PCC Paving Field Inspection 2024

Iowa Department of Transportation

Construction and Materials Bureau

Technical Training and Certification Program

CHAPTER 1

INTRODUCTION

1

PCC Paving Field Inspection

Iowa Department of Transportation
Office of Construction and Materials

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2

Section 1 - Introduction

PCC Paving Field Inspection

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Housekeeping

- Introduction
  - Instructors
  - Students
- Schedule
- Facilities
- Iowa DOT function code - 156
- Participation and experiences encouraged please omit specific names and organizations

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Manual

- PowerPoint slides
- Appendices
  - Plans
  - Specifications
  - Inspection checklist

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Course Description

- Not a certification class but specific work type training
- Targeted for inspectors with limited to no experience
- Focus will be on mainline full depth slip form paving
- Still has applicability to overlays and urban paving

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Objectives

- Introduce concepts of PCC pavement construction
- Review PCC pavement specification requirements and provide understanding of their importance
- Identify inspector duties and provide inspection resources to aid in PCC pavement daily inspection
- Give guidance on how to handle typical problems
- Provide and environment and opportunity to learn and ask questions

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Concrete Pavement Performance

- Factors influencing performance of a concrete pavement
  - Proper design
  - Appropriate specifications
  - Use of quality/durable materials
  - Quality of construction
  - Service environment

  Inspection
- Inspection is the connection between specifications and quality of construction
  - Ensuring conformity
  - Influencing overall performance

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CHAPTER 2

SAFETY

1

Section 2 - Safety

PCC Paving Field Inspection

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Work Zone Safety Statistics

- Work zone fatalities in 2021
  - Nationally - 956
  - Iowa - 5
- Work zone worker/inspector fatalities in 2021
  - Nationally - 108
  - Iowa - 2
- Workers/inspectors account for approximately 15% of work zone fatalities nationally
  - Runovers/backovers – 48%
  - Caught in between or struck by object – 14%
  - Vehicle crashes – 14%

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Work Zone Safety Statistics

- Approximately 42,000 work zone injuries per year
  - Contact with objects or equipment
  - Slips, trips, or falls
  - Vehicle crashes
  - Exposure to harmful substances or environments

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It Can Happen To You


Employee killed on I-235 project

The sudden and tragic death of **Gary Crabtree**, construction technician from the Des Moines construction office, has touched all who knew him. Police say Crabtree was killed on the I-235 project Thursday, Dec. 14, when he was struck by a cement truck.

Sean Pavlock, construction technician in Des Moines construction worked with Crabtree both in that office and Ames prior to 2002.

"Most everyone in our office is very close. Some of us came up from Ames when that construction office closed in 2002. Gary was a big kid at heart. He could always make you smile or laugh. He was also one of the most safety conscious and thorough guys we have."

A 16-year veteran of the department, Crabtree, 62, lived in Madrid with his wife, Robin. Crabtree is survived by one daughter, Justine and her husband, Tim Larsen of Treynor, Iowa; five grandchildren, Alexander, Caleb, Braden, Jamison, and Olivia; one brother, Marvin (Judy) Crabtree of Perry; three sisters, Jane (Roy) Eppert of Luther, Corenne (Dean) Barnett of Madrid, and Arlene Battani of Story City; his father-in-law and mother-in-law, John and Elma Ogaldez of Madrid; one brother-in-law, Ron Zennifel, Ogaldez of Madrid, and many nieces and nephews. Crabtree was preceded in death by his parents and one infant son.

Crabtree was an army veteran, serving during the Vietnam War from 1966 until he was honorably discharged in 1968. He joined the DOT in April 1990 as temporary summer help and was hired as a permanent employee later that summer.

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Safety Preparedness

- Understand traffic control and staging requirements
- Ensure traffic control is properly installed prior to any operation
- Be knowledgeable of emergency numbers and procedures
- Have access to first aid kit and fire extinguisher
- Actively participate in safety meetings
- Wear proper personal protective equipment
- Ensure vehicle is identifiable and properly equipped

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Traffic Control

- Conduct ongoing periodic reviews
  - Beginning
  - Stage changes and shifts
  - Day and night
- Monitor for
  - Proper set up
  - Reflectivity
  - Skids
  - Complaints
  - Crashes
- Document and communicate deficiencies to contractor
- Timely adjustments and repairs

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First Aid Kit

- Availability
- Properly stocked
- Replace every other year

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Personal Protection Equipment

- Vest
  - Class 2 minimum for daytime work
  - Class 3 required for nighttime work (pants/hat)
  - Florescent yellow green
  - ANSI/ISEA 107-2020
- Safety glasses
- Ear protection
- Steel toed boots
- Hard hat when overhead work is present

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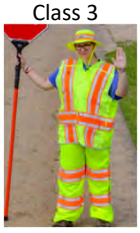
Class 2

Class 3



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Apparel

- Long pants preferred
- Shirt and hat offering protection from sun
- Avoid
  - Loose/baggy fitting clothes
  - Hoodies with draw strings
  - Ties
  - Tennis shoes

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Vehicle

- Properly identified
- A-light
  - 360-degree visibility
  - Top mount
  - Strobes
- Reflective back and/or side tape
- Activate early when slowing/entering work zone
- Use in work zone

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Hazards

- Many types exist on a PCC paving project
- Maintain situational awareness and avoid complacency
- Watch over others, especially those less experienced
- Recognize and report concerns to contractor foreman as well as your supervisor
- Halt work if serious/necessary
- Resume work only after necessary corrections have been made

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Traffic Hazards

- Assume traffic is
  - Inexperienced
  - Distracted
  - Impaired
- Stay alert
- Avoid complacency
- Leave yourself
  - Physical barrier
  - Distance
  - Way out
- Control dust by wetting grade
- Maintain safe traffic flow and limit obstructions

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Equipment Hazards

- Being backed over or run over is main hazard
- Assume operators do not see you
- When possible, make acknowledgement with operator
- Understand and stay out of blind spots
- Ensure backing warnings are operational, if not disqualify equipment
- Limit distractions and phone calls
- Position test location away from equipment movement paths
- Leave yourself an escape route
- Utilize internal traffic control to control movements and limit backing

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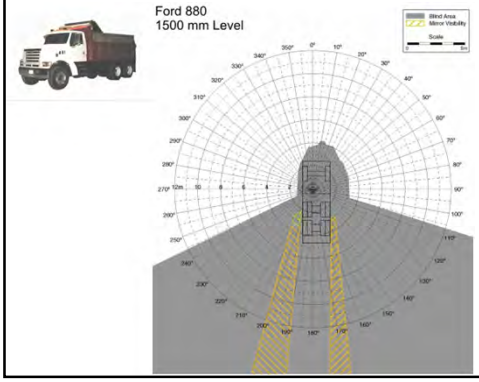
Blind Spots – Dump Truck



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Tripping Hazards

- Stringline, baskets, rough grade, and tie steel
- Avoid by
  - Seeing where you are walking
  - Staying off phone
  - Not backing up
  - Using stringless or offset stringline
  - Keeping clean work area

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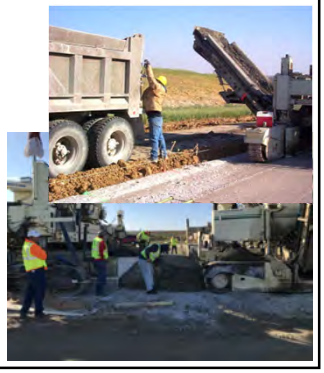
Pinch Points and Crushing Hazards

- Avoid walking underneath the belt placer
- Stay out of area between spreader, paver, and stringline
- Discuss access to paver and bridges with contractor and limit to only when required



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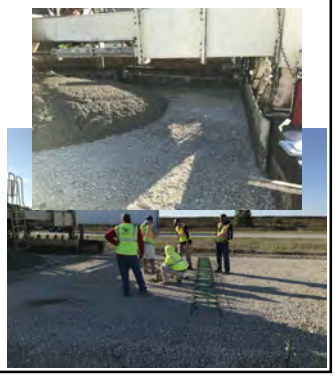
Sampling and Testing Hazards

- Stay clear of auger when sampling
- Test in an area away from equipment and traffic
- If sampling location is unsafe then find another option or do not sample



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Finishing Hazards

- Be aware of finishers
- Avoid getting hit with handle of float
- Handles should always be on downstream side of traffic

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Portland Cement Concrete Hazard

- Portland cement concrete is highly alkaline and can cause mild to severe skin reactions
- Wear gloves and safety glasses when handling
- In case of contact wash skin immediately or flush eye out repeatedly

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PCC Dust Hazards

- If inhaled can cause silicosis
- Use wet sawing or early entry sawing
- Avoid operations generating dust

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Plant Site Hazards

- Park out of the way and check in at office
- Be aware of traffic flow
- Sample safely
- Make acknowledgement with loader operator
- Follow rules of contractor
- Production vehicles have right of way

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CHAPTER 3

CONTRACT DOCUMENTS AND DESIGN

1

Section 3 - Contract Documents and Design

PCC Paving Field Inspection

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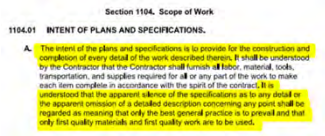
1104.01 Intent of Plans and Specifications

- Plans and specifications are contract documents
- Details work to be completed by telling
  - What
  - Where
  - How
  - With what materials
  - Quantity
- Specification and plans will not capture everything, still require best practices and quality materials



Section 1104. Scope of Work

1104.01 INTENT OF PLANS AND SPECIFICATIONS.

A. The intent of the plans and specifications is to provide for the construction and completion of every detail of the work described therein. It shall be understood by the Contractor that the Contractor shall furnish all labor, material, tools, transportation, and supplies required for all or any part of the work to make each item complete in accordance with the spirit of the contract. It is understood that the apparent silence of the specifications as to any detail or the apparent omission of a detailed description concerning any point shall be regarded as meaning that only the best general practice is to prevail and that only first quality materials and first quality work are to be used.

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1105.04 Conformity With and Coordination of the Contract Documents

- 11 contract documents
- Contract document above overrides contract document below
- Example
  - Plan note requiring concrete compressive strength testing overrides materials IM 204 requirements for strength

1105.04 CONFORMITY WITH AND COORDINATION OF THE CONTRACT DOCUMENTS.

A. In case of a discrepancy between contents of the contract documents, the following items listed by descending order shall prevail:

1. Addendum
2. Proposal Form
3. Special Provision
4. Plans
5. Standard Bridge Plans, Standard Culvert Plans, and Standard Road Plans
6. Developmental Specifications
7. Supplemental Specifications
8. General Supplemental Specifications
9. Standard Specifications
10. Materials I.M.
11. Notice to Bidders

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Materials Instructional Memorandums (IM)

- Released every October and April
- Provides information on materials
  - Approval procedures
  - Sampling and testing procedures
  - Minimum sampling and testing frequencies
  - Conditions for acceptance and use
  - Approved sources
- Accessed from ERL webpage https://iowadot.gov/erl/

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General Supplemental Specifications (GS)

- Update the Standard Specification
- Revision are reviewed and approved by the Iowa DOT Specification Committee
- GS-23001 was released with the release of the Standard Specification in October 2023
  - 23 indicates the 2023 Standard Specification
  - 001 indicates the update number
- Updates occur ever April and October
- Current and historic accessed from
  - ERL webpage https://iowadot.gov/erl/- entire specification with changes
  - Book – only sections with changes

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Divisions

Division 11	General Requirements and Covenants
Division 20	Equipment Requirements
Division 21	Earthwork, Subgrades, and Subbases
Division 22	Base Courses
Division 23	Surface Courses
Division 24	Structures
Division 25	Miscellaneous Construction
Division 26	Roadside Development
Division 41	Construction Materials

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Sections

DIVISION 21. EARTHWORK, SUBGRADES, AND SUBBASES

This work consists of grading and construction of subgrades and subbases as required for the various types of work in the following sections. Complete the work in conformance with the lines, grades, thicknesses, and typical cross sections shown in the contract documents or as established by the Engineer.

2101. Clearing and Grubbing.
2102. Roadway and Borrow Excavation.
2103. Presplitting and Production Blasting of Rock Slope Cuts.
2104. Channel Excavation.
2105. Stripping, Salvaging, and Spreading Topsoil.
2106. Settlement Plates.
2107. Embankments.
2108. Overhaul.
2109. Natural Subgrade.
2110. Soil Aggregate Subbase.
2111. Granular Subbase.
2112. Wick Drains.
2113. Subgrade Stabilization Material.
2115. Modified Subbase.
2116. Full Depth Reclamation.
2120. Fuel Adjustment.
2121. Granular Shoulders.
2122. Paved Shoulders.
2123. Earth Shoulders for Pavements and Bases.
2125. Reshaping Ditches.
2126. Reclaiming Present Surfacing Material.
2127. Reconstruction of Roadbed.
2128. Furnish and Apply Granular Shoulder Material.

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Sections

DIVISION 23. SURFACE COURSES

Construct surface courses on a prepared base, subbase, or subgrade according to the requirements specified for the various types in the following sections. Comply with the lines, grades, thicknesses, and typical cross sections shown in the contract documents or established by the Engineer.

2301. Portland Cement Concrete Pavement.
2302. Portland Cement Concrete Widening.
2303. Flexible Pavement.
2304. Detour Pavement.
2305. Safety Edge.
2306. Bituminous Fog Seal (Pavement).
2307. Bituminous Seal Coat.
2308. Bituminous Fog Seal (Shoulders).
2309. Surface Recycling by Heater Scarification.
2310. Portland Cement Concrete Overlay.
2312. Granular Surfacing.
2314. Surface Application of Calcium Chloride.
2315. Driveway Surfacing.
2316. Pavement Smoothness.
2317. Primary and Interstate Pavement Smoothness.
2318. Cold In-Place Recycled Asphalt Pavement.
2319. Slurry Leveling, Slurry Wedge (Edge Rut Treatment), and Strip Slurry Treatment.
2320. Polymer-Modified Microsurfacing.

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Sections

DIVISION 41. CONSTRUCTION MATERIALS

4100. General Provisions.
4101. Portland Cement.
4102. Water for Concrete and Mortar.
4103. Liquid Admixtures for Portland Cement Concrete.
4104. Burlap for Curing Concrete.
4105. Liquid Curing Compounds.
4106. Plastic Film and Insulating Covers for Curing Concrete.
4107. Plastic Film for Subgrade Treatment.
4108. Supplementary Cementitious Materials.
4109. Aggregate Gradations.
4110. Fine Aggregate for Portland Cement Concrete.
4111. Class L Fine Aggregate for Portland Cement Concrete.
4112. Intermediate Aggregate for Portland Cement Concrete.
4115. Coarse Aggregate for PC Concrete.
4117. Class V Aggregate for Portland Cement Concrete.
4118. Bedding Material for Non-Primary Road Projects.
4119. Bedding and Backfill Material for Interstate and Primary Road Projects.
4120. Granular Surfacing and Granular Shoulder Aggregate.
4121. Granular Subbase Material.
4122. Crushed Stone Base Material.
4123. Modified Subbase Material.
4124. Aggregate for Slurry Mixtures.
4125. Aggregate for Bituminous Sealcoat.
4127. Aggregate for Flexible Paving Mixtures.
4128. Stabilization (Foundation) Material
4130. Revetment Stone, Erosion Stone, and Gabion Stone.
4131. Porous Backfill Material.
4132. Special Backfill Material.
4133. Granular Backfill Material.
4134. Floodable Backfill Material.
4136. Joint Fillers, Sealers, and Seals.
4137. Asphalt Binder.
4138. Cutback and Liquid Asphalts.
4139. Liquid Sealing Materials for PCC Surfaces.
4140. Emulsified Asphalt.

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Developmental Specification (DS)

- Provide specifications for
  - Experimental or new technologies
  - Special requirements or processes used only in certain situations
- Assigned only to specific projects
- Applied and closely monitored by a controller
- Adjusted based on observed results
- Approved by the Iowa DOT Specification Committee
- Applicable DS will be listed in bidding proposal and contract
- Accessed
  - Specifications webpage https://iowadot.gov/specifications/Developmental-Specifications-DS/2015
  - Contracts webpage for specific letting and project https://iowadot.gov/contracts/biddocuments/november2021

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DS-23027 and DS-23051

- DS-23027 is Quality Management Concrete (QM-C)
  - Optimized mix design using Shilstone combined grading principles
  - Applied to slipform paving projects over 50,000 SY
- DS-23051 is Diamond Grinding for Rumble Strips
  - For installation of diamond ground rumble strips or sinusoidal diamond ground rumble strips
  - Can be used on any project

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Standards

- Detailed drawings showing standardized dimensions, materials, construction methods and uses
- Created for items used repetitively on various levels of roadways
- Simplifies design, encourages consistency, and promotes use of current practices
- Maintained by the Design and Bridge Methods Sections
- Standard Road Plans referenced in plan in Tabulation 105-4
- Critical to use the correct version of date shown in tabulation
- Accessed
  - ERL webpage https://iowadot.gov/erl/
- Types
  - Standard road plans
  - Standard culvert plans
  - Standard bridge plans
  - Sign truss standards

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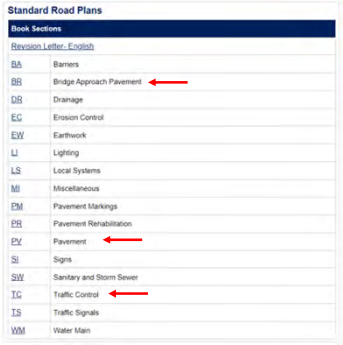
Standards



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PV-101 Joints

- Provides details for
  - Transverse contraction joints
  - Longitudinal contraction joints
  - Expansion joints
  - Dowel assemblies

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Plans

- Primary centralized location detailing where, how many, sequence, and in what way contract bid items are to be completed
- Information is provided graphically and in tabular format
- References other contract documents
- Parts of plans may be in color for ease of reading
- Organized in a specific manner “sheets” for consistency and ease of finding information
- Online plan reading course is recommended for new inspectors

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Plans

- A sheets provide general project information such as location, work type, and project number
  - Location map with stationing and mileposts
  - Index of sheets
- B sheets provide typical cross sections
  - Grading
  - Paving
  - Shoulders
  - Sideroads/Ramps
  - Superelevation
  - Special situations – tapers, islands, medians, etc….

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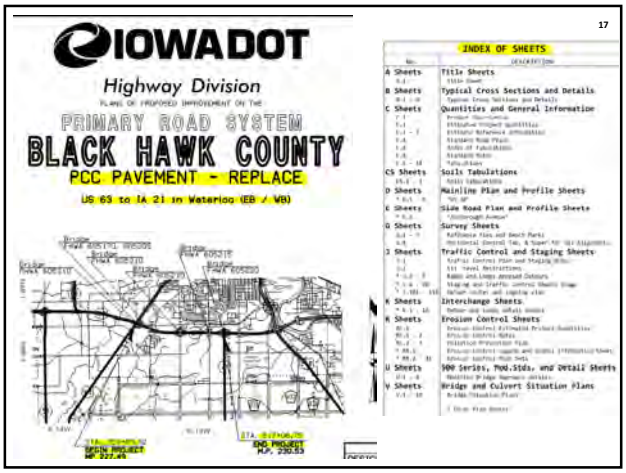

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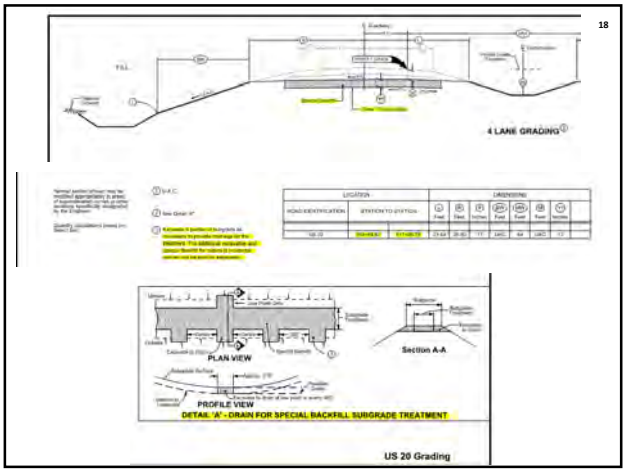

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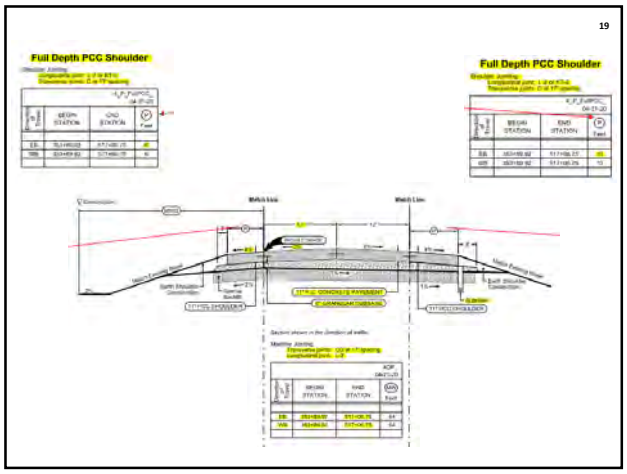

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Plans

- C sheets provide detailed item information and standards used
  - Project description
  - Estimated project quantities
  - Estimate reference information
    - Special notes for bid items
    - References to additional information
    - Incidentals
    - Method of measurement basis of payment (for 2599 items)
  - Standard road plans tabulation
  - Standard notes
  - Tabulations

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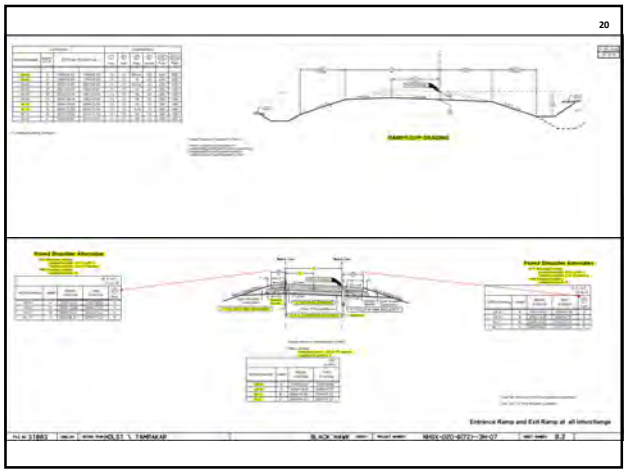

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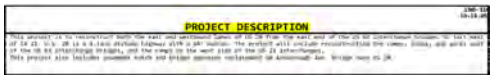

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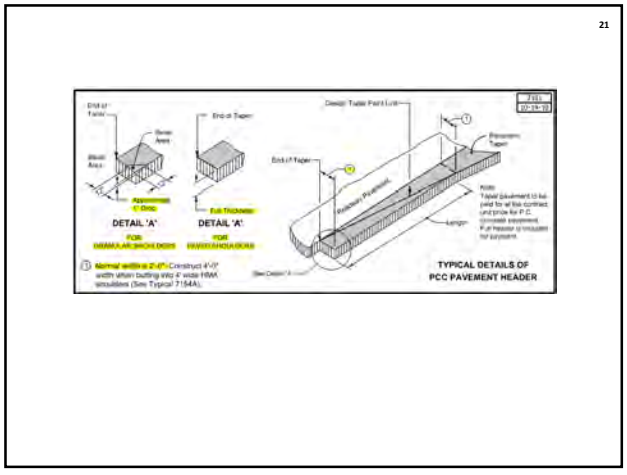

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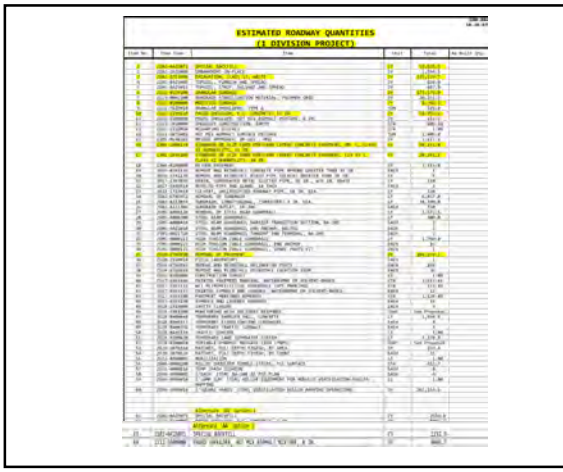

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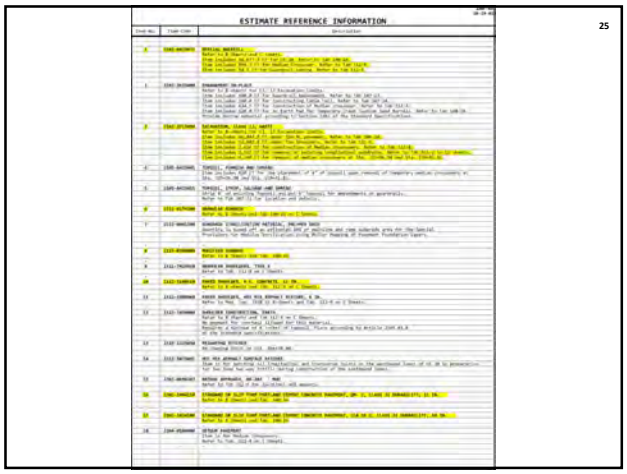

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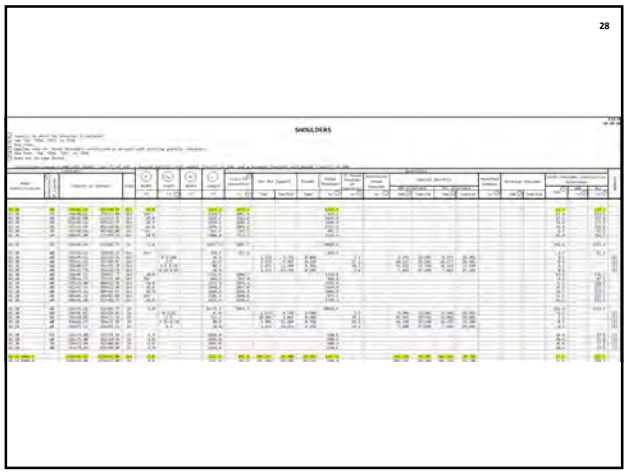

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Plans

- D (mainline), E (side roads), and F (detour) sheets provide mainline plan (overhead) and profile (side) view information
  - New and existing drainage features
  - Horizontal and Vertical curves
  - Entrances
  - Profile elevations – see typicals for lateral location
  - Ditch cut information

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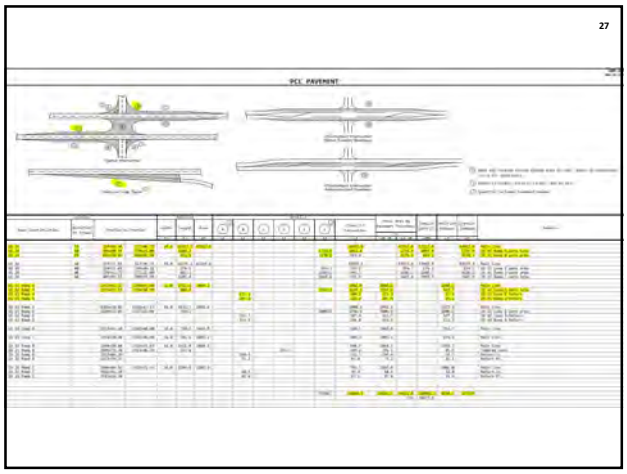

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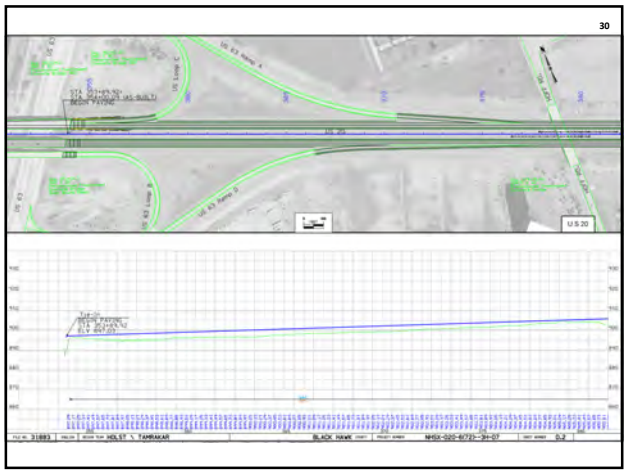

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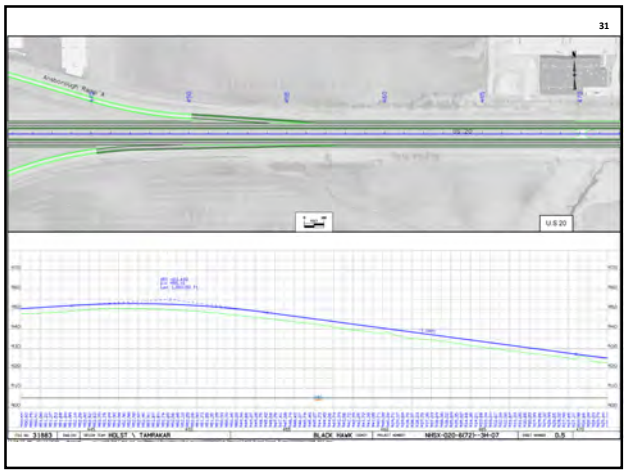

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Plans

- G sheets provide survey information
  - Reference ties
  - Benchmarks
- H (mainline) and HE (side road) sheets provide right of way (ROW) information
  - Station and offset
  - Property owner
- J sheets provide construction staging and traffic control
  - Tabulations of traffic control, special events, coordinated operations
  - Legend and symbol sheet
  - Staging sheets showing traffic locations
  - Modified TC standards

