Development and deployment of concrete pavement performance related specifications

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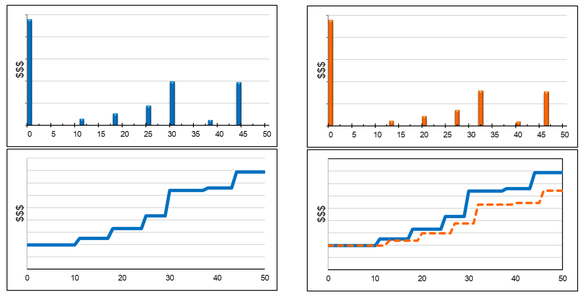
Performance related specifications (PRS) have rational and defendable pay factors that provide a measure of the value of quality that is directly related to performance.



PRS ties construction quality to life cycle cost or total cost of ownership

Select acceptance quality characteristics that are:

Measureable
- More rapid the better

Correlate with performance
- Prediction models

Are under contractor's control
- Can be varied on the project

Each has
- Target
- Rejectable level
- Maximum level

Specification development and deployment timeline

Summer '13	• Shadow Specification
March '14	• Engineering Management Approval
March-May '14	• Develop Specification
July '14	• First Industry Meeting
July '14	• First Draft of Special Provision
Fall-Winter '14	• Multiple Stakeholder Meetings
April '15	• Training on Procedures
May '15	• Specification in effect

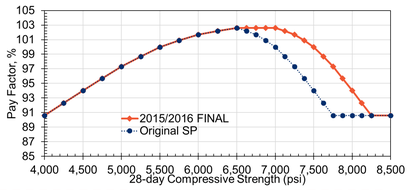
PRS Benefits

- Improved design-to-construction communication
- Develop more rational pay factors
- Improved and focused testing by all parties
- Improved understanding of performance by all
- Improved quality focus
- Clearer distinction in roles and responsibilities
- Creates a more innovative environment

Acceptance Quality Characteristics

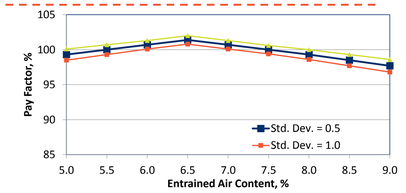
28-Day Compressive Strength

Cylinders cast by contractor
Delivered to QA and tested in their lab
1 random station per sublot
Data entered into I-MIRS



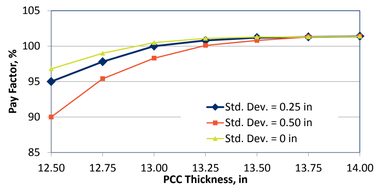
Entrained Air Content

Measured by QA
4 random locations per sublot
Data entered into I-MIRS



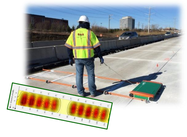
Thickness

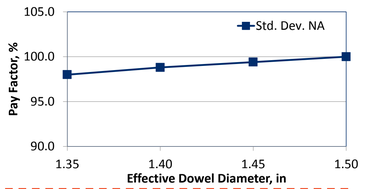
Testing by independent assurance
Measured by MIT T-2 Device
4 random locations per sublot – 6 disks
Data entered into I-MIRS



Dowel Alignment

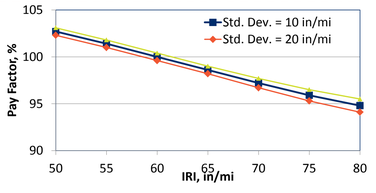
Measured by MIT Scan2 Device
5 joints at random location per sublot
Data used to calculate effective dowel diameter



