



CONCRETE PAVEMENT THE INSPECTORS PERSPECTIVE

SWIFT 2015 Workshop - Chris Olidis, P.Eng.

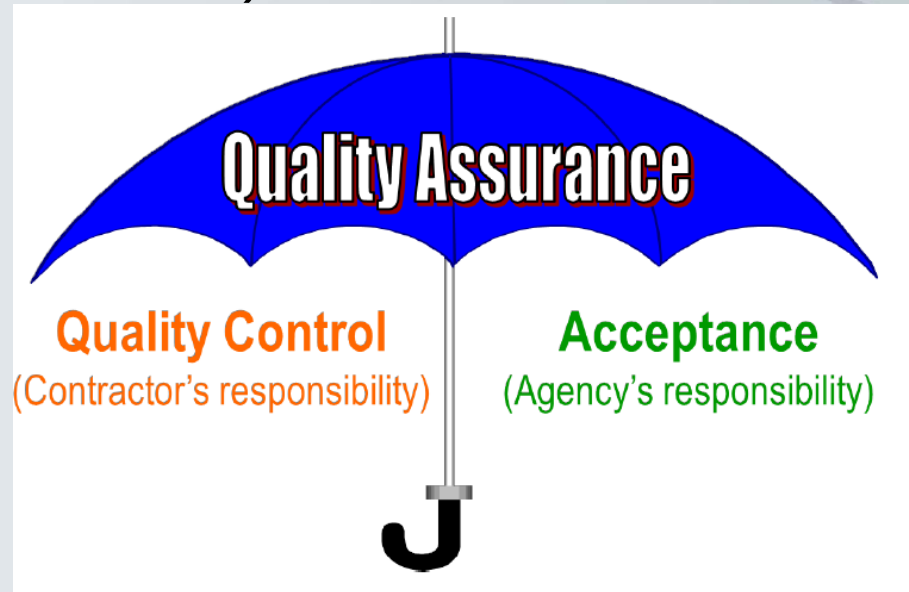


PRESENTATION OUTLINE

- Quality management
- Concrete pavement distress
 - Select types of premature deterioration
- What to watch out for during construction to help mitigate
 - Lets fix the problem before it happens

QUALITY MANAGEMENT

- Quality Management is the overall system or process for assuring project quality (AASHTO/FHWA)



QUALITY CONTROL

- The system used by a Contractor to monitor, assess and adjust their production or placement processes to ensure that the final product will meet the specified level of quality.
- Quality control plans often follow ISO principals
 - Say What You Do
 - Do What You Say
 - Document It

CONSTRUCTION ACCEPTANCE

- All factors used by the Owner/Agency (i.e., sampling, testing, and inspection) to evaluate the degree of compliance with contract requirements and to determine the corresponding value for a given product.



CANADIAN AIRFIELD STANDARDS

- Applicable Public Works and Government Services Canada Specifications
 - *ASG-6 Pavement Construction: Materials and Testing*
 - *ASG-20 Pavement Construction: Methods and Inspection*

BEST PRACTICE REFERENCES



U.S. Department of Transportation
Federal Highway Administration

Field Reference Manual for Quality Concrete Pavements

Publication No. FHWA-HIF-13-059

September 2012



An **IPRF** Research Report
Innovative Pavement Research Foundation
Airport Concrete Pavement Technology Program

Report IPRF-01-G-002-1

Best Practices for Airport
Portland Cement Concrete
Pavement Construction
(Rigid Airport Pavement)



Programs Management Office
1010 Massachusetts Avenue, N.W.
Suite 200
Washington, DC 20001

April 2003

ACPA Document No. JP007P



TSC 13-1, January 2013

Inspector's Manual for Hot-
Mixed Asphalt and Portland
Cement Concrete Pavement
Construction



INSPECTION CHECKLIST EXAMPLES

No.	Item	✓ When Complete
1.	Paver is clean	☐
2.	Vibrators are working	☐
3.	Vibrator spacing, height and orientation is correct	☐
4.	No leaks	☐
5.	Width, crown and cross-slope is correct	☐
6.	Dry run on string	☐
7.	Double check crown, cross-slope and thickness after dry run	☐