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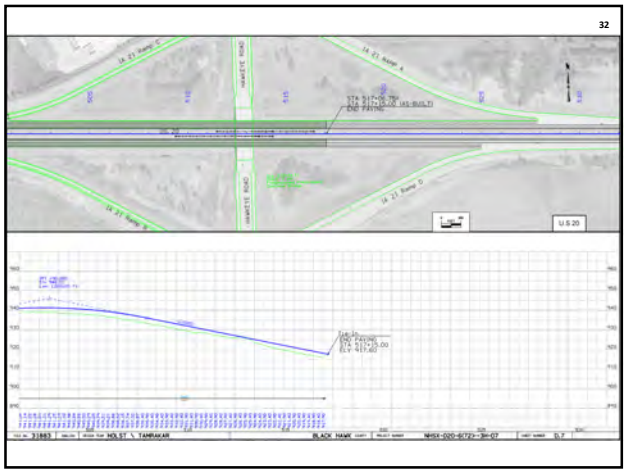

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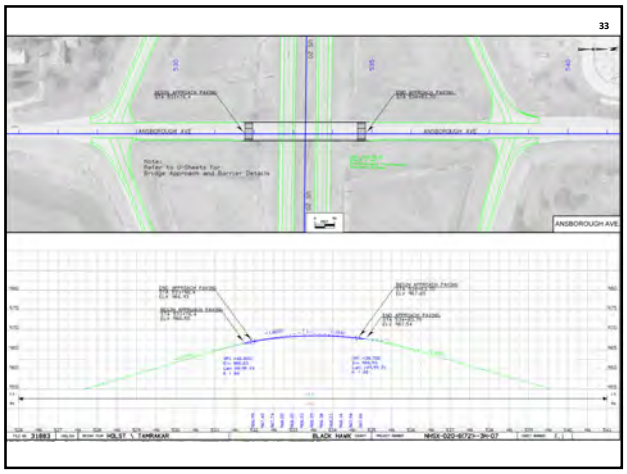

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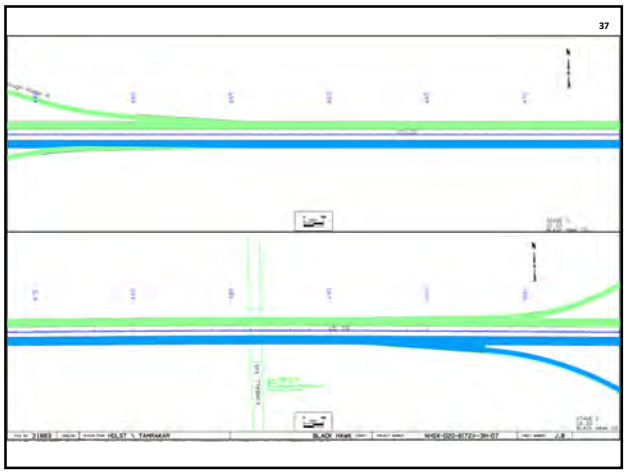

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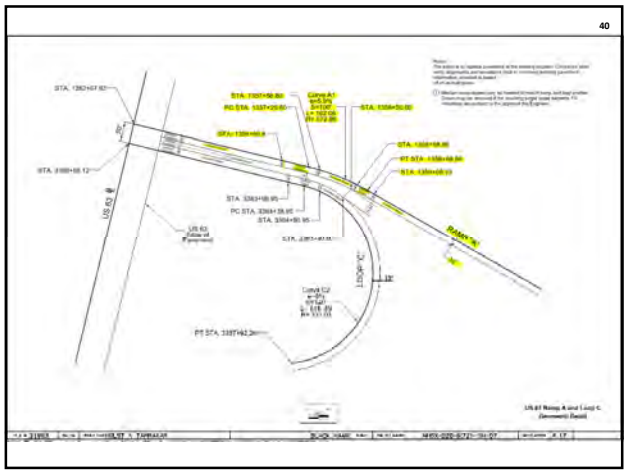

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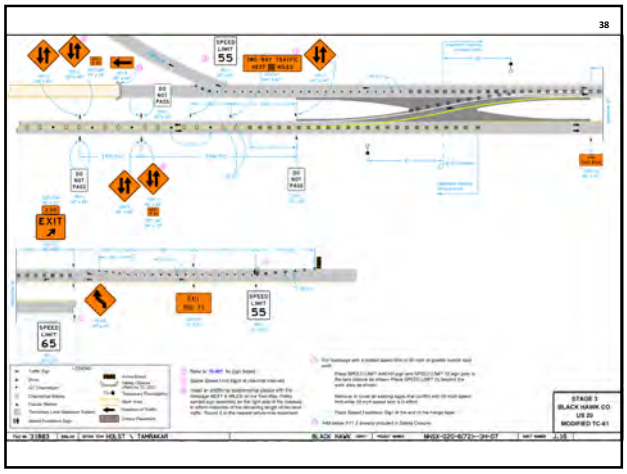

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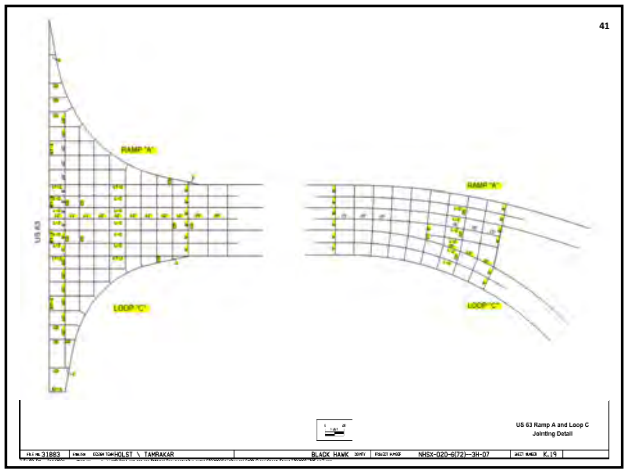

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Plans

- K sheets provide plan and profile views of interchanges/ramps
- L sheets provide intersection geometrics
  - Geometric sheets
  - Staking sheets
  - Edge profile sheets
  - Jointing sheets

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Plans

- M sheets provide storm and sanitary as well as water main information
- MIT sheets provide wetland/stream mitigation information
- N sheets provide signing and traffic signal information
- P sheets provide lighting information
- QR sheets provide borrow information
- R sheets provide information related to the pollution prevention plan (PPP) and placement of sediment and erosion control measures

42

43

Plans

- S sheets provide sidewalk plan sheets and detailed ADA compliant layout information
- T sheets provide tabulation of earthwork quantities
- U sheets provide 500 series details, modified standards and special details
- V sheets provide bridge and culvert situation plans
- W (mainline), X (side roads), Y (ramp) sheets provide cross section information
- Z sheets provide borrow cross section information

43

44

Contract

- Executed form of the proposal
- Provides
  - Location and description
  - DBE goal
  - Proposal guaranty
  - Federal aid wages
  - Contract time
  - Proposal notes
  - Proposal specifications lists (GS, SS, DS, SP)
  - Item quantities, unit prices, bid amounts
  - Addendums

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45


IOWA DOT

Contract Schedule

Page 2 of 11

Contract ID: 07-0206-072

Awarded Vendor: CEDAR VALLEY CORP., LLC

SECTION 0001 Roadway Items - NHSX-020-8(72)--3H-07 $13,032,617.65

Alt Set ID: Alt Mbr ID:

Contract Line Number	Item Number: Item Description	Item Quantity and Units	Unit Price Dollars	Unit Price Cents	Bid Amount Dollars	Bid Amount Cents
0130	2125-0225000 SHAPING DITCHES	1.000 STA	3,000	00	3,000	00
0140	2212-5575001 HOT MIX ASPHALT (HMA) PATCHES	7,400.000 TON	133	00	992,400	00
0150	2301-1660000 BRIDGE APPROACH, BR-223 - MOD.	1,117.224 SY	165	00	184,342	92
0160	2301-1554110 STANDARD OR SLIP-FORM PORTLAND CEMENT CONCRETE PAVEMENT, QM-C, CLASS 3X DURABILITY, 11 IN.	101,127.000 SY	40	37	4,082,448	99
0170	2301-1034120 STANDARD OR SLIP FORM PORTLAND CEMENT CONCRETE PAVEMENT, CLASS C, CLASS 3X DURABILITY, 17 IN.	10,243.100 SY	69	72	490,048	43
0180	2304-0125000 DETOUR PAVEMENT	3,555.000 SY	56	10	197,191	68
0190	2416-0127110 REMOVE AND REINSTALL CONCRETE PIPE APRONS GREATER THAN 36 IN.	1.000 EACH	2,750	00	2,750	00
0200	2416-1511120 REMOVE AND REINSTALL RCBM PIPE CULVERT GREATER THAN 36 IN.	5.000 LF	475	00	2,555	00
0210	2417-2301000 DRAIN, CORRUGATED METAL SLOTTED PIPE, 36 IN., W/I.M. GRATE	110.000 LF	162	50	17,825	00
0220	2417-5080010 BEVELED PIPE AND GUARD, 14 INCH	2.000 EACH	3,000	00	6,000	00

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Addendum

- Revision to the contract documents occurring two weeks or more after plan turn in
- Often generated from omissions having significant bidding or project impacts
- Least desirable method of making revisions due to timing and assuring distribution
- Overrides all other contract documents
- Issued by Contracts Bureau and provided electronically directly to bidders
- Accessed
  - BidX webpage for specific letting and proposal ID https://ui.bidx.com/ia/lettings

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47

1105.04 Conformity With and Coordination of the Contract Documents

- Work shall be within reasonably close conformity of contract documents
- Work not within reasonably close conformity may be accepted by engineer provided it is reasonably acceptable and documented
- Work not within reasonably close conformity that is unacceptable shall be corrected at the expense of contractor

F. All work performed and all materials furnished shall be in reasonably close conformity with the lines, grades, cross sections, dimensions, and material requirements, including tolerances, shown in the contract documents.

G. If the Engineer finds the material or the finished product in which the material is used is not within reasonably close conformity with the contract documents but that reasonably acceptable work has been produced, the Engineer will then make a determination if the work shall be accepted and remain in place. In this event, the Engineer will document the basis of acceptance by contract modification which will provide for an appropriate adjustment in the contract price for such work or materials as is necessary to conform to the determination based on engineering judgment.

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Reasonably Close Conformity

- Consult and discuss with engineer and potentially PCC Field Engineer
- Engineer decision heavily influenced by inspector input
- Fair and reasonable
- Consider
  - Specific circumstances
  - Past precedence
  - Long term quality and durability
  - Project safety, traffic, staging, and duration
  - Future maintenance and life cycle costs
  - Public perception and aesthetics
- Appendix 2-34 of the Construction Manual (CM) provides price adjustment schedules
- Removal will typically be contested more rigorously as it involves additional operations, equipment, and time

48

49

Reasonably Close Conformity Example

- Specification for concrete air content for paving is 6.0 to 10.0 percent in front of paver
  - Test result is 7.7%
    - Considered within reasonably close conformity "complying"
  - Test result is 10.3%
    - Not within reasonably close conformity not significant risk, other occurrences, been running on high end of specification
    - Engineer decides to price adjust according to the schedule in the construction manual
  - Test result is 10.3%
    - Not within reasonably close conformity not significant risk, only occurrence, and contractor has been exceptional with respect to quality
    - Engineer decides to accept with no price adjustment
  - Test result is 3.5%
    - Not within reasonably close conformity with significant risk
    - Engineer decides to remove and replace

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CHAPTER 4

JOINTING

1

Section 4 - Jointing

PCC Paving Field Inspection

1

2

Cracking

- PCC pavements crack naturally from internal stresses that develop after placement
- Stresses result from
  - Plastic and drying shrinkage – moisture loss
  - Subbase friction/restraint
  - Thermal contraction
  - Temperature and moisture gradients
  - Applied loads

2

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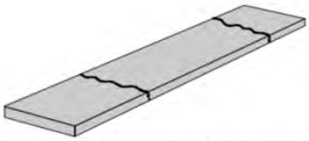
Natural Crack Progression

- 12 to 24 hours
- Moisture loss
- Thermal contraction



Cracking begins at a 40-80 ft. interval

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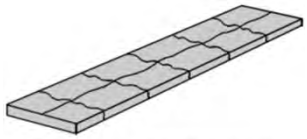
Natural Crack Progression

- 12 hours to months
- Temperature gradients
- Moisture gradients
- Thermal cycles
- Applied loads



Stresses continue to buildup leading to cracking at a 15-20 ft. interval

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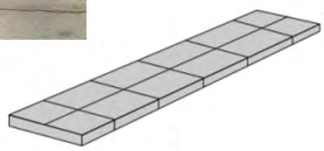

Natural cracking can be mitigated through jointing

5

6

Purpose of Joints

- Creates a straight, predictable, and maintainable locations for cracks to occur
- Accommodates thermal movements
- Provides load transfer between slabs
- Mitigates curling and warping stresses
- Impacts ride quality, deflections, and stresses under traffic
- Filled to protect against intrusion of water and incompressible materials

6

7

Joint Types

- PV-101
  - Contraction
    - Transverse
    - Longitudinal
  - Construction
    - Transverse
    - Longitudinal
  - Expansion
    - Transverse
    - Longitudinal

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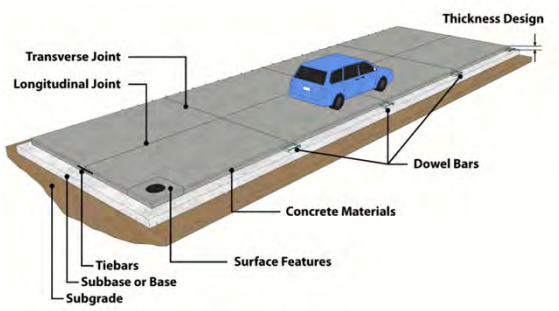

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Transverse Contraction

- Create location for expansion and contraction which prevents buckling from thermal expansion
- Perpendicular for Iowa DOT
- Perpendicular or skewed for local agency
- Responsible for load transfer between slabs in the direction of traffic
- Spacing is important to performance

9

10

Transverse Contraction

- C joint for pavements typically
  - Less than 8 inches thick
  - Carrying fewer than 100 trucks per day per lane
  - Aggregate interlock for load transfer
- CD joint for pavement typically
  - Equal to or greater than 8 inches thick
  - Carrying more than 100 trucks per day per lane
  - Dowels for load transfer

10

11

Aggregate Interlock

- Relies on interaction of aggregate particles on either side of joint beneath saw cut to transfer load and keep slabs aligned
- Load transfer efficiency improves with
  - Smaller crack opening
  - Use of longitudinal tie bars
  - Stiff uniform subgrades
  - Crushed stone subbases
- Faulting and pumping can result over time

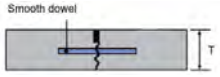
Joint Opening Below Saw Cut	Joint Efficiency
1/16"	>50%
1/8"	<50%
1/4"	0%

11

12

Dowels

- Relies on smooth non-bonded dowels across joint to transfer load and keep slabs aligned
- Provides superior long-term performance under heavy traffic loading compared to aggregate interlock by limiting
  - Horizontal and vertical slab movement
  - Minimizing influences of crack opening
  - Lowering deflections and stress
- Placed across entire width of slab



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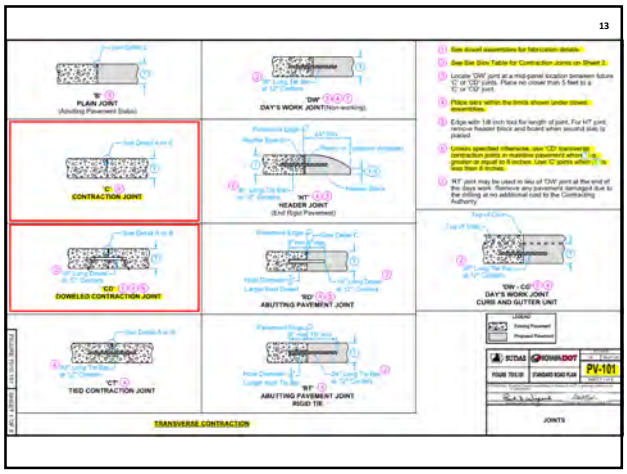

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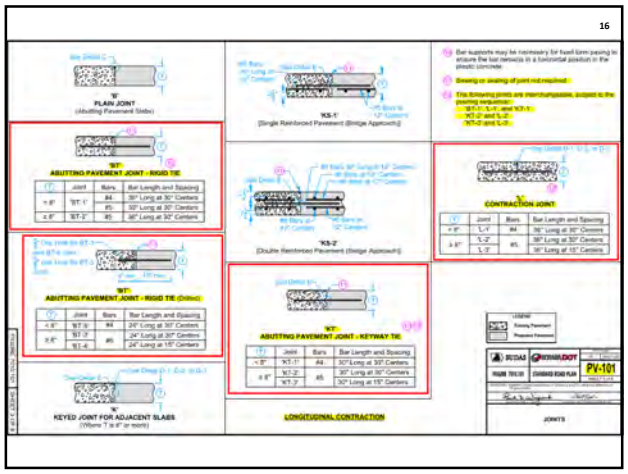

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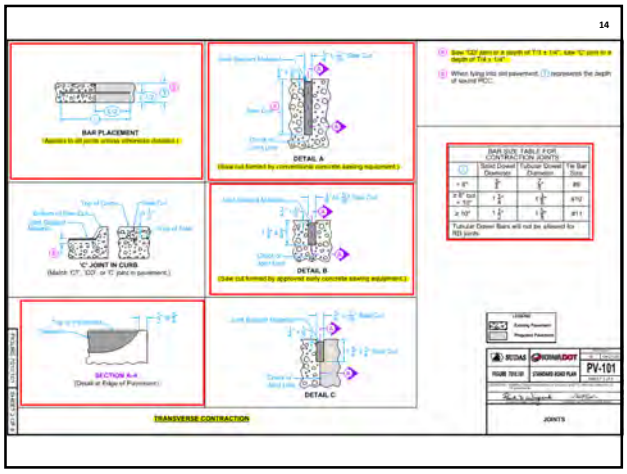

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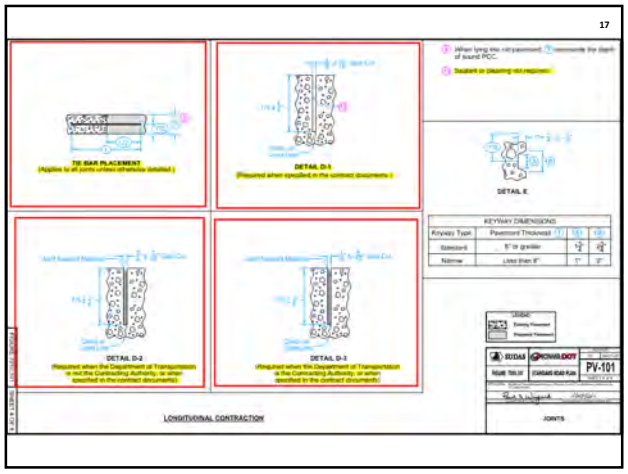

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Longitudinal Contraction Joints

- Create location for expansion and contraction which prevents cracking from thermal expansion
- Ties slabs together to act monolithically and keep from separating
- Deformed steel or combination of deformed steel and keyway
- Increases aggregate interlock
- Delineate traffic lanes

15

18

Contraction Joint Spacing

- Plans should indicate
- Proper joint spacing reduces potential for
  - Random cracks
  - Corner breaks from curling and warping
- General rules
  - Transverse
    - 6 to 7 inch thick pavement – 2 times thickness in feet
    - 8 to 9 inch thick pavement – 15 feet
    - 10 inch or greater thick pavement – 17 foot maximum
  - Longitudinal
    - 10 to 12 feet or at 1/3rd or ¼ points
    - Not recommended greater than 12.5 feet

18

19

Construction Joints

- Provide connection to adjoining pavement
- Edge of placement due to (longitudinal)
  - Limitation of paver width
  - Abutting lane or shoulder
  - BT or KT joint
- Beginning or end of placement due to (transverse)
  - Abutting existing pavement
  - Completion of days work
  - Break down or substantial delay
  - DW, or RT joint

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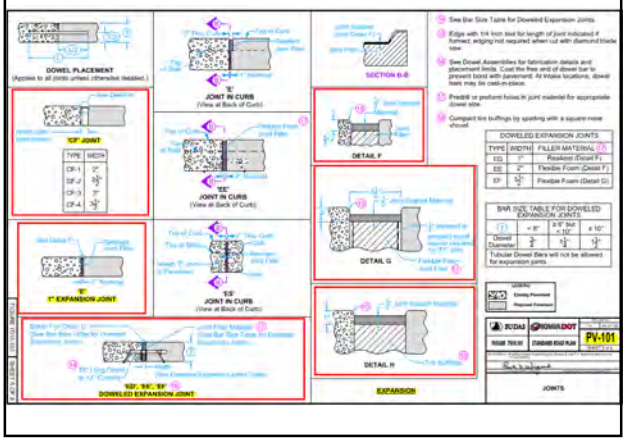

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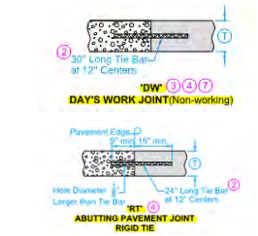
DW and RT Joint

- DW uses header board and bars are inserted into plastic PCC
- RT uses a runout and sawing, or form followed by drilling and epoxying of bars
- Available time and stagging will determine which is used
- Place at mid-panel between C or CD joint when possible
- Never closer than 5 feet to C or CD joint



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Jointing Layouts

- Provided in L sheets for complex areas like intersections, ramps, tapers, etc…
- Identify joint type, location, and spacing
- Provide for
  - Review and discussion prior to construction
  - More accurate bids
  - Better consistency
  - Clear guidance
- Not perfect but can be adjusted to meet field conditions

23

21

Expansion Joints

- Isolates pavement from
  - Fixed objects like bridges and intakes
  - Objects that move differentially like other pavements
- Allow pavement to move without damaging adjacent pavement or structure
- Full depth and full width
- Typically doweled to provide load transfer
- Wide opening is filled with compressible filler to prevent incompressible material intrusion

21

24

Good Jointing Practices

- Match existing joints or cracks
- Place joints to meet in-pavement structures such as manholes and intakes
- Don't exceed maximum spacing
- Joint angles should be 70 degrees or greater
- No more than 4 joints should intersect
- Slabs are square or pie shaped
- Slabs are never less than 2 feet wide
- Place expansion joints where needed

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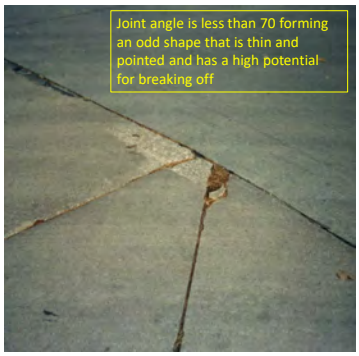

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CHAPTER 5

CERTIFICATIONS

1

Section 5 - Certifications

PCC Paving Field Inspection

1

2

Technical Training and Certification Program

- IM 213
- Ensures certified inspection is used for quality control (QC), verification (V), and independent assurance (IA) testing
- Provides confidence that equipment and procedures used for testing materials and work are correct and consistent
- Required by specification and part of agreement for federal and state funding

2

3

Technical Training and Certification Program for PCC

Certification	Name	Prerequisite	Focus
Level I PCC	PCC Testing Technician	None	Grade Sampling and Testing
Level II PCC	PCC Plant Technician	Aggregate Technician and Level I PCC	Certified Plant Inspection and Monitoring
Level III PCC	PCC Mix Design Technician	Level II PCC	Design of Specialized PCC Mixes
NA	PCC Paving Field Inspection	None	Inspection of PCC Paving
Ride Quality	Ride Quality Technician	None	Pavement Smoothness Evaluation

3

4

Fraud Federal Code

- Title 18 United States Code 1020
- FHWA Form 1022
- Applicable to contractors, subcontractors, suppliers, inspectors, engineers, etc... on federal aid projects
- Knowingly makes false statement, representation, or reports related to quality, quantity, or cost of
  - Materials
  - Work
  - Submissions
  - Certifications
- Punishable by not more than
  - $10,000 fine
  - 5 years in prison
  - Or both

4

5

Fraud State Code

- Iowa Code 714.8, subsection 3
- Applicable to contractors, subcontractors, suppliers, inspectors, engineers, etc…. non-federal aid funded projects
- Knowingly executes or tenders a false certification, affidavit, or certificate required by law or given in support of payment
- Depending on amount of money claimed for payment
  - Class C or D felony
  - Potential fines and/or prison

5

6

Decertification of Certified Technicians

- Use of false or fraudulent information to secure or renew a certificate
- Use of false or fraudulent documentation by the certificate holder
- Use of misleading, deceptive, untrue or fraudulent representations by the certificate holder

6

CHAPTER 6

QUALITY ASSURANCE

PROGRAM IM 205

AND IM 204

1

Section 6 -

Quality Assurance Program IM 205 and IM 204

PCC Paving Field Inspection

1

2

Quality Assurance Program

- IM 205
- Assures the quality of materials and construction work incorporated into projects is in reasonable conformity with the contract documents
- Types of sampling and testing
  - Quality control
  - Verification
  - Independent assurance

2

3

Quality Control Sampling and Testing

- Evaluation of materials and construction work to ensure quality is satisfactory
- Conducted at high frequencies to identify issues early and allow for timely adjustments
- Minimizes risk to contracting authority and contractor
- Performed by the certified contractor personnel
- Location, frequency, and procedures identified in IM 204
- May be used for verification when
  - Required and allowed by specification
  - Validated by contracting authority

3

4

Verification Sampling and Testing

- Evaluation of materials and construction work to ensure quality is satisfactory for acceptance and payment
- Conducted less frequently than QC testing
- Performed by certified contracting authority personnel
- Sample location and times are randomly determined by the contracting authority and should be unknown to the contractor
- Contractor may assist in obtaining samples as directed and witnessed by the contracting authority
- Samples should remain in the possession of the contracting authority unless secured with tamper proof measures
- Location, frequency, and procedures identified in IM 204
- Contracting authority personnel and equipment will be independently evaluated with IA testing

4

5

Independent Assurance Sampling and Testing

- Evaluation of personnel and equipment involved in verification sampling and testing to ensure correctness
- Conducted on a systematic time frame or when issues are suspected
- Performed by certified contracting authority district materials personnel
- Evaluation based on
  - Calibration checks
  - Split sample
  - Proficiency samples
  - Observation of sampling and testing
- Issues identified must be resolved immediately
- Location, frequency, and procedures identified in IM 204

5

6

Testing Disputes

- Can occur if QC tests are used for acceptance and must be verified
- District materials engineer will follow a dispute resolution process to try and resolve the dispute
- Contracting authority results will be used for acceptance for disputes that cannot be resolved or if QC testing is found to be in error

6

7

Sampling and Testing Guide

- IM 204
- Provides **minimum** sampling and testing requirements for various materials and construction work
- Contracting authority at any time can test more frequently especially if known or suspected deficiency exists
- Appendix E Portland Cement Concrete Pavement, Pavement Widening, Base Widening, Curb and Gutter, and Paved Shoulders

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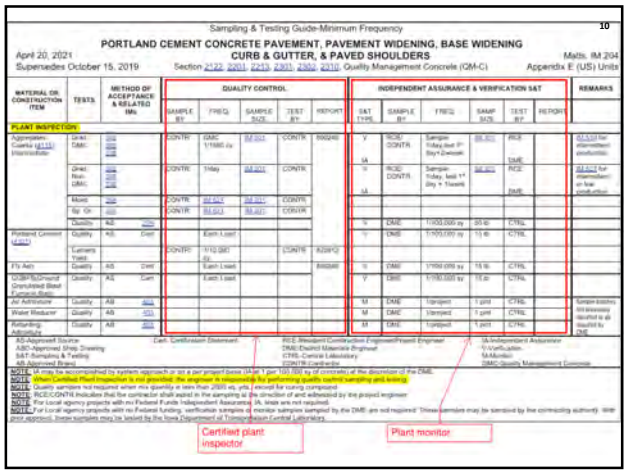

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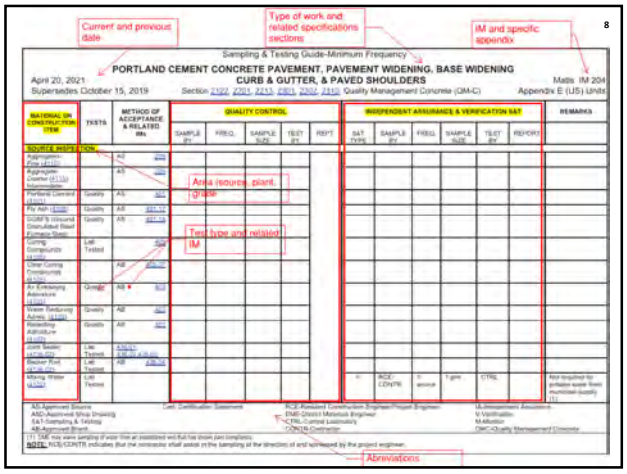

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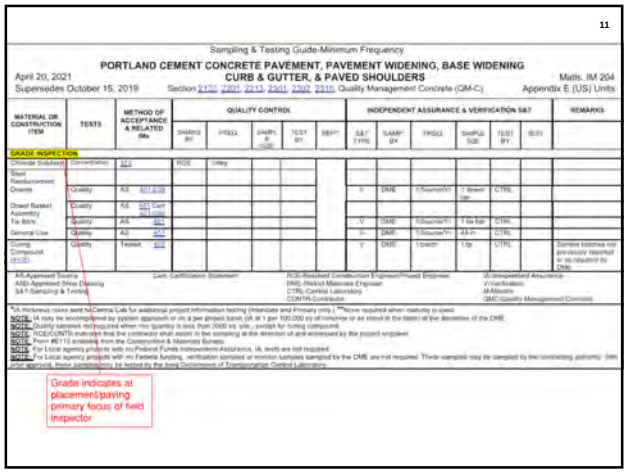

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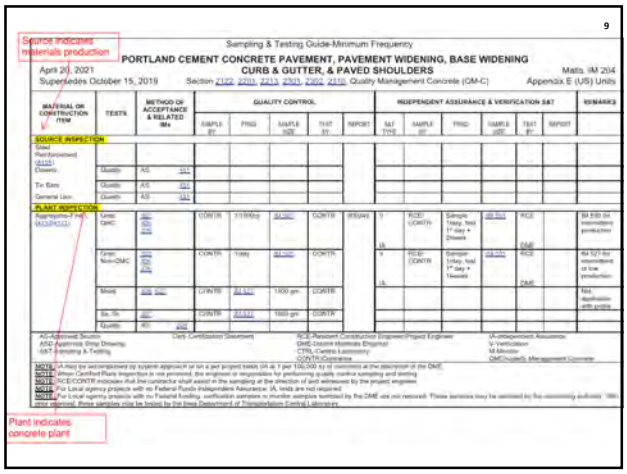