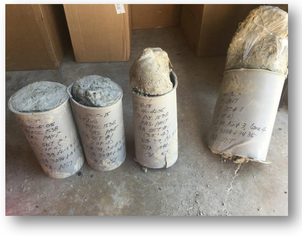


Smoothness

Measured by high speed profiler
Use IRI in right and left wheel path



Construction Challenges



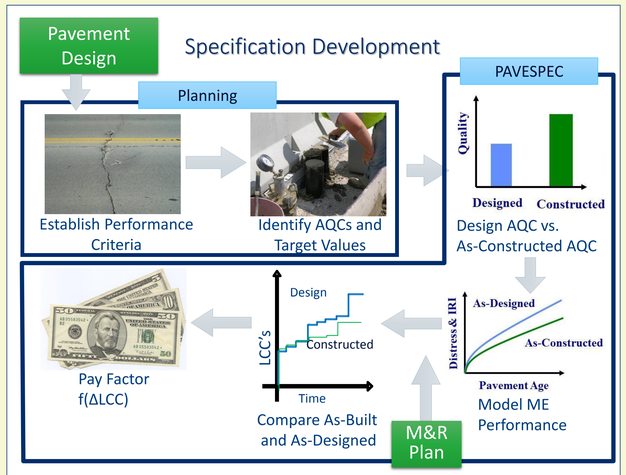
The cylinders cast by the contractor one time tipped over and hardened outside of the mold

LOT 2

The construction schedule was extended and cold weather paving required changes to mixes and ACQ requirements

Sometimes equipment was parked on the pavement when it was time to test for smoothness or dowel alignment or thickness.

Sometimes the pavement was dirty when the contractor called to request smoothness testing.



Contractor performance in first construction season was good with only smoothness being difficult to achieve incentive pay. A lot 2 was created to accommodate cold weather paving that was required do to changes in the overall project schedule. Overall contractor pay was near 100%, which was a goal of the PRS.

2015 Results

Lot 1 Quality Pay Factors by Type and Contract	A	B	C	D	E	F	G	H	I
Air Content	100.7	101.1	101.2	101.4	101.6	101.5	101.1	100.9	101.0
Strength	99.3	99.8	99.8	96.8	102.2	100.2	102.0	100.1	100.6
Thickness	101.2	101.3	101.1	101.0	100.6	100.2	101.2	101.1	100.8
Dowel Diam.	99.9	99.9	99.9	100.0	99.9	99.9	99.9	99.8	99.5
Smoothness	98.8	96.9	100.3	97.2	94.2	98.1	96.2	96.0	95.2
Composite PF	**99.9**	**98.9**	**102.3**	**96.4**	**98.3**	**99.9**	**100.3**	**97.8**	**97.0**

Lot 1 Composite Pay Factor	**99.6**

Lot 2 Quality Pay Factors by Type and Contract	A	B	C	D	E	F	G	H	I
Air Content		101.3	101.2	101.1	101.6	101.4	101.0	101.4	
Thickness		101.1	100.9	101.0	101.0	100.5	100.6	100.7	
Dowel Diam.		99.9	100.0	100.0	99.9	99.9	100.0	99.9	
Composite PF		**102.3**	**102.1**	**102.1**	**102.5**	**101.8**	**101.6**	**102.0**	

Lot 2 Composite Pay Factor	**102.1**
2015 Overall Construction Estimate (11/18)	**100.5**

2016 was several of the same contractors and some new. Performance improved across the board. Quality of pavement is generally exceeding the design.

2016 Results

	A	B	C	D	E	F	G
Air Content	100.9	101.1	100.8	101.4	101.1	100.7	101.4
Strength	98.5	100.9	101.3	101.8	101.4	102.2	101.9
Thickness	100.4	101.1	101.0	101.0	100.7	100.8	101.2
Dowel Diam.	99.9	100.0	100.0	99.9	99.8	99.8	99.8
Smoothness	97.8	99.2	99.4	99.9	97.5	97.7	97.3
Composite PF	**97.5**	**102.3**	**102.5**	**104.0**	**100.5**	**101.2**	**101.5**

2016 Overall Construction Estimate (11/18)	**101.9**