PCC Paving Field Inspection

Winnipeg, Manitoba

National Concrete Pavement Technology Center

Tech Center

IOWA STATE UNIVERSITY
Institute for Transportation

Introductions

Instructors

- Gary Fick
- Jerod Gross

Representing the National Concrete Pavement Technology Center

www.cptechcenter.org

2

PCC Paving Field Inspection

- Why are we here?
- How do We Achieve Quality for PCC Paving?
- Got a project….Now what?
- What is concrete?
- What kinds of equipment are used?
- What happens before you start paving?
- What happens when you're finally paving?
- What is the inspector's role?
- What about all of the other road building stuff?
- What do you look for in urban paving?
- What paperwork?

Q: WHY ARE WE HERE?

Why are we here?

Why are we here?

- PCC in paving applications has some different requirements than structural applications
- Pavements typically function in extremely challenging environments where they can be subjected to very high moisture and temperature changes on a frequent basis

Why are we here?

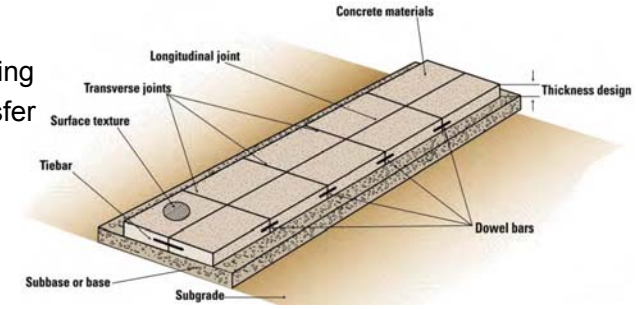
PCC Paving Applications

- Highway pavements
- Streets and local roads
- Airfield pavements
- PCC overlays
- Parking areas
- Drainage channels
- Trails, sidewalks, driveways

Pavement Elements

Select parameters that economically meet needs of project

- Support system
- Environment
- Materials
- Thickness
- Joint spacing
- Load transfer



Q: HOW DO WE ACHIEVE QUALITY FOR PCC PAVING?

A: "Making sure the quality of a product (concrete paving) is what it should be…"
- Philip Crosby

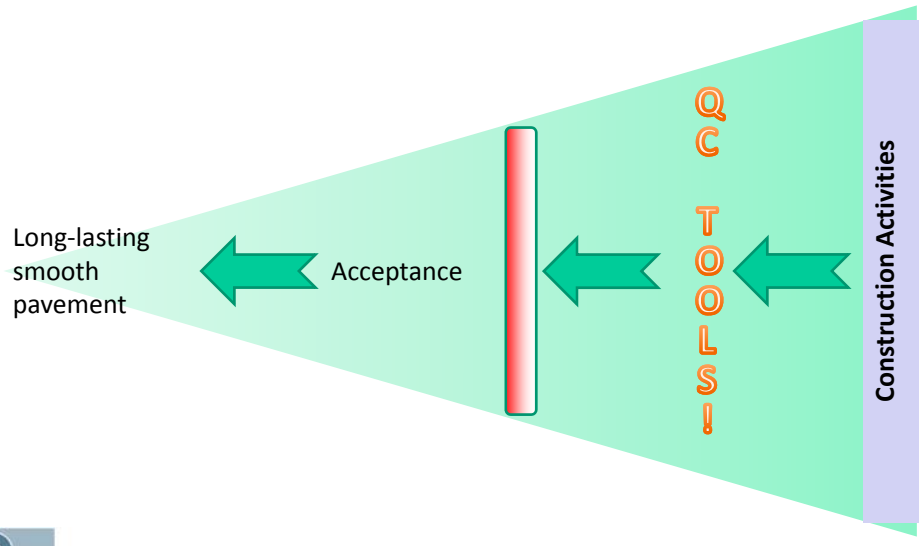
How do We Achieve Quality for PCC Paving?

- **What is quality?**
- Who cares?
- How do we get it?

What is quality?

- How do you define quality?
  - "Conformance to requirements"
  - "The customer deserves to receive exactly what we have promised to produce. " -- Crosby
- What is the result of quality?
  - Long-lasting pavement
  - A good riding surface

What is quality?



Who cares?

Contractor

- Workability
- Constructible
- Money
  - Incentives vs. Disincentives
  - Rework = Lost $$

Who cares?

Owner

- Better working environment
  - Project partners are qualified
  - Contractor knows how the Agency will accept/pay for the product
  - QC Plans remove some of the daily stress
- Get the product you are paying for
  - Cost effective
  - Low maintenance
  - Smooth
  - Durable

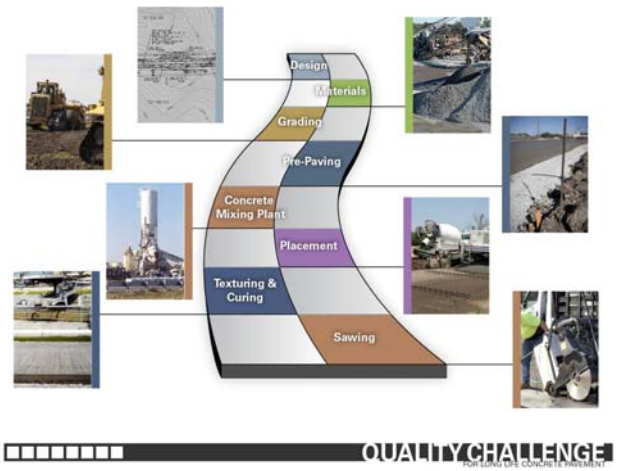
How do we get it?

How do the following people affect quality?

- Designer/Specifier
- Agency Inspector
- QC Technician
- Loader Operator at the concrete plant
- Truck Driver
- Paver Operator
- Concrete Finisher
- Texture/Cure Machine Operator

15

How do we get it?



16

How do we get it?

17

Q: I'VE GOT A PROJECT, NOW WHAT?

18

Preparation

General Instructions

- Review plans, special provisions, appropriate manuals, standard specifications, and supplemental specifications
- Discuss your responsibility and authority with the project engineer
- Review format and required content of your inspection diary
- Review required Schedule of Materials Control, testing procedures, and forms
- Discuss notification, changes, corrections, delays, rejections, tolerances, and checks with the project engineer

General Instructions

- Attend and/or coordinate a pre-paving/pre-construction meeting with the Engineer and Contractor
- Know the contractor's key site contact and who the materials supplier(s) will be.
- Make sure testing devices are calibrated and correlated prior to the day's pour.
- Contact District Materials Engineer to schedule appropriate independent assurance sampling and testing at applicable work intervals.
- Review utility requirements.
- Review documentation of pay item quantities.

Preparation

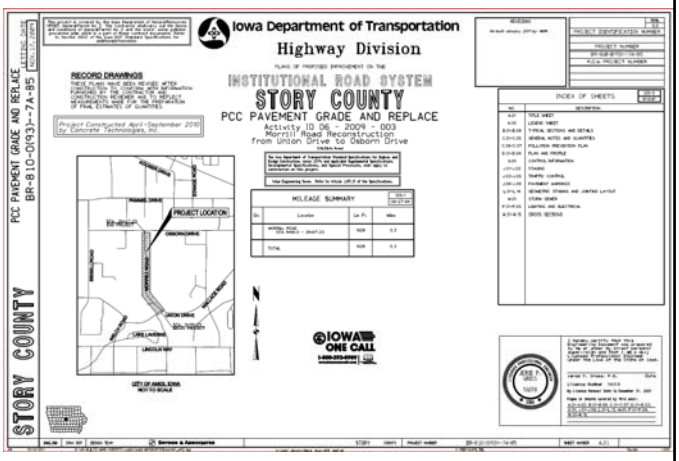
Things you will need:

- Plans
- Proposal/Contract
- Specifications
- Standard Details
- Documentation Tools
- Testing Equipment
- Storm Water
- Safety Review
- Traffic Control Items

Preparation – Plans

Title Sheet(s)

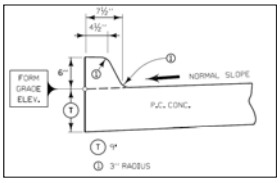
- Location
- Project Description
- Project Length(s)
- Vehicle Counts
- Index of Sheets
- Begin/End Stations of Project/Divisions

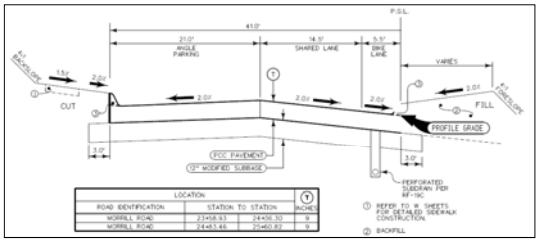


Preparation – Plans

Typical Cross Sections

- Provide standard dimensions and other important information
- Separated by location
- Can be multiple on one project
  - ➢Mainline
  - ➢Superelevations
  - ➢Curbs
  - ➢Ramp Grading & Paving
  - ➢Shoulder Details





LOCATION			T INCHES
ROAD IDENTIFICATION	STATION TO STATION		
MORRILL ROAD	23+58.93	24+36.30	9
MORRILL ROAD	24+83.46	25+60.82	9

Preparation – Plans

Estimate of Quantities and Item Description

- Design quantities
- Reference notes for individual items
- References to standard details

ESTIMATED ROADWAY QUANTITIES — 100-0A MODIFIED

Item No.	Item Code	Item	Unit	Quantity	As-built Quantity
1	2101-0850002	CLEARING AND GRUBBING	UNIT	~~200~~ 215	215
2	2102-2710070	EXCAVATION, CLASS 10, ROADWAY AND BORROW	CY	3,669	4094
3	2102-2710080	EXCAVATION, CLASS 10, UNSUITABLE OR UNSTABLE MATERIAL	CY	149	375.1
4	2105-8425015	TOPSOIL, STRIP, SALVAGE, AND SPREAD	CY	~~503~~ 733	733
5	2115-0100000	MODIFIED SUBBASE	CY	2,055	2470.79
6	2123-7450000	EARTH SHOULDER CONSTRUCTION	STA	32	32
7	2201-0505050	BASE, STD OR SLIP FORM PCC PVMT, 5 IN.	SY	287	277.8
8	2214-5145150	PAVEMENT SCARIFICATION	SY	~~956~~ 978	812
9	2301-1033090	STD OR SLIP FORM PCC PVMT, CLS C, CLS 3 DURABILITY, 9 IN.	SY	4,457	4311.8
10	2301-6911722	PORTLAND CEMENT CONCRETE PAVEMENT SAMPLE	LS	1	1
11	2303-0033500	HMA (3M, ESAL), SURF, 1/2", NO. ERC	TON	~~92~~ 93	93