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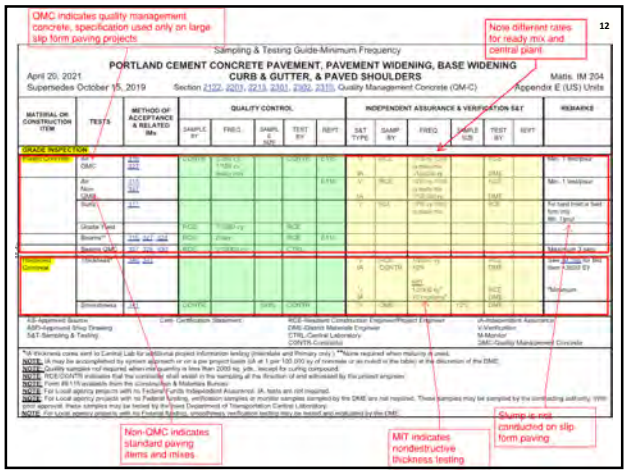

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CHAPTER 7

MATERIALS & MIX DESIGN

Section 7 - Materials & Mix Design

PCC Paving Field Inspection

1

What is Portland Cement Concrete

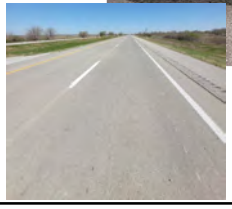
- Concrete is the most widely used construction material in the world
- Composite material made up of component materials (cement, water, aggregates)
- Concrete is an engineered material designed to meet the intended application
- Concrete is NOT cement

2

Cement Versus Concrete

Cement

Concrete



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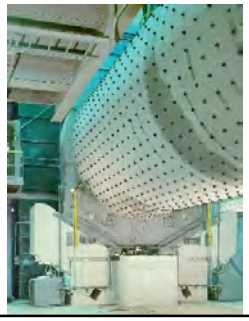
Portland Cement Production

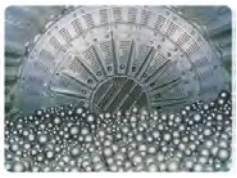
- Limestone and clay are crushed, blended, & burned in a rotating kiln at 2700 °F.
- Materials chemically combine to form cement clinker

4

Portland Cement Production



- Cement clinker and gypsum ground in ball mill
- Produces the fine, gray powder



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Portland Cement Types

- Major Types C150 & C595
- Typically used Type I/II , but now blended is most common (IL)
- Standard Specification 4101
- IM 401 - approved sources

Five major cement types and their characteristics ASTM C150

Cement Type	Use	Characteristic
I	Normal use	> 8% C_3A
II	Moderate sulfate resistance	< 8% C_3A
III	High early strength	Fine ground type I
IV	Low heat of hydration	< 35% C_3S
V	High sulfate resistance	< 5% C_3A

Blended cements and their composition ASTM C595

Cement Type	Composition
IS(X)	X is the percent GGBFS – (example IS(20))
IP(X)	X is the percent pozzolan – (example IP(25)
IL(X)	X is the percent limestone – (example $IL_1$10)

6

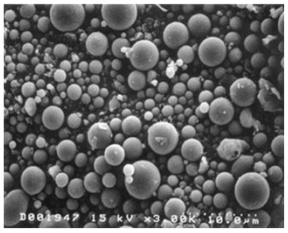
Supplementary Cementitious Materials (SCMs)

- Materials used to partially replace Portland cement and provide concrete that has
  - Improved concrete properties
  - Lower costs
  - Lower carbon footprint
- Fly ash and ground granulated blast furnace slag (GGBFS) are most commonly used for paving
- 50% replacement allowed

7

Fly Ash

- Byproduct of coal burning electric generating stations
- Fine spherically shaped particles are collected in electrostatic precipitators
- Reacts with water (cementitious) and/or in the presence of cement hydration compounds (pozzolanic)



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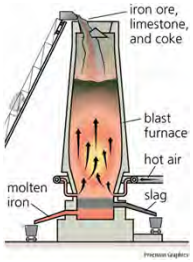
Fly Ash Classes

- Class C and Class F
- Class C cementitious & pozzolanic
- Class F pozzolanic
- Standard Specification 4108
- IM 491.17 - approved sources

9

Slag (GGBFS)

- Byproduct of iron production
- Limestone added to blast furnace becomes molten and removes iron impurities
- Molten limestone (slag) floats to the surface and is tapped and rapidly cured with a water jet to form glassy granulated slag
- Glassy granulated slag is ground to produce extremely fine GGBFS with an angular shape
- Reacts with water (cementitious)



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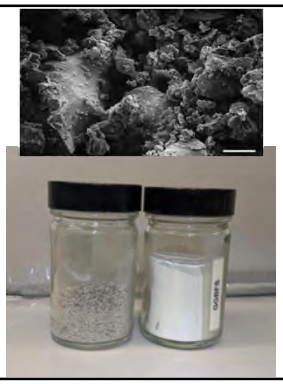
GGBFS Grades

- Grade 100 or 120
  - Relates to how reactive
- Standard Specification 4108
- IM 491.14 approved sources



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Water

- Standard Specification 4102
- Natural sources are acceptable after testing
- Potable municipal sources are acceptable without testing
- Avoid shallow or depletable natural sources
- District materials can sample and coordinate testing

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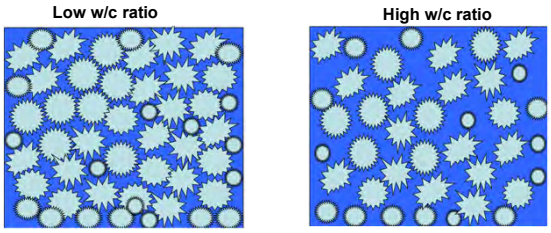
W/C Ratio

- Weight of all water added divided by weight of all cementitious materials
- The w/c ratio is a critical parameter for durability and strength



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Chemical Admixtures

- Air Entraining, Water Reducing, Retarding
- Enhance properties of a good mix NOT fix a poor mix or bad construction practices
- Standard Specification 4103
- IM 403 – approved sources

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Air Entraining Admixtures

- Stabilize and entrain millions of tiny bubbles formed during mixing
- Entrained air bubbles provide freeze thaw protection
- Secondary effect of
  - Reduced strength
  - Improved workability
  - Decreased bleeding potential
- Compressive strength is reduced approximately 5 percent for every 1 percent of entrained air

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Freeze Thaw Damage

- Concrete allows water into the capillary pores
- Freezing temperatures turn the water into ice expanding by about 9 percent in volume
- Air bubbles act as pressure relief valves to accept the displaced water and expanding ice and prevent damage to the paste

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Water Reducers

- Reduce the quantity of water required to achieve a given degree of workability
- Secondary effect of
  - Retarding set
  - Entrain air

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Retarders

- Delay and slow the early stages of hydration
- Usually classified as a water reducer/retarder
- Although hydration is delayed and slowed, ultimate strength and durability are the same or slightly increased
- Used for long or metro hauls and during hot weather
- Provides additional 30 minutes delivery time with dump trucks & ready mix

18

Coarse Aggregate

- Standard Specification 4115
- Material retained on the #4 sieve and above
- Typically meets gradation 3, 4, or 5 on Table 4109.02-1
- Crushed limestone, crushed quartzite, or gravel
- A washed crushed limestone is commonly used in Iowa
- Meet specified durability class

19

Intermediate Aggregate

- Standard Specification 4112
- Material passing the ½ inch sieve and retained on the #4 sieve
- Meets gradation 2 on Table 4109.02-1
- Used to obtain a well graded combined grading on QM-C & C-SUD mixes
- Introduced as separate third bin, providing easy adjustments to aggregate blends

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Class V Aggregate

- Standard Specification 4116
- Sand gravel blend from Platte River in Nebraska with ~½ inch top size
- Meets gradation 7 on Table 4109.02-1
- Well graded combination typically at a 45% coarse aggregate and 55% Class V
- Requires use of class F fly ash or GGBFS to reduce potential alkali silica reactivity

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Fine Aggregate

- Standard Specification 4110
- Natural sand passing the #4 sieve
- Meets gradation 1 on Table 4109.02-1
- Shale and coal limits but no durability classes

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Approved Aggregate Sources & Durability Classes

- IM T-203
- Durability classes are assigned to coarse and intermediate aggregate based on physical and chemical tests
- Three classes
  - Class 2 = minimal deterioration only after 20 years, non-interstate usage
  - Class 3 = minimal deterioration only after 25 years, non-interstate usage
  - Class 3I = minimal deterioration only after 30 years, interstate usage
- Selected by designer based on road classification and traffic volumes
- Identified in the PCC paving bid item

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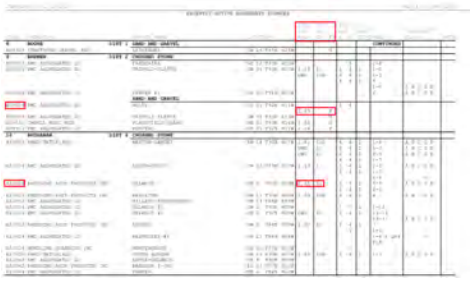
T-203



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Mix Designs IM 529

- Prescriptive traditional Iowa DOT approach to mix design
- Typically Class C used for mainline
  - Class A may be used on shoulders
- QM-C – contractor designs well graded aggregate proportions
- C-SUD – similar to QMC
- **NOTE** – QM-C & C-SUD designed for slip form machine
  - Use C-WR mixes for hand work

27

Mainline Paving

- Paving bid item will identify the class of mix and the durability class of aggregate to be used
- Typically
  - Class C less than 50,000 SYs
  - QM-C equal to or greater than 50,000 SYs
- 2301.02 B. 1. a., contractor may use any aggregate blend per IM 529 except 5 and 6 may not be used on interstate or primary roadways
- 2301.01, if the mix is not specified, Class C concrete shall be used

16	2301-1004110	STANDARD OR SLIP-FORM PORTLAND CEMENT CONCRETE PAVEMENT, QM- C, CLASS 3I DURABILITY, 11 IN.	SY	94,152.8
17	2301-1034100	STANDARD OR SLIP FORM PORTLAND CEMENT CONCRETE PAVEMENT, CLA SS C, CLASS 3I DURABILITY, 10 IN.	SY	20,241.1

28

Other Paving

- Shoulders
  - 2122.02 B. refers to 2201, use Class A, Class C, or the mixture used in mainline paving

10	2122-5190110	PAVED SHOULDER, P.C. CONCRETE, 11 IN.	SY	54,792.6

- Detour
  - 2304.02, use PCC or HMA as options
    - Normal – Class A with Class 2 or better durability coarse aggregate
    - Median crossovers – Class C with Class 3 or better durability coarse aggregate
    - Left in place - Class C with Class 3 or better durability coarse aggregate

18	2304-0100000	DETOUR PAVEMENT	SY	3,515.0
19	2304-0100000	DETOUR PAVEMENT, Item is for Median Crossovers.		

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SCM Substitution

- Maximum substitution rate 2301.02 B. 6.
  - Fly ash - 20%
  - GGBFS - 35%
  - Total - 50%
- Fly ash only substitution allowed when using type IP or IS cement
- October 16 to March 15 substitution only allowed when using maturity
- Substitution rates can be determined from
  - Mix nomenclature
  - Plant report

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CHAPTER 8

PROJECT TEAM AND PLANNING

1

Section 8 -
Project Team and Planning

PCC Paving Field Inspection

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Project Team

- Engineer – responsible for managing inspectors and certifying contract administration
- Inspector - acts on behalf of engineer, responsible for inspection and contract administration
- Contractor – private company in contract with the contracting authority to complete the work
- Subcontractor – private company that completes work for the contractor
- Consultant - private company hired by the contracting authority or contractor that provides engineering and/or inspection services
- Certified Plant Inspector (CPI) – responsible for plant quality control and certified plant inspection
- Plant Monitor – responsible for verifying certified plant inspection is properly done
- District Materials Engineer - responsible for certifying materials incorporated and testing completed meets contract requirements
- PCC Technician – responsible for providing PCC technical assistance at the district level

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Project Team Mission

- Complete the project on time and on budget with construction practices and materials meeting the contract document requirements
- Work cooperatively
- Communicate effectively
- Fair and reasonable
- Adversarial, punitive, or my way only attitudes will result in difficulties

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Pre-Construction Conference

- CM 2.11
- After award of contract but prior to starting work
- Scheduled well in advance of starting work to allow questions and problems to be addressed
- Organized and run by the Engineer
- Include contractor, subcontractor(s), inspectors, and others deemed critical for execution of the work
- Items discussed include
  - Contract administration items
  - Personnel and contact information
  - Schedule
  - Utilities
  - Project specific details
- Opportunity to ask questions and get everyone on same page

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Pre-Concreting Conference

- CM 9.01
- Meeting between Engineer, inspectors, contractor, and suppliers prior to paving
- Focused on concrete production and pavement quality issues including
  - Safety
  - Personnel and duties/authority
  - Material and mix approvals
  - Haul routes, delivery methods, and times
  - Subgrade treatment
  - Steel placement
  - Placement and finishing techniques
  - Tining and curing
  - Joint sawing
  - Sampling and testing
  - Protection from rain and cold
  - Opening method and requirements
  - Procedures if problems occur
  - Questions and concerns
- Paving operation happens quickly, costs a lot, and is permanent so it must be right first time

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CHAPTER 9

SUBGRADE AND SUBBASE

1

Section 9 - Subgrade and Subbase

PCC Paving Field Inspection

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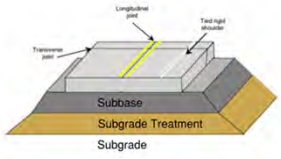
Rigid Pavement System

- PCC pavement is rigid
- Design relies on
  - Structural capacity of the PCC
  - Uniformity of support of underlying layers
- Underlying layers include
  - Subbase
  - Subgrade treatment
  - Subgrade



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Uniformity

- Critical to
  - Limit pavement settlement and cracking
  - Ensure consistent and adequate pavement thickness
  - Provided drainability
  - Enhance pavement smoothness
- Major causes of non-uniformity and instability are
  - Expansive soils
  - Frost heave susceptible soils
  - Erodible soils that can pump from repetitive loading
  - Improper construction and compaction
    - Cut fill transitions
    - Trenches

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Subgrade

- Standard Specification 2107, 2109, 2301.03 B
- Lowest foundational layer for the pavement consisting of natural soil that is graded and compacted
- Typically Class 10 which is general fill between select and unsuitable
- Weak or unsuitable areas must be addressed before building upon

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Subgrade Treatment

- Standard Specification 2107, 2109, 2301.03 B
- Upper most portion of subgrade consisting of highest quality material or stabilized material that is graded and compacted
- Used when subgrade is unsuitable and does not provide the desired support or uniformity
- Method used depends on the type, quality, and quantity of soils available on-site
- Methods include
  - Select soil
  - Special backfill
  - Polymer grid
  - Fly ash stabilization

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Select Soil

- Standard Specification 2102 D. 1.
- Select materials can be
  - Cohesive soils
  - Granular soils
  - Special backfill
  - Modified subbase
- Use of on-site soils or borrow is preferred as it is cheaper than importing material or using other methods
- Excellent density and shear strength after compaction
- Localized weak areas can be enhanced by coring out and using additional select
- Select sand will be top coated with 3 inches of special backfill to improve cohesiveness and stability

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Special Backfill

- Standard Specification 2102 D. 1., 4132
- Uniform mixture of coarse and fine particles of
  - Crushed stone, crushed PCC, crushed composite pavement, or reclaimed HMA
  - Mixtures of gravel, sand, and soil
  - Uniformly blended combinations of all
- Must meet gradation requirement
- Provides excellent stability when compacted due to high fine particle content
- Used to stabilize localized areas of soft and unstable subgrade

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Fly Ash Stabilization

- Special provision
- Used to stabilize wet or unstable subgrade or low quality select material
- Process
  - Spreading fly ash
  - Intergrinding fly ash, water (when needed), soil
  - Immediate compaction prior to setting
- Type C ash is used as it is self cementing
- Addition rate is approximately 10 to 15 percent of dry weight of soil
- Avoid placing on windy days

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Polymer Grid

- Standard Specification 2113
- High strength polymer material called subgrade stabilization material in specification
- Typically placed on subgrade with special backfill placed on top
- Used when
  - Other methods have not been successful
  - On-site materials are not available, or haul is excessive
- Works by using high tensile strength and interlock with granular material to dissipate loads
- Ensure
  - Placed only under pavement avoiding subdrains
  - Proper overlap
  - Not damaged or cut
  - Limited UV exposure

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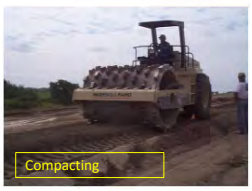

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Construction of Subgrade and Subgrade Treatment

- Under pavement or base
- Remove stones 4 inches or larger
- Compact with appropriate moisture and roll until uniformly firm
- Repair any damage or rutting immediately
- Before final template shape is made proof roll the subgrade and make necessary corrections
- Intelligent compaction is being used on pilot projects to provide real time understanding of stability and uniformity
- Ensure proper cross slope to provide drainage prior to trimming

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Trimming

- Standard Specification 2109
- Top of subgrade or subgrade treatment will intentionally be left high to facilitate cutting to the desired profile and template shape
- Trimmers are typically used but motor graders have also been used
- Control by stringline or automatic machine guidance (AMG)
- Trimmed profile and template shape should be within 0.05 feet of specified elevations

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Subbase

- Standard Specification 2109
- Foundational layer directly beneath the pavement consisting of crushed stone, sand-gravel, or recycled material
- Provides
  - Protection of the subgrade and subgrade treatment
  - Improved drainability
  - Stronger and more uniform support
- Materials used independently or in combination
  - Granular subbase
  - Modified subbase
  - Special backfill

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Granular Subbase

- Standard Specification 2111, 4121
- Uniform mixture of coarse open graded high quality
  - Crushed stone
  - Gravel with 30% fractured faces retained above 3/8”
  - Crushed PCC pavement
  - Uniformly blended combinations of all
- Some support is provided but drainability is primary function
- Most typical for interstate and primary paving

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Construction of Granular Subbase

- Standard Specification 2111
- Operate delivery trucks off subgrade except where unloading
- Uniformly moist prior to and during compaction
- Compact with a maximum of 3 passes of a non-vibratory steel or pneumatic roller
- Evaluate placing and compacting procedures on initial section placed for
  - Degradation
  - Consolidation
  - Drainability
- 1 gallon of water that does not drain away after 1 minute indicates poor drainability
- Do not place more than 2 month prior to placement of pavement
- Do not allow construction traffic to drive on it

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Trimming of Granular Subbase

- Standard Specification 2111
- Typically left high to facilitate cutting to the desired profile and template shape
- Controlled by stringline or GPS machine control
- Trimmed profile and template shape should be + 0 to -0.05 feet of specified elevations
- Salvaged material may be reused
- Watch for fine and coarse segregation/banding as well as top layer of fines
- Ample wetting prior to trimming and careful spreading operations help to alleviate segregation and a top layer of fines

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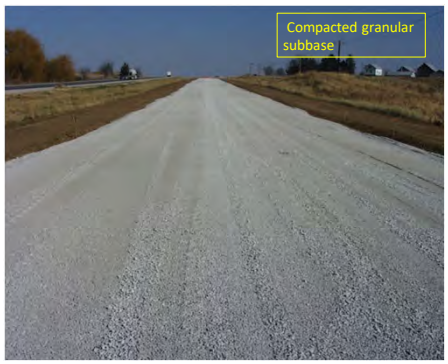

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Modified Subbase

- Standard Specification 2115, 4123
- Uniform mixture of coarse and fine particles
  - Crushed stone
  - Gravel with 75% fractured faces retained above 3/8”
  - Recycled pavements meeting IM 210 requirements
  - Uniformly blended combinations of all with maximum of 50% RAP
- Some drainability is provided but support is primary function
- Used when stagging or constrained space forces construction traffic to drive on subbase

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Construction and Trimming of Modified Subbase

- Standard Specification 2115
- Uniformly moist prior to and during compaction
- Place in uniform lifts of no more than 6 inches
- Compact with a minimum of 6 passes of a vibratory or non-vibratory steel or pneumatic roller
- Trimmed profile and template shape should be + 0 to - 0.05 feet of specified elevations

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Special Backfill

- Standard Specification 4132
- Uniform mixture of coarse and fine particles of
  - Crushed stone, crushed PCC, crushed composite pavement, or reclaimed HMA
  - Mixtures of gravel, sand, and soil
  - Uniformly blended combinations of all
- Little to no drainability is provided but support is primary function
- Used only when
  - High levels of stability are desired
  - Stagging or constrained space forces construction traffic to drive on subbase

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Construction and Trimming of Special Backfill

- Uniformly moist prior to and during compaction
- Place in uniform lifts of no more than 6 inches
- Compact with a vibratory steel roller until desired stability is achieved
- Trimmed profile and template shape should be + 0 to - 0.05 feet of specified elevations

31

Track Line

- Standard Specification 2109
- Construct subgrade and subbase 3 feet beyond the edge of pavement on each side
- Parallel to the projection of the cross slope to limit yield loss and ensure proper pavement thickness
- Solid and durable to support all paving equipment
- Avoid placing longitudinal subdrains until after paving
- Kept free of surplus materials and debris
- Significant influence on ability to achieve pavement smoothness

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CHAPTER 10

SURVEY AND STAKING

1

Section 10 - Survey and Staking

PCC Paving Field Inspection

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Pavement Controls

- Standard Specification 2526.03 A. 10.
- Established to set elevation and alignment of pavement
- Provided by
  - Stringline - hubs
  - AMG - control points
- Hubs and control points are provided by the contracting authority construction survey crew
- Contractors use hubs to set their stringline or control points to establish position with total stations
- AMG is used by all but one major paving contractor at this time

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Stringline Paving Hubs

- Set on each side of pavement every
  - 50 feet on tangents
  - 25 feet on horizontal and vertical curves
  - Curve and superelevation transition points
- Metal tack is placed in hub to mark exact location and elevation
- Transition point hubs are painted a different color

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Stringline Paving Hub Grades

- Information to grade paving hubs can be found in the contract documents and includes
  - Typical cross sections
  - Plan and profile sheets
  - Paving details
  - Survey data on G sheets
- Prior to setting paving hubs, the contracting authority survey crew and contractor will need to agree upon the grade method
- Two methods of setting grade are
  - Offset grade – hand placement
  - Projected grade – mainline slip form
- Offset grade is a level transfer of elevation from the edge of pavement to the hub
- Projected grade is the extension of a line drawn through both edges of a pavement to the hubs

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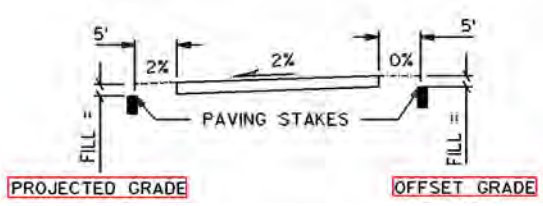

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Stringline Paving Hub Grades

- A flat is provided at each hub with
  - Station
  - Offset to edge of pavement
  - Cut or fill from adjacent top edge of slab (offset method)
  - Cut or fill from plane projected through both edges of slab (projection method)
  - Superelevation cross slope
- Information written on both sides of flat

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Setting Stringline

- Contractor is responsible for setting stringline based on paving hub grades
- Stringline may be wire, cable, woven nylon and must be capable of being pulled extremely taught
- Stakes must be sufficiently rigid and long to be driven into the ground while still allowing for stringline adjustment
- Stakes are placed vertically plumb and outside of the paving hubs
- Stringline is inserted into the holder arm and a winch is used to tighten the line
- Adjusting the holder arm up or down and in and out positions the stringline directly above the metal pin in the hub and a set
  - Distance above profile grade
  - Offset from pavement edge

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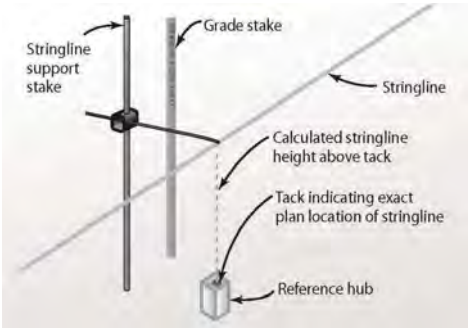

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Checking Stringline

- Tension should be tight
- Eying stringline should be done from below to identify dips and bumps
- Issues should be immediately investigated and resolved
- Survey mistakes should be resurveyed and corrected instead of being corrected by eyeballing adjustments in

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Stringline Machine Control

- Slip form paving equipment uses automatic sensors that run off the string line for elevation and alignment control
- Paver rotates about the sensor
- Alignment sensing wands are in the front and back and typically only on one side
- Elevation sensing wands are on all four corners
- Need to be checked by contractor for proper tension and sensitivity

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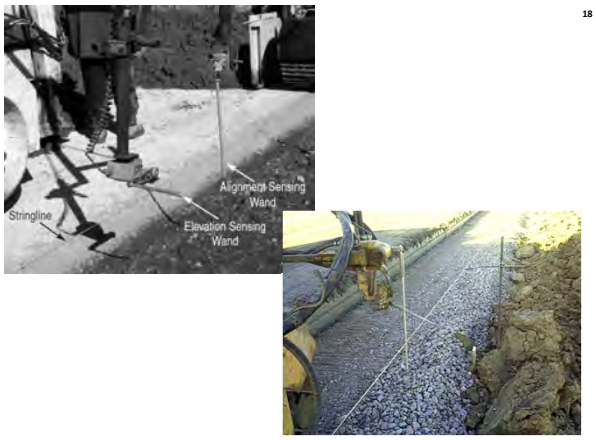

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AMG

- Total stations are positioned anywhere in a clear line of sight to the control points and paver
- Total stations establish their location by sighting prisms positioned on known control points
- Total stations continuously read X, Y, Z position of paver by sighting two prisms located on the paver
- X, Y, Z information is transmitted via radio signal from the total stations to the computer on the paver
- Computer has a preloaded 3D design model of the pavement that it references the X, Y, Z paver position
- Computer adjusts the elevation of the paver on each of the four corners of the pan to achieve
  - Correct pavement thickness
  - Crossfall
  - Mainfall

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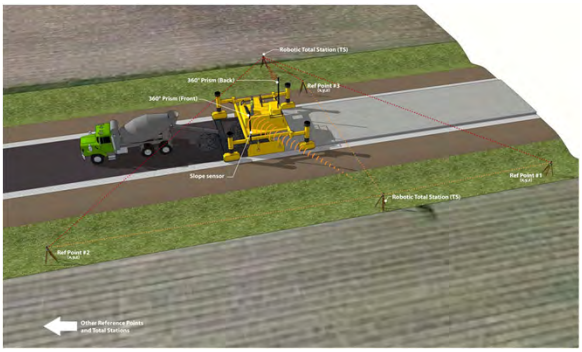

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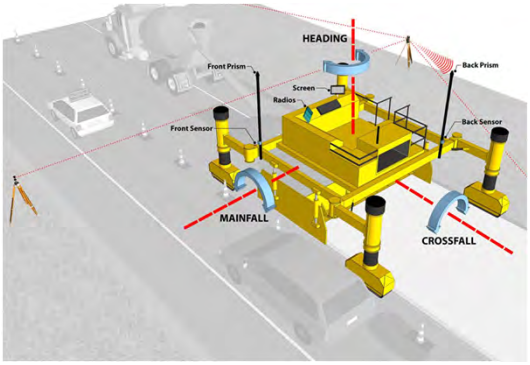

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AMG Control Points

- Set at maximum 500 foot intervals on each side of pavement
- Positioned out of the way from work and public but allowing total station to always see at least 3
- Established from accurate field surveying and tied to known benchmarks
- Furnish x y z coordinates and station offset information for each
- Set paving hubs with cut or fill to finish pavement elevation at superelevation transitions and at station equation locations
- Additional paving hubs will not be required for mainline pavement

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Tie Ins

- Bridges and adjoining pavement
- Contractor must obtain elevations of existing element centerline and edge of pavement at 10 foot intervals for a minimum of 100 feet from element
- Extremely critical this is done early for AMG as models may need to be reworked
- Stringline can be more readily adjusted by eying in

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Checking Grade

- Important to ensure grades of all layers are correct
- Ensure
  - Proper thickness of each layer
  - Correct elevation of finished pavement
- Contractor should be checking
- Contracting authority may witness as well as perform independent checks
- Issues found should be communicated and corrected immediately

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Stringline Grade Check

- Accomplished by
  - Hooking one end of a string to the stringline support stake
  - Running the string under the stringline directly across the roadway and under the string attaching it to the stringline support stake
    - String should be tight so as not to sag but not too tight to distort the stringline
  - Measuring the offset from each hub towards the centerline and marking
    - This is the edge of pavement
  - Measuring vertically from each mark from the grade to the stringline
  - Calculating the desired distance using the machine constant, typical cross section, and survey data for the station being checked
  - Comparing the measured distance to the desired distance

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Stringline Grade Check

- Procedure may be used for subgrade, subbase, or pavement by adjusting the desired distance calculation
- DD (subgrade) = machine constant + pavement thickness + subbase thickness
- DD (subbase) = machine constant + pavement thickness
- DD (pavement) = machine constant

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AMG Grade Check

- Accomplished by using rover to set on surface and provide elevation and alignment
- Check point hubs at 1,000 foot intervals on mainline
- Trust in model, equipment, and technology

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CHAPTER 11

PCC PAVING BATCH PLANTS

1

Section 11 - PCC Paving Batch Plants

PCC Paving Field Inspection

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Batch Plants

- Standard Specification 2001.21, 2301.02 C, IM 527
- Two types
  - Central – batch separate ingredients into mixer drum where they are completely mixed before discharge into a transport vehicle
  - Ready mix – batch separate ingredients into a concrete mixing truck where mixing occurs during transit

