



Roller Compacted Concrete

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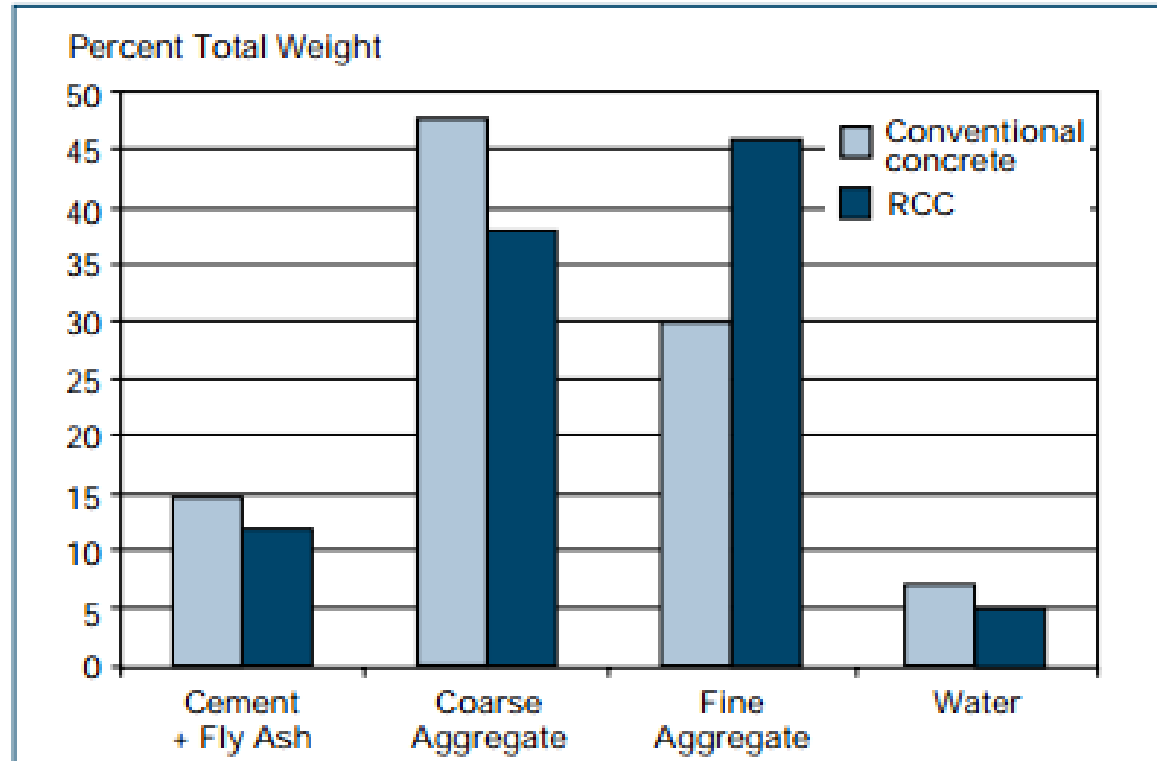
Project Engineer- Illinois Tollway Materials

Applied Research Associates, Inc.

February 24, 2015

Roller Compacted Concrete (RCC)

- Same materials as conventional concrete
- Zero-slump mix
- Placed and compacted with asphalt-type equipment



Source: Guide for Roller-Compacted Concrete Pavements, 2010



Notable RCC Paving Projects

- Diamond Ground RCC on Highway 78 in Aiken, SC
- City Streets
 - Columbus, OH
 - Streamwood, IL
- GDOT I-285 Shoulders
- US-78 near Charleston, SC



Tollway Special Provision

■ Equipment

Mixing Plant

- Batch
- Continuous Flow Pugmill
- Ribbon Mixer
- Central Mix

Trucks – non-agitator with a cover

Paver – high density or conventional asphalt paver

Compaction

- 10 Ton Roller - primary compaction
- Finish Roller



Tollway Special Provision – Mix Design

ITEM	CRITERIA
Cement Factor	5.25 (min)
Water/Cementitious Ratio	W:C ratio = 0.30 to 0.40. Fly ash and slag cement content shall not exceed 25 percent of total cementitious content.
Coarse Aggregate	CM07, CM11, CM13, CM14, CM16
Fine Aggregate	FM01, FM02, FM20
Maximum Wet Density and Optimum Moisture Content	Modified Proctor Test in accordance with ASTM D1557
Compressive Strength	Minimum 4,000 psi @ 7- days and at least 5000 psi @ 28-days (cylinders molded in accordance with ASTM C1435)



Tollway Special Provision – Mix Design

Sieve Size	Percent Passing
1-in.	100
3/4"	95-100
1/2"	70-90
3/8"	60-85
#4	40-65
#16	20-40
#100	6-18
#200	0-8



Tollway Special Provision

■ Construction Requirements

□ Test Section

- Perform modified Proctor
- Perform a growth curve
- Establish rolling pattern
- Make cylinders
- Extract cores

Tollway Special Provision - Construction

- Temperature Control For Placement
- Transportation
- Compaction
- Fresh Joints
- Cold Joints
- Curing
- Contraction Joints