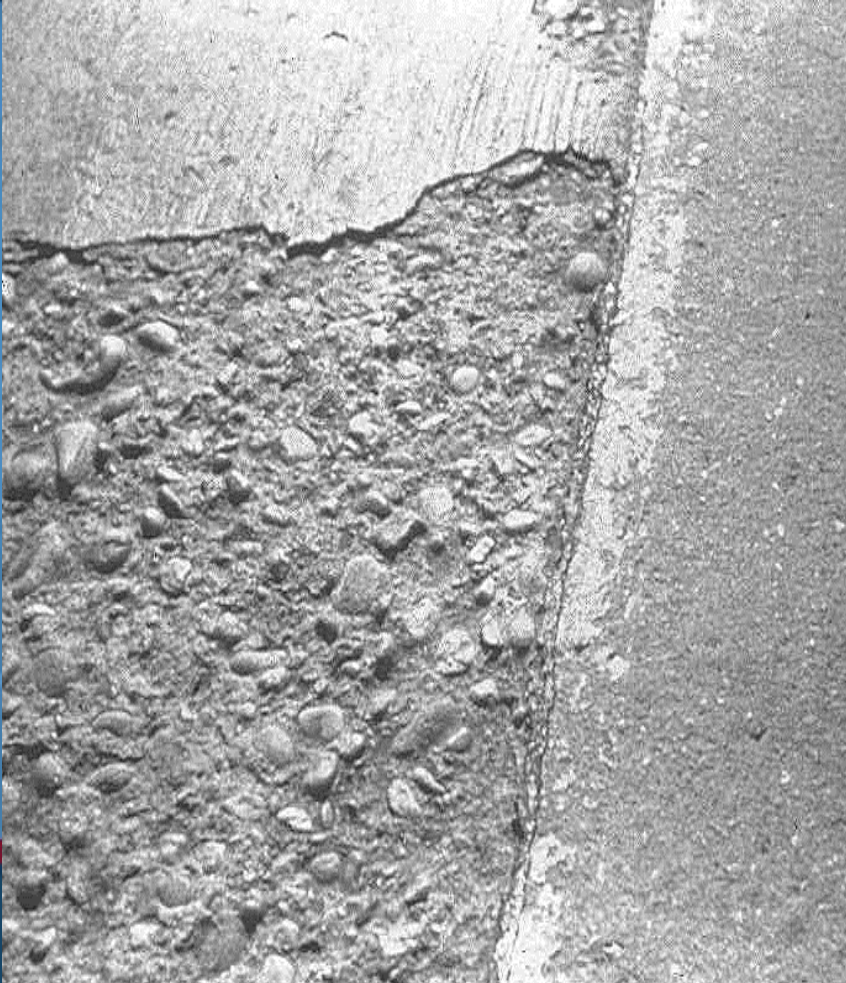
CONCRETE PLANT CHECKLIST:

1. Check foundations of stockpiles for proper separation and adequate drainage.
2. Check bins for adequate partitions to prevent intermingling of aggregates.
3. Check scales with test weights throughout range to be used.
4. Check scales for seals by approved agency.
5. Check water meter for accuracy.
6. Check for leakage of lines.
7. Check capacity of boilers and chillers if their use is anticipated.
8. Check admixture dispensers for accuracy.
9. Check mixers for hardened concrete around blades.
10. Inspect concrete hauling units for cleanliness.
11. Check to assure that all concrete making materials have been certified and approved for use.
12. Observe stockpiling operations – verify that segregation and contamination will not occur.
13. Observe charging of the bins – verify that segregation and contamination will not occur.
14. Review aggregate moisture tests.
15. Observe batching operations at start and periodically during production.
16. Check scales for zeroing.
17. Check to ensure proper batch weights are set on the scales.

COMMON PCC DISTRESS

- Scaling / delamination
- Frozen concrete
- Shrinkage cracks (in plastic and hardened PCC)
- Rain damage
- Paving joint damage
- Slab cracking (restrained joints)

SCALING / DELAMINATION



PROBABLE CAUSES?

- Lack of adequate air entraining agent (air content).
- Freeze thaw cycles (climate).
- Over finishing during construction (map cracking that progresses to scaling).



HOW TO AVOID?