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Calibration

- Central batch plants are calibrated each time they are moved or yearly if they are permanent
- Ready mix plants are calibrated yearly
- Calibrations are witnessed by District Materials staff and conducted by the contractor/producer in conjunction with a certified weigh company
- Approved ready mix plants are found at https://iowadot.gov/Construction_Materials/materialsforms/211ad.pdf

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Central Batch Plant

- Used predominantly on large PCC paving projects
- Advantages
  - High production volume of approximately 4,000 yd^3
    - Large batch size
    - Short mix times
  - Improved quality control
    - Dedicated mix and project
    - Consistent and monitored mixing
  - Ability to move to project site
- Disadvantages
  - Calibrated each time moved and set up
  - Concrete can not be adjusted at point of placement

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Ready Mix Batch Plant

- Used predominantly on urban PCC paving projects
- Advantages
  - Continuous agitation
  - Ability to adjust mix at point of placement
  - Highly directional discharge
- Disadvantages
  - Lower production volume
  - Potential for less quality control

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Certified Plant Inspection

- Standard Specification 2521, IM 527
- Required for all projects
- Responsible for overall quality control at the batch plant including
  - Sampling and testing of aggregates for gradation
  - Inspecting proportioning equipment
  - Monitoring plant operations
  - Identifying and tracking all materials received and used
  - Protecting, curing, and testing of strength specimens
  - Preparing and submitting daily diary and plant report
- Performed by
  - PCC Level II technician
  - Contractor on Iowa DOT projects
  - Contractor or local agency as defined in contract documents
- Only duties performed
- Incidental to the contract unit price of the concrete item when performed by contractor

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Plant Monitoring

- IM 527
- Required for all projects unless contracting authority is performing certified plant inspection
- Responsible for
  - Verifying certified plant inspection is being performed properly
  - Verification sampling and testing of aggregate gradation
- Performed by
  - PCC Level II technician
  - Contracting authority unless contracting authority is performing certified plant inspection
- Can perform monitoring at multiple locations as well as other duties

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Mixing of Materials

- Standard Specification 2001.21, IM 527 Equipment 3. a. and b.
- Goal is to provide folding action to
  - Completely coat aggregate particles
  - Develop air
  - Provide uniform mixture
- Do not exceed batch size on mixer manufacture bureau (MMB) plate
- Meet desired range of rotational speed on MMB plate
- Mixing time for central batch plant
  - Minimum of 60 seconds and a maximum of 5 minutes
  - Checked by CPI and verified by plant monitor
  - Total cycle time must exceed charge time + discharge time + 60 seconds
- Mixing time for ready mix batch plant
  - 70 to 90 revolutions at mixing speed
  - Checked at plant or on grade depending on revolution counter
- Notify the contractor, CPI, and plant monitor if mix inconsistencies occur

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CHAPTER 12

DELIVERY AND PLACEMENT

1

Section 12 - Delivery and Placement

PCC Paving Field Inspection

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Delivery of PCC

- Standard Specification 2301.02 C. 4, IM 527 Equipment 3. a. and b.
- Goal is to provide concrete to paver at a consistent and uniform rate to allow steady forward progress
- Too few trucks will result in the paver having to stop and start
- Too many trucks will result in backups and possibly exceeding allowable concrete delivery times
- Delivery is provided by dump, agitator, or ready-mix truck

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Delivery Time

- Inspector is responsible for checking
- Ensures PCC does not begin to hydrate and stiffen excessively prior to placement and consolidation
- Depends on method of delivery used
- Placement on grade is considered directly in front of paver for immediate consumption/incorporation
- Immediately notify contractor of violations and reject trucks to prevent incorporating concrete that has excessively stiffened

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Dump Truck

- Non-agitating
- Used exclusively with a central batch plant
- Predominant delivery method to mainline paving
- Advantages
  - Can haul other materials
  - Quick loading and unloading
- Disadvantages
  - Short delivery time
  - Non-directional discharge
  - Overhead clearance needed when discharging

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Dump Truck

- Delivery time
  - Time from when discharge from the mixer stops until completely placed on grade
  - 30 minutes without retarder
  - 60 minutes with use of approved retarder at prescribed rate
- Record time of discharge at plant then follow truck to grade to mark time completely placed on grade
- Discuss/consider retarder if timing out or excessive stiffening occurs

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Agitator

- Agitating with paddles while truck is moving
- Used exclusively with a central batch plant
- Used for hand pours and when extended delivery times are needed
- Advantages
  - Long delivery time
  - Directional discharge
- Disadvantages
  - Slow loading and unloading
  - Single use
  - Overhead clearance needed when discharging

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Agitator

- Delivery time
  - Time of cement water contact until completely placed on grade
  - 90 minutes
- Record time of materials charged into mixer at plant then follow truck to grade to mark time completely placed on grade
- Normally not an issue

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Ready Mix Truck

- Agitating when drum is turning
- Used with central or ready-mix batch plant
- Predominantly used in urban paving and low volume paving
- Advantages
  - Long delivery time
  - Directional discharge
  - Additions
- Disadvantages
  - Slow loading and unloading
  - Single use

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Ready Mix Truck

- Delivery time
  - Time of cement water contact until completely placed on grade
  - 90 minutes
- Ticket is required and provided by CPI with time batched
- Determine time batched to time completely placed on grade

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Ready Mix Truck Certification

- Standard Specification 2001.21 C. 3.
- Authorized representative must certify that
  - Review has occurred within last 30 days
  - Interior of the mixer drum is clean and free of hardened concrete
  - Fins or paddles are not broken or worn excessively
  - Other parts are in proper working order
- Keep current and signed certification in truck

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Additions

- Standard Specification 2301.02 C. 4. c.
- Ready mix trucks only
- Ticket will indicate water
  - In aggregate - CPI
  - Added at plant - CPI
  - Added on grade - inspector
  - Maximum allowed -CPI
- Total water must not exceed maximum allowed
- Addition of water or admixture and water require a minimum of 30 additional revolutions at mixing speed
- Record any addition and resulting tests on ticket
- Communicate any additions back to the CPI for reports

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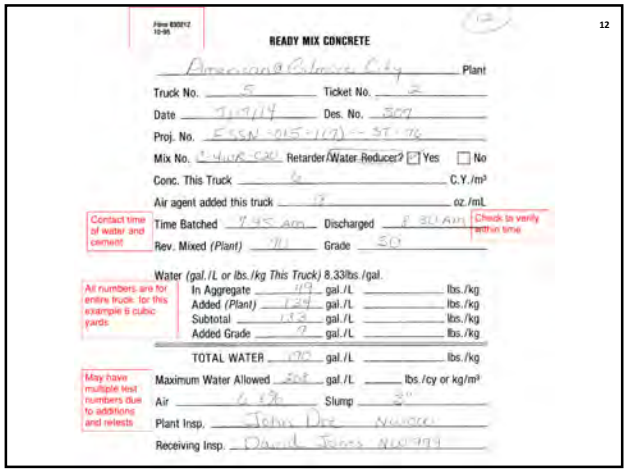

READY MIX CONCRETE

Plant

Truck No. 5 Ticket No. 2

Date 7/9/14 Des. No. 309

Proj. No. ESSN-015-1(12) -- 37.76

Mix No. C-4WR-CAC Retarder/Water Reducer? ☑ Yes ☐ No

Conc. This Truck 6 C.Y./m³

Air agent added this truck 12 oz./mL

Contact time of water and cement

Time Batched 7:45 am Discharged 8:30 AM

Check to verify within time

Rev. Mixed (Plant) 70 Grade SO

Water (gal./L or lbs./kg This Truck) 8.33lbs./gal.

All numbers are for entire truck for this example 6 cubic yards

In Aggregate	119	gal./L	lbs./kg
Added (Plant)	124	gal./L	lbs./kg
Subtotal	153	gal./L	lbs./kg
Added Grade	17	gal./L	lbs./kg
TOTAL WATER	170	gal./L	lbs./kg

May have multiple test numbers due to additions and retests

Maximum Water Allowed 306 gal./L lbs./cy or kg/m³

Air 6.5% Slump 3"

Plant Insp. John Doe NUCPT

Receiving Insp. David Jones NUCPT

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Residual Material

- Ensure concrete does not stick in trucks, eventually letting loose and resulting in dried clumps/defects in the pavement
- Dumps trucks should be
  - Elevated and vibrated to remove buildup
  - Removed from service and cleaned if vibration does not work
- Ready mix and agitators should be
  - Inspected by the contractor periodically
  - Cleaned/washed to remove buildup
- Care should be taken to ensure all wash water is removed prior to loading next load

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Wetting Subgrade and Subbase

- Standard Specification 2301.03 F. 3.
- Wet to a depth of not less than 1 inch prior to placement of PCC
- Prevents water from being drawn out of the concrete limiting
  - Cracking potential
  - Loss of workability
- Avoid excessive wetting resulting in ponding
- May not be necessary to wet following rain event

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Placement

- Standard Specification 2301.03 F.
- Deposit concrete to minimize
  - Excessive horizontal movement
  - Segregation
  - Disturbance of reinforcement
  - Variable head in front of paver
- Methods include
  - Belt placer and spreader
  - Direct placement on grade

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Belt Placer Spreader

- Combined placing and spreading machine positioned in front of the paver that is self propelled and stringline or AMG guided
- PCC is unloaded onto the retractable belt from a side haul road and conveyed and deposited in front of the paver
- Deposited concrete is distributed the width of the pavement using an auger and then struck off to a predetermined depth using an adjustable strike-off
- Accepts PCC from ready mix or dump trucks on either right or left side haul roads

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Belt Placer Spreader Advantages

- Improved safety by limiting backing trucks
- Reduces risk of segregation by limiting horizontal movement of PCC
- Better production due to fast unloading
- Allows presetting and inspection of pinned dowel baskets
- Eliminates driving on trimmed base and track line
- Aids paving startup by allowing PCC placement close to paver
- Better smoothness resulting from consistent width and height of PCC head in front of paver

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Direct Placement on Grade

- PCC is delivered directly on the grade by backing down grade and depositing or by using chutes to directionally discharge
- Typical on local agency, urban paving, and overlays due to
  - Lack of space for haul road
  - Not using dowel baskets
  - Not using granular subbase
- Spreader still used

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Placement Inspection

- Visually look at deposited PCC for signs of segregation
- Limit horizontally moving concrete long distances by ensuring discharge directed evenly in placement
- Edge closer to belt will typically slump more than edge away from belt
- Watch for inconsistent width and height of PCC head in front of paver
- Limit stops and starts

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Grout Box Material Around Edge

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Grout Box Material Incorporated into Pavement

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CHAPTER 13

STEEL PLACEMENT

1

Section 13 -
Steel Placement

PCC Paving Field Inspection

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Dowel Bars

- Standard Specification 4151.02 B.
- Types
  - Epoxy coated solid steel (round or elliptical)
  - Galvanized tubular steel with end caps
  - Glass fiber reinforced polymer (GFRP)
- Supplied by approved manufactures meeting Buy America requirements
- Provided in assemblies except for DW, RD, or RT joints
- Ends do not need to be epoxy coated
- Bond breaker
  - Prevents bonding to concrete and locking joint up
  - Complete assembly dip required for dowels not passing pull out test

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Dowel Bar Assemblies

- Standard Specification 4151.02 B., PV-101
- Protected from weather exposure if stored outdoors longer than 2 months
- Placed on wood supports to prevent ground contact
- Dowels must be friction fit or alternately welded to assembly
- Dowels must be parallel to one another horizontally and vertically
- Size and height are dependent on pavement thickness and are identified on PV-101

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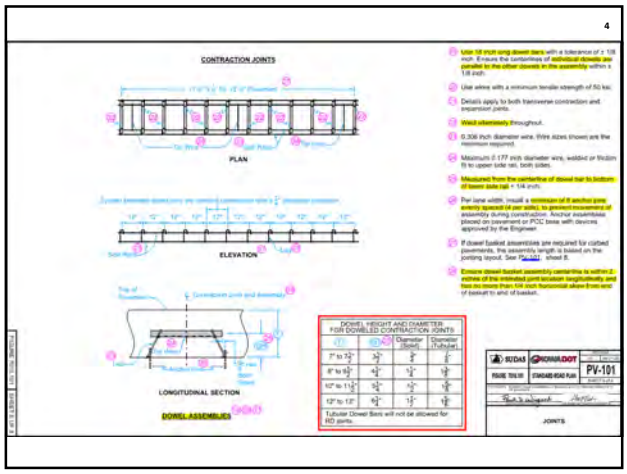

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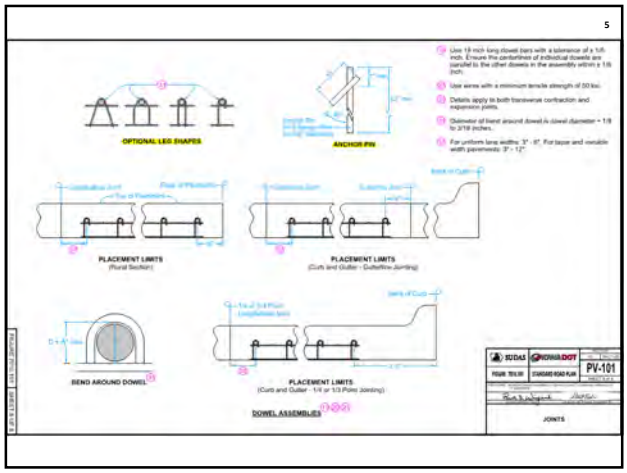

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Placing Dowel Assemblies

- Standard Specification 2301.03 E. 2., PV-101
- Mechanical dowel bar inserters are not allowed
- Placed after inspector has approved subgrade/subbase profile
- Install according to plan and PV-101
- Review assemblies to ensure
  - Coated with a bond breaker when required
  - Free of dirt and other foreign substances
  - Not bent or damaged
- Normally begin setting from construction joint at tie in to adjoining pavement
- Adjustments must be made to match jointing at side roads, intersections, crossovers, and tapers

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Placing Dowel Assemblies

- Proper horizontal and vertical alignment is critical for dowel bars to not lock the joint and damage the pavement
- Assemblies should be secured with a minimum of 8 pins evenly spaced 4 per side
- Pins should be placed behind the basket relative to the direction of paving to resist being pushed by concrete

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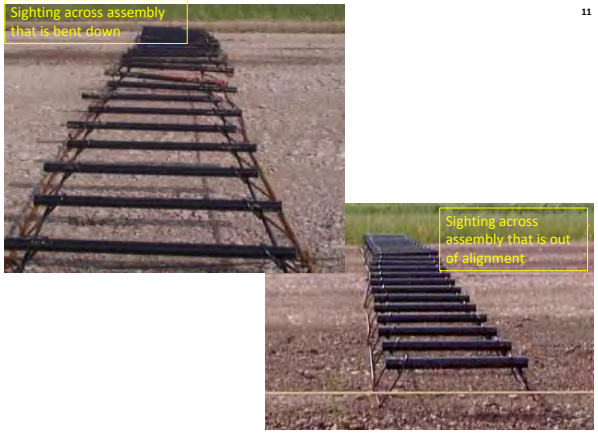

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Checking Dowel Assemblies

- CM 9.25
- Placed and pinned assemblies should be inspected prior to cutting tie wires and paving
- Final inspection involves
  - Sighting down the pavement to see if dowels are in a straight line relative to one another
  - Sighting across the assembly to see if the dowels are following a consistent slope of the subbase and none are bent up or down
  - Sighting across the assembly to see if
    - Assemblies align with each other
    - Pin or mark placed by the contractor places the joint approximately at the midpoint of the dowel and assemblies are
  - Measuring pin or mark between assemblies to ensure proper spacing
  - Center of dowel to lower rail is DH dimension per PV-101

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Cutting Tie Wires

- Tie wires are part of the dowel assembly that provides rigidity during shipping, handling, and paving
- Theory of cutting tie wires is to provide added protection from the joint locking up
- Maximum of 3 tie wires may remain uncut on each assembly
- Contractor should only cut tie wires after inspector has approved placement

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Tie Bars

- Standard Specification 4151.02 A.
- Deformed epoxy coated (bent or straight)
- Bent bars are used to provide clearance for paver tracks
- Supplied by approved manufactures meeting Buy America requirements
- Cut or sheared ends do not need to be epoxy coated
- Free of dirt and other foreign substances

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Placing Tie Bars

- Standard Specification 2301.03 E. 1., PV-101
- Placed by
  - Mechanical insertion
  - Physical insertion
  - Pinned on grade
  - Drilling and epoxying
- Insertion should occur prior finishing and directly behind/next to vibrators to ensure consolidation around bar
- Depth should be approximately mid thickness
- Maintain at least 18 inches of distance from CD joint
- According to plan and PV-101

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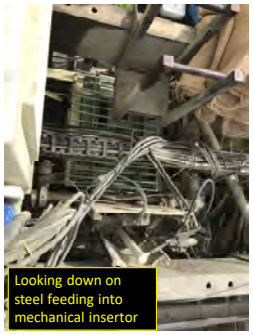

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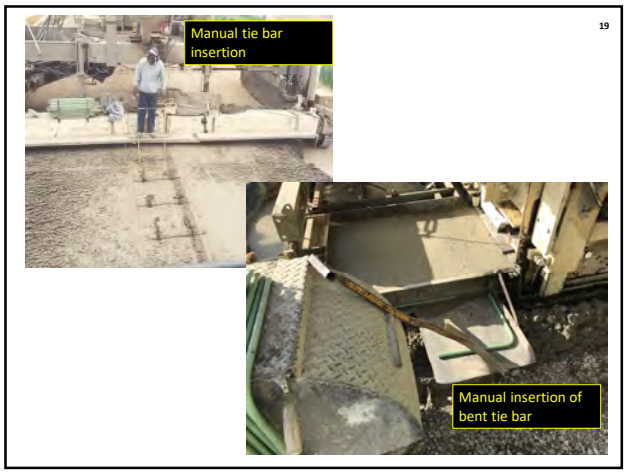

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Checking Tie Bars

- CM 9.26 and 9.27
- Before use, verify bar size and length
- Pinned, drilled and epoxied, and inserted bent bars will allow for visual inspection of depth and location prior to/during paving
- Depth and position of inserted straight bars can be accomplished by
  - Probing plastic concrete
  - Using a pin finder or MIT scan device on hardened concrete
- Tolerances
  - Depth – 1 inch above T/2 to 1 ½ inch below T/2
  - Angle – minor variation from horizontal and perpendicular to joint
  - Extend 12 inches across joint
- Most critical on superelevated curves

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CHAPTER 14

SLIP FORM PAVING

1

Section 14 -
Slip Form Paving

PCC Paving Field Inspection

1

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Slipform Paving

- Process used to consolidate, form into shape, and finish the surface of plastic concrete into pavement
- Extrusion process pulling forms continuously through and surrounding the plastic concrete
- Requires low slump concrete so edges do not slump off
- Allows for production of up to 1 mile per day
- Capable of producing very smooth pavement
- Beginnings at Iowa Highway Commission

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Slipform Paver Common Elements

- Self-propelled by either two or four tracks
- Adjustable width typically between 12-38 feet but some can pave as wide as 45 feet
- Stringline or AMG controlled
- Augers or plow to evenly distribute concrete
- Variable speed hydraulically controlled internal vibrators used to consolidate concrete
- Pan and side forms

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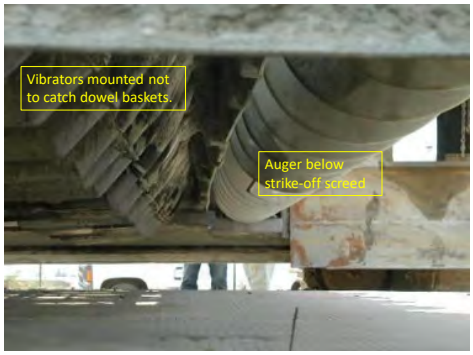

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Slipform Paver Requirements

- Standard Specification 2301.03 A. 3. b. 3)
- Designed specifically for placing, consolidating and finishing PCC pavement without fixed forms
- Leaves edges vertical
- Self propelled and equipped with means to evenly distribute PCC
- Vibrates PCC full width and depth in single pass
- Produces a surface reasonably free of voids and tears
- Automatic horizontal and vertical grade controls
- Use protective mats when tracking on previously placed pavement to prevent surface damage

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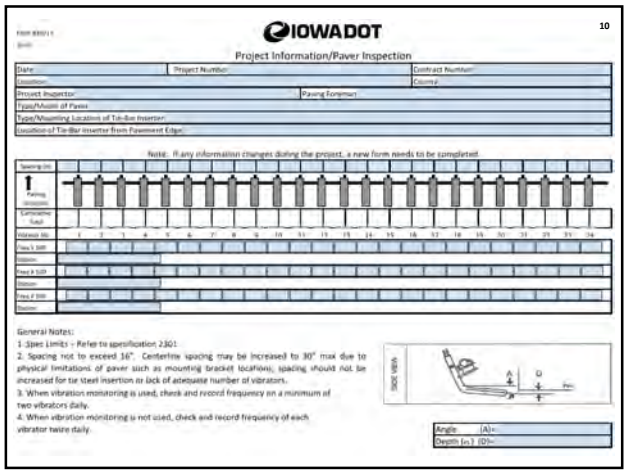
IOWADOT

Project Information/Paver Inspection

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Slip-form Paver Checks

- Form 830213
- Performed by inspector after paver setup is completed onsite by contractor and before paving begins
- Paver width
  - Measure the distance between the side forms
  - Slightly less than the pavement width to allow for extrusion and expansion when concrete comes out of paver
- Vibrators
  - Measure and record vibrator angle and position
  - Vibrators should be angled downward to 10 to 30 degrees from horizontal
  - Spacing should not exceed manufacturers recommendations or 16 inches to ensure adequate zone of influence and proper consolidation

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CHAPTER 15

SLIPFORM PAVING

GRADE INSPECTION OF

PLASTIC CONCRETE AND PAVEMENT

1

Section 15 -

Slipform Paving Grade Inspection of Plastic Concrete and Pavement

PCC Paving Field Inspection

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Grade Inspection

- Get all equipment and tools required for inspection
- Confirm plans with contractor and make inspection team, PCC technician, and plant monitor aware
- Check weather discuss protection with contractor if there is a chance of rain
- Visually check area to be paved that day double checking
  - Grades
  - Dowel assemblies
  - Condition and wetness of grade

Inspector Tool Kit

IPAD with contract documents loaded
Cellular phone with camera
Hardcopy 11 X 17 of plans
Pen/Pencils
Sharpie markers
Survey field book
Calculator
Air meter
Backup air meter available on project/trailer
Slump Cone
Beam boxes
Buckets
Spade
Rags
Gloves
Spray paint
Small trowel
Numbers for stationing
6' metal ruler
4' or longer smart level
50 foot long tape
50 foot String
Vibrator checker (rod and measurement device)
Pavement depth checker
Tire depth gauge
PPEs
First aid kit

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Sampling

- IM 327
- Need to be properly obtained, protected, and be representative
- After all water and admixture additions have been made
- Not beginning or ending of load
- Paving sampling could be from
  - Grade
  - Ready mix chute
  - Slab

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Temperature

- Standard Specification 2301.03 S, IM 385
- Monitored when ambient and material temperatures are extreme
  - Early or late season
  - Mid-summer hot periods
- Frequency not specified

Maximum Concrete Temperature	None Specified
Minimum Concrete Temperature	40°F

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Unit Weight and Yield

- IM 340
- Conducted by contractor as part of QC on QM-C projects
- Unit Weight
  - Measures the weight of concrete for a given volume
  - Input for yield calculation and a quality control tool to identify problems with air content/testing
  - Determined in conjunction with air content
- Yield
  - Compares the theoretical concrete mix unit weight to the measured unit weight
  - Quality control tool to identify mix proportion issues
  - Acceptable yield range of 0.980 to 1.020

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Air Content

- IM 318
- Measures volume of entrained air in plastic concrete
- Air meters should be evaluated, cleaned, and calibrated annually
- Calibrating and/or conducting correlation testing prior to project startup and periodically during production is recommended
- A backup air meter should be readily available
- Aggregate correction factors, provided by district materials, should be subtracted from the measured result
- Take care of equipment and equipment will take care of you

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Air Content

- IM 318, 216
- Calibration
  - Checked quickly using a calibrated air plug
  - Replace air meter if calibration fails
- Correlation testing
  - Side by side air tests on the same concrete
  - Correlating if test are not greater than 0.4% apart
  - Investigate and resolve problem if not correlating

Example:
Iowa DOT inspector witnesses and conducts correlation testing against contractor on a QMC paving project.

Results:
Construction - 7.5%
Contractor - 7.1%
Difference = 0.4%
Correlation

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Slipform Air Content

- Standard Specification 2301.02 B., CM 9.63
- Target air content is 8.0% ± 2.0% when measured on the grade just prior to consolidation
- Target air content may be adjusted by the Engineer based on random tests of the consolidated concrete behind the paving machine
- Additional random tests will be used to consider the need for a target change, but not for acceptance

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Slipform Air Content

- 8.0% target is used to allow for loss through the paver
- Concrete mix is designed and desired to have at least 6.0% air content after consolidation
- Actual loss should be compared to anticipated loss (2.0%)
  - Once per day 1st 3 days
  - Once per week thereafter
- Contractor should work towards target by adjusting mix when air content is less than 7.0% or greater than 9.0%
- Witnessed and recorded QC test on QM-C projects can be considered as additional verification test
- CM Appendix 2-34 B provides price adjustment schedule

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Slipform Air Content Example 1

- Higher loss
  - Day 1 loss = 3.0%
  - Day 2 loss = 2.5%
  - Day 3 loss = 3.0%
  - Action taken
    - Inspector is communicating losses each day to contractor
    - Contractor should be trying to adjust mix and/or paver for loss
    - Contractor should be targeting higher side of limit to ensure 6.0% air content after consolidation
    - As loss is consistently higher, target should be adjusted by engineer to 9.0%
    - Loss should continue to be verified weekly

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Slipform Air Content Example 2

- Lower limit air contents
  - Loss is checked and is consistently 2.0%
  - Air content is 6.0%, 6.2%, 6.5%, 6.2%
  - Action taken
    - Inspector is communicating to contractor that air needs to be raised
    - Contractor is already aware and is adjusting mix to hit target air content
    - Ensure adjustments are working by taking additional tests

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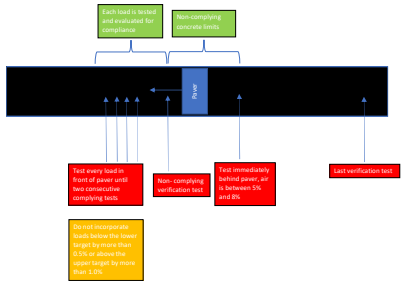
Slipform Non-Complying Test, Air Behind Complying



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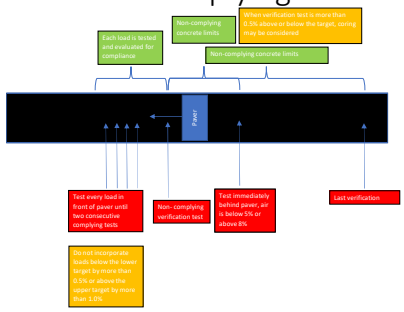
Slipform Non-Complying Test, Air Behind Non-Complying



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Appendix 2-34 C

TABLE C1
CONCRETE AIR CONTENT PRICE ADJUSTMENTS

Air Content Range			% Payment of Unit Price
Minimum		Maximum	
1.1*	and	below	0%
0.6	to	1.0	50%
0.1	to	0.5	75%
	Low air tolerance limit		100%
	Target		100%
	High air tolerance limit		100%
0.1	to	0.5	98%
0.6	to	1.0	90%
1.1	to	1.5	80%
1.6	to	2.0	65%
2.1	to	3.0	50%
3.1	and	above	0%

*The Engineer may require concrete represented by air content more than 1.1% below the low air tolerance limit to be removed and replaced.