25

Preparation – Plans

Estimate of Quantities and Item Description

- Design quantities
- Reference notes for individual items
- References to standard details

ESTIMATE REFERENCE INFORMATION — 100-4A 10-29-02

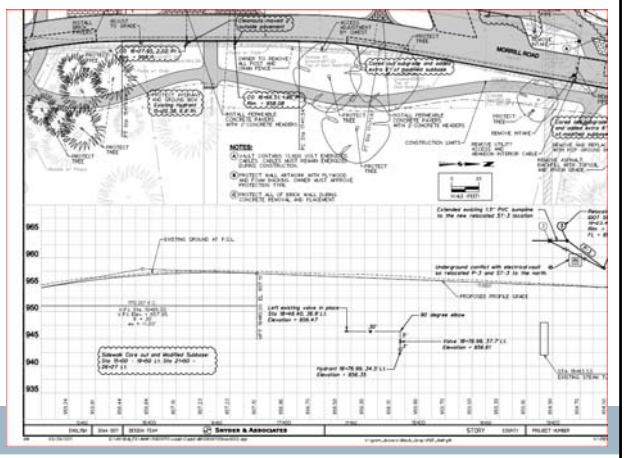
Item No.	Item Code	Description
1	2101-0850002	CLEARING AND GRUBBING Refer to D sheets and tabulation on Sheet C.03. Clearing and Grubbing areas shall be marked out and approved by the Engineer prior to beginning of clearing operations. Contractor shall take care to protect all trees and other plant material to remain.
2	2102-2710070	EXCAVATION, CLASS 10, ROADWAY AND BORROW Quantity includes 4,097 CY cut and 328 CY fill + 30% shrink. Quantity includes excavation for sidewalk per cross sections. Surplus material shall become property of the Contractor. Payment will be per specifications. Excavation to remove unsuitable soils will be measured separately and paid as additional Class 10 excavation. No additional payment will be made to provide and place suitable backfill soil that is available on site to replace the excavated unsuitable material.
3	2102-2710080	EXCAVATION, CLASS 10, UNSUITABLE OR UNSTABLE MATERIAL Item includes preparation of poor subgrade. Payment will be per specifications. One inch nominal clean crushed limestone may be used as new subgrade if existing soil has excessive moisture or is unstable. Payment for the crushed limestone will be for the contract quantity.
4	2105-8425015	TOPSOIL, STRIP, SALVAGE, AND SPREAD Quantity is based on 6 inch depth of respread over all disturbed seeding areas.
5	2115-0100000	MODIFIED SUBBASE Construct under Morrill Road Roadway and Driveways.
6	2123-7450000	EARTH SHOULDER CONSTRUCTION Payment will be per the Specifications.
7	2201-0505050	BASE, STD OR SLIP FORM PCC PVMT, 5 IN. Quantity is based on brick paver areas. Construction measurement and payment shall be according to section 2201 of the Specifications.
8	2214-5145150	PAVEMENT SCARIFICATION Includes removal of 2 inches of existing HMA surface from Union Drive to Station 12+20 to match the existing cross section. Refer to Sheet D.01 for the limits of pavement scarification.
9	2301-1033090	STD OR SLIP FORM PCC PVMT, CLS C, CLS 3 DURABILITY, 9 IN. Iowa Department of Transportation Standard Specification Section 2316 Schedule B Smoothness shall apply to all mainline paving. Microtexture shall be applied to all finished concrete surfacing with artificial turf or coarse carpet.

26

Preparation – Plans

Plan & Profile Sheets

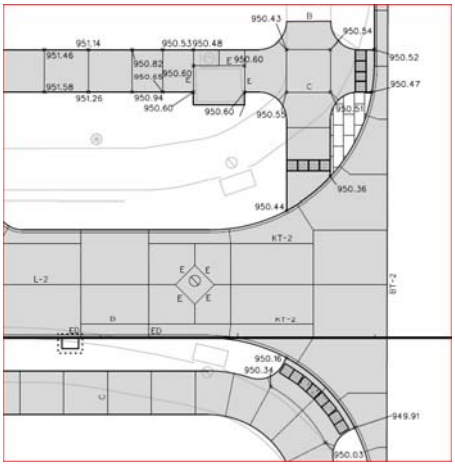
- Give plan & profile view
  - Entire project
  - Side Roads
  - Ramps
- Show new and existing features
  - Drainage structures
  - Entrances
  - Ditch Cuts



Preparation – Plans

Geometrics Sheets

- Staking
- Jointing
- Edge profiles
- Intersections



Preparation – Proposal/Contract

Proposal/Contract

- Quantities
- Contract Period
- Utility Attachments
- Other Requirements

Preparation – Proposal/Contract

Contract

- Unit Prices
  - ➢Familiarize
  - ➢What's an overrun cost?
- Addendums
- Plan Revisions
- Letting Date
  Dictates specification version

Preparation - Specifications

Specifications

- Standard
  - ➢Correct (UPDATED) Version
- Supplemental
- Special Provisions
- Supplemental Agreement

Preparation – Standard Details

Standard Details

- Show you how to construct something according to agency standard
- Provides uniformity
- Ensure you have the current version associated with project letting
- Print out the ones specifically for the project
- Use a computer (if you can) for the entirety

Preparation – Documentation Tools

Documentation Tools

- Computer
- Fieldbook
  - Software
  - Paper
- Camera (Smart phones work well)
- Paper
- Writing Utensils
- Blank Forms

Photo: City of Syracuse

Preparation – Testing Equipment

Testing Equipment

- Ruler
- 4’ Level
- Thermometer
- Shovel
- Measuring Wheel
- Air Meter
- Rubber Mallet
- Brush
- Slump Cone
- Scale
- Spray Paint
- Tire Tread Depth Gauge
- Hammer
- Bucket
- Stamps (station location)
- Vibrator Checker
- Beam Boxes/Molds

Preparation – Storm Water

- Regulations
- Inspections
- Be aware of construction runoff!
- Best Management Practices

Preparation – Safety Review

- Backing hazards ⇨ congested work areas
- Overhead power lines

Preparation – Traffic Control Items

Inspect and adjust as needed each morning and evening.

- Reflectance of signage and delineators
- Arrow boards and message boards
- Barrier wall and attenuators
- Condition of detour pavement

37

Q: WHAT IS CONCRETE?

A: It is not cement…..

38

What is Concrete?

- Concrete Materials
- Concrete Terminology
- Concrete Properties

Concrete Materials

Concrete Materials

- 4 Basic Ingredients
  - Aggregates
  - Cement
  - Water
  - Air
- Other Stuff
  - Chemical Admixtures
  - SCM's

41

Concrete Materials

9 - 15%
Cement

15 - 16%
Water

Paste
(cement + water)

25 - 35%
Fine aggregate

Mortar
(paste + fine aggregate)

30 - 45%
Coarse aggregate

Concrete
(mortar + coarse aggregate)

42

What is Concrete?

- (Portland) Cement
  Fine gray powder that reacts with water
- Concrete
  Mass of sand and rock held together by hydrated cement paste

43

Concrete Materials – Cement

- Most Expensive Ingredient
- How is it made?
  - Limestone + Clay + Iron Ore + Heat ➔ Clinker
  - Clinker + Gypsum ➔ Portland Cement

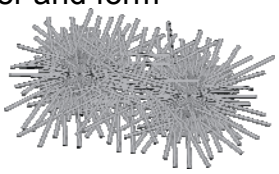
Portland Cement: Material made by heating a mixture of limestone and clay in a kiln at about 1450 C, then grinding to a fine powder with a small addition of gypsum.

44

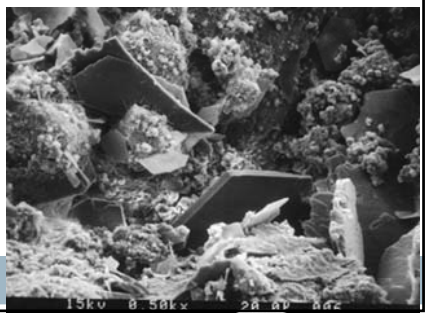
Concrete Materials – Cement

How does it work?

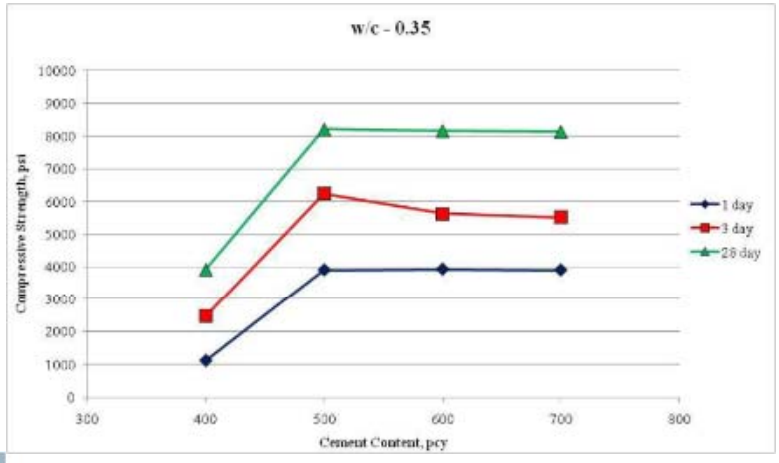
- Cement + Water ➔ Hydration ➔ Crystals + Heat
- Needle like crystals grow and stick together and form gel-like mass
  - C-S-H & C-H



- Longer Growth ➔ Stronger Concrete
  - ➢Needs water in mixture to continue growth
  - ➢Not too much—Not too little
  - ➢Keep water in mixture
    - –CURING



Concrete Materials – Cement



28 day strength = 32 Mpa (4641 psi)

46

Concrete Materials – Aggregates

Aggregates occupy most of the volume in a mix and have a significant effect on PCC properties

- Workability
  - Placement and consolidation
- Thermal expansion
- Cement content
- Water demand
- Strength

47

Concrete Materials – Aggregates

- Traditional Two Aggregate Mixtures
  - ➢ Fine Aggregate (Sand)
  - ➢ Coarse Aggregate (limestone & gravel)
- Well Graded Mixtures
  - ➢ Less Cement
  - ➢ Increased Workability
  - ➢ Decreased Shrinkage
  - ➢ Reduced Segregation