- Ensuring we have a workable mix
 - A mix that can easily be placed, consolidated, and finished
 - Coarse vs fine aggregate split
- Equipment set up and operation
 - Ensure consistent concrete head
 - Paver speed too fast
 - Vibrators and/or finishing pan adjustment

LET THE PAVER DO THE WORK



MINIMIZE MANUAL FINISHING

- Keep hand finishing to a minimum
- Longer floats / straight edges / bump cutters provide a smoother surface



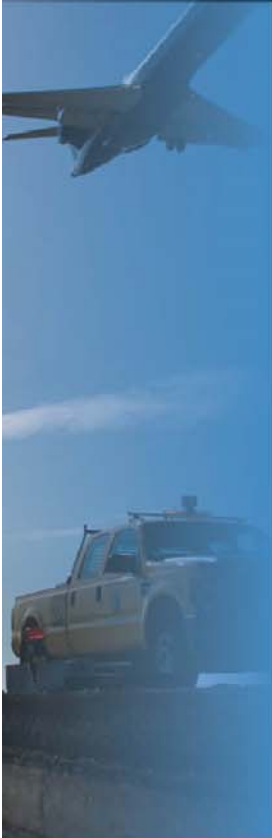
LIMIT EXCESSIVE HAND WORK!

- Excessive hand finishing will draw too much water to the surface
- Increased water/cement ratio
- Can reduce air content
- Decreased strength and durability

OVER FINISHING THE JOINT



NO! NO! NO!



FROZEN CONCRETE



THE GREAT WHITE NORTH

- Cold temperatures are a fact of life



HOW TO AVOID?

- Schedule to avoid cold weather concrete
 - Air temperature at or below 5° (CSA A23.1)
- Protect concrete for the first few days
 - Ensure sufficient thermal blankets are available



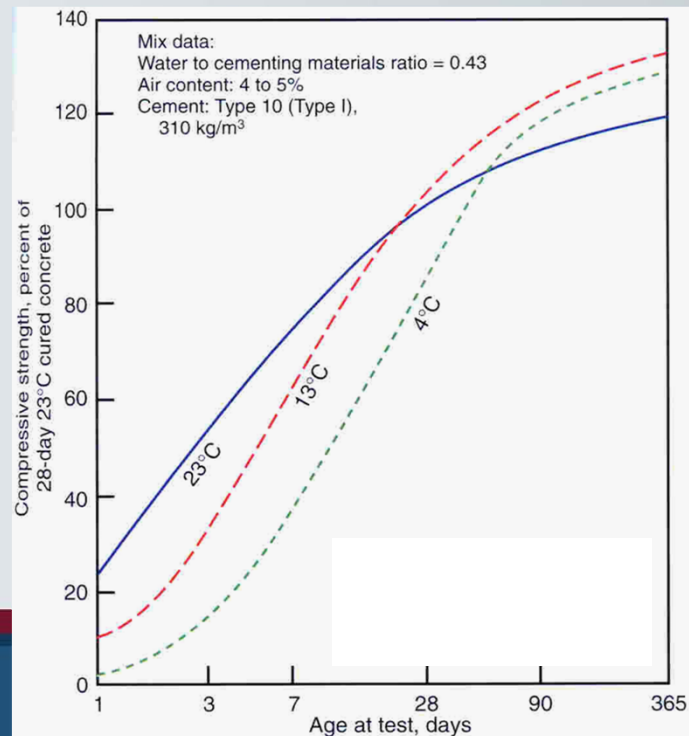
MONITOR STRENGTH GAIN

- Concrete strength gain is a function of temperature and time
 - Time-temperature record is used to determine curing of concrete (calibrated for each mix)
 - Thermocouples installed in concrete are used to measure the actual temperature of the concrete



IMPACT OF TEMPERATURE

- Freezing before final set/hardening is permanent
- Retarded strength gain if after final set/hardening



