PCCP Construction and Inspection: What is Really Important?

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Q: What is *Really* Important?

• Foundation Preparation
  ➢ Elevation/Profile
  ➢ Uniform Support
  ➢ Adequate Construction Support

• Dowel Positioning Issues
  ➢ Basket Wires – Cut or Not?
  ➢ Basket Anchoring
  ➢ Proper Saw Cut Marking and Sawing

• Machine Setup and Control
  ➢ Stringline Setup and Maintenance
  ➢ Stringless Control Issues
  ➢ Paver Setup

• Concrete Mixture Control

• Concrete Delivery and Placement
  ➢ Steady Delivery of Concrete to Grade
  ➢ Concrete Placement Options (Belt Placer/Spreader vs Truck Dump)

• Edge Slump Control and Remediation
• Finishing Techniques
• Construction Joints
  ➢ Formed vs. Overrun and Saw
• Curing Issues

A: It’s *all* important ...
PROPER FOUNDATION PREPARATION
Stability and Uniformity are the Primary Objectives

- Subgrade/subbase is the construction platform.
- Paving machines and forms ride/rest on the grade.
  - Less risk of stability problems with overlay construction, but still important!
- Stability is also important for haul roads.
  - Unstable grades may cause mix delivery problems.
- Stability also important for a safe work site and for long-term pavement performance!
Soft track line will cause machines to slip and constantly adjust to seek elevation - leads to big bumps or dips.
Use of planks to spread paving machine load may reduce problem ... but, correct solutions is to build grade correctly from the start.
Finished Grade Tolerances Are Also Important

- Controlled grades minimize adjustments by paving machine and crew:
  - Machine responses to adjustments for thickness.
  - Elevation sensor adjustments to keep “on” the stringline.
  - Auger or plow work to properly distribute of concrete.

- The fewer adjustments by the equipment or process, the higher the probability of a smooth profile.

- Also improves “yield” by reducing variations in volume of concrete required per length of paving.
Reasonable Surface Tolerances

- Granular subbase: ±1/2 inch (12 mm)
- Asphalt-stabilized subbase/layer: ±1/4 inch (6 mm)
- Lean concrete subbase: ±1/4 inch (6 mm)

Proof rolling the base/subbase (and trackline!) prior to trimming is a good practice to identify trouble spots.
PLACE DOWELS AND REINFORCING ACCURATELY AND SECURELY
Smoothness Considerations for Dowel Baskets

- Use care positioning baskets to prevent snagging or dislodging them by the spreader or paver:
  - Near mid-depth vertically.
  - Not too close to edge of pavement horizontally:
    - 6 in. (150 mm) minimum.
    - 12 in. (300 mm) recommended.
Smoothness Considerations for Dowel Baskets

- Dislodged baskets or bars often become bumps.
- Leave spacer wires intact because they add stability (Note: some specifications may require them to be cut).
- Secure with stakes, pins, nails or clips appropriate for the subbase.
- Use enough fasteners or stakes to keep in place under extrusion pressure:
  - Secure both sides.
  - Use appropriate fastener for base/subbase.
Recommended practices for:

- Anchor types (design, length, etc.)
- Anchor locations and quantities
- Construction practices to minimize potential basket damage and movement
- Basket braces and other supplemental support systems
Dowel Alignment & Location Monitoring

- MIT Scan2B.
- MIT DOWEL-SCAN
- GPR
- MIRA (Ultrasonic)
CONCRETE DELIVERY AND PLACEMENT
Consistent Concrete Delivery

- Consistent delivery and placement is essential!
  - Keep paver moving.
  - Steady continuous paver operation produces fewer bumps/dips.
- Match plant production and truck delivery (number and capacity) to paver requirements.
- Consider:
  - Plant location.
  - Discharge time.
Concrete Placement Options

Truck Dump

Placer

Placer/Spreader
Use of Placers and Placer-Spreaders *May*:

- Allow paver to move at more consistent speed.
- Provide more consistent head of concrete to paver.
Too much head of concrete leads to roughness –
paver must work as a plow.
Too little concrete leads to roughness: paver attempts to fill gap or hand work required.
Good material distribution, no signs of segregation or other problems.
Considerations for Truck Dump Option

- Limited room for haul roads, placer access, placer-spreaders side-belt use

- Grade is free of reinforcing or dowels:
  - Dowel and tie bar insertion
  - Baskets can be secured just ahead of paving

- Base type: will truck traffic degrade unbound material?