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Pavement Width

- Indicated in the plan typicals
- Inspector will need assistance from a helper
- No specified frequency, check periodically
- Checked by using long tape to span the width of the pavement and measure
- Notify contractor of any measurement that is less than design width

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Edge Slump

- Standard Specification 2301.03 H., CM 9.53
- Slipform paving only
- Occurs when the placed top edge of pavement slumps down after it is extruded from the paver
- Typically results from excessive PCC fluidity caused by excessive moisture in the mix
- Causes low points that hold water and can be a potential maintenance and safety issue
- Pay special attention to edges that will have an adjoining pavement

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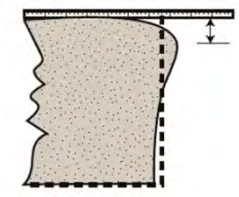
Edge Slump Measurement

- Visually obvious when a significant problem exists
- No specified frequency, check periodically by
  - Placing level on surface
  - Measuring vertical distance from bottom of level to greatest point of outward movement
- 1/4 inch is tolerable, but contractor should actively work towards 1/8 inch or less when adjoining pavement
- 3/8 inch or less is typically acceptable when no adjoining pavement



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Edge Slump

- To prevent and stop
  - CPI adjusts aggregate moistures
  - Loader operator works all areas of stockpile to minimize moisture variability
- Prior to curing and hardening contractor must fix excessive edge slump by
  - Securing form of same height as pavement against edge
  - Adding, consolidating, and refinishing concrete to the proper height

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Cross Slope

- CM 9.44
- Indicated in plan typicals
- Improper cross slope or localized areas of improper cross slope can occur from
  - Pan being improperly set
  - Poor finishing and/or excessive finishing
- No specified frequency, check periodically
- Check by setting smart level perpendicular to the roadway and reading % slope
- Avoid 18 inches by edge as this area could be influenced by edge slump
- Five measurements in different areas should be taken and averaged
- Notify contractor if the average deviates by more than 0.2% from design

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Yield

- Comparison of concrete batched to theoretical concrete placed
- Provides accounting of concrete and assists in identifying issues with
  - Pavement thickness, width, or cross slope
  - Grade consistency
  - Batch plant
  - Air content

Process

- Identify a truck at the plant
- Determine cumulative concrete batched including that truck
- Subtract off any wasted concrete
- On grade, identify truck and estimate length placed with concrete from truck incorporated
- Determine theoretical concrete placed by multiplying the design width and depth by length placed

- $Yield = \frac{Concrete\ Batched}{Theoretical\ Concrete\ Placed} X\ 100$
- Do not conduct immediately after startup
- Notify contractor if less than 103%

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Vibration

- Standard Specification 2301.03 A. 3. a. 6), IM 384, CM 9.64
- Needed to consolidate concrete and eliminate defects
- Over vibration can cause
  - Segregation of aggregates resulting in mortar pockets called vibrator trails that are prone to shrinkage, water intrusion, and early deterioration
  - High air loss resulting in concrete with low air content that is susceptible to freeze-thaw deterioration

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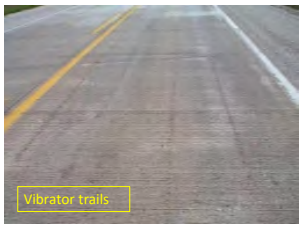

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Slipform Paving Internal Vibration Requirements

- Single pass operating at a frequency between 4,000 and 8,000 vibrations per minute (VPM)
- Avoid operating in a way that causes segregation
- Replace failing vibrators before paving begins the next day or same day if paving is paused
- Stop paving if two adjacent vibrators fail
- Stop vibration if forward progress stops

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Slipform Paving Internal Vibration Electronic Monitoring Device

- Required on
  - Interstate and Primary projects with mainline paving bid item over 50,000 square yards
  - When specified in contract documents for mainline paving greater than 600 feet
- Provide following functionality
  - Readout display near operator and inspector
  - Operates continuously
  - Display all vibrator frequencies
  - Records time, station, track speed, and frequency every 5 minutes or 25 feet of travel
- Submit data first three days of paving and weekly thereafter
- If device fails, revert to manual checks and fix within 3 days

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Slipform Paving Internal Vibration Checks

- IM 384, DS-23027
- QM-C
  - QC watches electronic monitoring device and checks vibrators twice per day
  - Inspector checks minimum of two random vibrators per day
- Non-QM-C
  - Inspector checks vibrators twice per day with one check being near startup
- Discuss options to safely obtain reading with the contractor
- Best readings are obtained from the hydraulic line protector hose above the vibrator
- Notify contractor when vibrators are not working or VPMs are outside limits
- CM Appendix 2-34 C provides price adjustment schedule

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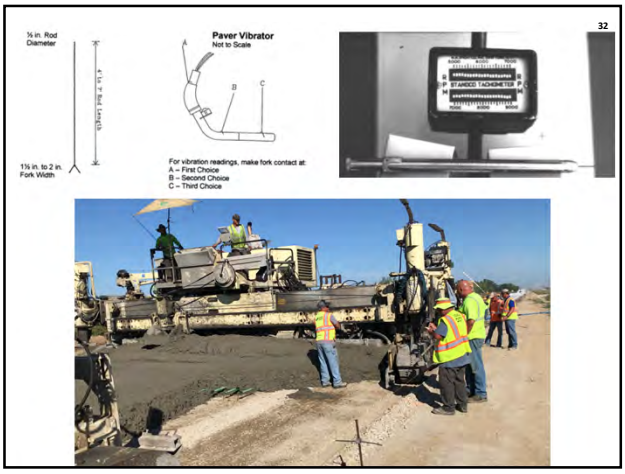

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TABLE C3
VIBRATOR FREQUENCY PRICE ADJUSTMENTS

Vibrator Frequency			% Payment of Unit Price
Minimum		Maximum	
below 3500		-	90%
3500	to	3999*	95%
4000	to	8000	100%
8001	to	9000	90%
9001	to	10,000	75%
above 10,000			50%

* Engineer may extend the lower specification limit to include this range
Note: Price adjustment shall apply to area half the distance to the adjacent vibrator or edge of slab and the length traveled during the non-compliance

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Real Time Smoothness

- Measures the smoothness of the plastic concrete behind the paving machine
- Provides real time data to the operator so that
  - Adjustments can be made to the paving machine to improve smoothness
  - Minor imperfections can be fixed before concrete cures
  - Locations of major imperfections can be noted to be corrected after concrete cures
- Not a substitute for smoothness testing.

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Real Time Smoothness

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CHAPTER 16

FINISHING

1

Section 16 - Finishing

PCC Paving Field Inspection

1

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Finishing

- Determines the final appearance, surface properties, and smoothness of a pavement
- Impacts durability of the surface
- Skill, knowledge, and experience are needed to properly finish pavement with various concrete mixes and field conditions encountered
- Primarily accomplished by paver pan
- Additional finishing is provided by hand finishing

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Finishing Requirements

- Standard Specification 2301.03 H. 1., 4., CM 9.40, 9.41
- After consolidation use pan to strike and finish concrete true to line and grade
- Ensure additional water is not added onto the surface
- Burlap may be attached behind the pan to help close the surface
- Avoid adding water to the burlap to the extent that a slurry is created
- Surface may be floated

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Impacts of Finishing Excess Water and Paste Into Surface

- Finishing of excess water and slurry on the surface creates a weakened high w/c ratio layer below the surface
- Weakened layer is porous and saturates easily
- Scaling occurs when the moisture freezes in the weakened layer and expands popping off the concrete surface
- Magnified by deicing chemicals

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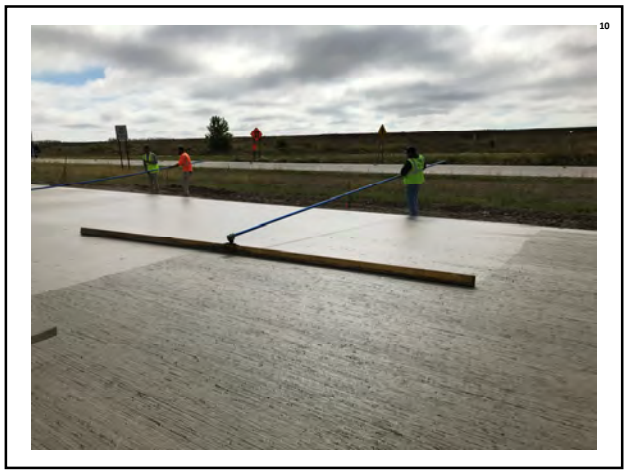

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Finishing Straightedge Requirements

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- Contractor should periodically check pavement longitudinally with a 10 to 20 foot straightedge
- Surface should not deviate from a straight line by more than
  - 1/8 inch in 10 feet
  - 1/2 inch in 10 feet in the area 6 inches from the edge
  - 1/4 inch in 10 feet 1 inch from the edge with adjoining pavement
- Correct imperfections by hand floating

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Good Finishing Practices

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- Paver must be properly set up for conditions
- Mix must have adequate paste and working time for conditions
- Hand finishing should be kept to a minimum
- Do not apply water onto the surface of the pavement or finish if bleed water is present
- Adjust for excessive slurry on the surface by
  - Controlling vibration effort
  - Limiting water added to the burlap
  - Reducing hand finishing
- Closing every bug hole and achieving perfection is not necessary prior to texturing
- Meticulously check for surface deviations with straight edges
- Overlap straightedges by 1/2 their length

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CHAPTER 17

SURFACE TEXTURE AND CURING

1

Section 17 -
Surface Texture and Curing

PCC Paving Field Inspection

1

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Surface Texture

- Standard Specification 2301.03 H. 2.,3., CM 9.40
- Comprised of
  - Microtexture
  - Macrotexture
- Applied while concrete is workable
- Improves dry and wet frictional characteristics for shorter stopping distances and enhanced safety
- Contributes to roadway noise

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Microtexture

- Depths less than 0.008 inch
- Provided primarily by fine aggregate
- Typically, sufficient for friction in dry conditions and wet conditions with speeds less than 50 mph
- Does not influence traffic-tire noise or splash and spray of moisture

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Microtexture Requirements

- Provided on driving areas of pavement
- Methods
  - Artificial turf
  - Coarse carpet
  - Burlap
- Burlap is most typical and may be wetted and weighted
- Pulled longitudinally over finished surface by a bridge that is pulled by paver or along in front of cure cart
- Produce tight, uniform, and textured surface
- Avoid
  - Mortar buildup on drag - gouging
  - Excessive weight – tearing and gouging
  - Bridge wandering back and forth – wavy appearance and ride feel

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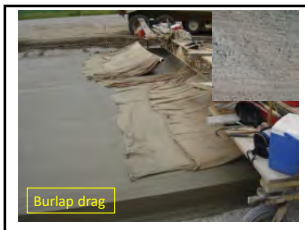

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Macrotexture

- Depth of 1/16 to 3/16 inch
- Small surface channels and grooves formed into the plastic concrete (tining)
- Longitudinal or transverse depending on application
- Provides wet weather friction especially at higher speeds by allowing water to escape the from beneath the tires
- Increases tire-pavement noise as well as splash and spray of moisture

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Macrotexture Application

- When speeds are greater than 35 mph place according to Table 2301.03-1
- Not required when surface corrections are made

Table 2301.03-1: Macrotexture Requirements

Pavement/Placement Type	Macrotexture Orientation		Macrotexture Not Required
	Longitudinal	Transverse	
Mainline - slip-form	X		
Mainline - handwork		X	
Turn lanes - slip-form	X	1	
Turn lanes - handwork		X	
Ramps - slip-form	X	1	
Ramps - handwork		X	
Gapped sections of mainline - slip-form	X	1	
Gapped sections of mainline - handwork		X	
Radii			X
Crossovers			X
Paved Medians			X
Shoulders			X
Irregular Areas			X
Bridge Approaches		2	

1. Transverse macrotexture permitted for placements less than 600 feet in length.
2. Transverse tining required unless longitudinal grooving in concrete is specified in the contract documents.

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Macrotexture Requirements

- Single row of tines that are 1/8 inch ± 1/64 inch wide and produce grooves 1/8 inch ± 1/16 inch deep
- Transverse
  - Uniformly spaced at 1/2 inch intervals
  - 4 to 6 inch non-tined strip centered the transverse joint
  - Where abutting pavement will be placed, extend as near to edge as possible without damaging edge
  - May be placed by hand
- Longitudinal
  - Uniformly spaced at 3/4 inch intervals
  - Mechanically placed with equipment that has horizontal and vertical control to ensure straightness and uniformity
  - 2 to 3 inch non-tined strip centered on the longitudinal joint
- When no abutting pavement, do not tine 6 inches from edge or 1 foot from the face of a curb
- Do not tine area where rumble strips will be placed

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Macrotexture Requirements

- Ensure proper timing
  - Too early will result in grooves refilling with mortar or the surface tearing or pulling coarse aggregates
  - Too late will result in shallow groove depths
- Ensure proper depth, uniformity, and troweled shape by proper tine down pressure and angle
  - Too much down pressure will result in over depth grooves
  - Too vertical of tine inclination will result in pushing of mortar instead of a troweled cut
- Excessive noise and poor driver ride feel can result from over depth or improperly cut grooves

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Macrotexture Inspection

- Texture machine operating properly and all control devices functioning correctly
- Pad line maintained in smooth and stable condition
- Tines are parallel and not bent resulting in undercutting of adjoining groove
- No build up of dry mortar near tips of tines resulting in tearing or pulling coarse aggregate
- Steel tines not worn and comb in good condition, to ensure sufficient groove depth
- Tines are lifted when stopping to avoid depressions

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Macrotexture Depth Inspection

- Groove depths are determined using a tire tread depth gauge on plastic or hardened concrete
- Measured from crumb free finished concrete surface to bottom middle of groove to nearest 1/32 inch
- Periodically during placement where accessible
- Twice per day on hardened concrete
  - Consistently high or low, obtaining and averaging five measurements on a diagonal line across a pavement
  - High and low, obtaining seven measurements on a diagonal line across pavement and averaging complying and high or low
- Notify contractor when average depth is outside limits

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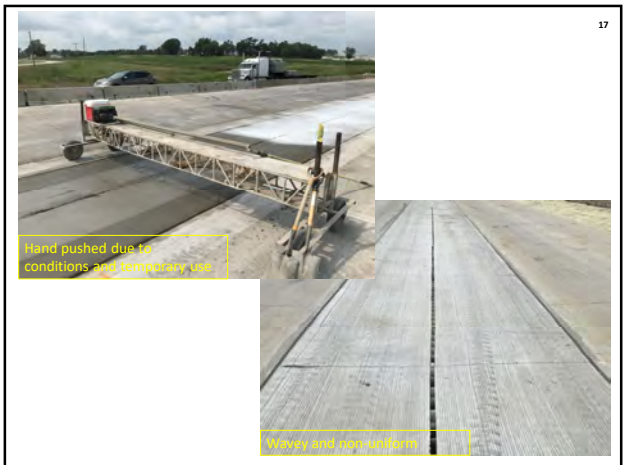

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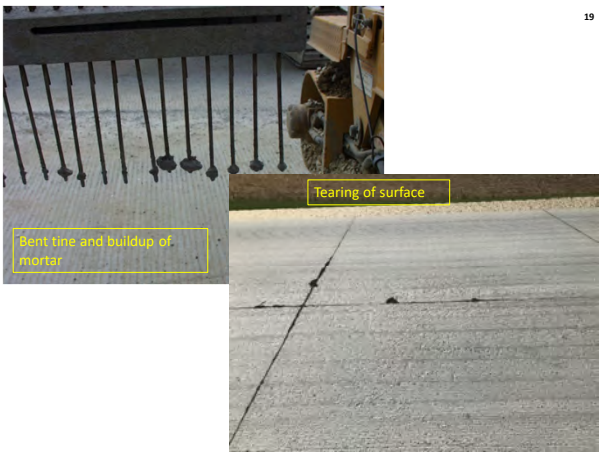

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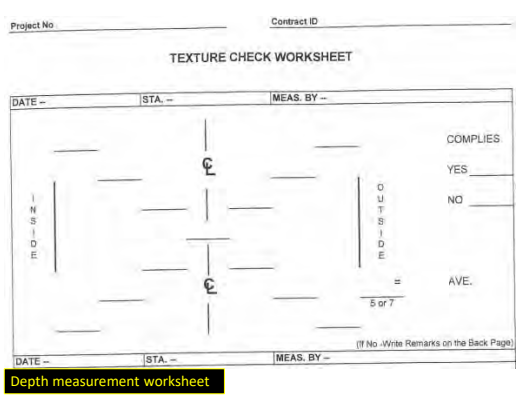

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Curing

- Standard Specification 2301.03 K., 4105, CM 9.56
- Ensures adequate moisture and temperatures are maintained at early ages for continued hydration
- Proper curing enhances development of strength, resistance to freezing, volume stability, and scaling resistance
- After completing finishing and texture

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Curing Materials

- White pigmented meeting ASTM C309
- Delivered in reusable plastic totes labeled with brand and lot number
- Approved brands and lots can be checked on https://maple.iowadot.gov
- Gently agitate in tote prior to use and during use to prevent settlement and separation
- Do not use curing compound that has frozen
- Capable of being sprayed down to 40 ˚F
- Dry to the touch in no more than 4 hours and no foot tracking after 12 hours

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Curing Application Requirements

- Fine spray to form a continuous film on the entire surface and sides of pavement
- As soon as free water has disappeared but no later than 30 minutes after completing finishing – timing is critical
- Rate of no less than 0.067 gallons per SY
- Power spraying equipment
  - Capable of producing a fine spray
  - Not being overly pressurized and damage the concrete surface
- Hand sprayers can be used for irregular areas
- Apply cure prior to placing any cold weather protection or as soon as rain protection is removed

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Curing Inspection

- Visually determine uniformity, surface should look like a white piece of paper
- Ensure adequate coverage on sides of slab
- On windy days shields should be used to ensure uniformity and adequate coverage rate
- Adjustments to tining down pressure should be made instead of waiting for concrete to harden and delaying curing
- Watch time especially on hot, dry, windy days

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Curing Inspection

- Calculate application rate by determining the spacing between totes
- $Tote\ Spacing = \frac{Application\ Rate/9\ X\ Curing\ Container\ Volume}{Slab\ Width+Thicknes\ X\ 2}$
- Notify contractor if curing is not complaint
- CM Appendix 2-34 C provides price adjustment schedule

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TABLE C5

LATE CURING APPLICATION PRICE ADJUSTMENTS

Time After Finishing (hrs)			% Payment of Unit Price
½	to	<1	95%
1	to	<1½	80%
1½	to	<2	65%
2	to	<3	50%
More than 3			40%

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CHAPTER 18

JOINT SAWING AND FILLING

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Section 18 - Joint Sawing and Filling

PCC Paving Field Inspection

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Joint Sawing

- Standard Specification 2301.03 N., PV 101, CM 9.21
- Provides the weakened location in concrete to establish jointing specified in the plans
- Timing of sawing is critical
  - Too long results in random cracks forming
  - Too early creates raveling and surface damage
- Window of time between the extremes is when sawing must take place
- Two type of saws that may be used are
  - Conventional
  - Early entry

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Sawing Window

- Dependent on
  - Mix proportions - earlier with more cement/paste, later with SCMs
  - Time of day paved
  - Weather conditions and rapid changes – earlier when hotter
  - Types of aggregates - earlier with quartzite and river gravels
  - Hardness of aggregate
- No standard test to identify window
- Contractors know from experience or scratch test approximately when sawing window will be
- Sawing will need to occur regardless of time or inclement weather
- Skip sawing can be used to offset a rapidly closing sawing window and prevent random cracking

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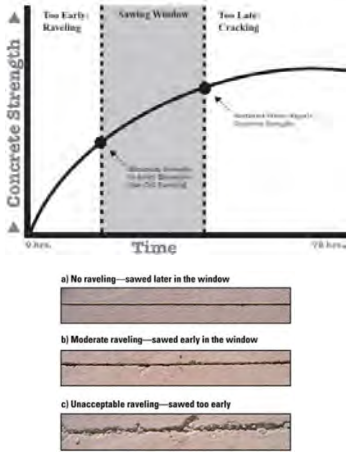

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Conventional Saw

- Large diameter, heavy and, powerful
- Wet or dry process employing a diamond blade
- Typically window opens around 8 to 12 hours after placement
- More noise and dust (dry)
- Wider blade and deeper cut to activate joint

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Early Entry Saw

- Smaller, lighter, and, less powerful
- Dry process employing diamond blade
- Typically, window opens around 3 to 4 hours after placement
- Dustless due to high moisture in concrete when cutting at early age
- Less noise from smaller motor
- Narrower blade and shallower cut to activate joint
- Up cutting to help keep debris out of joint
- Skid plate straddling blade to reduce raveling

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Sawing Requirements

- Completed in single cutting operation
- True to line and dimensions in contract documents
- Begin as soon as concrete has hardened sufficiently to prevent raveling and surface damage
- Complete before uncontrolled cracking occurs
- Use any saw designed for sawing concrete
- Continuous operation regardless of time or weather

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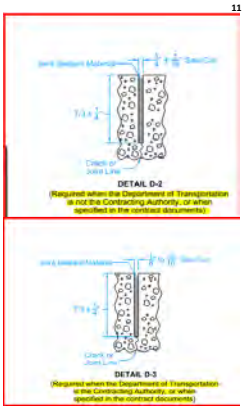
Longitudinal Joint Sawing Detail

- Conventional or early entry for Iowa DOT projects
- Conventional for local agency projects
- Depth is T/3 ± 1/4 inch regardless of saw type



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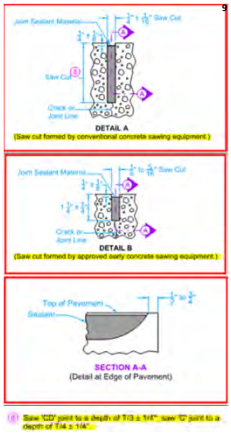
Transverse Joint Sawing Detail

- Conventional or early entry
- Do not saw through edge of pavement
  - Especially critical for early entry with upcut
  - Reservoir for sealant
  - Prevent edge blowouts



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Sawing Inspection

- Proper location according to contract documents or as field adjusted
- Centered on dowel assembly position marks
- Proper width and depth for
  - Joint type
  - Saw type
- Proper timing indicated by absence of raveling, surface damage, or random cracking
- Improper edge termination and edge blowout

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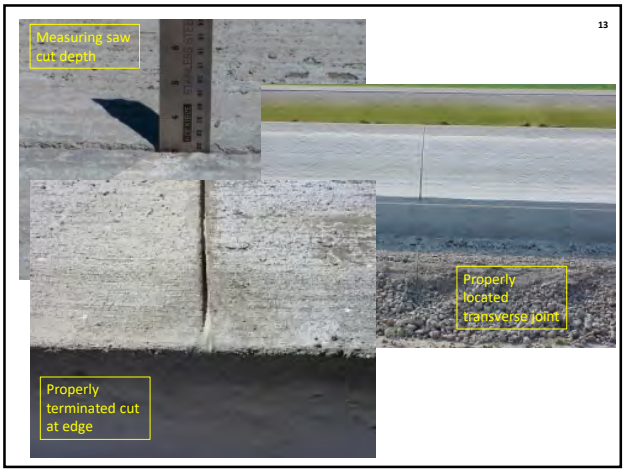

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Random Cracking

- CM Appendix 9-6
- Discontinue sawing joint if a crack develops ahead of saw, complete joint with crack saw and seal
- Repair uncontrolled cracking at no additional expense to the contracting authority as approved by engineer

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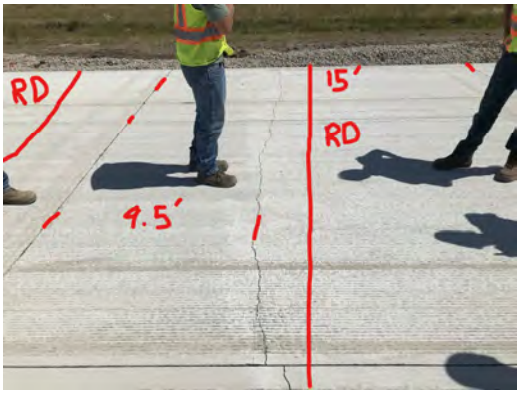

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Filling Joints

- Standard Specification 2301.03 P., 4136.02 A., CM 9.22, 9.23
- Minimize infiltration of surface water and noncompressibles into joint
- Debate continues regarding benefits of filling versus not filling
- Filled during initially construction and typically not revisited as maintenance activity

16

16

Filling Requirements

- Filled unless otherwise specified (including overlays) prior
- Approved source hot or cold poured
- Within 3 hours after sawing, clean sawed faces using
  - High pressure water blast 1,000 psi or greater for wet sawing
  - Air blast of moisture oil free compressed air for dry sawing
- Immediately prior to filling, clean joint with air blast and verify joint appears clean and dry
- Place only when ambient temperatures are above 40 ˚F
- Follow manufacture's recommendation for heating and application
- Fill to 1/8 to 3/8 inch below the pavement surface to
  - Allow room for squeezing when the pavement expands
  - Prevent plows from tearing off
- Remove excess filler from the pavement surface

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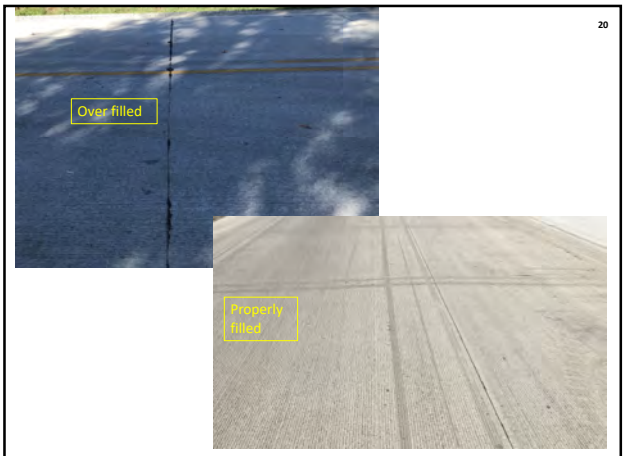

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Filler Inspection

- Sawed faces are being properly cleaned and dried prior to filling
- Appropriate ambient temperatures
- Proper amount of filler
- Excess filler removed

21

CHAPTER 19

OPENING

Section 19 - Opening

PCC Paving Field Inspection

1

Opening

- Standard Specification 2301.03 U., CM 9.15, 9.16
- Method to determine when pavement can be loaded without damage
- Methods
  - Flexural beam strength and age
  - Maturity
- Dependent on operation and equipment being used
- Contracting authority determines sufficient strength for opening based on contractor maturity testing

2

Opening Requirements

- Based on Table 2301.03-3, with flexural beams cast on grade during paving
- Unless otherwise specified, maturity method may be used in place of flexural beam strength and age
- Revert to Table 2301.03-03 should circumstances arise that opening cannot be determined by maturity

3

Table 2301.03- 3: Minimum Flexural Strength

Strength Class of Concrete	Minimum Age	psi
A	14 calendar days[(a)]	500
C	7 calendar days[(b)]	500
M	48 hours[(c)]	500

(a) 10 calendar days for concrete 8 inches thick or more.
(b) 5 calendar days for concrete 9 inches thick or more.
(c) Pavement may be opened for use prior to 48 hours when minimum flexural strength requirements are met.

4

Opening Exceptions

- Some construction equipment will be allowed to operate on pavement prior to strength and age or maturity requirements being met
- Equipment not essential for work is prohibited
- Sawing equipment is allowed as soon as surface is capable of not being damaged by saw weight
- Joint cleaning equipment is allowed provided
  - 24 hours and flexural strength of 150 psi when opening with beam strength and age
  - 150 psi when opening with maturity
  - Vehicle and trailer meets axle weight restrictions of CM Appendix 9-4
  - Tires are pneumatic
  - Axles are 5 feet apart or greater

5

Flexural Strength Beams

- IM 328 and IM 316
- Fabricated and tested by inspector
- 4 X 4 or 6 X 6 beams acceptable
- Proper fabrication, handling, curing and testing
- Keep moist and protect from extreme temperatures
- Average of two beams must exceed strength listed in Table 2301.03-3

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Maturity

- IM 383
- Non-destructive method for estimating concrete strength
- Based on the concept that concrete strength is dependent on hydration time and temperature
- Two step process

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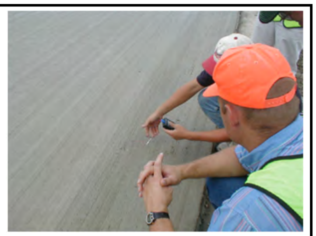
Maturity - Steps



- 1- Develop Strength Maturity Curve
  - Casting 12 beams and test at four ages
- 2 - Monitoring field placed concrete
  - Placing minimum of 2 probes per day
  - Monitoring temperatures & calculate TTF
- Open when the TTF for field placed concrete exceeds the curve TTF
  - Contracting authority approves
  - Contracting authority afforded opportunity to witness

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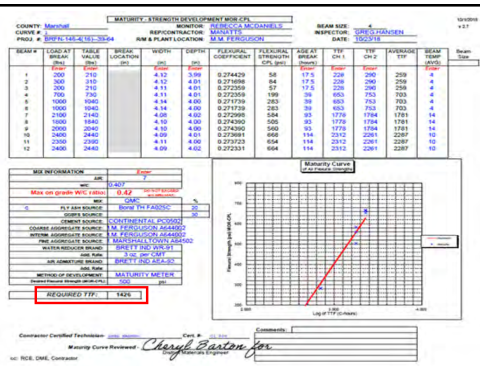


MATURITY - STRENGTH DEVELOPMENT MOR-CPL

COUNTY: Marshall
CURVE #: 1
PROJ. #: BRFN-146-4(16)--39-64
MONITOR: REBECCA MCDANIELS
REP/CONTRACTOR: MANATTS
R/M & PLANT LOCATION: M.M. FERGUSON
BEAM SIZE: 4
INSPECTOR: GREG HANSEN
DATE: 10/23/18

BEAM #	LOAD AT BREAK (lbs)	TABLE VALUE (lbs)	BREAK LOCATION (in)	WIDTH (in)	DEPTH (in)	FLEXURAL COEFFICIENT	FLEXURAL STRENGTH CPL (psi)	AGE AT BREAK (hours)	TTF CH 1	TTF CH 2	AVERAGE TTF	BEAM TEMP (AVG)
	Enter	Enter		Enter	Enter			Enter	Enter	Enter		Enter
1	200	210		4.12	3.99	0.274429	58	17.5	228	290	259	4
2	300	310		4.12	4.01	0.271698	84	17.5	228	290	259	4
3	200	210		4.11	4.01	0.272359	57	17.5	228	290	259	4
4	700	730		4.11	4.01	0.272359	199	39	653	753	703	4
5	1000	1040		4.14	4.00	0.271739	283	39	653	753	703	4
6	1000	1040		4.14	4.00	0.271739	283	39	653	753	703	4
7	2100	2140		4.08	4.02	0.272998	584	93	1778	1784	1781	14
8	1800	1840		4.10	4.00	0.274390	505	93	1778	1784	1781	14
9	2000	2040		4.10	4.00	0.274390	560	93	1778	1784	1781	14
10	2400	2440		4.09	4.01	0.273691	668	114	2312	2261	2287	10
11	2350	2390		4.11	4.00	0.273723	654	114	2312	2261	2287	10
12	2400	2440		4.09	4.02	0.272331	664	114	2312	2261	2287	10

Beam Size

MIX INFORMATION	Enter	%
AIR:	7	
W/C:	0.407	
Max on grade W/C ratio:	0.42	
MIX:	QMC	
C FLY ASH SOURCE:	Boral TH FA025C	20
GGBFS SOURCE:		30
CEMENT SOURCE:	CONTINENTAL PC0502	
COARSE AGGREGATE SOURCE:	M.M. FERGUSON A644002	
INTERM. AGGREGATE SOURCE:	M.M. FERGUSON A644002	
FINE AGGREGATE SOURCE:	MARSHALLTOWN A64502	
WATER REDUCER BRAND:	BRETT IND WR-91	
Add. Rate:	3 oz. per CMT	
AIR ADMIXTURE BRAND:	BRETT IND AEA-92	
Add. Rate:		
METHOD OF DEVELOPMENT:	MATURITY METER	
Desired Flexural Strength (MOR-CPL):	500 psi	

REQUIRED TTF: 1426

Maturity Curve

Log of TTF (C-Hours)