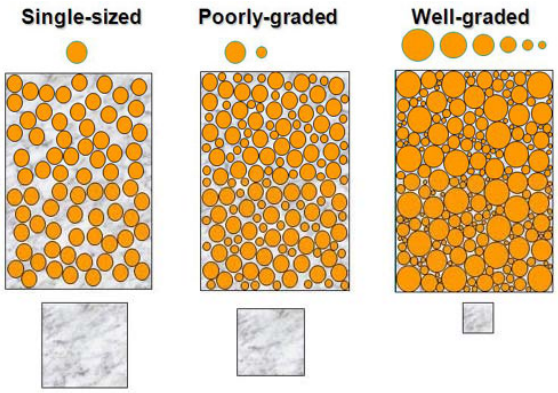
- Two Important Aspects of Aggregates
  - ➢ Gradation
  - ➢ Durability

48

Concrete Materials – Aggregates

Gradation

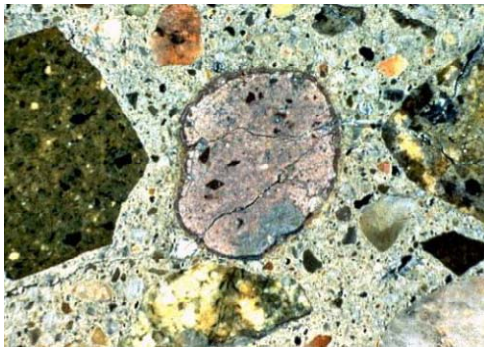
- Distribution of Particle Sizes
- "Well Graded"
  Somewhat equal proportions



Concrete Materials – Aggregates

Durability

- How aggregates perform over time correlates to pavement life
- Geology
- Service Records
- Testing
  - ➢Freeze/Thaw
  - ➢Wetting/Drying
  - ➢Absorption
  - ➢MRD
    - –D-Cracking
    - –Alkali-Silicate Reactivity



Concrete Materials – Aggregates

- All types of rocks are all used in concrete
- Particle shape can affect workability, but gravels to crushed aggregates can be used
- Most aggregates can be used
  - Reactive (ASR/ACR) calls for mitigation
  - D-Cracking prone should not be used
- The driving factor in aggregate selection is usually economics and source availability
- Uniformity

51

Concrete Materials – Water

Different Sources
- Municipal
- Well
- Lakes
- Streams/Rivers
- Permitted?
- Effluents?

52

Concrete Materials – Water

- Water is necessary for the hydration reaction in portland cement to occur
- Quantity of water is based on cement content to meet strength, durability, and workability requirements
- Water content is stated by the water to cement ratio (w/c) or the water to cementitious materials ratio (w/cm)

53

Concrete Materials

What is the most important parameter affecting concrete performance?

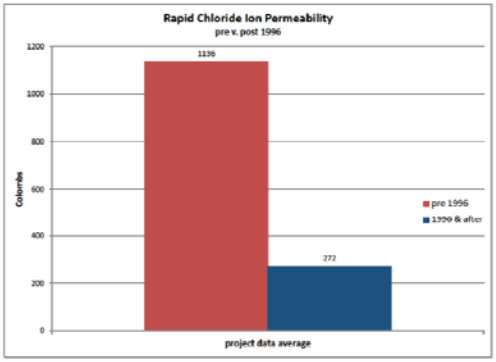
54

W/CM Ratio

One of the most important elements affecting concrete performance is water to cementitious material ratio (w/cm) ratio

Table: Chloride Permeability Based on Charge Passed

Charge Passed (Coulombs)	Chloride Permeability	Typical of
>4,000	High	High W/C ratio (>0.60) conventional PCC
2,000–4,000	Moderate	Moderate W/C ratio (0.40–0.50) conventional PCC
1,000–2,000	Low	Low W/C ratio (<0.40) conventional PCC
100–1,000	Very Low	Latex-modified concrete or internally-sealed concrete
<100	Negligible	Polymer-impregnated concrete, Polymer concrete



55

Concrete Materials – SCMs

Supplementary Cementitious Materials
"Cement-like Stuff"

- Fly Ash
- Slag
- Silica Fume
- Ground Limestone
- Others

56

Concrete Materials – SCMs

Fly Ash

- By-product of burning coal in electricity generating power plants
- Pozzolanic

  Reacts with H_20 and $Ca(OH)_2$ to form cementing compounds
- Benefits of using fly ash
  - ➢Increased long term strength
  - ➢Increased workability
  - ➢Reduced heat of hydration
  - ➢Reduced permeability
  - ➢REDUCED COST

57

Concrete Materials – SCMs

Two Types of Fly Ash

•Class C Fly Ash

- ➢ Increased compressive strength at all ages
- ➢ May slow hydration
- ➢ Pozzolanic and Cementitious

•Class F Fly Ash

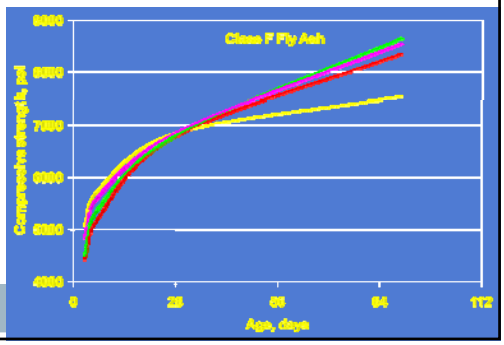
- ➢ Increased compressive strength
- ➢ Initially slow hydration, but goes on longer
- ➢ Pozzolanic

15% Max Fly Ash (Winnipeg - Class C)

20% Max Fly Ash (Manitoba)

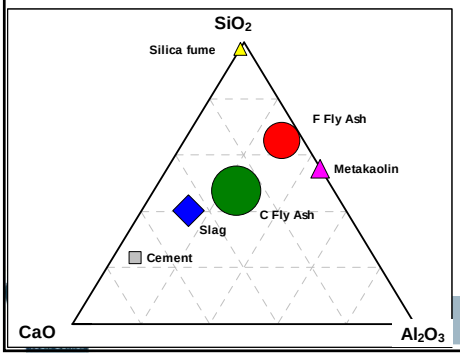
No ash between Oct 1 and May 15 (Winnipeg)

No ash if under 0°C or expected to be under 0°C within 3 days (Manitoba)



Concrete Materials – SCMs

	Silica	Alumina	Calcium Oxide	Sulfate
Type I Cement	22%	5%	65%	1%
Class F	52%	23%	5%	0.8%
Class C	35%	18%	21%	4.1%
Slag	35%	12%	40%	9%



Property Limits	Specified Limit
Fineness (% retained on 45µm	Max. 34%
Autoclave Expansion	0.8%
CaO %	8 – 20%
SiO2 %	Min. 50%
SO3 %	Max. 3%
Loss on Ignition	Max. 3%
Moisture Content	Max. 3%
Pozzolanic Strength	Min. 75% at 28 days

Manitoba Infrastructure Fly Ash

59

Concrete Materials – SCMs

Slag Cement

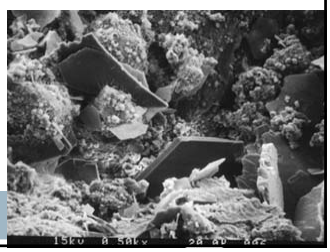
- By-Product of iron production
- "Cream" floating on top of iron furnace
- Quenched and ground into white powder
- Blended at cement plant or at ready-mix / batch plant
- Benefits
  - ➢Increased Strength
  - ➢Decreased Permeability
  - ➢Increased Sulfate Resistance
  - ➢Decreased Alkali Aggregate Reaction Potential

60

How Do SCMs Work?

Cement
+
Water
= C-S-H
+

SCM + Water + CH = more C-S-H



Concrete Materials - Admixtures

Types of Admixtures:

- Air Entraining
- High/Mid Range Water Reducing
- Retarding
- Accelerating
- Corrosion Inhibitors

62

Concrete Materials – Admixtures

Admixtures are used to:

- Enhance concrete properties
- Change fresh concrete behavior
- Reduce overall cost
- NOT to fix a bad mixture!

63

Concrete Materials – Air Entraining

- Used to entrain small air bubbles in concrete
- Benefits of Air Entraining
  - Improve durability of concrete exposed to moisture during freeze/thaw
  - Improve concrete resistance to surface scaling caused by deicers
  - Reduce segregation and bleeding

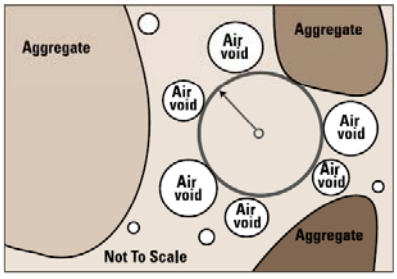
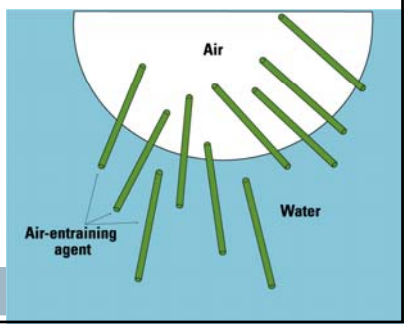


Figure 3-16. Spacing factor is the average distance from any point to the nearest air void. (Ozyildirim)



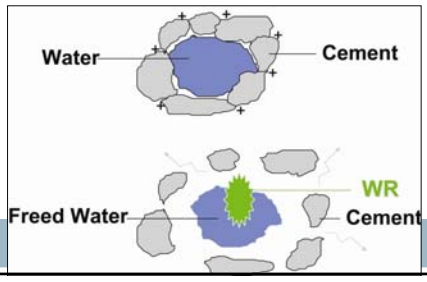
Concrete Materials – Air Entraining

- Types
  - ➢Neutralized Salt of Pine Wood Resins (Vinsol)
  - ➢Other organic compounds
  - ➢Synthetic detergents
- 1% increase in air content ➔ ~5% decrease in compressive strength

65

Concrete Materials – Water Reducers

- "FREE the Water"
- Change the electrical charges on cement particles
  - ➢Similar to anti-static laundry products
- Set up organic fingers that force particles apart (steric effect)
- Reduce quantity of mixing water required to produce a certain slump
- Typical water reducers can reduce water content by 7%-10%
- High Range Water Reducers reduce water content by 12%-30%



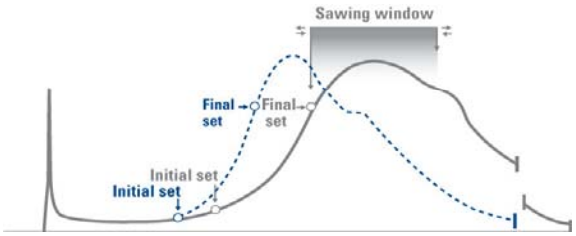
Concrete Materials – Retarders

- Retard the rate of hydration of concrete
  Not necessarily set time
- Balance the effects of high temperature
  - Lower concrete temperature or use retarders
- Retarders do not lower the temperature
- Most retarders also work as water reducers

Concrete Materials – Accelerators

What happens?