Tollway Special Provision

■ Quality Control

Plant Tests

- Cylinders (ASTM C1435)
- Total Moisture (AASHTO T318-02 or hot plate)

Field Tests

- Growth Curve (ASTM C1040)
- In-Place Density (ASTM C1040)
- Cores for Strength (ASTM C42)

Tollway Special Provision

■ Acceptance Criteria

- Cores
- Compressive Strength (cylinders)
- Density Requirements (98% of maximum wet density)
- Thickness

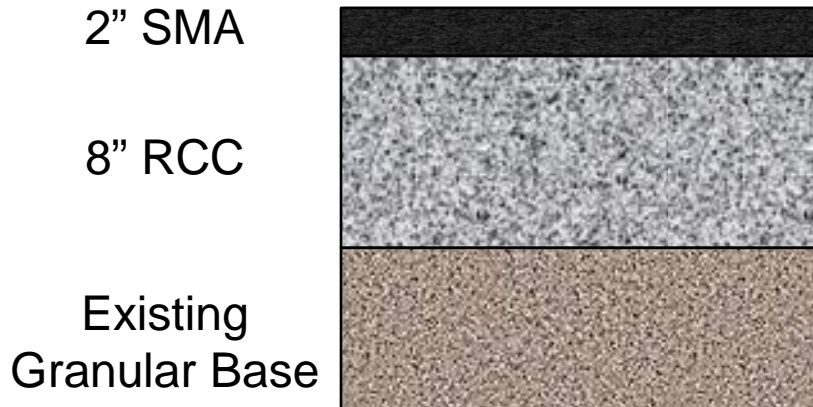
■ Opening to Traffic

- Construction Traffic at 2200 psi
- Public Traffic at 3500 psi

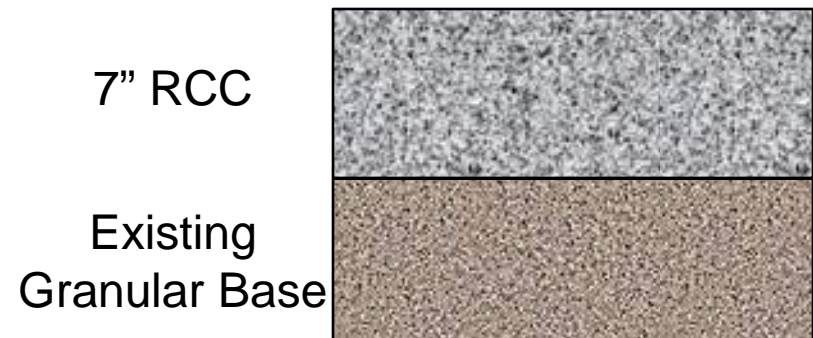


Pavement Designs

Hinsdale, O'Hare and Lincoln Oases



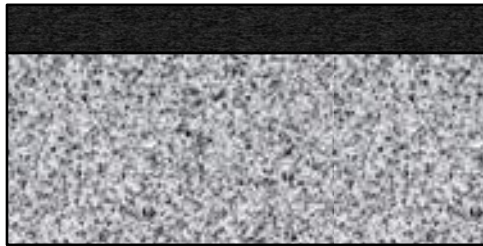
Des Plaines Oasis



Cost Comparison per Square Yard

2" SMA

8" RCC



2014 Bids

\$46.83 / Sq. Yd.

10" JPCP



2014 Bids

\$55.81 / Sq. Yd.