Contractor Certified Technician-
Cert. #-
Maturity Curve Reviewed - Cheryl Barton for
District Materials Engineer
Comments:

cc: RCE, DME, Contractor

9

CHAPTER 20

THICKNESS

Section 20 - Thickness

PCC Paving Field Inspection

1

Thickness

- Standard Specification 2301.04 A., 2301.05 A, IM 346, 347, 396
- Method for verifying
  - Design thickness has been achieved
  - Pavement can withstand loading over its intended service life
- Three methods
  - Method A – MIT scan (Iowa DOT)
  - Method B – coring (local agencies)
  - Probing plastic concrete

2

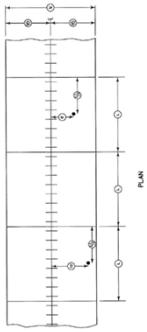
Thickness Requirements

- Does not apply to detour and temporary pavements or paved drives
- Division of sections, lots, and measurement locations will be determined by
  - District materials for Iowa DOT projects
  - Local agency for local agency projects
- Evaluate for bid items of the same design thickness more than 3,500 SY by
  - Method A MIT Scan for interstate and primary projects
  - Method B coring for non-primary projects
- Evaluate for bid items of the same design thickness less than 3,500 SY by
  - Probing plastic concrete

3

Method A MIT Scan

- Random locations, approximately every 200 feet, will be provided to inspector by district materials
- Inspector will anchor metal targets at all locations adjusting so targets are
  - 1/2 way between dowel assemblies
  - Three feet from tie steel
- Randomness occurs contractor not knowing which targets will be tested



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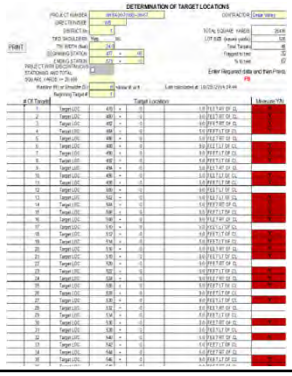

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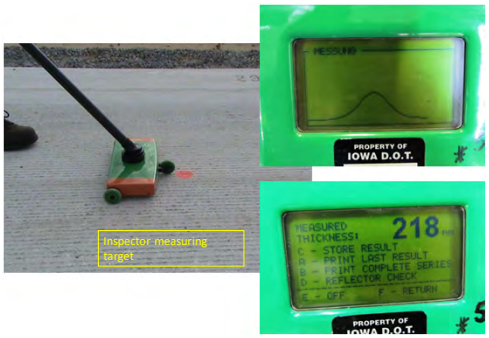
Method A MIT Scan

- Inspector tests locations indicated with a Y on the location sheet
  - Avoid influences from steel toed boots or other steel
  - Three readings are required per target
- District materials will
  - Perform IA testing
  - Download data into payment spreadsheet
  - Assist in calculating incentive disincentive (I/D)
- Each bid item of the same design thickness will have a payment spreadsheet
- Inspector is responsible for entering final quantity and unit price information into payment spreadsheets

8



9

Method B Coring

- Random locations, approximately every 2000 SY, will be provided to inspector by local agency
- Inspector will
  - Mark the core locations on the pavement
  - Witness coring by contractor
  - Take immediate possession of cores
- Locations should be adjusted to avoid hitting steel
- Randomness provided by random locations and contractor not knowing locations until after paving is complete

10

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Method B Coring

- Inspector tests all cores by 9 pointing
  - Remove granular subbase from the bottom of cores prior to testing
  - Do not test any damaged cores
- Each bid item of the same design thickness will have a payment spreadsheet
- Inspector is responsible for entering all data into payment spreadsheets and calculating I/D

12

IOWA DEPARTMENT OF TRANSPORTATION
ACCEPTANCE AND ASSURANCE TESTING OF PCC CORE THICKNESS
OFFICE OF CONSTRUCTION AND MATERIALS

PAY SUMMARY

13

16

Method B – Contractor QC & Local Agency QA

- FHWA approved used of contractor test results for local agencies – DS-23049
- Agency determine locations 1/2000 SY
- Place discs prior to paving
- Contractor performs testing
- Agency randomly check 1 per 7 locations
  - Probing
  - Borrow MIT Gage
  - Survey

14

Payment

- MIT Scan and coring
  - Payment spreadsheet will apply Table 2301.05-1
  - I/D determined with the thickness index (TI)
  - TI is based on the thickness average and standard deviation
  - I/D calculated for each bid item of the same design thickness
- Probing plastic concrete
  - Apply Table 2301.05-2
  - No I/D
  - Maximum 100 percent pay

17

Probing Plastic Concrete

- Inspector determines random location every 350 SY
- Probe plastic concrete by
  - Anchoring base plate and carefully referencing location
  - Probing concrete with measuring device, striking base plate
  - Locking top plate when it is in contact with pavement and then removing probe from concrete
  - Measuring from bottom of rod to top plate and recording thickness to nearest 1/16 inch
- Report on form and average all measurements

15

Deficient Thickness

- Below design thickness by one inch or more
- Deficient areas defined according to IM 346
- Remove and replace deficient areas
- Areas replaced are removed from payment evaluation

18

CHAPTER 21

SMOOTHNESS

Section 21 - Smoothness

PCC Paving Field Inspection

1

Smoothness

- IM 341 & Section 2317
- Method for assessing the desired level of comfort experienced by the traveling public driving on the pavement
- I/D determined by Mean Roughness Index (MRI)
- Determined by Contractor using an automated inertial profiler
- District Materials performs verification on 10%
  - Be sure to notify DME

2

Primary and Interstate Smoothness 2317

- Evaluate MRI unless specifically excluded by the contract documents
- Evaluate all permanent mainline pavement surfaces by MRI, except excluded
  a. Roads intersecting the mainline pavement less than 600 feet in length.
  b. Road connections 150 feet before an intersection that end at a stop sign (yield sign at roundabouts)
  c. 20 feet on either side of bridges, bridge approach, existing EF joints, manholes, or water valve boxes
  d. Ramps and loops.
  e. Bridge approaches (evaluated according to Section 2428).
  f. Storage lanes, turn lanes, and other auxiliary lanes less than 1000 feet.
  g. Pavement less than 8.5 feet in width.
  h. Single lift pavement overlays 2" or less, unless existing surface corrected by milling or scarification.
  i. Single lift pavement overlays 2" or less placed directly on PCC pavement.
  j. Paved shoulders.
  k. Detour pavement.
  l. Crossovers.
  m. Individual sections of pavement less than 100 feet in length.
  n. Roundabouts
- Excluded areas should be evaluated for bumps and dips and corrected

3

Non-primary Smoothness 2317

- Do not evaluate PI unless specifically included in the contract documents
- Excluded areas included in 2317

4

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CHAPTER 22

HAND PLACEMENT

1

Section 22 -
Hand Placement

PCC Paving Field Inspection

1

2

Hand Placement

- Areas of paving placed without a paving machine
- Constructed by placing concrete on grade directly within the confines of forms and/or existing pavement
- Used for irregular areas like
  - Radii (Returns)
  - Ramp tapers
  - Gaps
- Consolidated and finished by hand

2

3

Forms

- Standard Specification 2301.03 A. 3. a. 1) c)
- Not required to support heavy equipment
- Clean steel or wood (2 by stock)
- Height at least equal to design thickness at edge
- Top of form is true plane without variation of 1/8 inch in 10 feet
- Face of form is true plane without variation of 1/4 inch in 10 feet

3

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Forms

- Upper edge of face must be finished to develop a square edge
- Sufficiently stiff and staked to remain vertical and true to line of grade during finishing and placing
- For radii, use flexible or curved forms
- Set to required grade and alignment
- Check alignment by eying and measuring from existing placements
- Check grade using a string or level and ensure that cross slope exists to facilitate drainage

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Placement

- Standard Specification 2301.03 A. 3. d.
- Place and pin dowel assemblies and tie steel
- Wet grade and forms prior to placing concrete
- Directly place concrete on grade a with ready mix truck or agitator truck
- Concrete should be evenly distributed into the placement and as close as possible to final location

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Placement

- Handheld internal vibration is required to ensure adequate consolidation
- Move concrete with shovels and not by dragging vibrators
- Vibrators should be operated
  - Between 3,500 and 6,000 VPM
  - By inserting vertically in and out of the concrete
  - Only until the paste comes to the surface and glistens
- Strike the concrete of by running a vibratory, roller, or truck pulled screed on the top of the forms

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Finishing

- Accomplished with straight edges, floats, and edgers
- Edging is required for all concrete abutting to forms or other placements to provided a clean edge and prevent spalling
- Ensure water is not added and finished into the surface
- Texturing should be accomplished according to Table 2301.03-1
- Curing should be applied immediately after texturing has been completed
- Voids or honeycombed areas should be repaired after form removal

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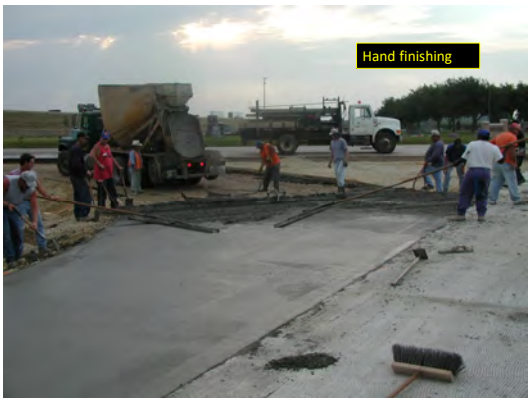

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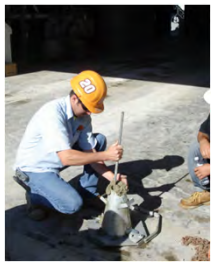
Slump

- Standard Specification 2301.02 B., IM 317
- Provides measure of how easily the concrete flows (consistency)
- Not an indicator of water in the mix as water reducer may skew results
- Required only for non-slipform paving



	Minimum	Target	Maximum
Slipform			
Non-slipform	0.5		4

14

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Slump

- Every effort should be made to not incorporate concrete outside of the limits
- Notify contractor immediately if a test is outside the limits
- Contractor should stop placing from the truck and may pull it off to the side to spin and try to reduce slump
- Continue testing subsequent trucks until two complying tests occur in a row
- Continued incorporation without adjustment is unacceptable and should result in a non-compliance and price adjustment
- CM Appendix 2-34 B provides price adjustment schedule

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Non-slipform Air Content

- Target air content is 7.0% ± 1.5% at ready mix truck
- Air loss is not as considerable as handheld internal vibration is significantly less intense
- Air may be increased by adding air entraining agent, water, and spinning the drum additional revolutions
- Air may be reduced by continued spinning of the drum at a high speed
- De-airing admixtures are not allowed

17

17

Non-Slipform Non-Complying Test

- Every effort should be made to not incorporate concrete outside of the limits
- Notify contractor immediately if a test is outside the limits
- Contractor should stop placing from the truck and may pull it off to the side to adjust air
- Continue testing subsequent trucks until two complying tests occur in a row
- Continued incorporation without adjustment is unacceptable and should result in a non-compliance and price adjustment

18

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Appendix 2-34 B

TABLE B
CONCRETE SLUMP PRICE ADJUSTMENTS

Deviation From Allowable Slump Range	% Payment of Unit Price
½"	95%
¾"	85%
1"	75%
1 ¼"	65%
1 ½"	50%
>1 ½"	0%

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16

CHAPTER 23

PAVEMENT PROTECTION

1

Section 23 - Pavement Protection

PCC Paving Field Inspection

1

2

Protection

- Newly placed pavement is vulnerable to damage prior to setting and achieving strength and must be protected from
  - Rain
  - Cold
- Failure to provide protection can result in damage resulting in
  - Price adjustments
  - Repairs
  - Removal and replacement
- Long term performance, cost of future maintenance, and risk to contracting authority should be considered when evaluating and resolving damage

2

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Rain Protection

- Standard Specification 2301.03 K. 4., CM 9.53 A., 2.53 B. 2.
- Incorporating rainwater into the mix or finishing it into the surface because it
  - Raises the w/c ratio
  - Creates weak layers of paste susceptible to early deterioration
- Protect pavement surface and edges from rain damage
- Have protective materials readily available
  - Sheets of burlap
  - Plastic
  - Blankets
  - Planks and stakes

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Rain Protection

- Check weather forecast before and during paving
- If rain is imminent or occurring, discontinue paving and protect unhardened concrete and secure along edges
- Protect starting at paver and working backwards
- Do not attempt to remove surface water or complete texture or apply curing prior to protecting
- Provide drainage as required to prevent water from flowing along the edge and causing undermining

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Correcting Rain Damage on Plastic Concrete

- Unconsolidated concrete in front of the paver or in trucks exposed to significant and impactful rainwater should not be incorporated
- Do not finish rainwater into the concrete surface
- After rain has stopped, remove protection
- Undamaged surfaces with curing that has been washed off should be recured
- Slightly damaged surfaces may be retextured provided curing has not been applied
- Eroded edges may be repaired by setting side forms and replacing eroded concrete with new concrete

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Loss of mortar from coarse aggregate
Unconsolidated concrete that was exposed to significant rainfall and was removed

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10
Case 1 - loss of texture from most of surface

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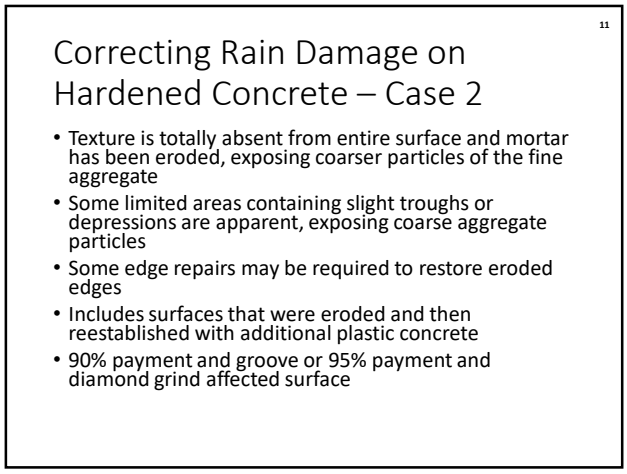
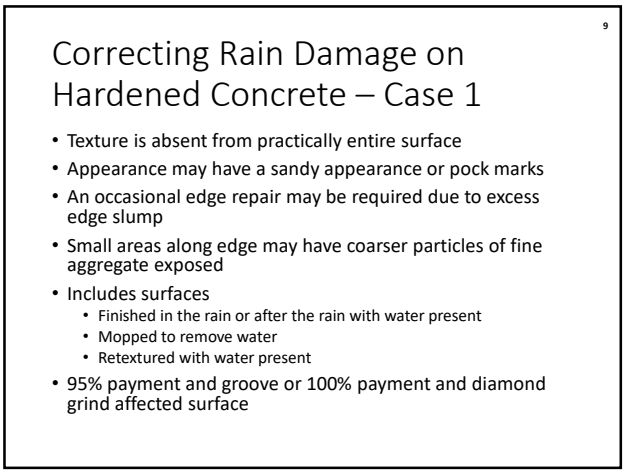
8
Water evident on surface and finishing operations continuing

8


11
Correcting Rain Damage on Hardened Concrete – Case 2
• Texture is totally absent from entire surface and mortar has been eroded, exposing coarser particles of the fine aggregate
• Some limited areas containing slight troughs or depressions are apparent, exposing coarse aggregate particles
• Some edge repairs may be required to restore eroded edges
• Includes surfaces that were eroded and then reestablished with additional plastic concrete
• 90% payment and groove or 95% payment and diamond grind affected surface

11


9
Correcting Rain Damage on Hardened Concrete – Case 1
• Texture is absent from practically entire surface
• Appearance may have a sandy appearance or pock marks
• An occasional edge repair may be required due to excess edge slump
• Small areas along edge may have coarser particles of fine aggregate exposed
• Includes surfaces
• Finished in the rain or after the rain with water present
• Mopped to remove water
• Retextured with water present
• 95% payment and groove or 100% payment and diamond grind affected surface

9


12
Case 2 - complete loss of texture and exposure of sand coarse particles on surface

12

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Correcting Rain Damage on Hardened Concrete – Case 3

- Surface mortar removed to the extent that coarse particles are visible
- Considerable erosion of edges has occurred, but not to an extent that pavement width is affected
- Intermittent edge repair may be required as well as some surface patching of troughs or depressions
- 85% payment and diamond grind affected surface

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Correcting Rain Damage on Hardened Concrete – Removal

- Severe rain damage may require "localized area" repair by bridge deck overlay procedures
- Full depth removal and replacement may be required if edge damage is severe
- Severe cases of rain damage should be referred to the Construction and Materials Bureau for review prior to determination of repair or replacement

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Cold Protection

- Standard Specification 2301.03 K. 3., S, CM 9.55
- Placing concrete in cold conditions can significantly slow hydration and rate of strength gain
- Exposure to freezing prior to achieving adequate strength can damage the concrete and significantly reduce ultimate strength
- Concrete is protected by
  - Placing it under correct conditions
  - Protecting it once placed

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Placement Restrictions

- Mutually evaluate and discuss current and forecasted weather conditions to identify best placement window
- Avoid batching with frozen clumped aggregates
- Do not place concrete on frozen subgrade
- Ensure weather is favorable prior to mixing and during placement
  - Start if air temperature is 34 °F and rising
  - Stop if air temperature is 38 °F and falling
- Concrete temperature must be at least 40 °F

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Cold Weather Protection

- Protect pavement less than 36 hours old according to Table 2301.03-2
- Apply cure prior to placing protection
- Stop concrete placement to allow adequate time to place protection before freezing conditions
- Protection may be temporarily removed to conduct sawing and filling of joints
- Protection will be paid as extra work at a rate per square yard of surface protected per 2301.05, K. 1.
  - Within the contract period
  - Only when authorized after November 15th

18

Table 2301.03- 2: Concrete Pavement Protection Requirements

Night Temperature Forecast	Type of Protection[(a)]
35°F to 32°F	One layer of burlap for concrete.
31°F to 25°F	Two layers of burlap or one layer of plastic on one layer of burlap.
Below 25°F	Four layers of burlap between layers of 4 mil plastic, insulation blankets meeting the requirements below, or equivalent commercial insulating material approved by the Engineer.

(a) Protection shall remain overnight the first night covering is required. After the first night of covering, protection may be removed when one of the following conditions is met:
1. The pavement is 5 calendar days old.
2. Opening strength is attained.
3. Forecasted low temperatures exceed 35°F for the next 48 hours.
4. Forecasted high temperatures exceed 55°F in the next 24 hours and subgrade temperatures are above 40°F.

19

CHAPTER 24

MISCELLANEOUS ITEMS

1

Section 24 - Miscellaneous Items

PCC Paving Field Inspection

1

2

Date and Station Stamping

- CM 9.46
- Provides a permanent reference for forensic review or future work
- Stamped
  - In plastic concrete on troweled surface
  - Not closer than 1 foot to the edge
  - Typically, readable from shoulder
- Placement date should be placed at the beginning and end of every day's placement near header
- Stations should be placed as close to the station while avoiding joints

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Designated Haul Roads

- Standard Specification 1107 and CM 2.12
- Designated road on which contractor hauls materials
- May require agreements with local agencies
- Haul road reviews and agreements must be in place prior to being used for hauling
- Fugitive dust must be controlled and is the responsibility of the contracting authority on approved haul roads
- Inspector and plant monitor should ensure approved haul roads are being used and monitored for condition

4

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Project Site Haul Roads

- Built by contractor for delivery of concrete to paver
- Normally outside the stringline next to the new pavement
- Responsibility of the contractor to maintain and prevent excessive rutting and dust
- Excessive rutting can pump the stringline stakes resulting in bumps in the pavement

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Documentation

- Forms and worksheets are provided to aid in conducting, recording, and summarizing inspection activities
- Paper and fillable pdf forms and worksheets
  - Form E109 – subgrade/final grade check
  - From 830213 – project information/paver inspection
  - Form E135 – pavement field page
  - Form E115 – air and slump tests
  - Form E110 – depth checks
  - Form E111 – PCC items checklist
  - Form E141 – maturity record
  - Form E140 – tining depth checks
  - Pavement worksheet – edge slump, width and yield
  - Texture worksheet – texture
  - Joint check worksheet – joints

7

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Documentation

- Proper documentation is critical for
  - Payment
  - Project finalization and audit
  - Identifying and resolving issues
- Material or work that is non-complying should be
  - Discussed immediately with the contractor and engineer
  - Formally documented using form 830245

8

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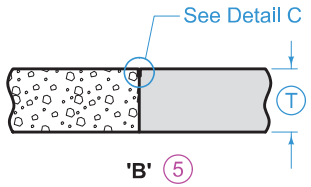
Housekeeping Items

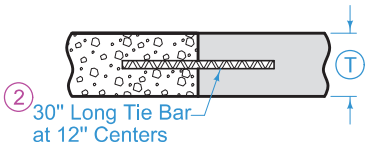
- Inspector should be aware of situations that may impact the project and public perspective
- Consider
  - Unsafe conditions or operations
  - Compliance with NPDES General Permit #2
  - Control of fugitive dust
  - Access
  - Burning of waste

9

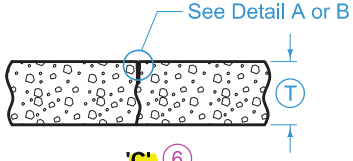
APPENDIX A



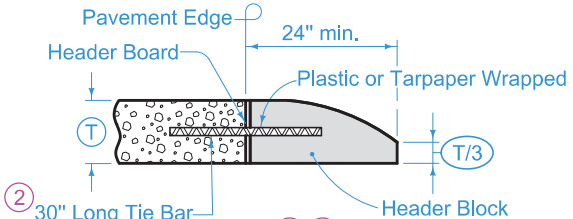
'B' (5)
PLAIN JOINT
(Abutting Pavement Slabs)



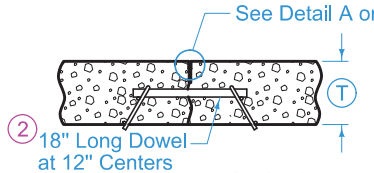
'DW' (3)(4)(7)
DAY'S WORK JOINT(Non-working)



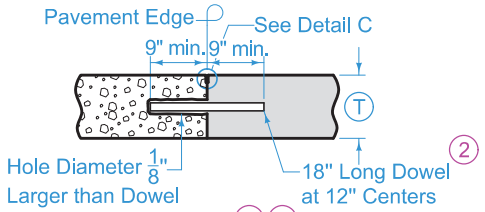
'C' (6)
CONTRACTION JOINT



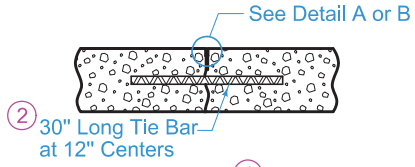
'HT' (4)(5)
HEADER JOINT
(End Rigid Pavement)



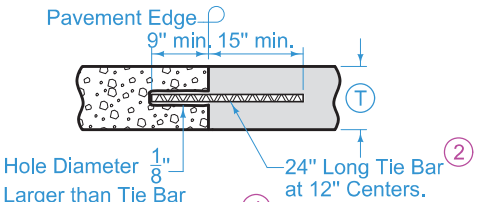
'CD' (1)(4)(6)
DOWELED CONTRACTION JOINT



'RD' (4)(5)
ABUTTING PAVEMENT JOINT



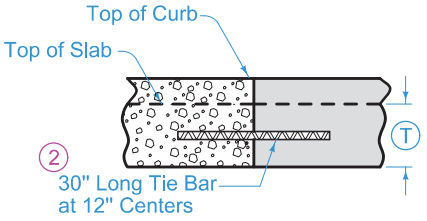
'CT' (4)
TIED CONTRACTION JOINT



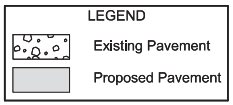
'RT' (4)
ABUTTING PAVEMENT JOINT
RIGID TIE

TRANSVERSE CONTRACTION

1. See dowel assemblies for fabrication details.
2. See Bar Size Table for Contraction Joints on Sheet 2.
3. Locate 'DW' joint at a mid-panel location between future 'C' or 'CD' joints. Place no closer than 5 feet to a 'C' or 'CD' joint.
4. Place bars within the limits shown under dowel assemblies.
5. Edge with 1/8 inch tool for length of joint. For HT joint, remove header block and board when second slab is placed.
6. Unless specified otherwise, use 'CD' transverse contraction joints in mainline pavement when (T) is greater or equal to 8 inches. Use 'C' joints when (T) is less than 8 inches.
7. 'RT' joint may be used in lieu of 'DW' joint at the end of the days work. Remove any pavement damaged due to the drilling at no additional cost to the Contracting Authority.



'DW - CG' (3)(4)
DAY'S WORK JOINT
CURB AND GUTTER UNIT



SUDAS | IOWA DOT

REVISION	
10	04-21-20

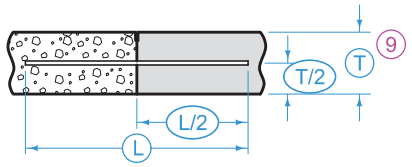
FIGURE 7010.101 | STANDARD ROAD PLAN | **PV-101** | SHEET 1 of 8

REVISIONS: Modified Dowel Assemblies on Sheets 6 and 7 to eliminate reference to 14' pavements.

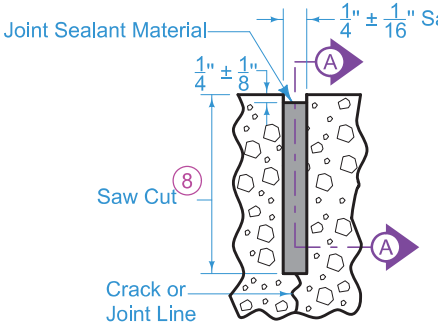
Paul D. Wigand — SUDAS DIRECTOR
Stuart Nine — DESIGN METHODS ENGINEER

JOINTS

FIGURE 7010.101 | SHEET 1 OF 8



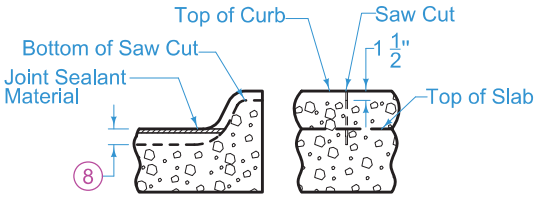
BAR PLACEMENT
(Applies to all joints unless otherwise detailed.)



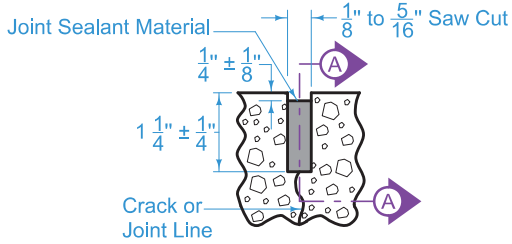
DETAIL A
(Saw cut formed by conventional concrete sawing equipment.)

8 Saw 'CD' joint to a depth of T/3 ± 1/4"; saw 'C' joint to a depth of T/4 ± 1/4".

9 When tying into old pavement, T represents the depth of sound PCC.

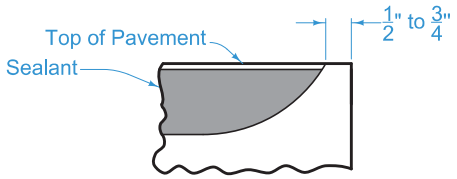


'C' JOINT IN CURB
(Match 'CT', 'CD', or 'C' joint in pavement.)

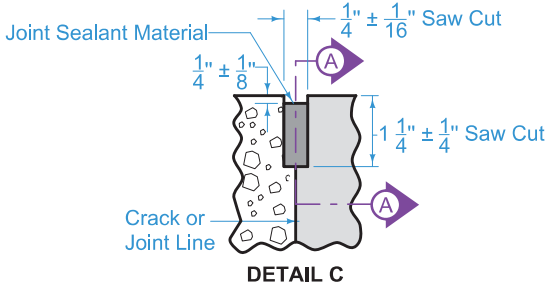


DETAIL B
(Saw cut formed by approved early concrete sawing equipment.)

BAR SIZE TABLE FOR CONTRACTION JOINTS			
T	Solid Dowel Diameter	Tubular Dowel Diameter	Tie Bar Size
< 8"	3/4"	7/8"	#6
≥ 8" but < 10"	1 1/4"	1 3/8"	#10
≥ 10"	1 1/2"	1 5/8"	#11
Tubular Dowel Bars will not be allowed for RD joints.			



SECTION A-A
(Detail at Edge of Pavement)



DETAIL C

LEGEND
Existing Pavement
Proposed Pavement

SUDAS | IOWA DOT

REVISION	
10	04-21-20

FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 2 of 8

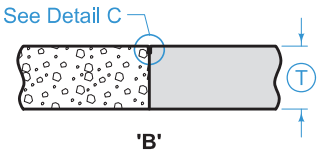
REVISIONS: Modified Dowel Assemblies on Sheets 6 and 7 to eliminate reference to 14' pavements.