- Impact on surface cleanliness for bonded overlay construction
Considerations for Using a Placer or Placer/Spreader

- Project conditions allow for adjacent haul/access road.
- Project conditions require secured dowel baskets or continuous reinforcement on grade before placement.
- Desire added assurance of meeting smoothness requirements.
PAVER SET-UP AND OPERATION
For a Slipform Paving Machine to Perform Well:

- Set up properly for the paving width:
  - Auger or plow.
  - Vibrators.
  - Pan.
- Critical parts must be clean!
- Replace worn parts.
- Maintain and assemble per manufacturer’s recommendations.
Paving Form Set-up

- Must be properly adjusted for good results.
- Establish a set-up procedure and follow it religiously.
- Properly account for overbuild.
- Pan must be straight & true:
  - Left to right.
  - Front to rear.
For good profile results, set pan parallel to stringline (planned pavement profile)
Poor Machine Alignment Causes Bumps/Dips/Tears Along Edges

Improper

Proper

Bumps
Improper Mold Profile Alignment for the Mixture May Cause Edge Slump
Check edge slump with straightedge to determine if the mixture/pan set-up is working.
The presence of some “bug holes” is preferable to excessive slurry and edge slump.
Excessive edge slump indicates a mix problem. Note signs of wet loads on pavement surface.
Are “buck boards” effective in remediating excess edge slump?
Vibrator Settings

- Typically 5000 – 8000 Hz for typical good paving mixtures.
- If added vibration is desired to make paving and finishing “easier,” something else is probably wrong with the operation.
- The concrete mixture is the first place to look:
  - Combined gradation.
  - Compatibility of mix materials.
  - Changes in consistency due to delays or slowed delivery.
Effect of Vibration on Air Voids

Loss of Air with Vibration Frequency

0.008 Threshold for Freeze-thaw Durability

Recommended Frequency Range

Vibrator Frequency (vpm)

Air Void Spacing Factor (in.)

w/c = 0.4  w/c = 0.5

0 5000 8000 11000 14000
Excessive vibration frequency (or paver speed too slow for normal frequency) leads to durability concerns (vibrator trails).
Finishing

- Less is usually more.

- A well-tuned paving operation requires little hand-finishing.
  - If a lot of effort is required, there is a problem with the operation or the concrete mix (or both).

- Adding finishing water to surface adversely affects durability.

- Over-finishing can adversely affect durability and/or smoothness.
Curing

Maintenance of a satisfactory moisture content and temperature in concrete during some definite period immediately following placing so that the desired properties may develop throughout a slab.
Curing Compound: **Good Practice**

*Note the edge!*
Curing Compound: Poor Practice
HEADER CONSTRUCTION
Construction of Headers (Transverse Construction Joints)

- Common source of bumps and localized roughness.
  - Improper form construction
  - Irregular hand finishing
- Two general options:
  - Formed headers.
  - Sawed headers.
Formed Header Construction

- **Two-part form method:**
  - Dowels protrude through the form.

- **False dowel method:**
  - False dowels attached to inside of header board.
  - False dowels removed with header board.
  - Real dowels are anchored in holes left by false dowel.
Constructing Smooth, Formed Headers

Position header form by measuring from the stringline on each side of pavement to minimize bumps.
Well-constructed Hand-formed Header
Sawed Header Construction

- Generally easier to construct smooth than formed headers.

- Method involves:
  - Paving through header location.
  - Sawing off excess concrete at header location.
  - Grouting or epoxying dowels in place.

- Dowel hole options:
  - Drilling holes and anchoring dowels
  - Pave over a basket with false dowels, remove false dowels to create holes, anchor real dowels.
Sawed Header Construction
Sawed header after dowels are installed - no hand finishing work required.
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Acknowledgments

American Concrete Pavement Association (ACPA)

National Concrete Pavement Technology Center (CPTech Center)
Thank You For Your Attention!

Questions?