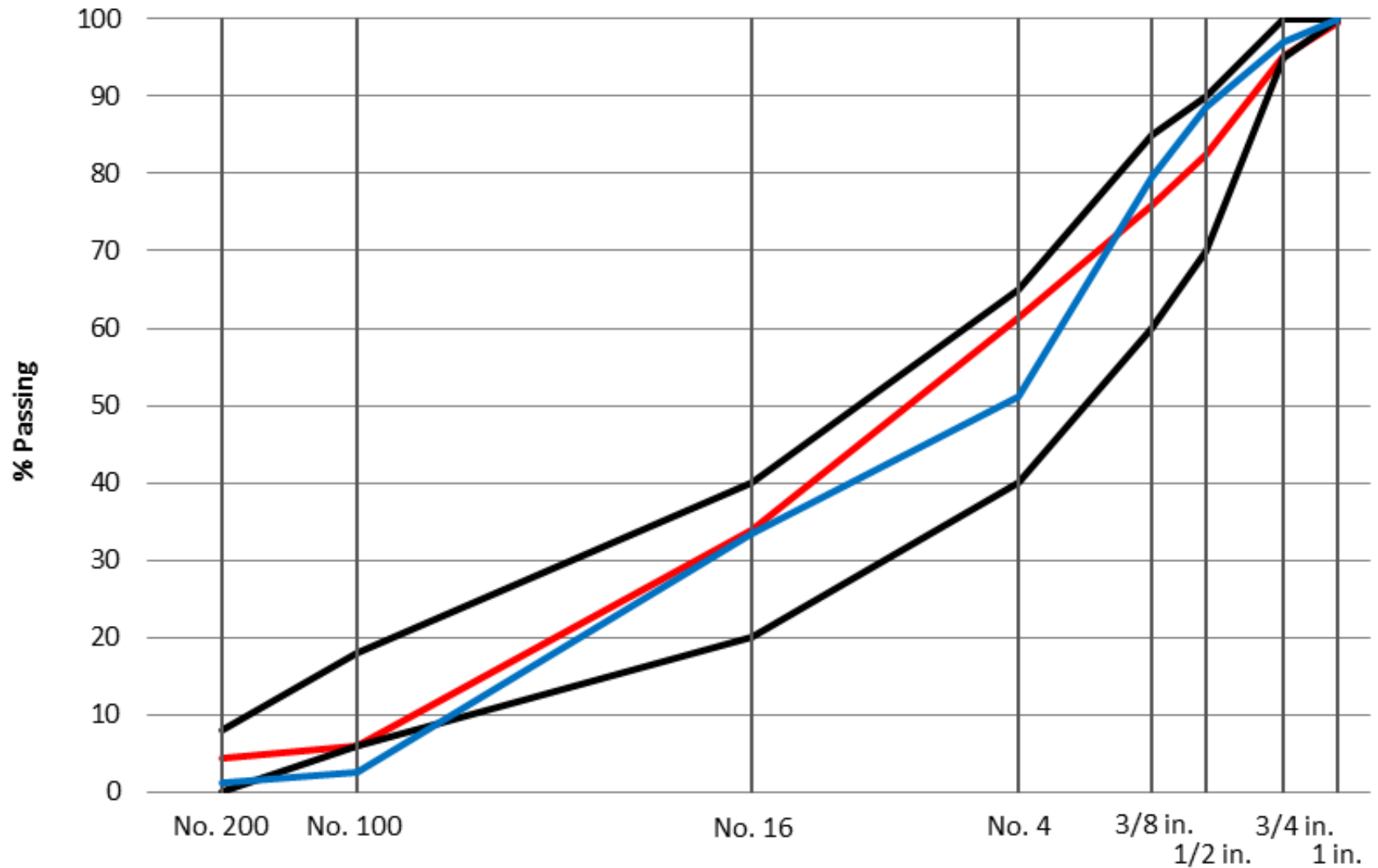
2015 Bids

\$61.43 / Sq. Yd.

RCC Mix Designs

Supplier #1	Supplier #2
Type 1 Cement	Type 1 Cement
Class C Fly Ash	Class C Fly Ash
Natural Sand – FM02	Natural Sand – FM02
Crushed Stone – CM11 Optimized	Crushed Stone – CM11
	Crushed Stone – CM13
Water	Water
Retarder	Retarder