Paul D. Wigand, SUDAS DIRECTOR
Stuart Nicholson, DESIGN METHODS ENGINEER

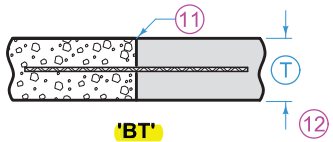
JOINTS

FIGURE 7010.101 SHEET 2 OF 8

TRANSVERSE CONTRACTION

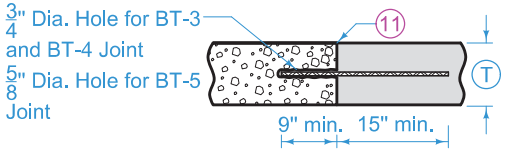


'B'
PLAIN JOINT
(Abutting Pavement Slabs)



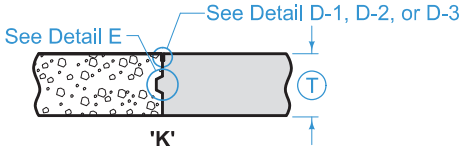
'BT'
ABUTTING PAVEMENT JOINT - RIGID TIE

T	Joint	Bars	Bar Length and Spacing
< 8"	'BT-1'	#4	36" Long at 30" Centers
		#5	30" Long at 30" Centers
≥ 8"	'BT-2'	#5	36" Long at 30" Centers

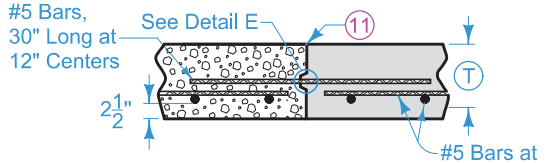


'BT'
ABUTTING PAVEMENT JOINT - RIGID TIE (Drilled)

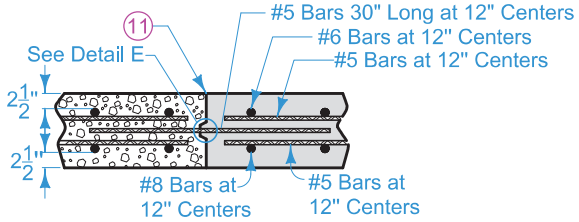
T	Joint	Bars	Bar Length and Spacing
< 8"	'BT-5'	#4	24" Long at 30" Centers
≥ 8"	'BT-3'	#5	24" Long at 30" Centers
	'BT-4'		24" Long at 15" Centers



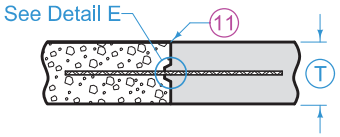
'K'
KEYED JOINT FOR ADJACENT SLABS
(Where T is 8" or more)



'KS-1'
[Single Reinforced Pavement (Bridge Approach)]



'KS-2'
[Double Reinforced Pavement (Bridge Approach)]



'KT' (10) (12)
ABUTTING PAVEMENT JOINT - KEYWAY TIE

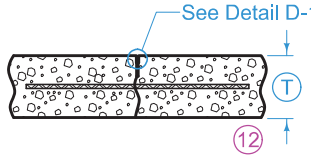
T	Joint	Bars	Bar Length and Spacing
< 8"	'KT-1'	#4	30" Long at 30" Centers
≥ 8"	'KT-2'	#5	30" Long at 30" Centers
	'KT-3'		30" Long at 15" Centers

LONGITUDINAL CONTRACTION

(10) Bar supports may be necessary for fixed form paving to ensure the bar remains in a horizontal position in the plastic concrete.

(11) Sawing or sealing of joint not required.

(12) The following joints are interchangeable, subject to the pouring sequence:
'BT-1', 'L-1', and 'KT-1'
'KT-2' and 'L-2'
'KT-3' and 'L-3'



'L'
CONTRACTION JOINT

T	Joint	Bars	Bar Length and Spacing
< 8"	'L-1'	#4	36" Long at 30" Centers
≥ 8"	'L-2'	#5	36" Long at 30" Centers
	'L-3'		36" Long at 15" Centers

LEGEND
Existing Pavement
Proposed Pavement

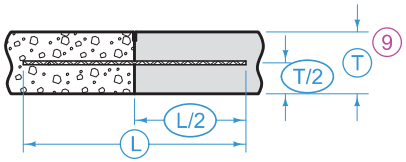
SUDAS | IOWADOT | REVISION 10 04-21-20
FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 3 of 8

REVISIONS: Modified Dowel Assemblies on Sheets 6 and 7 to eliminate reference to 14' pavements.

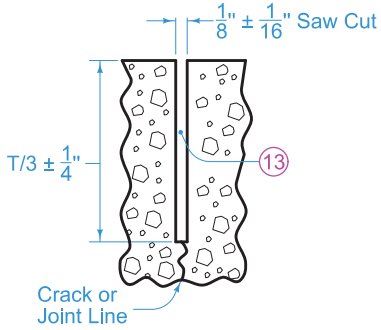
Paul D. Wigand, SUDAS DIRECTOR
Stuart Nicholson, DESIGN METHODS ENGINEER

JOINTS

FIGURE 7010.101 SHEET 3 OF 8



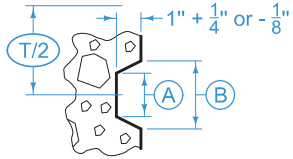
TIE BAR PLACEMENT
(Applies to all joints unless otherwise detailed.)



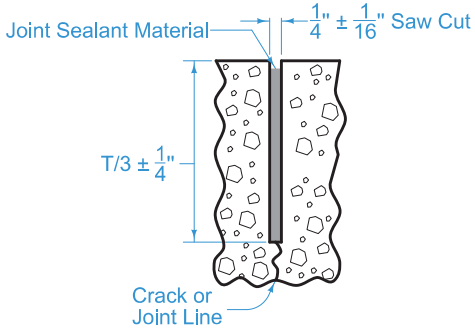
DETAIL D-1
(Required when specified in the contract documents.)

9 When tying into old pavement, T represents the depth of sound PCC.

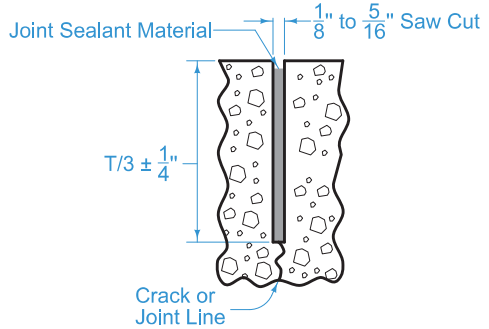
13 Sealant or cleaning not required.



DETAIL E

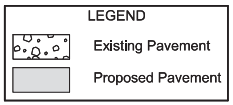


DETAIL D-2
(Required when the Department of Transportation is not the Contracting Authority, or when specified in the contract documents)



DETAIL D-3
(Required when the Department of Transportation is the Contracting Authority, or when specified in the contract documents)

KEYWAY DIMENSIONS			
Keyway Type	Pavement Thickness (T)	(A)	(B)
Standard	8" or greater	1 3/4"	2 3/4"
Narrow	Less than 8"	1"	2"



SUDAS | IOWADOT | REVISION 10 04-21-20

FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 4 of 8

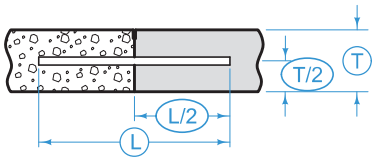
REVISIONS: Modified Dowel Assemblies on Sheets 6 and 7 to eliminate reference to 14" pavements.

Paul D. Wigand, SUDAS DIRECTOR | Stuart Nicholson, DESIGN METHODS ENGINEER

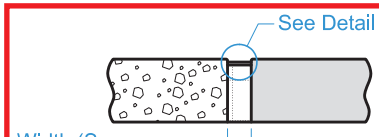
JOINTS

LONGITUDINAL CONTRACTION

FIGURE 7010.101 SHEET 4 OF 8

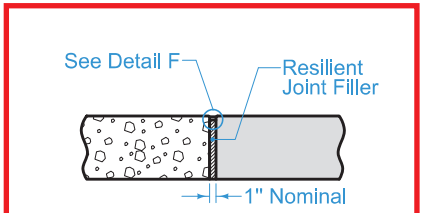


DOWEL PLACEMENT
(Applies to all joints unless otherwise detailed.)

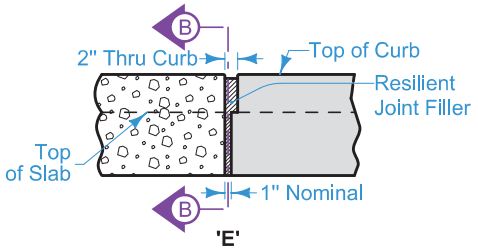


'CF' JOINT

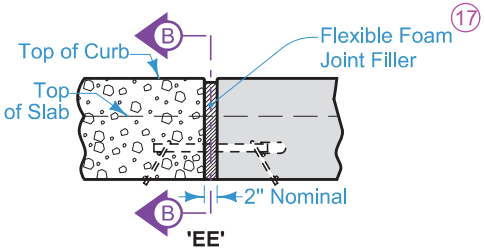
TYPE	WIDTH
CF-1	2"
CF-2	$2\frac{1}{2}$"
CF-3	3"
CF-4	$3\frac{1}{2}$"



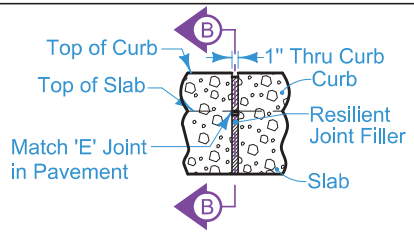
'E'
1" EXPANSION JOINT



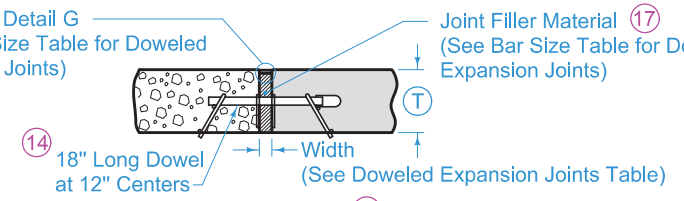
'E'
JOINT IN CURB
(View at Back of Curb)



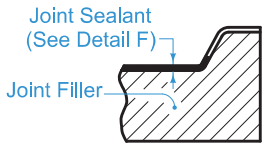
'EE'
JOINT IN CURB
(View at Back of Curb)



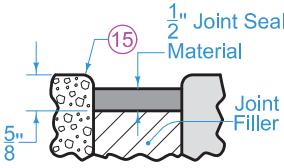
'ES'
JOINT IN CURB
(View at Back of Curb)



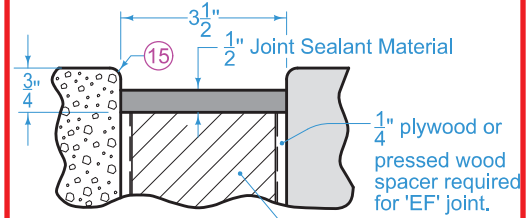
'ED', 'EE', 'EF' 16
DOWELED EXPANSION JOINT



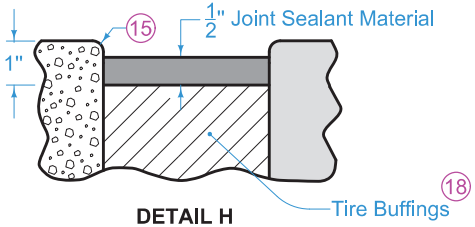
SECTION B-B



DETAIL F



DETAIL G



DETAIL H

EXPANSION

14 See Bar Size Table for Doweled Expansion Joints.

15 Edge with 1/4 inch tool for length of joint indicated if formed; edging not required when cut with diamond blade saw.

16 See Dowel Assemblies for fabrication details and placement limits. Coat the free end of dowel bar to prevent bond with pavement. At intake locations, dowel bars may be cast-in-place.

17 Predrill or preform holes in joint material for appropriate dowel size.

18 Compact tire buffings by spading with a square-nose shovel.

DOWELED EXPANSION JOINTS		
TYPE	WIDTH	FILLER MATERIAL 17
ED	1"	Resilient (Detail F)
EE	2"	Flexible Foam (Detail F)
EF	$3\frac{1}{2}$"	Flexible Foam (Detail G)

BAR SIZE TABLE FOR DOWELED EXPANSION JOINTS			
T	< 8"	≥ 8" but < 10"	≥ 10"
Dowel Diameter	$\frac{3}{4}$"	$1\frac{1}{4}$"	$1\frac{1}{2}$"
Tubular Dowel Bars will not be allowed for expansion joints.			

LEGEND
Existing Pavement
Proposed Pavement

SUDAS | IOWADOT

REVISION	
10	04-21-20

FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 5 of 8

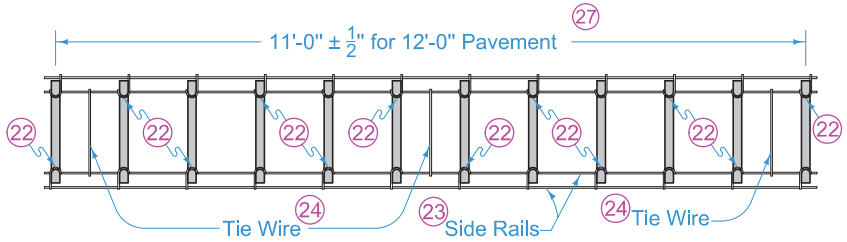
REVISIONS: Modified Dowel Assemblies on Sheets 6 and 7 to eliminate reference to 14" pavements.

Paul D. Wigand, SUDAS DIRECTOR
Stuart Nicholson, DESIGN METHODS ENGINEER

JOINTS

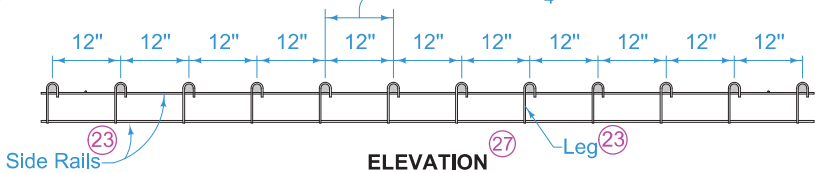
FIGURE 7010.101 SHEET 5 OF 8

CONTRACTION JOINTS

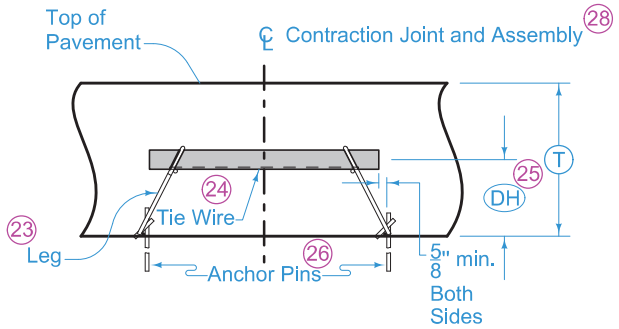


PLAN

Spaces between dowel bars are nominal dimensions with a $\frac{1}{4}$" allowable tolerance.



ELEVATION



LONGITUDINAL SECTION

DOWEL ASSEMBLIES (19) (20) (21)

19. Use 18 inch long dowel bars with a tolerance of ± 1/8 inch. Ensure the centerlines of individual dowels are parallel to the other dowels in the assembly within ± 1/8 inch.
20. Use wires with a minimum tensile strength of 50 ksi.
21. Details apply to both transverse contraction and expansion joints.
22. Weld alternately throughout.
23. 0.306 inch diameter wire. Wire sizes shown are the minimum required.
24. Maximum 0.177 inch diameter wire, welded or friction fit to upper side rail, both sides.
25. Measured from the centerline of dowel bar to bottom of lower side rail + 1/4 inch.
26. Per lane width, install a minimum of 8 anchor pins evenly spaced (4 per side), to prevent movement of assembly during construction. Anchor assemblies placed on pavement or PCC base with devices approved by the Engineer.
27. If dowel basket assemblies are required for curbed pavements, the assembly length is based on the jointing layout. See PV-101, sheet 8.
28. Ensure dowel basket assembly centerline is within 2 inches of the intended joint location longitudinally and has no more than 1/4 inch horizontal skew from end of basket to end of basket.

DOWEL HEIGHT AND DIAMETER FOR DOWELED CONTRACTION JOINTS			
(T)	(DH) (25)	Diameter (Solid)	Diameter (Tubular)
7" to 7 1/2"	3 1/2"	3/4"	7/8"
8" to 9 1/2"	4 1/4"	1 1/4"	1 3/8"
10" to 11 1/2"	5 1/4"	1 1/2"	1 5/8"
12" to 13"	6 1/4"	1 1/2"	1 5/8"
Tubular Dowel Bars will not be allowed for RD joints.			

SUDAS | IOWA DOT

REVISION 10 04-21-20

FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 6 of 8

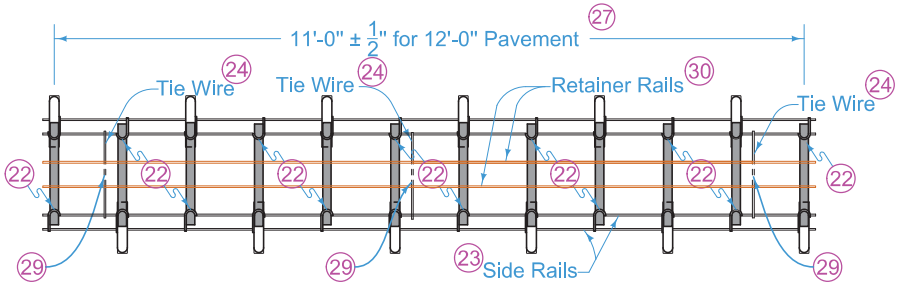
REVISIONS: Modified Dowel Assemblies on Sheets 6 and 7 to eliminate reference to 14' pavements.

Paul D. Wigand, SUDAS DIRECTOR — DESIGN METHODS ENGINEER

JOINTS

FIGURE 7010.101 | SHEET 6 OF 8

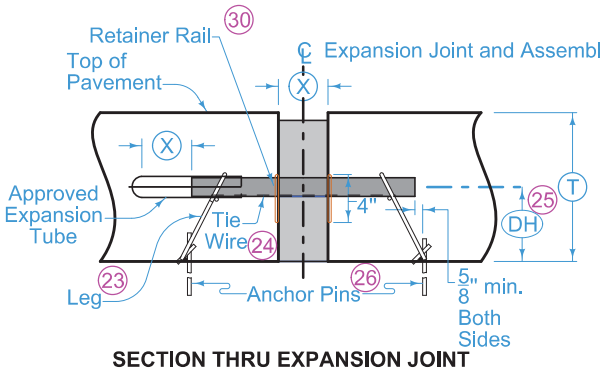
EXPANSION JOINTS



PLAN

Spaces between dowel bars are nominal dimensions with a 1/4" allowable tolerance.

ELEVATION



SECTION THRU EXPANSION JOINT

JOINT OPENING AND EXPANSION TUBE EXTENSION		
Joint Type	(X)	Minimum Tube Length
"ED"	1"	6"
"EE"	2"	7"
"EF"	3 1/2"	9"

DOWEL HEIGHT AND DIAMETER FOR DOWELED EXPANSION JOINTS		
(T)	(DH) 25	Diameter
7" to 7 1/2"	3 1/2"	3/4"
8" to 9 1/2"	4 1/4"	1 1/4"
10" to 11 1/2"	5 1/4"	1 1/2"
12" to 13"	6 1/4"	1 1/2"
Tubular Dowel Bars will not be allowed for expansion joints.		

DOWEL ASSEMBLIES 19 20 21

19 Use 18 inch long dowel bars with a tolerance of ± 1/8 inch. Ensure the centerlines of individual dowels are parallel to the other dowels in the assembly within ± 1/8 inch.

20 Use wires with a minimum tensile strength of 50 ksi.

21 Details apply to both transverse contraction and expansion joints.

22 Weld alternately throughout.

23 0.306 inch diameter wire. Wire sizes shown are the minimum required.

24 Maximum 0.177 inch diameter wire, welded or friction fit to upper side rail, both sides.

25 Measured from the centerline of dowel bar to bottom of lower side rail + 1/4 inch.

26 Per lane width, install a minimum of 8 anchor pins evenly spaced (4 per side), to prevent movement of assembly during construction. Anchor assemblies placed on pavement or PCC base with devices approved by the Engineer.

27 If dowel basket assemblies are required for curbed pavements, the assembly length is based on the jointing layout. See PV-101, sheet 8.

28 Ensure dowel basket assembly centerline is within 2 inches of the intended joint location longitudinally and has no more than 1/4 inch horizontal skew from end of basket to end of basket.

29 Clip and remove center portion of tie during field assembly.

30 1/4 inch diameter wire.

SUDAS | IOWADOT | REVISION 10 04-21-20

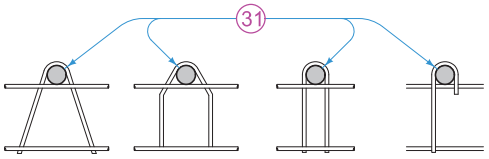
FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 7 of 8

REVISIONS: Modified Dowel Assemblies on Sheets 6 and 7 to eliminate reference to 14' pavements.

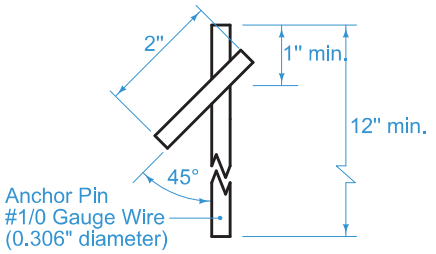
Paul D. Wigand, SUDAS DIRECTOR — Steven Megivern, DESIGN METHODS ENGINEER

JOINTS

FIGURE 7010.101 | SHEET 7 OF 8



OPTIONAL LEG SHAPES



ANCHOR PIN

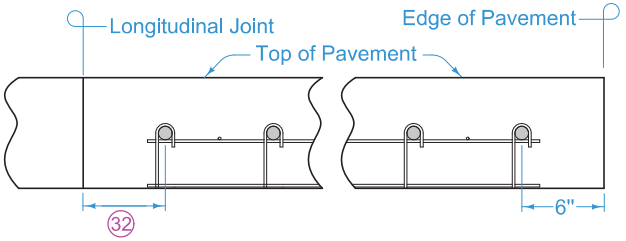
(19) Use 18 inch long dowel bars with a tolerance of ± 1/8 inch. Ensure the centerlines of individual dowels are parallel to the other dowels in the assembly within ± 1/8 inch.

(20) Use wires with a minimum tensile strength of 50 ksi.

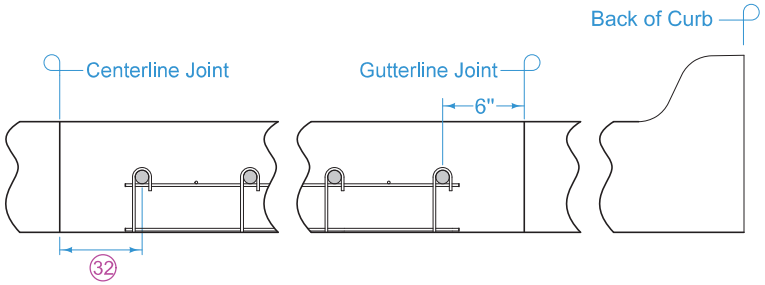
(21) Details apply to both transverse contraction and expansion joints.

(31) Diameter of bend around dowel is dowel diameter + 1/8 to 3/16 inches.

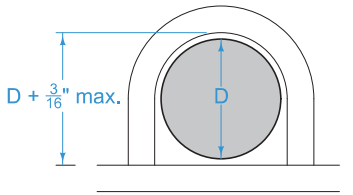
(32) For uniform lane widths: 3" - 6". For taper and variable width pavements: 3" - 12".



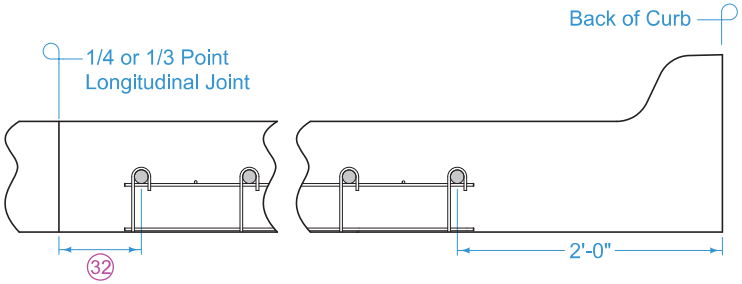
PLACEMENT LIMITS
(Rural Section)



PLACEMENT LIMITS
(Curb and Gutter - Gutterline Jointing)



BEND AROUND DOWEL (31)



PLACEMENT LIMITS
(Curb and Gutter - 1/4 or 1/3 Point Jointing)

DOWEL ASSEMBLIES (19) (20) (21)

FIGURE 7010.101 SHEET 8 OF 8

SUDAS | IOWA DOT

REVISION	
10	04-21-20

FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 8 of 8

REVISIONS: Modified Dowel Assemblies on Sheets 6 and 7 to eliminate reference to 14' pavements.

Paul D. Wigand, SUDAS DIRECTOR
Stuart Nicholson, DESIGN METHODS ENGINEER

JOINTS

Form 830213
10-07

Iowa Department of Transportation

Project Information/Paver Inspection

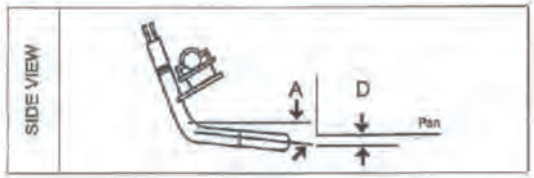
Date	Project Number	Contract Number
Location		County
Project Inspector	Paving Foreman	
Type/Model of Paver		
Type/Mounting Location of Tie-Bar Inserter		
Location of Tie-Bar Inserter from Pavement Edge		

Note: If any information changes during the project, a new form needs to be completed.

Spacing (in)																								
Paving Direction																								
Cumulative Total																								
Vibrator No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Freq X 100																								
Station																								
Freq X 100																								
Station																								
Freq X 100																								
Station																								

General Notes:

1. Spec Limits – Refer to specification 2301.
2. Spacing not to exceed 16". Centerline spacing may be increased to 30" max due to physical limitations of paver such as mounting bracket locations; spacing should not be increased for tie steel insertion or lack of adequate number of vibrators.
3. When vibration monitoring is used, check and record frequency on a minimum of two vibrators daily.
4. When vibration monitoring is not used, check and record frequency of each vibrator twice daily.



Angle	(A)=
Depth (in.)	(D)=

Form E135 PCC Pavement Field Page

Revised 2/16

PCC Pavement Field Page

Form E135

Line No.: ________

Item Code: ________

Description: ________

Project No.: ________

Category No.: ________

Contract ID: ________

Date	Station		Lane	Mix No.	Time		Length (ft)	Width (ft)	Estimated CY Today	Used (CY)		Est. Used (%)	Slip or Fixed (S / F)	Cold Weather (Y / N)
	From	To			Start	Stop				Today	To Date			

Form E115 Air and Slump Tests

Rev 01/19

Form E115

Air and Slump Tests

Line No.: _____ **Page No.:** _____

Contractor: _____ **Category No.:** _____

Project No.: _____ **Contract ID:** _____

Date	Location	Mix Type	Air (%)	Air After Correction (%)	Witnessed Quality Control Test (X)	Slump (In)	Application	Remarks

Form E110 Depth Checks

Rev 1/97 Form E110

Depth Checks

Line No.: ____________

Item Code: ________________________ Page No.: ______________

Description: ________________________________ Category No.: ______________

Project No.: ________________________________ Contract ID: ________________

	Location	Req'd	Actual Depth							
Date	Sta Sta (Side)	Depth	(Inches)							By

Form E111 PC Concrete Items Checklist

Rev 1/97

Form E111

PC Concrete Item Check List

Line No.: _____ **Page No.:** _____

Item Code: _____ **Category No.:** _____

Description: _____ **Contract ID:** _____

Project No.: _____

Date	Location		Basket	Tie Bars		Vibrator	Air & Slump	Depth	Width	Yield	Slope	Texture	Mix Temp.	Protect.	Cure Rate	By
	Sta	(Side)	(x)	Plastic (x)	Hard (x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(°F)	(Y/N)	(gal/sy)	

Form E141 Maturity Record

Revised 2/16 | Maturity Record | Form E141

Line No.: ______

Contractor: ______ Category No.: ______

Project No.: ______ Contract ID: ______

Location		Date	Mix	TTF	Date	TTF @	
Station	Station	Poured	Number	Target	Opened	Opening	Remarks

Form E140 Tining Depth Checks

New 02/98 | Form E140

Line No.: ______________

Item Code: ______________ Page No.: ______________

Description: Tining Depth Checks Category No.: ______________

Project No.: ______________ Contract ID: ______________

	Location		Actual Measurements (in.)								
Date	Station	Side	1	2	3	4	5	6	7	Avg.	By
										0	
										0	
										0	
										0	
										0	
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										0	
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										0	
										0	

Pavement Worksheet

Page No ____

Pavement Worksheet

Project No: _____ Contract ID: _____

DATE	STA.	STA.	EDGE SLUMP	WIDTH	CY/CM³ REGISTERED	CY/CM³ BATCHED	% YIELD	RUNNING TOTAL	RUNNING % YIELD	INSP. INITS.