- Shortened dormancy
- Earlier initial and final sets
- Steeper hydration curve
- Often higher peak temperature



Concrete Properties

- Air Content
- Slump
- Workability
- Water/Cement Ratio
- Permeability-Unit Weight
- Temperature
- Strength

Concrete Properties – Air Content

- Air system in concrete influences ability to resist freeze/thaw
- Pressure Meter
  Reports total air content – nothing about bubble sizes

- Super Air Meter (SAM)
  Reports a number tied to freeze thaw resistance

Concrete Properties – Slump

- Test that was used to indicate water content in mixture
- No longer a good indicator of water content due to admixtures and SCMs
- Can indicate a change in the mix – CONSISTENCY!!

71

Concrete Properties - Workability

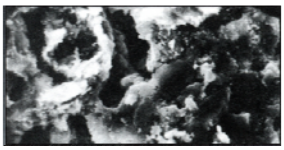
- Describes
  - How well concrete can be moved, molded, and shaped
  - Response to vibration
- Developing tests
  - Kelly Ball Test
  - The Box
- Affected by:
  w/cm ratio
  Aggregate gradation

72

Concrete Properties – Water Cement Ratio

- Relationship between amount of water in mixture and amount of cement
- w/c ➔ water to cement
- w/cm ➔ water to cementitious material
- Has a huge impact on the ultimate strength/durability of concrete
- The more water in mix the farther apart the cement particles are

w/c ratio = 0.42



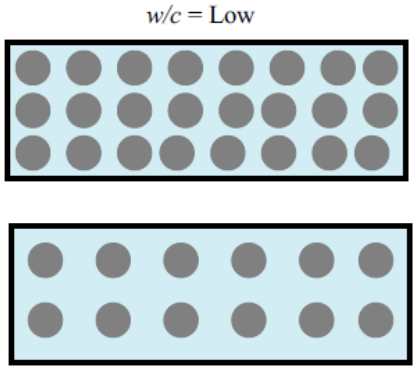
w/c ratio = 0.60

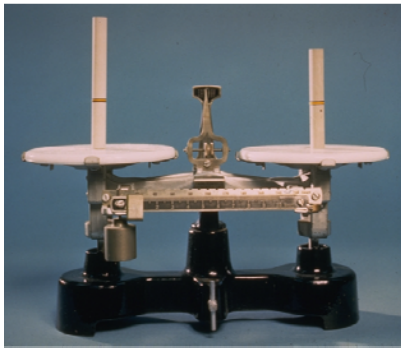
Concrete Properties
Permeability - Unit Weight

- Unit Weight = Mass of Concrete / Volume of Concrete
- Unit Weight determined during mix design
- Field Unit Weight = Design Unit Weight ➔ Good
- Field Unit Weight ≠ Design Unit Weight ➔ Bad
  - Something is wrong
    Check these before you scream
    - Scale (tare, calibration, etc.)
    - Calculator (operator error)
    - Math (1+1=3)

Concrete Properties
Permeability - Unit Weight

- More water – means more space between cement grains





Concrete Properties – Temperature

- When weather is cold…Is it warm enough for hydration to take place and the concrete will not be damaged?
  - Is the subbase/subgrade frozen
  - Cold Weather Protection!
- When the weather is hot…Is it so hot the mix sets too quickly and the concrete is damaged?
- Follow your specifications
- Find an engineer to make the final call (blame)
- Water freezes at ???

Concrete Properties – Strength

- Many factors affect strength
  - Mix Design
  - Construction practice
- Many ways to measure strength
- Two most common:
  - Compressive Strength
  - Flexural Strength

77

Concrete Properties - Strength

- Compressive Strength
  - Cylinders or Cores
  - Usually for commercial or structural work

- Flexural Strength
  - Beams cast during construction

    Preparation, curing, and handling are critical
  - Opening Strength
  - Two type of flexural test
    - Center Point
    - Third Point

78

Concrete Mix Design

Type 1 - Concrete for Pavements, Commercial Approaches, Curb and Gutter Sections, Curbs, Monolithic Curb and Sidewalks, Splash Strips and Bull-noses:

i. Class of Exposure: C-2
ii. Minimum Specified Compressive Strength @ 28 days = 32 MPa
iii. Minimum Cementitious Content = 340 kg/m^3
iv. Maximum Water/Cementitious Ratio = 0.45
v. Slump = 50 ± 20 mm (for slip form paving)
= 70 ± 20 mm (for hand placement)
vi. Aggregate Size = 20 mm Nominal
vii. Air Content = 5.0% to 8.0%

* includes Plain Dowelled Pavements

City of Winnipeg

Cement Requirements	
Type of Mix	Minimum Cementitious Content
Normal	340kg/m^3
Cold Weather or Early Strength	355kg/m^3

Concrete Physical Requirements	
Air Content (at delivery point)	6 – 8%
Slump	± 25mm from design slump
Minimum 28 Day Strength	32MPa
Max. Water / Cement Ratio	0.40

Min air 4.5% behind paver

Manitoba Infrastructure

79

WHAT KIND OF EQUIPMENT WILL BE USED?

80

Equipment

- Subgrade/Base Prep
- Transport Vehicles
- Placement and Consolidation
- Finishing
- Texturing
- Microtexture
- Macrotexture
- Curing
- Sawing
- Sealing

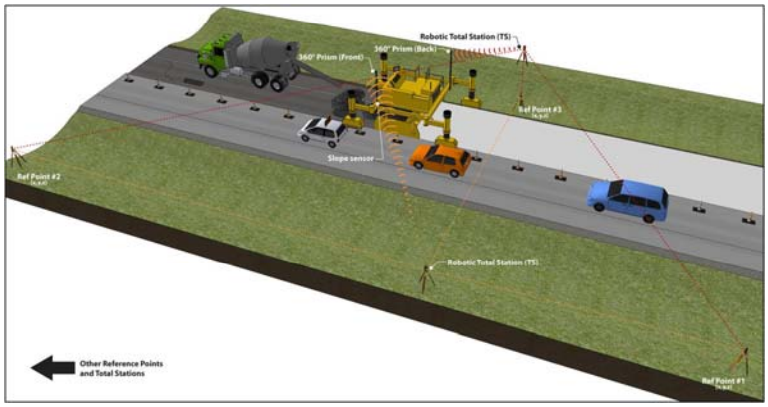
81

Equipment

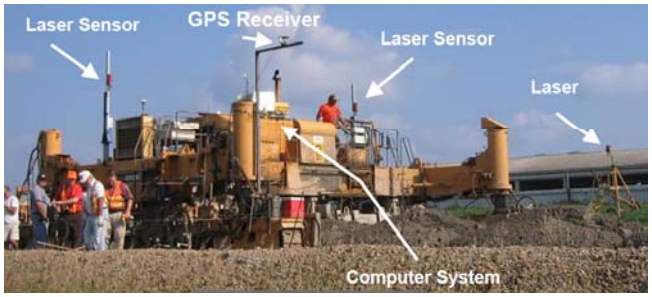
Stringline

82

Stringless Paving



Stringless Paving



Stringless Paver

Equipment

Motor Patrol

Equipment

Subgrade Trimmer

87

Equipment

Roller

88

Equipment

Transport

Equipment

Transport

Equipment

Transport

Equipment

Transport

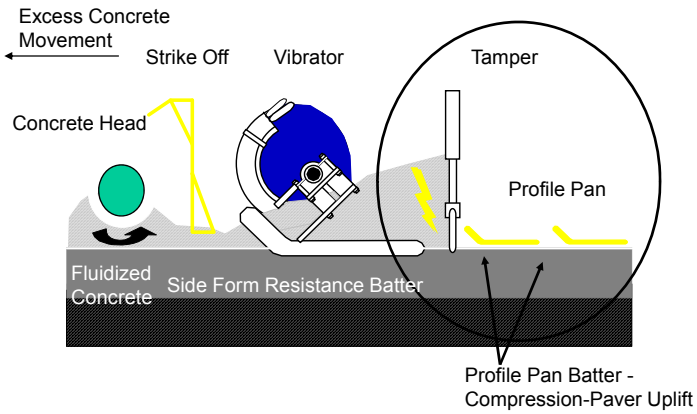
Equipment

Placing & Consolidating

Equipment

Placing & Consolidating

Extrusion Envelope



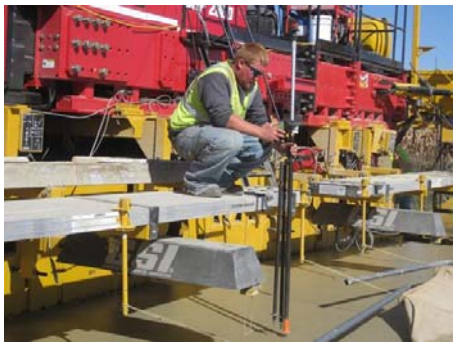
95

Equipment

Placing & Consolidating

96

Real Time smoothness device (GSI)



97

Equipment

Finishing

98

Equipment

Texture

Equipment

Texture

Equipment

Curing

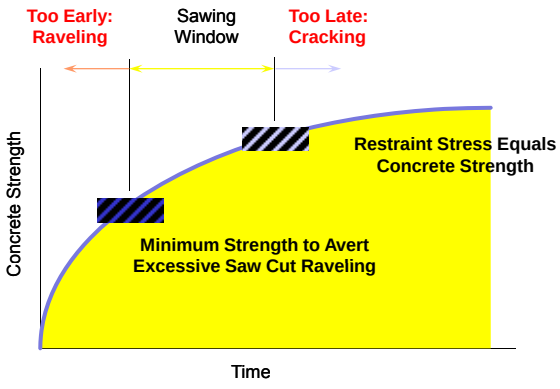
Equipment

Curing

Equipment

Sawing

Sawing Window



Equipment

Sawing

Equipment

Sawing

Equipment

Sealing

Equipment

Sealing

Equipment

Sealing

WHAT HAPPENS BEFORE YOU START PAVING?