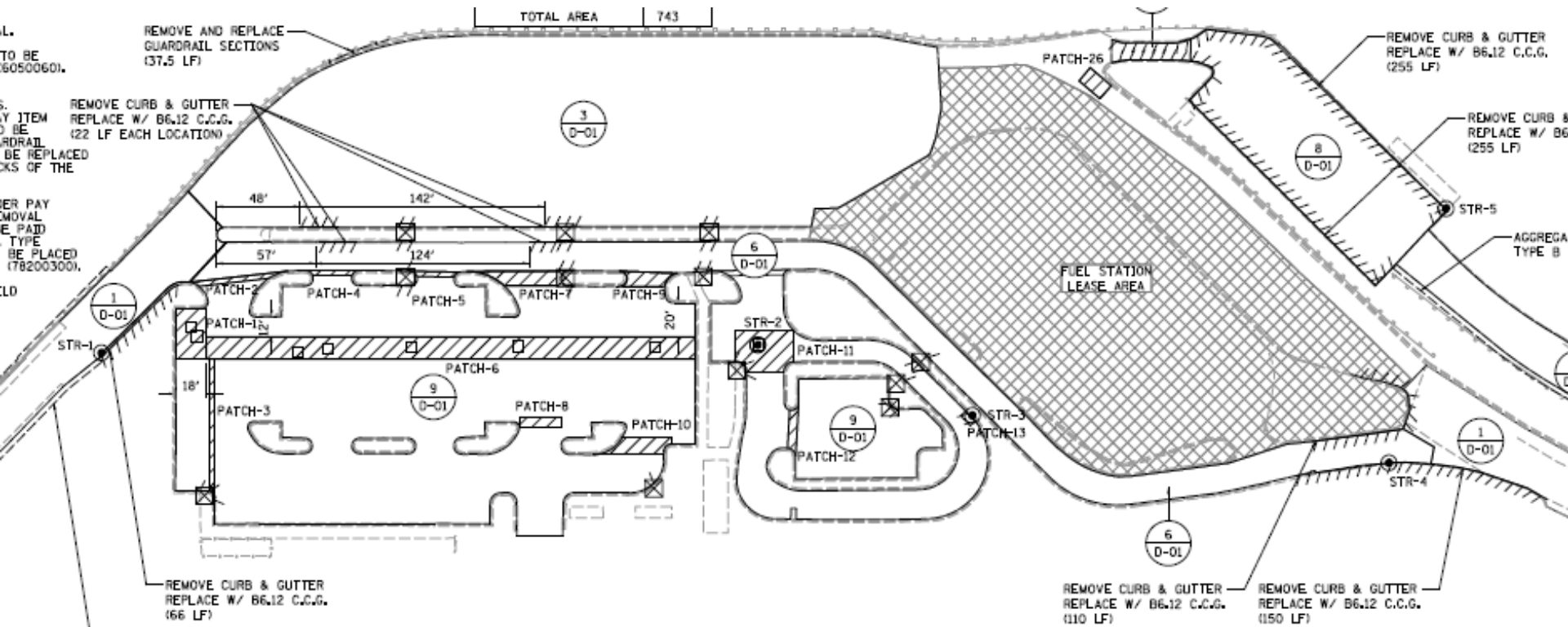
Combined Gradations



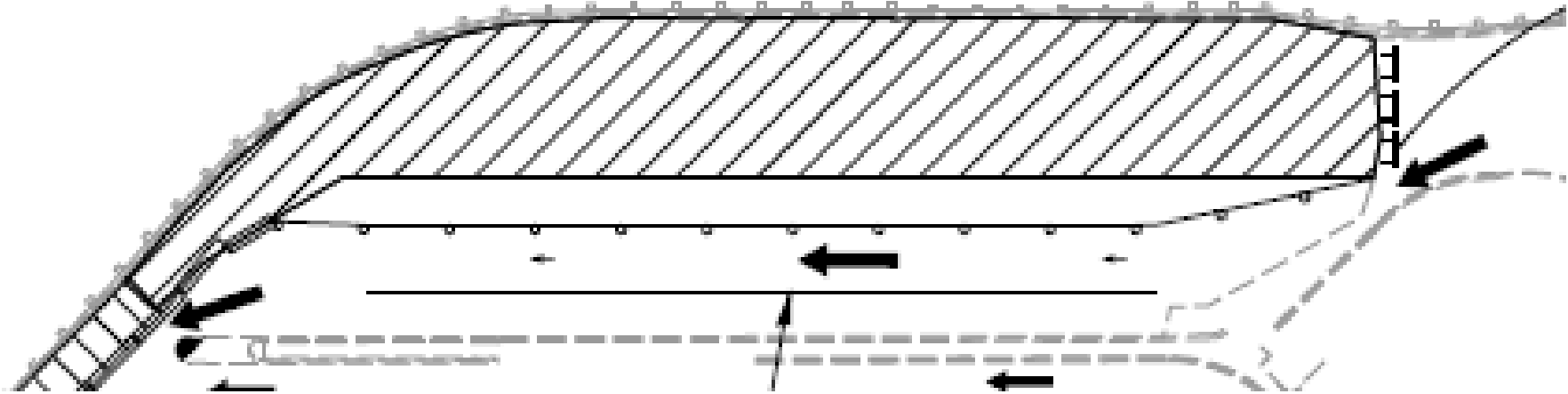
O'Hare Oasis (I-294)



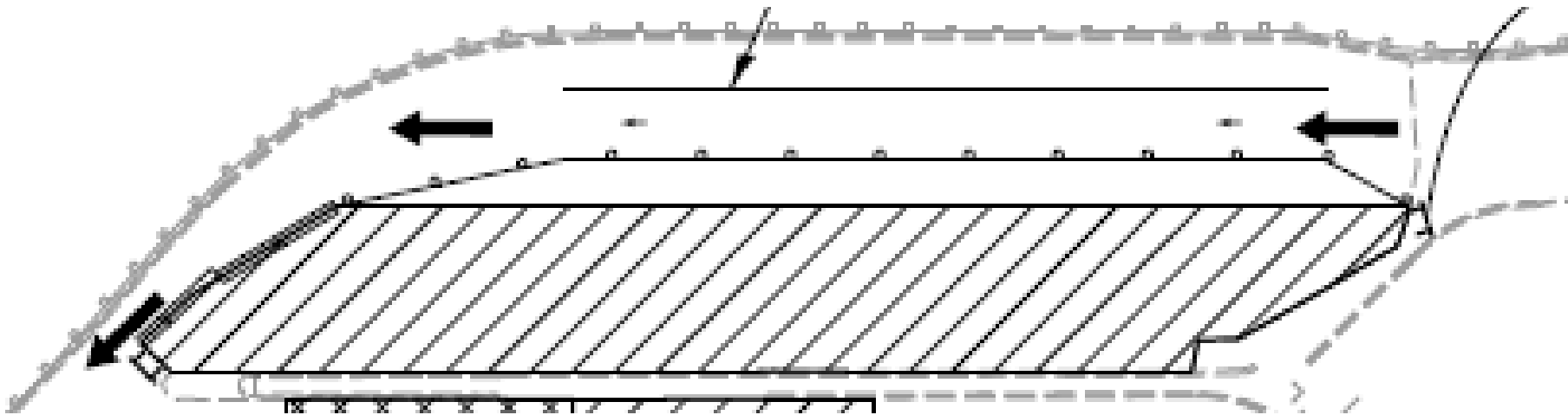
Southbound I-294 O'Hare Oasis - Site Plan