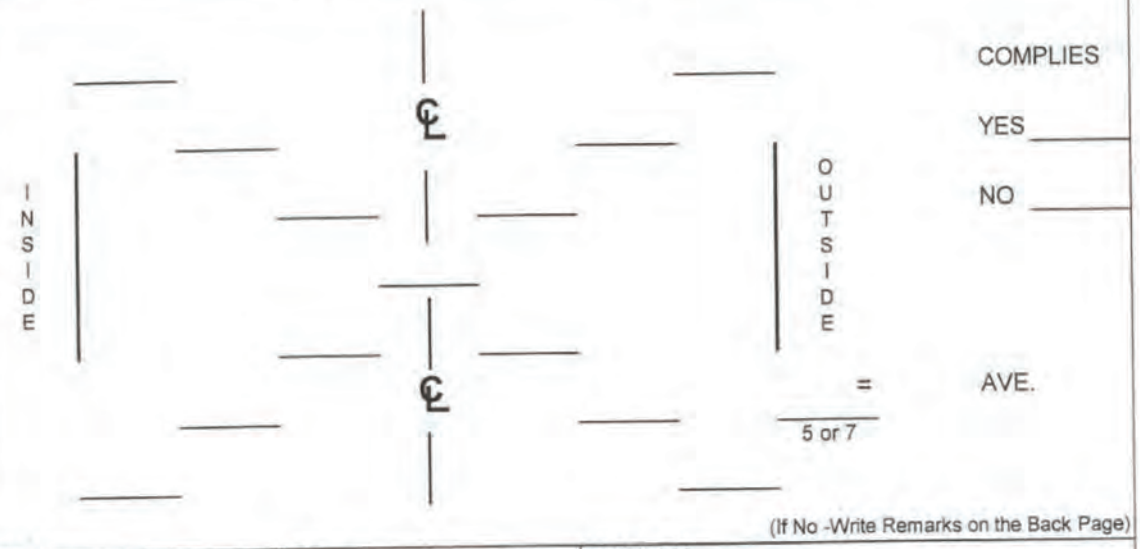
REMARKS _____

Texture Check Worksheet

Project No _____ Contract ID _____

TEXTURE CHECK WORKSHEET

DATE --	STA. --	MEAS. BY --



COMPLIES

YES _____

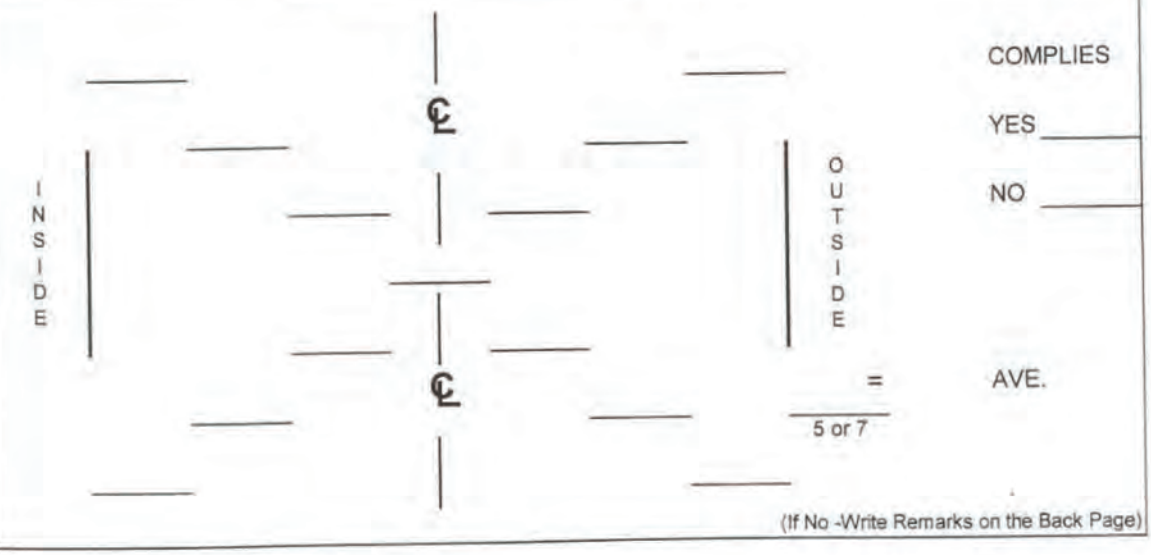
NO _____

= AVE.

5 or 7

(If No -Write Remarks on the Back Page)

DATE --	STA. --	MEAS. BY --



COMPLIES

YES _____

NO _____

= AVE.

5 or 7

(If No -Write Remarks on the Back Page)

Joint Check Worksheet

Page No _____

Project No _____ **Contract ID** _____

JOINT CHECK WORKSHEET

DATE	STA.	℄	TRANS	DEPTH	WIDTH	SAND BLASTED	SEAL	REMARKS	INSP. INITS.

NOTE

PCC Paving Field Inspection Checklist				
Duty	**Frequency**	**Record Checks**	**Specification/Resource**	**Commentary**
Prior to Concrete Placement				
Check proof rolling of subgrade	Everywhere prior to final trimming of subgrade.		Specification 2301.03, B, 3 all PCC paving Specification 2115.03, B, 2 Modified Subbase	All subgrades should be proof rolled with a sheep's foot roller no more than 1 week prior to trimming of the final grade. In addition, when Modified Subbase is used, the subgrade is to be proof rolled with a loaded truck to identify soft spots, etc.
Check stringline	As needed			Prior to checking subgrade and subbase cross slope and elevation, check to ensure that the stringline is properly placed relative to the paving hub. This can be done simply by measuring from the paving hub up to the stringline. Make sure to factor in the contractor's machine constant when measuring.
Check trimmed subgrade	10/mile (IM-204)	Form E109	Specification 2109.03, A, 10 plus or minus 0.05 foot	Check to ensure subgrade is trimmed to the proper cross slope and elevation. Usually checked by placing string across subgrade from stringline to stringline and measuring down to top of subgrade. When stringline is not available, a survey rod and level may be used. Laser levels have been used but are less common. GPS rovers have also been used, but may not be accurate enough to measure within the specification tolerances.

PCC Paving Field Inspection Checklist				
Duty	**Frequency**	**Record Checks**	**Specification/Resource**	**Commentary**
Make sure the contractor is not driving haul vehicles on granular subbase	As needed		Specification 2111.03, E	The specification prohibits the contractor from driving on the granular subbase material. This is a concern because excessive haul traffic on the granular subbase material can cause the material to break down and generate an excessive amount of fines. This is undesirable because granular subbase is intended to be a drainable material. Haul equipment must be operated on the material for delivery and placement purposes. A reasonable expectation of the contractor is that they get on and off the material within a 500 to 1000 foot stretch. When recycled materials are used, the distance should be kept closer to 500 feet. When virgin materials are used, the distance can be extended up to 1000 feet depending upon how much breakdown of the material occurs.
Check trimmed subbase (granular or modified)	10/mile (IM-204)	Form E109	Modified Subbase Specification 2115.03 plus 0 and minus 0.05 foot IM 204 Appendix C Granular Subbase Specification 2111.03, D, 4 plus 0 and minus 0.05 foot IM 204 Appendix D	Check to ensure subbase is trimmed to the proper cross slope and elevation. This, along with the subgrade checks, will ensure proper subbase thickness. Usually checked by placing string across subbase from stringline to stringline and measuring down to top of subbase. When stringline is not available, a level may be used. Laser levels have been used but are less common. GPS rovers have also been used, but may not be accurate. The width of the subbase should also be checked at this time to ensure that the proper placement width is being achieved. Note that subbase width typically includes an added three feet on each side of the pavement for a padline.
Check steel reinforcement storage			Specification 4151.02	Steel reinforcement should be stored in a manner that reduces the risk of corrosion, damage, and breakdown of epoxy coating. All reinforcement is to be stored on supports to prevent contact with the ground and extended contact with moisture. Epoxy coated bars should be covered with a non-transparent material if exposed for 2 months or more.

PCC Paving Field Inspection Checklist				
Duty	**Frequency**	**Record Checks**	**Specification/Resource**	**Commentary**
Check dowel basket placement		Form E111	Specification 2301.03, E Specification 4151.02, B Road Standard PV-101 Paving typicals in B sheets of project plans	Dowel baskets should be checked for spacing, alignment, proper anchorage, and adequate bond breaker coating. A quick and simple method to check alignment is to sight down the grade. Baskets that are out of alignment will be visible as the dowels will not line up. The baskets should also be checked to ensure that the dowel bars are level and parallel with each other. It is important to check alignment of dowels to ensure that the contraction joint works properly in the pavement. Once the joint is sawed and the pavement cracks, the concrete is intended to slide over the dowel as the pavement expands and contracts. If the dowels are out of alignment, the pavement cannot properly slide on the dowels which may result in random cracking. Baskets should be anchored with a minimum of 8 basket stakes per lane width. Dowel baskets are required to be coated with a bond breaker. Typically the bond breakers used are a bituminous material or a paraffin based material. Often the bituminous coating can become dry and brittle and will develop cracks in the material. If this occurs, recoating of the bars may be necessary. The contractor is not required to cut the tie wires on the baskets as long as the basket is manufactured correctly. The PV-101 road standard shows three wires on the basket. If more than three wires are provided, only three may be left uncut. One final check that should be made for dowel baskets is to check that the contractor has marked the center of each end of the basket to identify the location of the basket for purposes of sawing. This is typically done by placing a basket stake off each end of the basket along with a paint mark.

PCC Paving Field Inspection Checklist				
Duty	**Frequency**	**Record Checks**	**Specification/Resource**	**Commentary**
Inspect the finishing machine	Once each paver and when information changes.	Form 830213	Specification 2301.03, A, 3 Construction Manual Appendix 9-3	A few days prior to start of paving, several checks should be made on the paver, and form 830213 should be completed. Use this form to record vibrator spacing and angle. The paver width and cross slope should also be checked. The form can also be used to record vibrator frequency checks during paving.
Check paver vibration monitoring system			Specification 2301.03, A, 3, a Vibration monitoring required for all projects with mainline paving quantities greater than 50,000 square yards	Discuss layout of vibrators with contractor to confirm locations of each relative to data being recorded on monitoring system.
Check paver vibrator spacing	Once each paver and each time the paver width is changed.		Specification 2301.03 A, 3, a 16 inch maximum spacing	Record on form 830213. Spacing may be increased due to structural limitations of finishing machine. Greater spacing should not be allowed for tie steel insertion or lack of correct number of vibrators.
Check paver vibrator angle	Once each paver.		Specification 2301.03 A, 3, a Vibrators should be mounted parallel to direction of paving and trailing end tilted to approximately 15 degrees below horizontal	Record on form 830213.

PCC Paving Field Inspection Checklist				
Duty	**Frequency**	**Record Checks**	**Specification/Resource**	**Commentary**
During Concrete Placement				
Place date in headers	Daily			The date should be stamped in the headers at the beginning and end of each day's run. The date should be placed in the outer 2 feet of the pavement in a position where it will not be destroyed by possible milled shoulder rumble strip placement.
Check subgrade/subbase moisture	As needed.		Specification 2109.03, B Specification 2301.03, B	The subgrade or subbase should be periodically checked throughout the paving day to ensure that the material is uniformly moist. Moisture should be added as needed to keep the material in a uniformly moist condition. As the subgrade or subbase material dries out, moisture will be wicked out of the concrete and can cause loss of strength and reduction in effective pavement thickness. After periods of rain, addition of moisture may not be necessary if sufficient moisture is present.
Check dowel baskets	Periodically		Specification 2301.03, E	It is a good practice to periodically walk out in front of the paving train and check to make sure dowel baskets are still in proper alignment and free from contamination. Occasionally baskets can become damaged or contaminated with mud or other debris during handling and placement. These baskets should be cleaned and repaired or removed and replaced.
Check joint layouts	As needed		Specification 2301.03, E K and L sheets in project plans	There are certain locations on a project where specific joint types and spacings are required. Areas such as turn lanes, paved crossovers, and side road connections will have a specific jointing layout included in the K and L sheets of the project plans. It is important to review the project plans and inspect the contractors jointing layout prior to placing concrete.

PCC Paving Field Inspection Checklist				
Duty	**Frequency**	**Record Checks**	**Specification/Resource**	**Commentary**
Check concrete delivery time	At start of concrete placement and when delivery routes or distances change	Ready mix - Form 830212 Central batch - N/A	Specification 2301.02, C, 4	The specification requires that concrete hauled without continuous agitation be placed within 30 minutes after batching. This time may be extended an additional 30 minutes when a retarder is used with approval of the Engineer. Concrete hauled with continuous agitation must be placed within 90 minutes after batching. When using ready mix concrete, the time batched should be included on Form 830212 (Ready Mix Concrete) when received on grade. After discharge, the discharge time should also be recorded on the form. For central batch concrete, haul routes and haul times should be discussed with the contractor prior to placement. Factors such as delays due to heavy traffic (i.e. - rush hour in an urban area) should be discussed along with possible alternate haul routes. Haul times should be observed and recorded in the daily diary for the project.
Check and document water added on grade	Each load	Form 830212	Specification 2301.02, C, 4	Record water added to each load on the ready mix ticket for that load. Total water added to all loads for the placement should be totaled and reported to the plant inspector for inclusion on the plant report.
Check concrete placement operation	Periodically		Specification 2301.03, F Specification 2301.03, J	Concrete should be placed in a manner that minimizes segregation and disturbance of reinforcement. When a belt placer is being used, check to make sure that a deflector is in place and being used. This will help to minimize segregation. During hand placements, hand operated vibrators should not be used to move the concrete. They should only be used for consolidation purposes. Concrete placement should also be monitored to ensure that concrete does not sit on the grade for more than 30 minutes before consolidation and finishing. This is to ensure that the concrete is plastic and workable when consolidated and finished by the finishing machine.

PCC Paving Field Inspection Checklist				
Duty	**Frequency**	**Record Checks**	**Specification/Resource**	**Commentary**
Test slump of plastic concrete	Minimum 1/700 CY Minimum of 1 test per placement	Form E115 Form E111	Specification 2301.02, B, 3 Slip form paving N/A Non-slip form paving 0.5" to 4" IM 204 Appendix E, IM 317	There are no slump requirements for slip form pavement since the ability of the pavement to hold a slipped edge governs slump.
Test entrained air content of plastic concrete	Minimum 1/700 CY Minimum 1/100 CY for transit mix Minimum of 1 test per placement	Form E115 Form E111	Specification 2301.02, B, 4 Slip form paving target of 8% with a tolerance of plus or minus 2% Non slip form paving target of 7% with a tolerance of plus or minus 1.5% IM 204 Appendix E, IM 318, IM 327, IM 527, IM 530 Construction Manual 9.63	As concrete is placed, consolidated, and finished, air entrainment is lost. It is desirable to have an entrained air content of approximately 6% after finishing. The specification limits for air content are set up to account for air loss during placement and finishing. Air tests should occasionally be run behind the paver to confirm that the anticipated air loss is occurring and that the desired air content is achieved. It is recommended that air loss through the paver be checked once per day for the first three days of paving on a project. After that, checks should be made weekly to confirm the amount of air loss through the paver. It is important that verification tests for air content are random. Testing frequency must be random in order for the test to be valid. Testing should not be performed at regular intervals or at fixed times each day. On QM-C projects, verification testing should not be timed to match contractor quality control testing.
Observe and record contractor quality control air tests	As requested by contractor	Form E115	Construction Manual 9.63	Contractors are only required to perform quality control (QC) testing on QM-C projects. However, if the contractor elects to perform QC testing on a non-QM-C project, testing should be witnessed and documented, when requested by the contractor. Form E 115 includes a column indicating whether a test is a witnessed QC test or not. Witnessing and documenting contractor QC tests is important because it may reduce the amount of non-compliance and/or testing that a contractor may be responsible for when non-complying material is identified.

PCC Paving Field Inspection Checklist				
Duty	**Frequency**	**Record Checks**	**Specification/Resource**	**Commentary**
Check concrete mix temperature	Daily when near specification limits	Form E111	Specification 2301.03, S Minimum 40 degrees F at time of placement	It is important to check concrete temperatures in the early spring and late fall to ensure that the minimum mix temperatures are achieved. Early spring is the more critical time to ensure minimum mix temperatures since the subgrade/subbase as well as all of the mix ingredients are much colder after the winter. Typically mix temperatures are not an issue in the late fall as the mix ingredients are usually warmer than the ambient air temperatures. While Iowa does not have an upper limit for concrete mix temperatures, temperatures should be taken and recorded when complications with air entrainment or finishing are encountered during hot weather.
Check pavement width and cross slope	At start of paving and when paving widths change	Form E111	Specification 2301.03, A, 3 Specification 2301.03, F and G Paving typicals in B sheets of project plans	Similarly to checks made on the finishing machine prior to start of paving, the pavement itself should be checked to ensure that the proper width and cross slope are provided. Cross slope checks can be accomplished by running a stringline across the pavement from one stringline to another. Measurements can then be made down from the stringline to top of pavement at centerline and both pavement edges to determine the cross slope of the pavement.
Check depth of plastic concrete	Daily	Form E111 Form E110	Specification 2301.03, A, 3 Paving typicals in B sheets of project plans	Typically contractors check the thickness of the pavement in the plastic concrete to ensure that they are paving plan thickness or thicker. This activity should be observed by the grade inspector or the grade inspector should perform the checks on their own if the contractor is not.
Check concrete yield	1/1000 CY	Form E 137 Form E111	IM 204 Appendix E	Comparison should be made between the cubic yards of concrete batched and the cubic yardage of concrete required for a given area of pavement. Typically the quantity batched will be between 103% and 106% of the quantity required.

PCC Paving Field Inspection Checklist				
Duty	**Frequency**	**Record Checks**	**Specification/Resource**	**Commentary**
Check paver vibrator frequency	2/day	Form 830213 Form E111	Specification 2301.03, A, 3	It has been proven that excessive vibration can cause significant entrained air loss in concrete, and can result in non-durable concrete and premature deterioration. For this reason, vibration should be monitored very closely on every project. The specifications require contractors to use vibration monitoring systems for all slip form paving on projects with quantities 50,000 square yards and greater. These systems record significant information such as vibration rate, station location, paver speed, etc. The systems have a display that shows the vibration rate for each individual vibrator. When a vibration monitoring system is in use, inspectors should still check the vibration rate of individual vibrators by hand to ensure that the monitor is accurate. Vibration monitoring data is required to be submitted to the Engineer. This information should be reviewed on a regular basis to ensure that vibrators are run within the specification limits. For projects less than 50,000 square yards and no vibration monitors, each vibrator on the paver should be checked twice per day to ensure that the vibrator is within the allowable tolerances. The paver operator should never be allowed to adjust the paver vibrator rates prior to or during vibration rate checks.
Check hand operated vibrator frequency	Once per unit	Form E111	Specification 2301.03, A, 3	The specification requires the vibration rate of vibrators used for hand finished pavement to operate between 3500 vpm and 6000 vpm. This should be checked for each vibrator used prior to the first hand pour. Document the check in the daily diary and on Form E111.

PCC Paving Field Inspection Checklist				
Duty	**Frequency**	**Record Checks**	**Specification/Resource**	**Commentary**
Check centerline tie steel insertion in plastic concrete	Daily	Form E111	Specification 2301.03, E Road Standard PV-101	The final location and alignment of tie steel should be checked in the plastic concrete behind the finishing machine. Often a hack saw blade or trowel is inserted into the concrete at centerline to determine the location and depth of centerline tie steel. Once located at centerline, the depth and alignment of the ends of the bar should also be checked to ensure that the bar is not shifted horizontally or vertically out of alignment. Spacing of tie bars can be determined by observing the frequency of insertion on the finishing machine.

PCC Paving Field Inspection Checklist				
Duty	**Frequency**	**Record Checks**	**Specification/Resource**	**Commentary**
Check finishing operation	Periodically		Specification 2301.03, H	The primary purpose for hand finishing behind the finishing machine is to remove small imperfections in the final pavement surface and provide a uniform surface. The surface of the slab should be observed behind the finishing operation to determine if finishing operations are adequate. Occasional "bug holes" are permissible, but should be kept to a minimum. Overfinishing is also undesirable as it can affect pavement smoothness and potentially cause a loss of entrained air at the surface. A balance must be reached between the positive and negative effects of finishing. During finishing, free water may not be added to the surface of the pavement. A small amount of water may be added to a burlap drag attached to the back of the finishing machine. A good indicator that too much water is being added to the burlap drag is the presence of bubbles off the trailing end of the burlap. Another indicator that excessive water has been added to the burlap is the collection of excessive amounts of mortar by the floats. When excessive amounts of mortar are collected, this material should be wasted over the edge of the pavement and not finished into the surface. Addition of water to the burlap should be restricted. For smoothness purposes, the contractor is required to periodically check the pavement longitudinally with a 10 foot straightedge. The surface should not deviate more than 1/8" in 10 feet. Edge slump should also be checked. Up to 1/2" of edge slump is permissible if abutting pavement is not to be placed. If abutting pavement is to be placed, up to 1/4" of edge slump is permitted.
Check structural rumble strip placement (when required)	Periodically		Road Standard PV-11	Check spacing and depth of structural rumble strips in plastic concrete.

PCC Paving Field Inspection Checklist				
Duty	**Frequency**	**Record Checks**	**Specification/Resource**	**Commentary**
Check texture placement in plastic concrete	Periodically	Form E140 Form E111	Specification 2301.03, H Construction Manual 9.40	Microtexture should be placed using artificial turf, coarse carpet, or burlap. Placement of microtexture roughens the pavement surface and provides grip for tires to assist with stopping. Macrotexture (tining) can be placed either longitudinally or transversely (longitudinal tining is most common). Macrotexture is placed to provide a break in the pavement surface to allow water to escape from under tires during a rain and reduce the tendency for hydroplaning. When tining is placed transversely, a 4 to 6 inch gap centered around each transverse joint is to be left untined. Longitudinal tining should be straight and as parallel to centerline as possible. The depth of tining should be kept at or slightly less than the specified 1/8" target to minimize noise created by tires interacting with the pavement surface. When tining is placed longitudinally, a 2 to 3 inch gap centered around each longitudinal joint is to be left untined. Some contractors have attempted to leave a single tine in the center of the gapped area as a marker for their sawing operation. This practice should not be allowed due to concerns about alignment of the centerline sawcut and raveling.
Check cure brand and lot number	Periodically			White pigment cure is typically delivered to a project in reusable totes. The totes should periodically be inspected to ensure that the proper brand and lot number of the cure are identified on the tote. The lot number should also be cross checked with the list of approved lots of cure found in MAPLE on the Construction and Materials Bureau web site.

PCC Paving Field Inspection Checklist				
Duty	**Frequency**	**Record Checks**	**Specification/Resource**	**Commentary**
Check cure placement	Periodically for uniformity of coverage Daily for yield	Form E111	Specification 2301.03, K	The specifications require cure placement within 30 minutes after finishing. Timing of cure placement should be observed throughout each day to ensure that this requirement is being met. The specification also allows an extension of the 30 minute requirement when weather and/or mix properties require an extended period before curing. This is allowed to ensure tining can be placed at the proper depth. If a mix is still too plastic within the 30 minutes after finishing, it is not desirable to proceed with tining and curing if the tining depth will be too deep. Cure placement should be checked to ensure uniformity of application. Streaks should be minimal and areas of visible gray should be recured. Yield checks should be performed daily based upon total cure applied throughout the days run and the total square yardage of pavement cured including the sides of the pavement. If forms are used to support the edge of pavement, the pavement edge should be cured by hand if the forms are removed prior to the pavement reaching opening strength.
Place station markers in plastic concrete	Each station			Station markers should be placed in the outside two feet of the mainline pavement and in a position where they will not be removed or destroyed by possible milled shoulder rumble strip placement. If a station marker happens to fall on a transverse joint location, shift the marker to avoid falling on the joint. Place station markers facing outward so they can be read from the shoulder.

PCC Paving Field Inspection Checklist				
Duty	**Frequency**	**Record Checks**	**Specification/Resource**	**Commentary**
Check cold weather protection	When used	Form E137 Form E111	Specification 2301.03, K Specification 2301.05, K	Monitor forecast temperature conditions to determine if cold weather protection will be necessary during curing. Table 2301.03-2 identifies the required covering necessary based on forecast low temperatures. The table also includes conditions under which the cold weather protection may be removed. Quantities of cold weather protection must be tracked and recorded since payment is made to the contractor for providing it (see 2301.05, K).
Cast concrete beams to determine pavement opening strength	Two per day when maturity is not used to determine opening strength	Form E114	Specification 2301.03, U IM 328 IM 316	On projects in which the contractor chooses not to use maturity to determine pavement opening strength, opening strength is determined based upon a combination of time and flexural strength. Two beams are cast daily. Beams should be cured similarly to the pavement and stored on site overnight. The following day the beams can be moved to plant inspectors lab for further curing until broken. Care should be taken in handling the beams to avoid detrimental cracking that may cause low strength results.
Cast concrete beams for pavement design purposes	One set of two beams every 10,000 CY	N/A Beams tested in Central Materials	IM 328 QM-C Developmental Specification	On QM-C projects, inspectors should cast one set of two beams every 10,000 CY. These beams are to be delivered to Central Materials to be tested for 28 day flexural strength. Information obtained from testing of these beams is used to assist in future pavement designs.

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Monitor maturity probe placement on projects where maturity is used to determine pavement opening strength	Daily	Form E141 Form M142	Specification 2301.03, U IM 383	On projects in which the contractor chooses to use maturity to determine opening strength, the contractor is responsible for placement of the maturity probes and taking temperature readings. However, probe placement should be observed to ensure the temperature readings accurately reflect the temperature of the pavement. For instance, if portions of the pavement are in shaded areas, additional probes should be placed there as that pavement will gain temperature and strength more slowly than the unshaded areas. Maturity probe locations should be recorded on Form E141.

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After Concrete Placement				
Report water added on grade to plant inspector	Daily/each placement	Form 830212	IM 527	The plant inspector is required to report average water/cement ratio for each placement on the project plant report. When using ready mix concrete, this requires water added on the grade to be tracked and reported back to the plant inspector. Water added on grade should be reported to the plant inspector on a daily basis to allow timely completion of the plant report.
Check milled rumble strip placement		N/A	Road Standard PV-12 and PV-13	Milled rumble strips may be placed on the shoulder or centerline of the roadway. They are placed in the hardened concrete after opening strength is achieved. Rumble strip placement should be checked to ensure proper spacing, depth, and location requirements are being met.
Check saw cuts	Daily	Joint Check Worksheet	Specification 2301.03, N Road Standard PV-101 K and L sheets in project plans Construction Manual 9.20	Saw cuts should be checked daily to ensure proper depth, width, layout, straightness, and spacing. It is important to keep in mind that even though the joint layout may be correct during placement, the saw crew may not saw joints at the correct locations. Occasionally saw cutting errors are made in irregular areas due to lack of adequate marking of the joint layout in the plastic concrete. This may result in the saw operator not knowing where and/or what type of joints to saw. Saw cuts should also be checked to make sure the saw operator is pulling up the blade before reaching the edge of pavement as shown on the PV-101 standard. This is important for early entry sawing as the backward rotation of the saw blade can "blow out" the edge of the pavement if the saw cut is not stopped short of the pavement edge.

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Check joint filling	Daily	Joint Check Worksheet	Specification 2301.03, P Road Standard PV-101 Construction Manual 9.20	Joints should be checked to ensure that they are properly cleaned before filling, and joint filler should be placed to the proper level. Unless otherwise approved, joint filling should only be performed when pavement and ambient air temperatures are above 40 degrees F.
Check texture placement in hardened concrete	Daily	Form E140	Specification 2301.03, HConstruction Manual 9.40	In addition to the checks made in plastic concrete, macrotexture should also be checked in the hardened concrete. The depth of the tining should be checked to ensure that it falls within the specification requirements. The procedure outlined in Construction Manual 9.43 should be followed to determine compliance with tining depth requirements.
Review initial contractor smoothness information	Daily until 3 consecutive days of 100% pay or better	N/A	Specification 2317 Specification 2316 IM 341	The contractor is required to submit smoothness information daily until they have paved for three consecutive days resulting in 100% payment or better. There are several reasons for this requirement. First is to identify if there are equipment or process issues causing placement problems in the paving operation. It is not desirable to allow the contractor to continue paving if acceptable smoothness levels are not being achieved. This requirement also may identify problems in the contractor's smoothness evaluation. It also gives inspection staff the opportunity to review the contractor's profilograph settings to make sure they are correct.
Review final contractor smoothness information	After submittal of final profilograph reports and traces	N/A	Specification 2317 Specification 2316 IM 341	The contractor is required to submit all final profilograph reports and traces to the Engineer within 14 days after completion of paving. After receipt of all final reports and traces, the information should be reviewed to ensure that all sections of pavement have been evaluated. In addition, the smoothness information should be evaluated to determine if the incentive or disincentive requested by the contractor is accurate.

PCC Paving Field Inspection Checklist				
Duty	**Frequency**	**Record Checks**	**Specification/Resource**	**Commentary**
Determine time for opening pavement for use	Daily/as needed	Form E114	Specification 2301.03, U Form E141	The contractor is responsible for curing and breaking beams to determine time of opening. The contractor is also responsible for placing probes, taking temperature readings, and calculating TTF when maturity is used. However, the Engineer is responsible to determine if a section of pavement may be opened to traffic. For this reason, beam break and maturity information should be obtained from the contractor and reviewed prior to opening pavement to traffic. Maturity information should be recorded on Form E141.
Check longitudinal tie steel placement in hardened concrete	Spot check in each day's run	Form E111	Specification 2301.03, E Road Standard PV-101 Construction Manual 9.26 and 9.27	Check tie steel in hardened concrete to ensure proper alignment and that the correct number of bars are included in each panel (see Construction Manual 9.27). This check is important to determine that the bars are centered across the joint, level, and perpendicular to centerline. Tie steel checks in hardened concrete are typically made using a survey pin finder.
Determine pavement thickness	Once per project		Specification 2301.04 and 2301.05 IM 346 and 347	There are several steps to take In evaluating pavement thickness. First, random core locations for each section of pavement, as defined by IM 346, should be obtained from District Materials. Then the core locations should be marked on the pavement. Taking of the cores must be witnessed by inspection staff and inspectors must take immediate possession of the cores after removal from the pavement by the contractor. Cores should then be measured according to IM 347 and a thickness index determined for each section of pavement. After measurement, the cores should be delivered to District Materials for assurance testing.

PCC Paving Field Inspection Checklist				
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General				
Check traffic control	When travelling on the project			Even though traffic control checks are a responsibility of the contractor, if problems or deficiencies are observed, inform the contractor when the observations are made so that corrections can be made in a timely manner.
Check contractor's traffic control daily diary	As needed	N/A	Specification 2528.01, C	The contractor is required to check traffic control and record significant information. It is a good practice to review the contractor's diary occasionally to ensure that documentation is being recorded as required. For instance, after noting damaged signing or deficiencies in the traffic control devices or setup, review the daily diary to ensure the deficiencies and the remedies are recorded.
Monitor the project for fugitive dust	Daily	N/A	Specification 1107.07, E	The contractor is responsible for controlling fugitive dust on the project. When dust is being generated and leaving the project site, the contractor should be reminded of their responsibility to control dust and a request should be made to take measures to do so. In urban areas, it is even more critical that dust be controlled as property owners will be more sensitive to dust generated by the project.
Monitor contractor haul roads	Daily	N/A	Construction Manual 2.12	The contractor is required to submit a request for haul road designation for roads used to haul materials for the project. Once designated as a haul route, the contractor is expected to use the haul route for the designated purpose. The contractor's operations should be observed daily to ensure that haul traffic is using the appropriate, approved haul routes.

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Issue noncompliance notices	When noncompliance occurs	Form 830245		The owner is obligated to notify the contractor in writing when noncompliance occurs. This is done using Form 830245. Noncompliance notices should be issued as quickly as practical after observation of the noncompliance to give the contractor ample time to take corrective action. The noncompliance notice also provides a written record of notification being provided to the contractor.