Daily Items Before Paving

- Traffic Control
- Dust Control
- Safety
- Aggregate Stockpile & Plant
- Previous Day's Paving
  - Tie Bar Placement
  - Dowel Bar Placement
  - Thickness
  - Sawcut Depth/Raveling/Alignment
  - Texture
  - Smoothness (profile)
- Dowel Basket Placement
- Haul Road
- Vibrators
- Stringline Control

111

Traffic Control

Inspect and adjust as needed each morning and evening

- Reflectance of signage and delineators
- Arrow boards and message boards
- Barrier wall and attenuators
- Condition of detour pavement

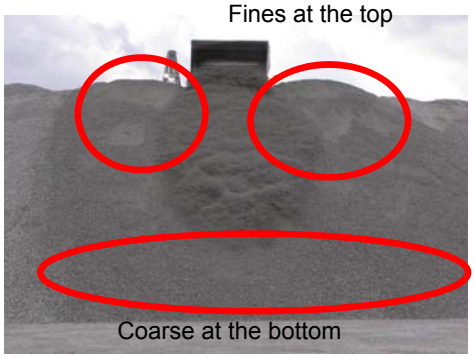
112

Dust Control

- Visibility ⇨ Safety
- Environmental awareness
- Public relations

Aggregate Stockpile Management

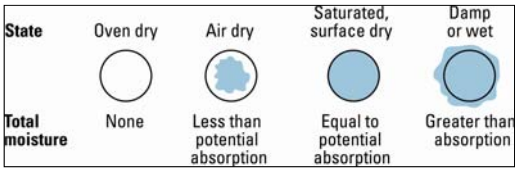
Minimize segregation
- Build long and wide-NOT high!
- Build stockpiles in tiers to avoid segregation



Picture courtesy of Martin Marietta Materials

Aggregate Stockpile Management

- Uniform Moisture
  - Stable and well drained foundation underneath stockpiles
  - Place a separation layer on top of soil
  - Draw from areas of known moisture content
  - Mix the pile to crate a uniform moisture



115

Aggregate Stockpile Management

Contamination - mud balls

116

Plant Set-up and Calibration

- Calibrate scales and water meters
  - Each time the plant is set-up
  - At regular intervals
- Verify that the batch control computer
  - Has correct mix design(s)
  - Has appropriate aggregate moisture contents
- **TEST BATCH!**

117

Mixture Verification Stage

- Compares field concrete to the mixture design
- **Is this the same concrete?**
- Trial Batch

SAME ?

118

Recommended Practices

Adequate mixing time
- Uniformity
- Air entrainment
- Strength
- Workability

Daily Items Before Paving

- Traffic Control
- Dust Control
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- Aggregate Stockpile & Plant
- Previous Day's Paving
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  - Sawcut Depth/Raveling/Alignment
  - Texture
  - Smoothness (profile)
- Dowel Basket Placement
- Haul Road
- Vibrators
- Stringline Control

Tie Bar Placement

- Longitudinal joints (T/3)
  - Contraction
  - Construction
- Aggregate interlock
- Prevent joint separation

Tie Bar Placement

•Longitudinal Tie Bars

#4 or #5 rebar x 30”

U.S. rebar size chart

Imperial Bar Size	"Soft" Metric Size	Mass per unit length		Nominal Diameter		Nominal Area	
		lb/ft	(kg/m)	(inch)	(mm)	($inch^2$)	(mm^2)
#2	#6	0.167	0.249	0.250 = ¼	6.35	0.05	32
#3	#10	0.376	0.561	0.375 = ⅜	9.525	0.11	71
#4	#13	0.668	0.996	0.500 = ½	12.7	0.20	129

Canadian rebar size chart

Metric Bar Size	Mass per unit length (kg/m)	Nominal Diameter (mm)	Cross-Sectional Area (mm^2)
10M	0.785	11.3	100
15M	1.570	16.0	200
20M	2.355	19.5	300

Reference: Betons Reinforcing Bar Company

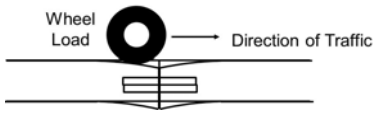
Tie Bar Placement

- Placement tolerance
  - Vertical – 2” cover
  - Alignment (tilt and skew) – not critical
  - **SPACING** – typically 15” from a transverse joint
- Verification
  - Visual for construction joints
  - Non-destructive methods for contraction joints (MIT Scan T2 or GPR)
- Inspection during construction

123

Dowel Bar Placement – Load Transfer

- 1” to 1 ½” diameter smooth bar x 18”
- Transverse joints
- Provide load transfer between slabs



124

Dowel Bar Placement

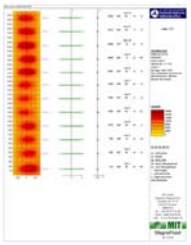
Placement tolerance
- Vertical – 2” cover
- **ALIGNMENT (TILT & SKEW)** – most critical, but tolerances are fuzzy; non-uniformity can cause joint lockup

Steel Placement (CRCP)

Affects crack spacing
- Adequate chairs for support
- Periodically anchored into subbase to resist movement from the paver
- Correct bar size and spacing
- Staggered laps

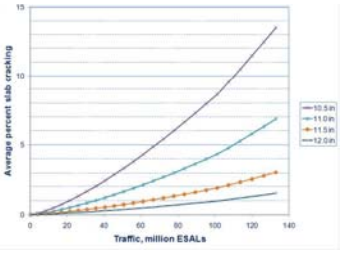
Dowel Bar Placement

- Verification
  - Non-destructive methods (MIT Scan), must cut the shipping wire
  - Coring
- Inspection during construction



Thickness

- Performance is sensitive to thickness
- Spot check edges
- Coring
- MIT T2



Sawcut Joints

Create a weakened plane to initiate cracking at the joints

Sawcut Joints

- Note when sawing began and ended
- Sawcut depth
- Joint location relative to dowel and tie bars
- Is there excessive raveling?
- Are there any random cracks?

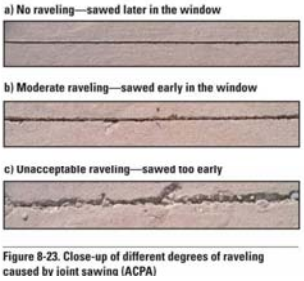
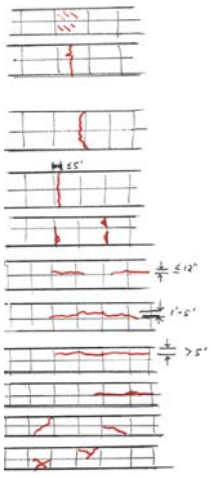


Figure 8-23. Close-up of different degrees of raveling caused by joint sawing (ACPA)

Sawcut Joints – Random Cracks

Recommended Repairs for Cracking in PCC Pavements

Defect	Orientation	Location	Description	Dowelled/Undowelled Transverse Joints	Recommended Repair
Plastic Shrinkage	Any	Anywhere	Partial-depth and more than 0.007 in. (0.18 mm) wide	Either	Do nothing
Uncontrolled Crack	Transverse	Mid-Panel	Full-Depth	Undowelled	Sawroute and seal crack
				Dowelled	Full-Depth Repair or LTR[a]
Uncontrolled Crack	Transverse	Crosses or ends at transverse joint	Full-Depth	Undowelled	Saw & seal crack; Epoxy sawed joint if uncracked
				Dowelled	Full-Depth Repair or If crack jumps from sawcut to edge of slab within 5 feet of edge of slab, stop sawcut, saw & seal crack
Uncontrolled Crack	Transverse	Parallel to & within 5 ft. (1.5 m) of joint	Full-Depth	Undowelled	Saw and seal crack Seal joint
				Dowelled	Full-Depth repair to replace crack and joint
Spalled sawcut or uncontrolled crack	Transverse	Anywhere	Spalling; more than 3.0 in. (73 mm) wide	Either	Partial-Depth Repair
Uncontrolled Crack	Longitudinal	Relatively parallel to & within 1 ft. (0.3 m) of joint. May cross or end at longitudinal joint	Full-Depth	Either	Sawroute & seal the crack or cross-stitch the crack Epoxy sawed joint if uncracked
Uncontrolled Crack	Longitudinal	Relatively parallel to & within wheel path; 1 - 6 ft. (0.3-1.8 m) from joint	Full-Depth, hairline, or spalled	Either	Remove and replace panel or cross-stitch crack
Uncontrolled Crack	Longitudinal	Relatively parallel to & further than 6 ft. (1.5 m) from a longitudinal joint or edge	Full-Depth	Either	Cross-stitch crack
Spalled sawcut or uncontrolled crack	Longitudinal	Anywhere	Spalled	Either	Partial-Depth Repair
Uncontrolled Crack	Diagonal	Anywhere	Full-Depth	Either	Full-Depth Repair
Uncontrolled Crack	Multiple per panel	Anywhere	Two or more full depth cracks dividing panel into 3 or more pieces	Either	Remove and replace panel



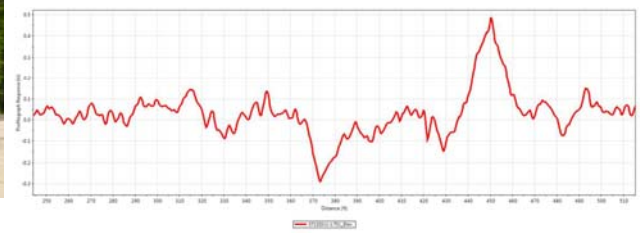
Iowa DOT Construction Manual Appendix 9-6

Texture

- Macro-texture (tining) affects tire-pavement noise
- Micro-texture (burlap drag) affects skid resistance
- No standard measurement technique
- Visually inspect for uniformity and texture depth

Smoothness

- Daily contractor quality control testing
- Request a summary report and profile data

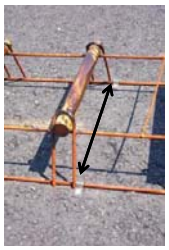


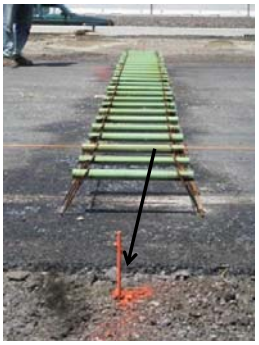
Daily Items Before Paving

- Traffic Control
- Dust Control
- Safety
- Aggregate Stockpile & Plant
- Previous Day's Paving
  - Tie Bar Placement
  - Dowel Bar Placement
  - Thickness
  - Sawcut Depth/Raveling/Alignment
  - Texture
  - Smoothness (profile)
- Dowel Basket Placement
- Haul Road
- Vibrators
- Stringline Control

Dowel Basket Placement
Inspection

- Joint spacing
- Lateral position
- Bar alignment
- Joint positively marked
- Bond breaker
- Anchoring to subbase





135

Haul Road
Inspection

- Identify unstable areas
- Notify the contractor
- Have a back up plan

Truck fire blocked haul road

136

Vibrators
Verification

- Contractor decides upon number, spacing and position
- Vibrator monitor in use?
  - Time
  - Location
  - Frequency

Vibrators
Verification

- Observe the contractor checking with a tachometer, before paving begins
- Dead vibrators may not be apparent behind the paver

Vibrator Trails

- Noted by deeper groove
- Notify contractor and make adjustments

Left core - aggregate segregation

Stringline Control

- The stringline is used to provide an accurate reference for elevation and alignment control of the trimming, base laying and paving train
- Air temp and relative humidity variations, equipment bumping the line, can affect the length of the line
- The grade should be checked before and during pour
- The paving equipment will follow the string
- It is easier and safer to adjust the string rather than to crank the paver sensors

140

WHAT HAPPENS WHEN YOU ARE FINALLY PAVING?

