking to the rubber tire roller

Possible causes:

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

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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!

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Compaction Issues – Crushing/Fracturing Aggregate

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**

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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

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Questions About anything we talked about today ?

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- If you are only here for the "Education Only" 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 Asphalt Inspector Certification session!

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