Southbound I-294 O'Hare Oasis - Stage 1



Southbound I-294 O'Hare Oasis - Stage 2



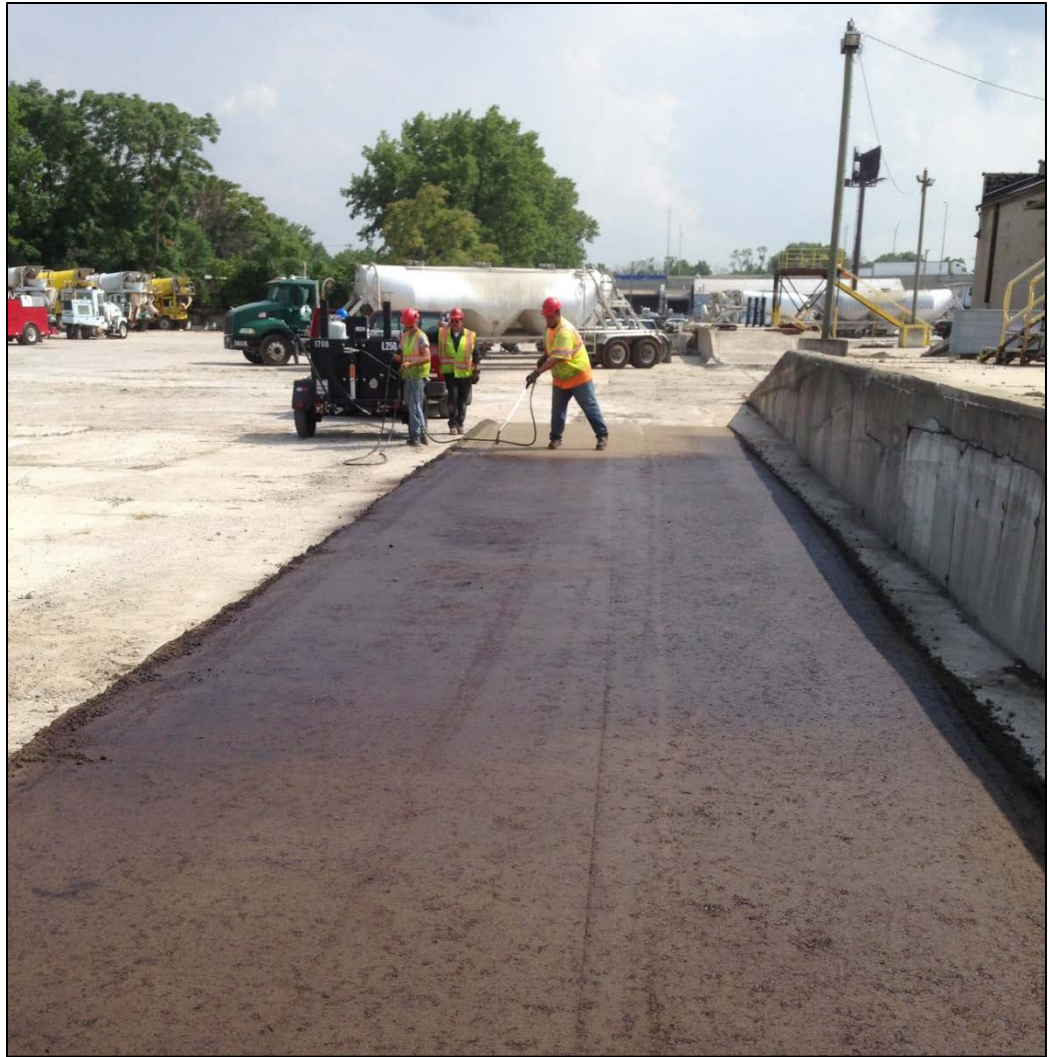
Plant Cylinders

- Cylinders were made at the plant using a vibratory hammer
- 6 x 12 cylinders