Daily Items During Paving

- Subgrade/Subbase Moisture
- Date Stamp and Sta. Marks
- Mixture Homogeneity and Uniformity
- Slab Geometry
- Batch Tickets
  - Proportions
  - Added Water
  - Aggregate Moisture
  - Delivery Time
  - Yield
- Vibrator Frequency and Consolidation
- Edge Slump
- Dowel Placement
- Hand Finishing
- Texturing
- Curing
- Sawing

Subgrade/Subbase Moisture

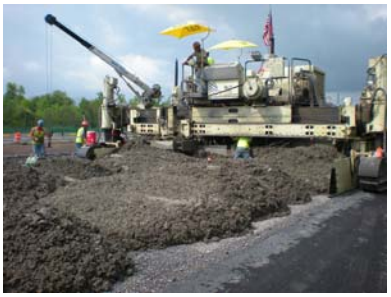
- Moisten base ahead of the paver
- Prevent excessive water loss into the base
  - Workability
  - Cracking

Date Stamp and Sta. Marks

Invaluable when troubleshooting problems

Mixture Uniformity

- Homogeneous - thoroughly mixed
- Uniform – consistent, not wet/dry/wet/dry …
- Belt placer segregation – separation of aggregate and mortar



Slab Geometry

- Width - morning
- Thickness - hourly
- Cross-slope - morning and through transitions

Daily Items During Paving

- Subgrade/Subbase Moisture
- Date Stamp and Sta. Marks
- Mixture Homogeneity and Uniformity
- Slab Geometry
- Batch Tickets
  - Proportions
  - Added Water
  - Aggregate Moisture
  - Delivery Time
  - Yield
- Vibrator Frequency and Consolidation
- Edge Slump
- Dowel Placement
- Hand Finishing
- Texturing
- Curing
- Sawing

147

Concrete Proportions

- Target weights and actual weights
- Compare proportions to the approved mix design – three times per day

Job	SD OL
Ticket No.	1041
Date	3/26/2011
Time	15:30
Batch Size (yd^3)	8
Formula #	

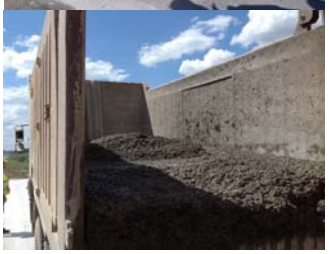
	Target	Actual	MC
Portland Cement	3680	3670	
Fly Ash (lb)	920	920	
Coarse Agg (lb)	10910	10920	3.0%
Intermediate Agg (lb)	3460	3450	2.7%
Fine Agg (lb)	10460	10480	3.8%
AEA (oz)	40	40	
Water Reducer (oz)	304	305	

Mix Water (gl)	119	120
Trim Water (gl)	10	10
Water from Agg (gl)	98	98
Total Water (gl)	227	228

148

Added Water

- **Water:Cementitious (w/cm) ratio is critical**
- Transit mixed concrete
  - Monitor water added
  - Reject the load if the max. w/cm is exceeded
- Central mixed concrete, assure that trim water is thoroughly mixed and included on the batch tickets



149

Aggregate Moisture

- Aggregates weights batched include water
- Moisture contents should be adjusted as needed
- Check batch tickets to see if it ever changes

Job	SD OL
Ticket No.	1041
Date	3/26/2011
Time	15:30
Batch Size (yd^3)	8
Formula #	2

	Target	Actual	MC
Portland Cement	3680	3670	
Fly Ash (lb)	920	920	
Coarse Agg (lb)	10910	10920	3.0%
Intermediate Agg (lb)	3460	3450	2.7%
Fine Agg (lb)	10460	10480	3.8%
AEA (oz)	40	40	
Water Reducer (oz)	304	305	

Mix Water (gl)	119	120
Trim Water (gl)	10	10
Water from Agg (gl)	98	98
Total Water (gl)	227	228

150

Delivery Time

Check transit time periodically

Job	SD OL
Ticket No.	551
Date	3/23/2011
Time	11:30
Batch Size (yd^3)	8
Formula #	2

	Target	Actual	MC
Portland Cement	3680	3670	
Fly Ash (lb)	920	920	
Coarse Agg (lb)	10860	10850	2.5%
Intermediate Agg (lb)	3470	3460	2.9%
Fine Agg (lb)	10500	10510	4.2%
AEA (oz)	40	40	
Water Reducer (oz)	304	305	

Mix Water (gl)	119	120
Trim Water (gl)	10	2
Water from Agg (gl)	98	98
Total Water (gl)	227	220

Grade Yield

- Concrete used / concrete required, expressed as %
  - Example: 256 cy / 240 cy = 107%
- Almost always greater than 100%
- If less than 100%
  - Deficient thickness (thin slab)?
  - Incorrect concrete proportions?

Daily Items During Paving

- Subgrade/Subbase Moisture
- Date Stamp and Sta. Marks
- Mixture Homogeneity and Uniformity
- Slab Geometry
- Batch Tickets
  - Proportions
  - Added Water
  - Aggregate Moisture
  - Delivery Time
  - Yield
- Vibrator Frequency and Consolidation
- Edge Slump
- Dowel Placement
- Hand Finishing
- Texturing
- Curing
- Sawing

153

Vibrator Frequency and Consolidation

- Sharp clean edges
- Closed smooth surface

154

Vibrator Frequency and Consolidation

- Some surface voids are better than slurry running off the edges
- Frequency should be adjusted for paving speed
- Vibrators off when stopped
- Collect and review vibrator monitor data when used

Edge Slump

- Concrete is extruded through a slipform paver
- Batter and overbuild allows for some edge slump
- Check periodically with a straightedge
- Halt paving if the edge keeps falling

Dowel Placement

Dowel bar inserter (DBI)

- Bars inserted in plastic concrete
- Positive marking for the saw crew
- Void left by inserter

Dowel Placement

Baskets or DBI

Manually verify bar location (min. 2x per day)

Hand Finishing

- Close voids in the surface
- Correct bumps and dips
- No added water
- Do not overfinish

159

Texturing

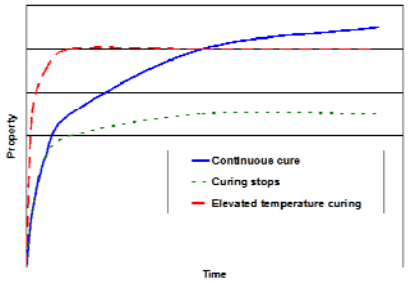
- Straight tines, clean mortar buildup from the burlap drags and tines
- Avoid positive texture (noise generator)

160

Curing Purpose

Prevent excessive water loss from the concrete

- Control plastic shrinkage cracking
- Lower permeability concrete



161

Curing Inspection

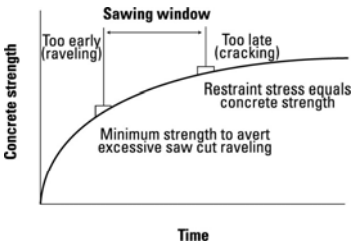
- Material meets specification
- Well agitated
- As close behind the paver as possible
- Specified coverage rate allowing for texture
  - ➢ Uniform coverage (no gray streaks)
  - ➢ Like a white sheet of paper

162

Curing Inspection

Curing
- Start early
- Keep it wet and warm
- Does it affect strength? Yes
- When it dries, it dies

Sawing



- Timing
  - Raveling
  - Cracking
- Sawcut depth
- Joint location relative to marks left by the paving crew
- Alignment

- Stick around and keep them on their toes

Fixed Form Paving

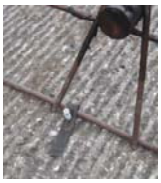
- Setting Forms
- Embedded Steel
- Spreading/Puddling
- Hand Vibration
- Strike-Off
- Hand Finishing
- Texturing
- Curing
- Stripping Forms

Setting Forms

- Set to line and grade
- Fine graded
- Shim forms when necessary
- Securely pinned

Embedded Steel

- Dowel baskets
- Tie bars
  - Chaired in contraction joints
  - Placed in forms or drilled and epoxied in construction joints



Spreading/Puddling

- Even distribution from the truck chute
- Shoveled ahead of the strikeoff
  - Stinger vibrators are not shovels
  - Rakes are not shovels

Hand Vibration

- Insert and remove vertically
- Repeat at a pattern that provides adequate consolidation
- Do not vibrate embedded steel

Strikeoff

- Hand method (wet screed)
- Vibrating screed
- Roller screed
- Bridge deck paver

Hand Finishing

- Correct bumps and dips
- Close surface voids
- Do not over-finish

Texturing

- Burlap/Turf drag
- Hand tining

Curing

- Small sprayer
- Apply before any evaporation occurs
  - Full coverage
  - Uniformly white

Stripping Forms

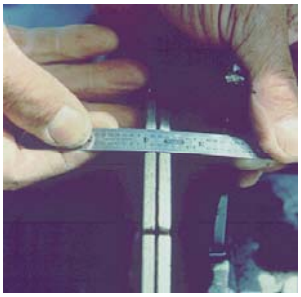
- Typically the following day
- Cure the edges

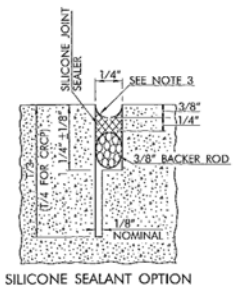
Incidental Items

- Dimension Sawing
- Joint Sealing
- Granular or Earthen Backfill (shouldering)

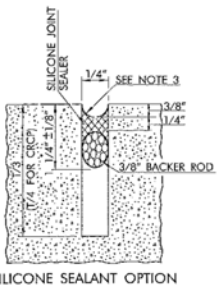
Dimension Sawing

- Only necessary for sealants that require a specific joint shape (width:depth)
- Flush the slurry from the widened joint





SILICONE SEALANT OPTION



SILICONE SEALANT OPTION

Joint Sealing

- Clean and dry joint faces
  - Sandblast
  - Dry compressed air
- Backer rod installation
- Sealant installation



177

Backfill

- Hauling equipment allowed on the pavement after opening strength has been met
- Protect pavement edges from damage (stay away):
  - loaded trucks
  - motor graders
  - rollers

178

Q: WHAT IS THE INSPECTOR'S ROLE?