PCC HYDRATION

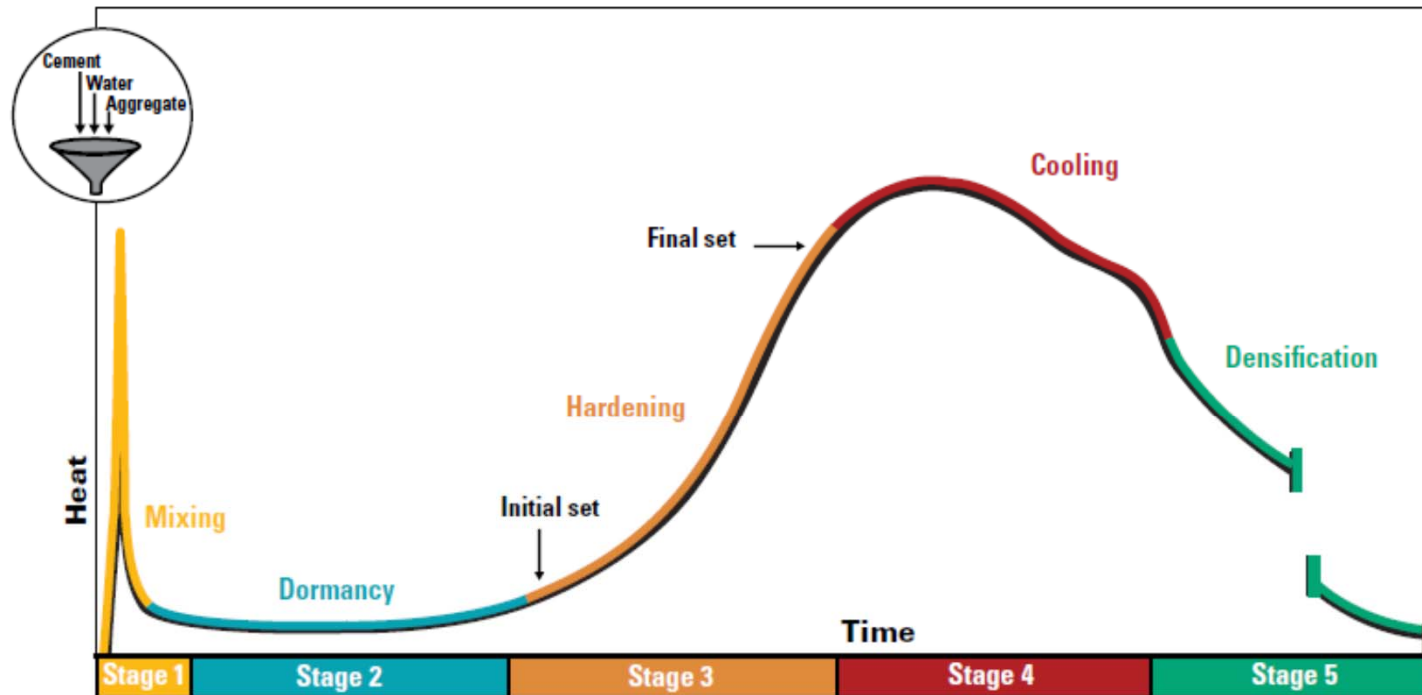


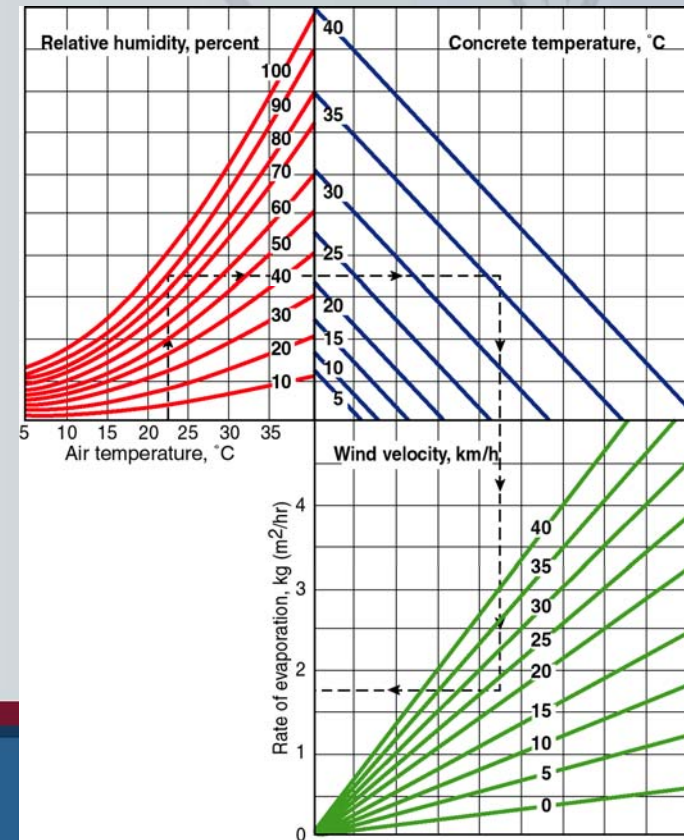
Figure 4-2. General hydration curve delineating the five stages

SHRINKAGE CRACKING - PLASTIC



PROBABLE CAUSES?