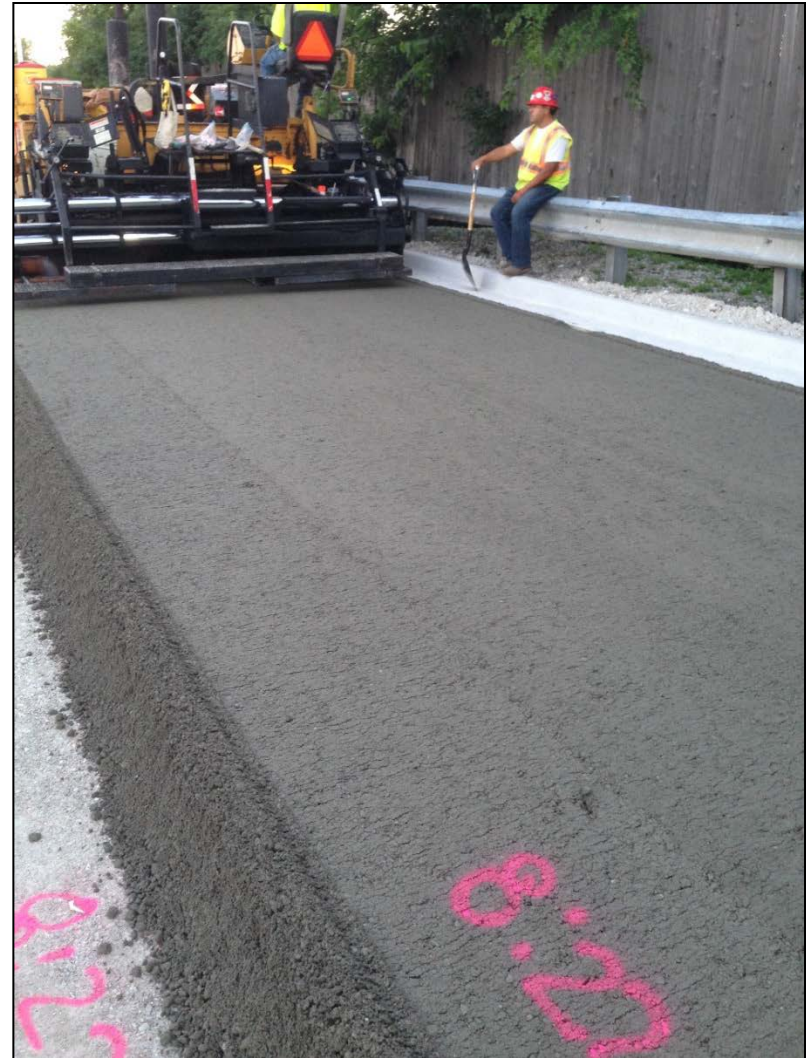
Test Section

- 50 Foot Test Section
- SS-1 Prime Coat



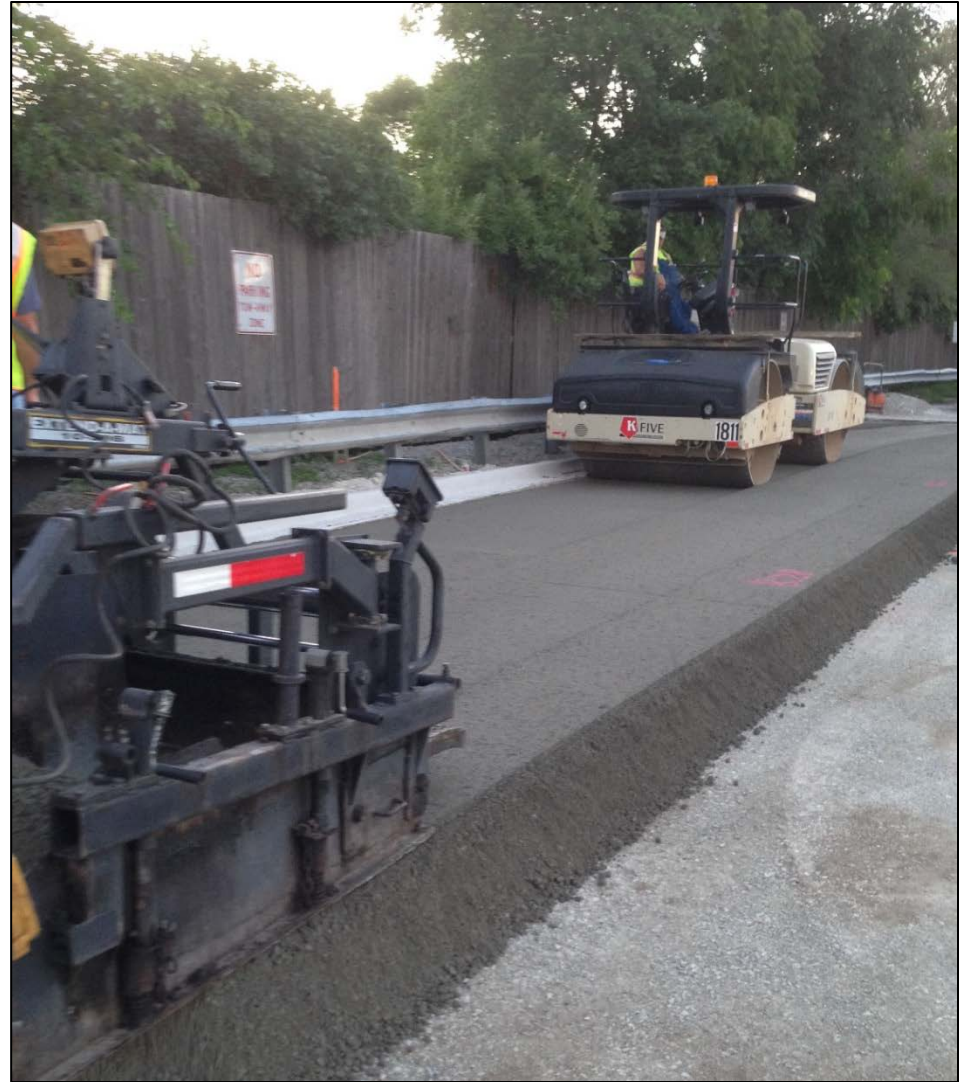
RCC Paving

- Lift thickness behind the paver was 10 inches
- Time was marked on RCC to track fresh joint