Inspector's Role

- Traffic Control
- Grade
- Concrete Delivery
- Concrete Placement
- Concrete Testing
- Pavement Testing
- Vibration
- Steel Placement
- Finishing
- Texture
- Curing
- Station Markers/Dates
- Concrete Strength
- Haul Roads
- DOCUMENTATION
- Housekeeping
- Non-Compliance Notices

Inspector's Role

REVIEW TIME!

What's wrong here?

What is Needed for Testing?

<u>Equipment:</u>
- Air meter
- Siphon bottle
- Bucket
- Mallet
- Shovel
- Slump cone
- Rod
- Trowel

- Assemble and check testing equipment
- Calibrate air meter regularly

Inspector's Role

Traffic Control

- Safety is paramount
- Every agency addresses it a little differently
- It is Everyone's responsibility
- Crash ➔ Stopped Traffic ➔ Stopped Paver

Inspector's Role

Grade

- Look for irregularities
- Wetting the subgrade
  - ➢Dry Subgrade ➔ Water Drawn from Concrete ➔ Inadequate Strength Gain/Cracking
  - ➢Do not overwet

Stringline

- Check alignment
- Walk ahead

Inspector's Role

Concrete Delivery
Delivery Time

Three Methods of Delivery

- Dump Truck
  - ➢Shortest Allowed Delivery Time
  - ➢Hardest to track
  - ➢Follow a truck in normal traffic
  - ➢Call plant for batch time if necessary

- Agitators

  Longer Allowed Delivery Time
  (sometimes equal to ready-mix)

- Transit Mixers (Ready-Mix Trucks)
  - ➢Longest Allowed Delivery Time
  - ➢Batch time written on ticket

185

Inspector's Role

Concrete Delivery
Added Water

- Ready-Mix trucks can add water at the grade
- Document volume of water added
  - ➢Extremely inaccurate
  - ➢Do not exceed max w/c ratio

READY MIX CONCRETE

Ashton Glenwood Plant
Truck No. T-13309 Ticket No. 1
Date 8/15/13 Des. No.
Proj. No. DHS-706-0(15)--74-65
Mix No. SW47BIPF Retarder/Water Reducer? ☒ Yes ☐ No
Conc. this Truck 9½ C.Y./m³
Air agent added this truck 23¾ oz./mL
Time Batched 4:00 Discharged 4:20
Rev. Mixed (Plant) 70 Grade

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

In Aggregate	70	gal./L	lbs./kg
Added (Plant)	145	gal./L	lbs./kg
Subtotal	215	gal./L	lbs./kg
Added Grade	15	gal./L	lbs./kg
TOTAL WATER	230	gal./L	lbs./kg
Maximum Water Allowed	291	gal./L	lbs./cy or kg/m³

Air 7.0 Slump 2 ¼
Plant Insp. Scott Sepenske SW130
Receiving Insp. Steve Wolf 456

186

Inspector's Role

Concrete Delivery
Added Water

- Mix for appropriate # of revolutions by spec (30)
- Adding water will:
  - Increase workability (slump)
  - decrease strength
  - increase permeability
- Communicate with plant
  Better to add more at plant than in truck later

Inspector's Role

Placement

- Belt Placer
  - ➢Should be uniform pile
  - ➢Segregation
    - – Aggregate gets thrown
    - – Paste piles next to belt
    - – Edge slump higher on side where trucks dump
- Ready-Mix
  - ➢Evenly spread with chute
  - ➢Stinger (Vibrator) is for consolidation—not moving concrete
    - – Do not drag
    - – Can cause segregation

Inspector's Role

Concrete Testing
Air Content

- Determine minimum testing frequency
  Do more than the minimum
- Know required air content - Target, Min, Max
- Slip-Form Paving
  - ➢What is target, min, max (in-place)
  - ➢Test in front of paver
  - ➢Test behind paver
    - Makes finishers mad
    - Establish loss through paver
      Can change throughout the day/time of year
  - ➢Regular testing in front of paver

189

Inspector's Role

Slump

- Consistency

- Slip-Form
  - ➢Ability to stand up
  - ➢High slump creates edge slump issues
  - ➢Usually not required
  - ➢Monitor visually for changes

190

Inspector's Role

Temperature

- Agencies have different specifications
  - ➢Know your specifications
  - ➢Water freezes at ??
- Check temperature regularly
- Changes in temperature can relate to:
  - ➢Air content
  - ➢Water demand
  - ➢Workability

191

Inspector's Role

Pavement Testing

Edge Slump

- Sign of mix inconsistency
- Edges coming out of paver should be vertical
- Test with straight edge
- Creates birdbaths
  - ➢Safety hazard
    - Rain
    - Ice
  - ➢Durability issues

192

Pavement Width

- Make sure it matches plans
- Slip-form paver should be right
  - ➢Check paver before paving
  - ➢Check first day of paving
- Check form widths
  - ➢Use hubs to check offsets
  - ➢Hubs may have been wrong, too

Inspector's Role

Cross Slope
- Double-check plans
- Check with:
  - ➢String line
  - ➢4' Level
    - – Ruler
    - – Digital
      - » Calibrated regularly
      - » Too accurate?
      - » Acceptable tolerance (0.5%, 0.25%??)

Inspector's Role

Depth Check

- Probing for thickness
- May indicate problems
- Thickness incentives reduce concern
- Use string line across forms

Inspector's Role

Vibration

- Important for consolidation
  - ➢Too much causes segregation, low air, cracking
  - ➢Vibrator trails will be evident in texturing
- Check vibrators regularly (2 x day)
  - ➢Determine vibration specs
  - ➢Use vibration monitors as a tool, but always verify

Inspector's Role

Steel Placement-Transverse Joints

Doweled Pavements

- Basket Assemblies
  - Provide load transfer
  - Smooth bars allow bar to slide in concrete
  - Contraction joint
  - Must be aligned with the pavement and the joint
  - Check for damage to baskets
  - Baskets staked and marked for saw crews

197

Inspector's Role

Steel Placement

Drilled Dowels

- Alignment
- Epoxy

Jointing

- Check plans for joint locations
- Think several stages ahead
- Ask for help if unsure

198

Inspector's Role

Steel Placement
- Longitudinal Joints
  - Keyway
    - ➢ Inserted by hand in plastic concrete
    - ➢ Ensure consolidation around bar (vibration)
      - Pullout after set
  - Drilled
    - Ensure proper:
      - ➢ Depth
      - ➢ Cleanout
      - ➢ Epoxy

199

Inspector's Role

Steel Placement
- Longitudinal Joints
  - Centerline Steel (Slipform)
    - Automatic or manual insertion
    - Verify steel location
      - ➢ Depth
      - ➢ Spacing
      - ➢ Especially in superelevated curves

200

Inspector's Role

Finishing

Slipform

- Some is usually necessary
- Too much indicates a problem
- Burlap drag
  - ➢Wet burlap sparingly
  - ➢No puddling
  - ➢Very small amount of slurry created by finishing tools

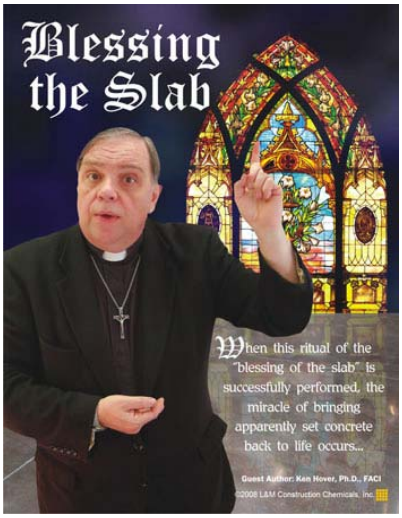
201

Inspector's Role

Finishing

Adding water to surface is often referred to as:

Blessing the Slab



202

Inspector's Role

Yield

- Determine theoretical volume of concrete to be used
- L (ft) x W (ft) x D (ft) / 27 = Theoretical CY
- Yield = CY Used/Theoretical CY x 100 = Yield %
- Normally is over 100%
- Slip-form is usually 103% - 106%, especially with thickness incentive

Extra concrete is good, especially if you're paying by the SY

203

Common Sense

If something is not right

STOP THE WORK

204

WHAT ABOUT ALL OF THE OTHER ROAD BUILDING STUFF?

Other Construction

- Earth shoulder
- Longitudinal subdrains
- Granular shoulders
- Paved shoulders

Other Construction

Earth shoulders

- Begins shortly after pavement has been opened to contractor's vehicles
- Completion prior to subdrain operations ensures proper drainage
- Material hauled with dump trucks or scrapers
- Spread and leveled with dozer or motor patrol

Other Construction

Earth shoulders

Other Construction

Earth shoulders
- Watch for equipment damage to slab

Other Construction

Longitudinal subdrains
- Excavation
  - Adjacent to edge of pavement
  - Trenching Machine

Maintain the system!

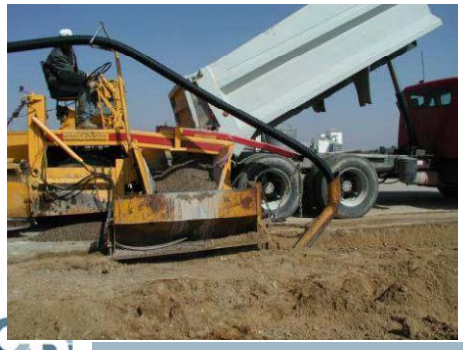
Other Construction

Longitudinal subdrains

- Placed with a “mule”
- Porous backfill placed on top of and around tubing/tile
- Ensure tubing/tile is not stretched excessively
- Ensure proper compaction

Other Construction

Longitudinal Subdrains



Other Construction

Longitudinal subdrains
Outlets
- Located at typical spacing or specified locations
- Rodent guards
- Markers?

Other Construction

Longitudinal subdrains

Other Construction

Granular shoulders

- After subdrain operations
  One of the very last operations
- Usually placed with aid of shouldering machine
- Compacted as specified
  Finish roller should not be driven on slab
- Usually finished with a motor patrol
- Take care not to damage slab

Other Construction

Granular shoulders

Other Construction

Granular shoulders

Other Construction

Paved shoulders

- Typically on interstates and four lane divided highways
- May be PCC or HMA
- Granular base typically placed underneath

Other Construction

Paved shoulders

Other Construction

Paved shoulders

Maturity Testing

- Strength determines pavement opening (not time)
- Inspector monitors the process
- Maturity involves casting 12 beams & developing a strength/maturity curve

Casting maturity beams at the plant site

WHAT TO LOOK FOR IN URBAN PAVING?