- Short cracks that result from rapid moisture loss while concrete is plastic
- A function of:
 - Temperature
 - Humidity
 - Wind



HOW TO AVOID?

- Prompt and adequate curing compound coverage



POOR COVERAGE

- Too many missed areas!



HOW TO AVOID?

- Prompt and adequate wet curing



SHRINKAGE CRACKING-HARDENED

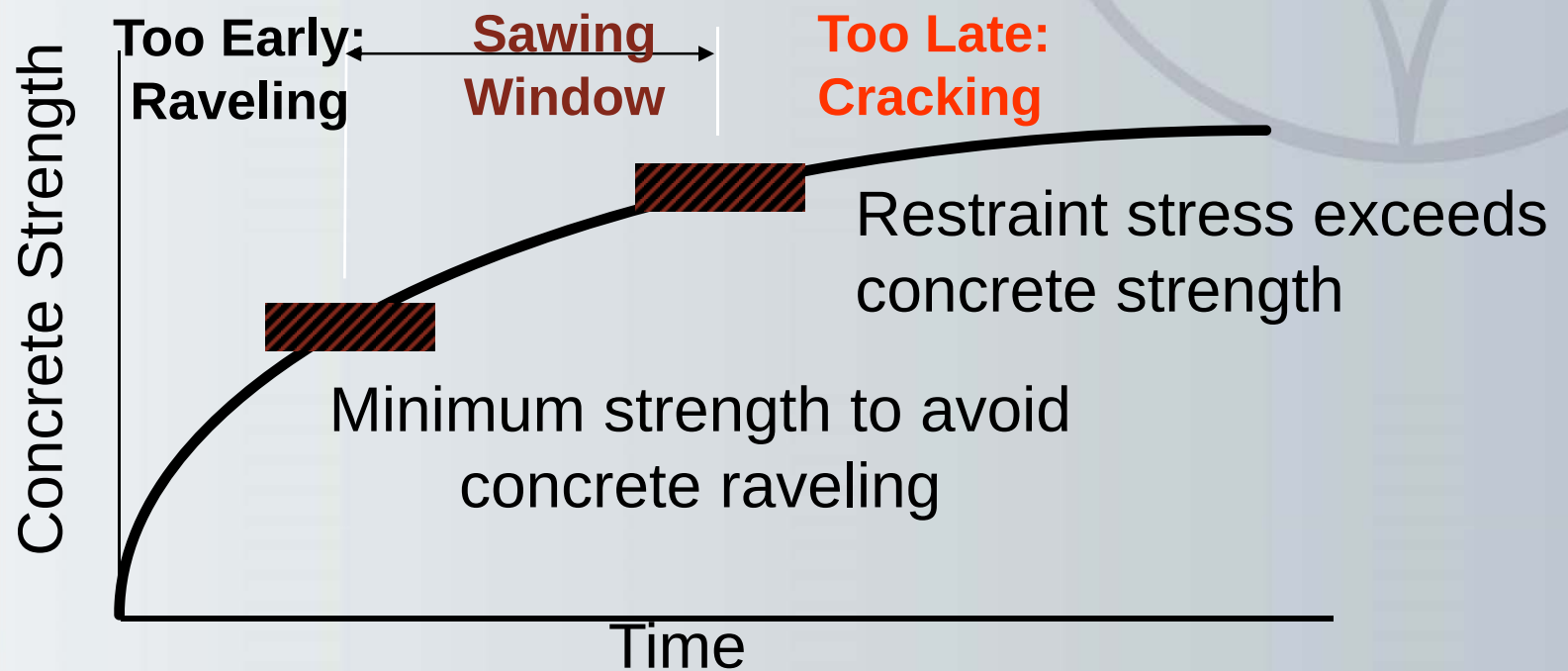
- In hardened concrete can occur as a result of drying shrinkage or thermal contraction



HOW TO AVOID?

- Use lower water content mixes
 - Higher w/c mixes experience more shrinkage cracking
 - Mixes with high sand content need more water
- Proper joint spacing and timely saw cutting of joints to control cracking

WHEN TO SAW CUT?