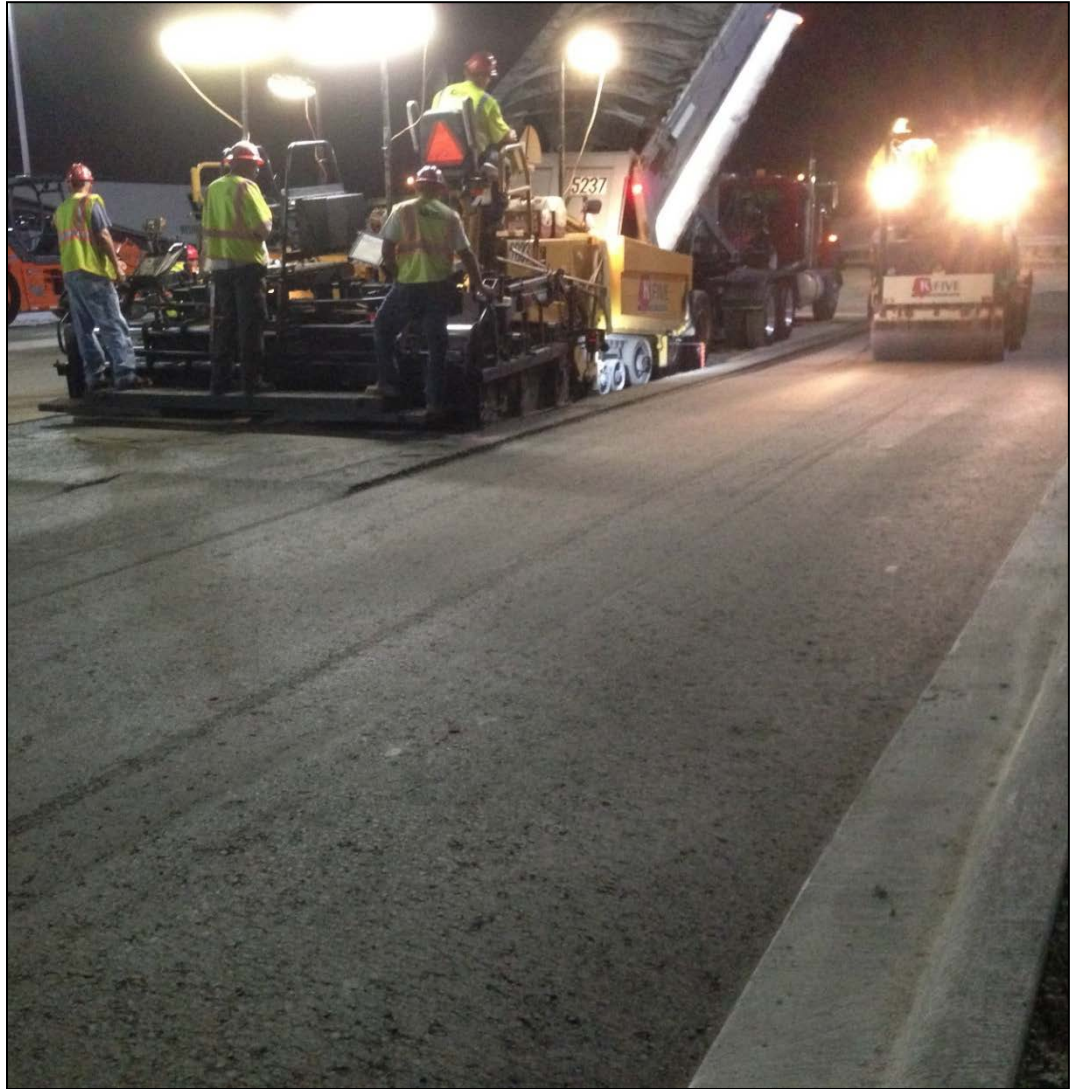
RCC Paving

- Vibratory roller stayed right behind the paver
- Roller left 18 inches of the longitudinal fresh joint uncompact