Urban Paving

Urban Paving

- Check ROW contracts for:
  - Property owners
  - Specific requests
  - Existing and proposed entrances
- Become familiar with locations of:
  - Intakes
  - Manholes
  - Sidewalks
  - Utilities – gas, water, electric, etc.

Urban Paving

- Base Material
  - Does it allow for contractor to utilize as a haul route
  - Monitor condition for rutting, debris, contamination
- Subdrains
  Protect trenches from over compaction and contamination

Urban Paving

Environmental Restrictions

Urban Paving

Curbs

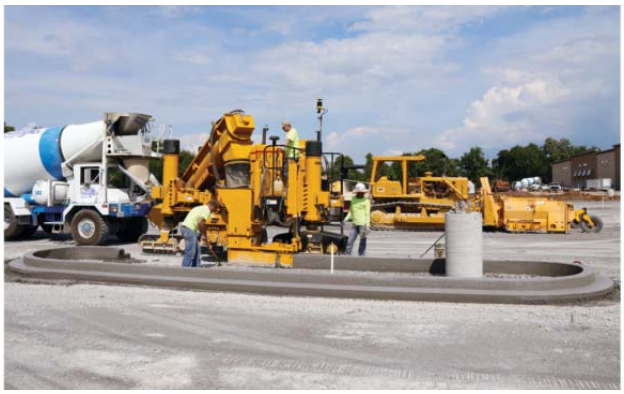
- Almost always
- Check gutter flow line elevations
- Hand finishing at driveway and sidewalk curb drops
- Median and stop sign islands require special shaping

Urban Paving

Curbs

Urban Paving

Curbs



Urban Paving

Hand Pours

Typically a larger number of hand pours

Urban Paving

Hand Pours
- Subgrade/BHase Prep
  - Uniformity!!
  - Check for soft spots
  - Utilities cause issues
    - Accesses
    - Trenches

231

Urban Paving

Hand Pours
- Form Placement
  - Clean Forms
  - Straight
  - Oiled
  - Anchored
  - Match thickness of paving
  - Achieve proper drainage

232

Urban Paving

Hand Pours
Form placement

Urban Paving

Hand Pours

- Concrete Placement
  - Vibratory Screed
  - Roller Screed
- Vibrator
  - For consolidation
  - Not for moving concrete (shovels)

Urban Paving

Hand Pours
Finishing
- Edging tool adjacent to forms
  Prevents tears and breaks
- Special attention to fixtures in pavement

Urban Paving

Obstructions
- Some obstacles can't be avoided
- Be aware of potential conflicts
- Quadruple check elevations
- Think and look ahead
- Delays can cost the contractor and/or the agency $$

Urban Paving

Boxouts

- Intake and manhole locations
- Side streets
- Accesses
- Pavement width changes

Urban Paving

Boxouts

- Usually formed with steel forms staked in place
- Rock placed in boxout to prevent filling with concrete
- Check forms for stability
- Post paving check for dowel bar locations

Urban Paving

Boxouts
Jointing is CRITICAL!!!

239

Urban Paving

Jointing

- Proper jointing is critical for long lasting pavement
- Check plans for joint spacing and placement
- Layout ahead of time with contractor
- Layout intersections and driveways first

240

The Rules of Jointing

Things to Do

- Match existing joints or cracks
- Place joints to meet in-pavement structures
- Remember max. joint spacing
- Place isolation joints where needed
- Can make field adjustments to joint location!
- Be Practical

Things to Avoid

- Slabs < 1 ft (0.3 m) wide
- Slabs > 15 ft (5.0 m) wide
- Angles < 60º (~90º is best)

  Do this by dog-legging joints through curved radius points
- Creating interior corners (L-shaped slabs)
- Odd Shapes (keep slabs square or pie-shaped)

241

Urban Paving

Jointing

242

Urban Paving

Jointing

243

Urban Paving

Jointing

244

Urban Paving

Obstructions

WHAT PAPERWORK?

Documentation

Document

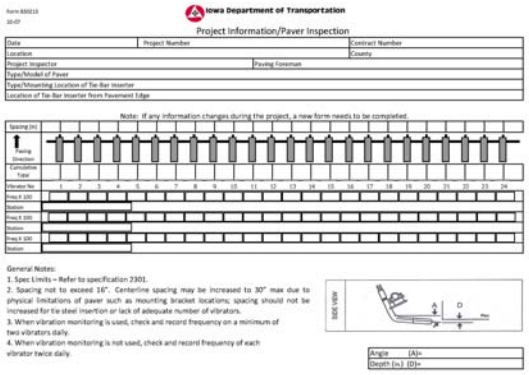
Document

Document

247

Helpful Forms

Paver Setup



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.

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

General Notes:

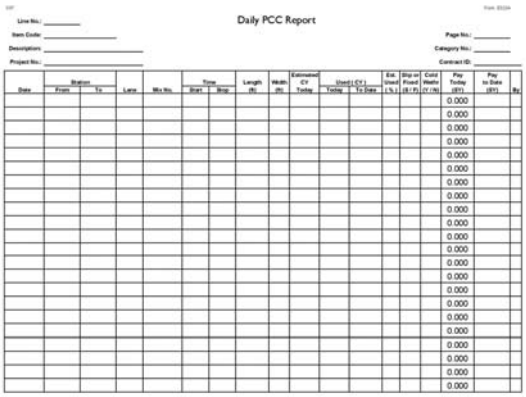
1. Spec Limits – Refer to specification 2301.
2. Spacing not to exceed 16". Centerline spacing may be increased to 30" max due to physical limitations of paver such as mounting bracket locations; spacing should not be increased for tie steel insertion or lack of adequate number of vibrators.
3. When 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)=

248

Helpful Forms

Daily Paving Summary



Daily PCC Report

Line No.: _____
Item Code: _____
Description: _____
Project No.: _____
Page No.: _____
Category No.: _____
Contract ID: _____

Date	Station From	Station To	Lane	Mix No.	Time Start	Time Stop	Length (ft)	Width (ft)	Estimated CY Today	Used (CY) Today	Used (CY) To Date	Est. Used (%)	Skip or Fixed (S / F)	Cold Joints (Y / N)	Pay Today (SY)	Pay to Date (SY)	By
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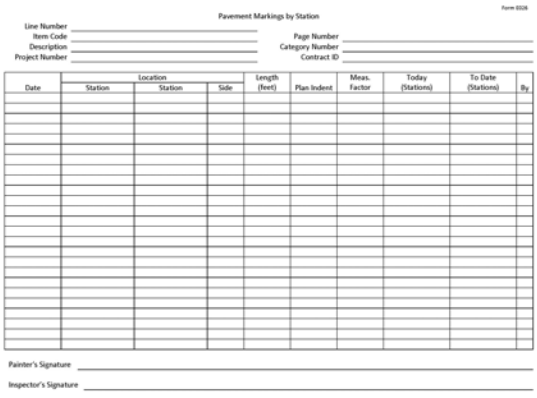
Helpful Forms

Pavement Markings



Pavement Markings by Station

Line Number _____
Item Code _____
Description _____
Project Number _____
Page Number _____
Category Number _____
Contract ID _____

Date	Location Station	Location Station	Side	Length (feet)	Plan Indent	Meas. Factor	Today (Stations)	To Date (Stations)	By

Painter's Signature _____
Inspector's Signature _____

Helpful Forms

Subgrade Checks

Rev 1/97 Form E109

Subgrade/Final Grade Check

Line No.: _____
Item Code: _____ Page No.: _____
Description: _____ Category No.: _____
Project No.: _____ Contract ID: _____

Date	Location Sta	(Lane) (Side)	Distance (Ft.)							By

Helpful Forms

Depth Checks

Rev 1/97 Form E110

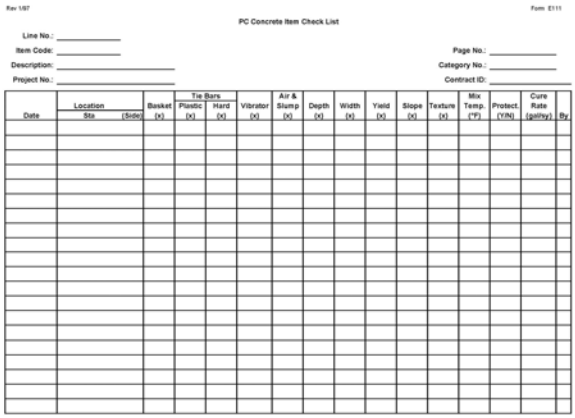
Depth Checks

Line No.: _____
Item Code: _____ Page No.: _____
Description: _____ Category No.: _____
Project No.: _____ Contract ID: _____

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

Helpful Forms

Paving Items



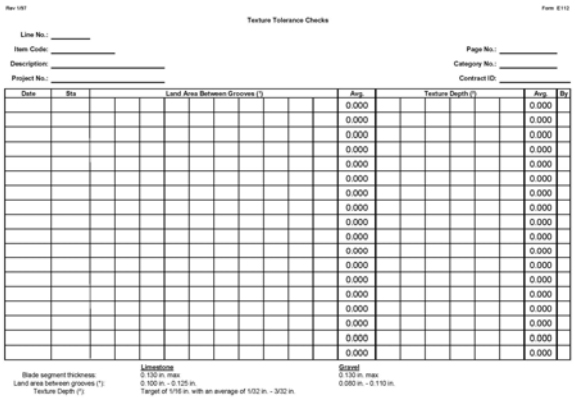
PC Concrete Item Check List

Line No.: _____
Item Code: _____
Description: _____
Project No.: _____
Page No.: _____
Category No.: _____
Contract ID: _____

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

Helpful Forms

Texture



Texture Tolerance Checks

Line No.: _____
Item Code: _____
Description: _____
Project No.: _____
Page No.: _____
Category No.: _____
Contract ID: _____

Date	Sta	Land Area Between Grooves (")	Avg.	Texture Depth (")	Avg.	By
			0.000		0.000	

Blade segment thickness:
Land area between grooves (");
Texture Depth (");

Limestone
0.130 in. max
0.100 in. - 0.125 in.
Target of 1/16 in. with an average of 1/32 in. - 3/32 in.

Gravel
0.130 in. max
0.080 in. - 0.110 in.

Helpful Forms

Air/Slump

Rev 9/06 Form E115

Air and Slump Tests

Line No.: _____ Page No.: _____

Contractor: _____ Category No.: _____

Project No.: _____ Contract ID: _____

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

Helpful Forms

Drawing

Rev 2/02 Form E100

Measurement Drawings

Line No.: _____

Item Code: _____ Page No.: _____

Description: _____ Category No.: _____

Project No.: _____ Contract ID: _____

Areas	Calculations	Units ( )	Total

Entries By: _____ Date: _____

Thank you for your time

Concrete Production: The Cement Hydration Process