WHEN TO SAW CUT?



Too early sawing: joint raveling



Too late sawing: Cracking relieves tensile shrinkage stress



JUST RIGHT!



RAIN DAMAGE



HOW TO AVOID?

- When it comes to weather, hope for the best, but plan for the worst



PAVING JOINT – EDGE SLUMP



EDGE SLUMP

- Indicative of a wetter mix
- Can effect pavement roughness
- Edge slump can also be created by improper set up of the paver and vibrators, paver speed, etc.



DON'T MASK IT

- Identify the problem – don't mask it
- 'Joint repair' by adding concrete can lead to premature deterioration



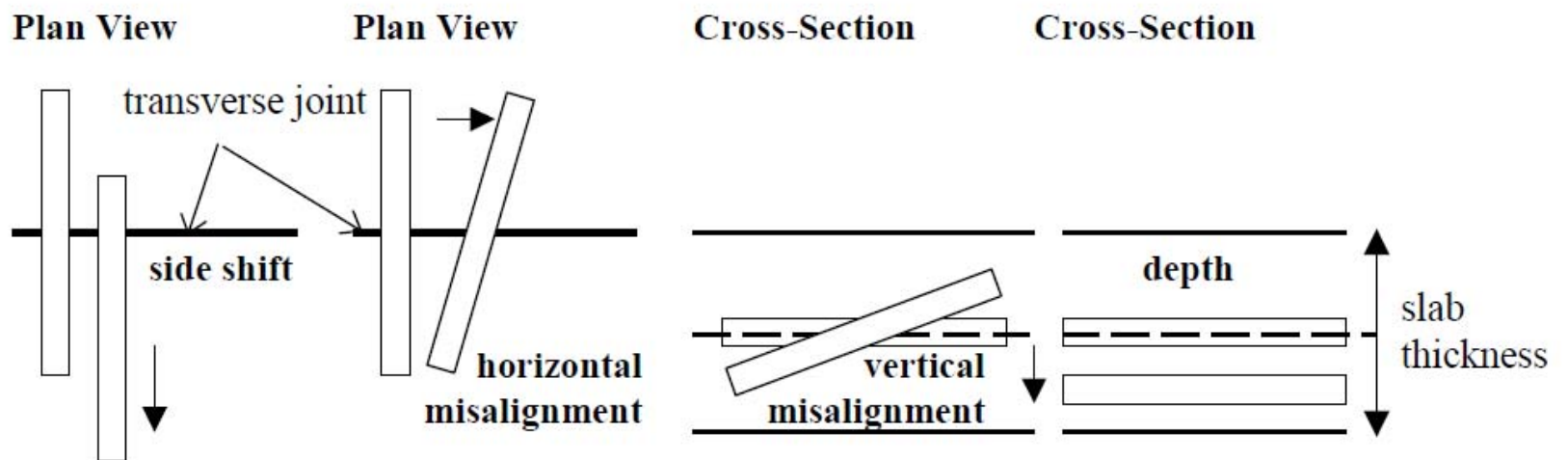
CRACKING – RESTRAINED JOINTS



DOWEL BAR MISALIGNMENT

- Dowel bar misalignment can affect pavement performance
 - joint spalling
 - corner breaks
 - random cracking
- Dowels must be aligned parallel to the slab surface and to the adjacent dowels
- Misalignment occurs when dowels have excessive vertical or horizontal skew

MISALIGNMENT TYPES



DRILL & GROUT INSTALLATION

- Make sure that dowels are parallel to slab surface and adjacent dowel



23. 4. 2001

HOW TO AVOID?

- Check for depth and alignment



DOWEL ALIGNMENT



BASKET OFF CENTRE



DRILL & GROUT INSTALLATION

- Don't drill and install at a joint



CARE AT JOINT CORNERS

- Fill-in lanes may combine both drilled longitudinal bars and transverse baskets



INTERSECTING JOINTS

- Make sure you don't restrain the joint corner



ADEQUATELY SECURED?

- Make sure that baskets are adequately secured to the substrate



ARE YOU SURE?



ACHIEVING PROJECT QUALITY

- Project quality is a well built pavement that provides long term durability
- Not a single factor, but the sum of doing a lot of things right
- Understanding the consequences of questionable processes during construction can help make decisions in the field



QUESTIONS?