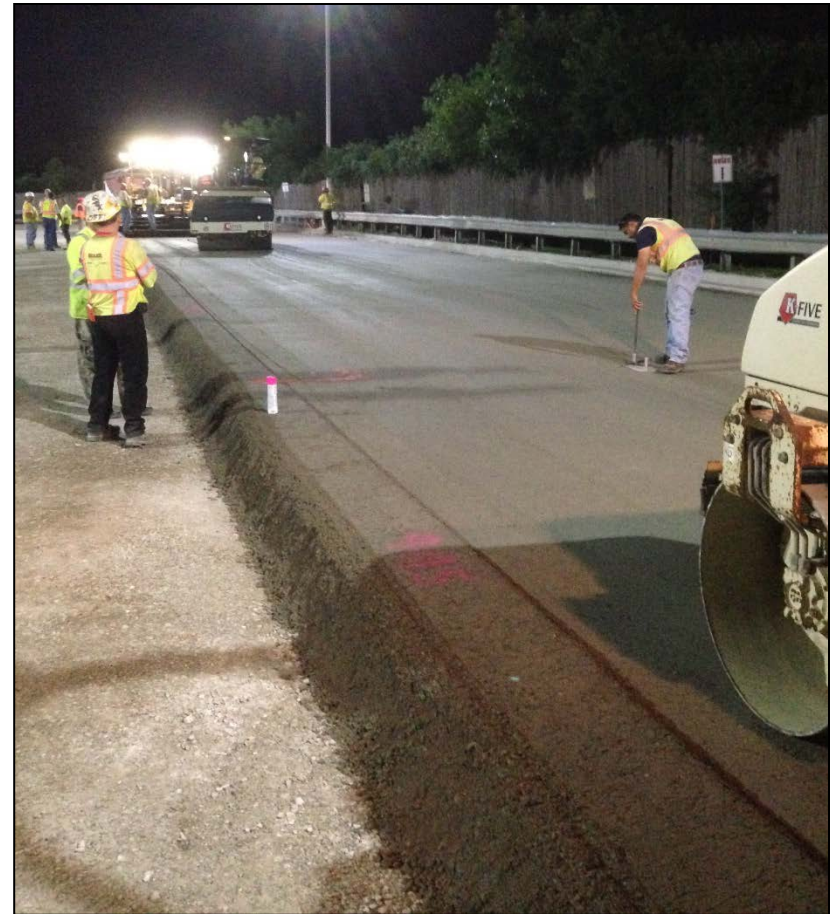
RCC Paving

- Paving second pass with fresh joint
- Compacting longitudinal joint



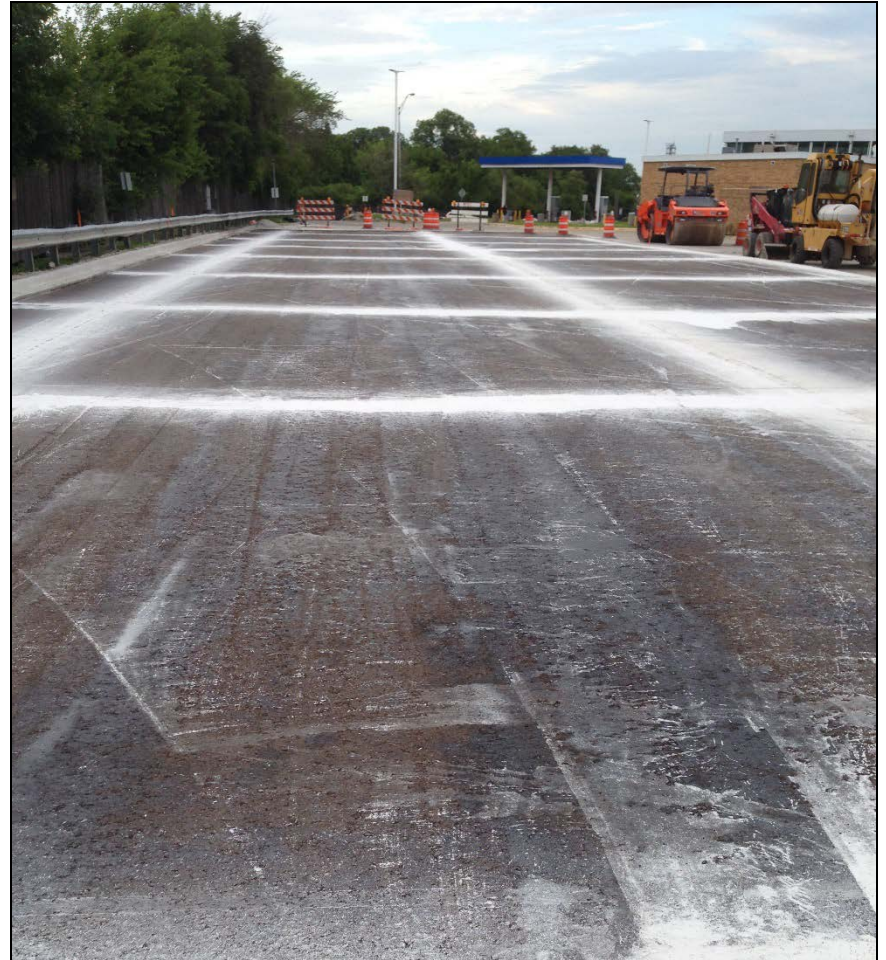
Density Testing

- Nuclear density testing in direct transmission mode
- 3 tests equally spaced across the lane



Finished RCC

- RCC surface protected with SS-1 prime coat
- Contraction joints at 25 foot spacing



RCC Core

- Uniform Compaction
- No Segregation
- 4-Inch Diameter



Opening RCC to Traffic



- RCC opened to public traffic before overlay
- No surface damage observed

Des Plaines Oasis Surface Distress

- Less than half of 1 parking lot
- Paved in November and December
- Lower temperatures
- Potential causes
 - Freeze / Thaw
 - Salt
 - Abrasion

Surface Texture Comparison



RCC Lessons Learned

- Require test strips
- Core & cylinder strengths
- Minimize hand work
- Use in appropriate application
- Contractor experience is crucial
- Potential for reduced cement factor

RCC Future at the Tollway

- No plans to use RCC in 2015 on the Tollway
- Refine the special provision
- Potential for use as shoulders or temporary pavement





THANK YOU

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