

SHRP 2 Project R21 (Composite Pavements)

Evaluation of MnROAD PCC-PCC Construction

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**August 23, 2010
MnROAD Open House**

R21. EAC-RCC Overview

Section		EAC over RCA PCC (MnROAD Cell 71)
Upper PCC	Thickness	3 in
	Mix	High portland cement (~550 lb/yd ³), 15% Fly ash, Class C (FAC)
	Coarse Aggregate	Crushed granite (maximum size 3/8 in)
Lower PCC	Thickness	6 in
	Mix	Low portland cement (~250 lb/yd ³), 60% FAC
	Coarse Aggregate	50% RCA, 50% Mn/DOT Class A Maximum aggregate size 1.25 in
Base		8 in, Class 5 unbound
Subgrade		Clay
Joint spacing		15 ft
Doweling		1.25 in (located 4.5 in from top of base)
Surface texture		EAC

R21. EAC-RCC Material Properties

PCC mix	Compressive strength (psi)			Modulus of rupture (psi)	
	7 day	14 day	28 day	7 day	28 day
EAC	5044	5315	5601	739	846
RCA	3599	4117	4509	578	658

- Above are average values for tests conducted on 80+ specimens across these two parameters
- SHRP2 R21 team thanks the FHWA Mobile Concrete Lab for their contributions to the above and for being on-site during construction

R21. EAC-Low Cost PCC Overview

Section		EAC over Low-cost PCC (MnROAD Cells 71 and 72)
Upper PCC	Thickness	3 in
	Mix	High portland cement (~550 lb/yd ³), 15% FAC
	Coarse Aggregate	Crushed granite (maximum size 3/8 in.)
Lower PCC	Thickness	6 in
	Mix	Low portland cement (~250 lb/yd ³), 60% FAC
	Coarse Aggregate	100% Mn/DOT Class A, Maximum aggregate size 1.25 in
Base		8 in, Class 5 unbound
Subgrade		Clay
Joint spacing		15 ft
Doweling		1.25 in (located 4.5 in from top of base)
Surface texture		EAC/Diamond grind

R21. EAC-Low Cost PCC Material Properties

PCC mix	Compressive strength (psi)			Modulus of rupture (psi)	
	7 day	14 day	28 day	7 day	28 day
EAC	5044	5315	5601	739	846
Low-cost	3773	4364	5003	468	575

- Above are average values for tests conducted on 80+ specimens across these two parameters
- Overall compressive and flexural strengths for all 3 concretes are more than adequate for long-lived PCC pavement

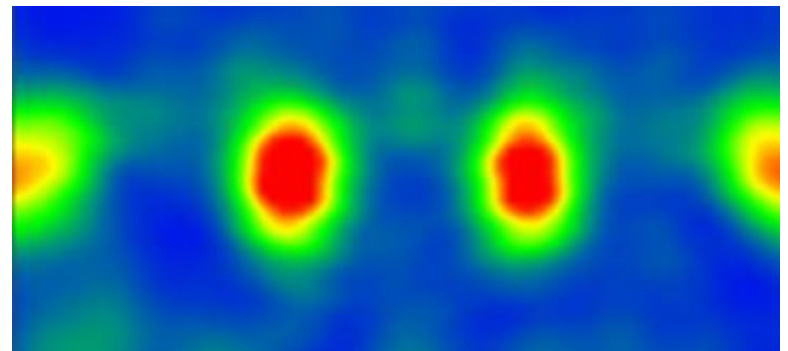
R21. Ultrasonic NDT and PCC-PCC interface

- In extreme circumstances (i.e. “worst case scenario”), interface may be compromised
- Use ultrasonic imaging to get quicker QA without sacrificing reliability

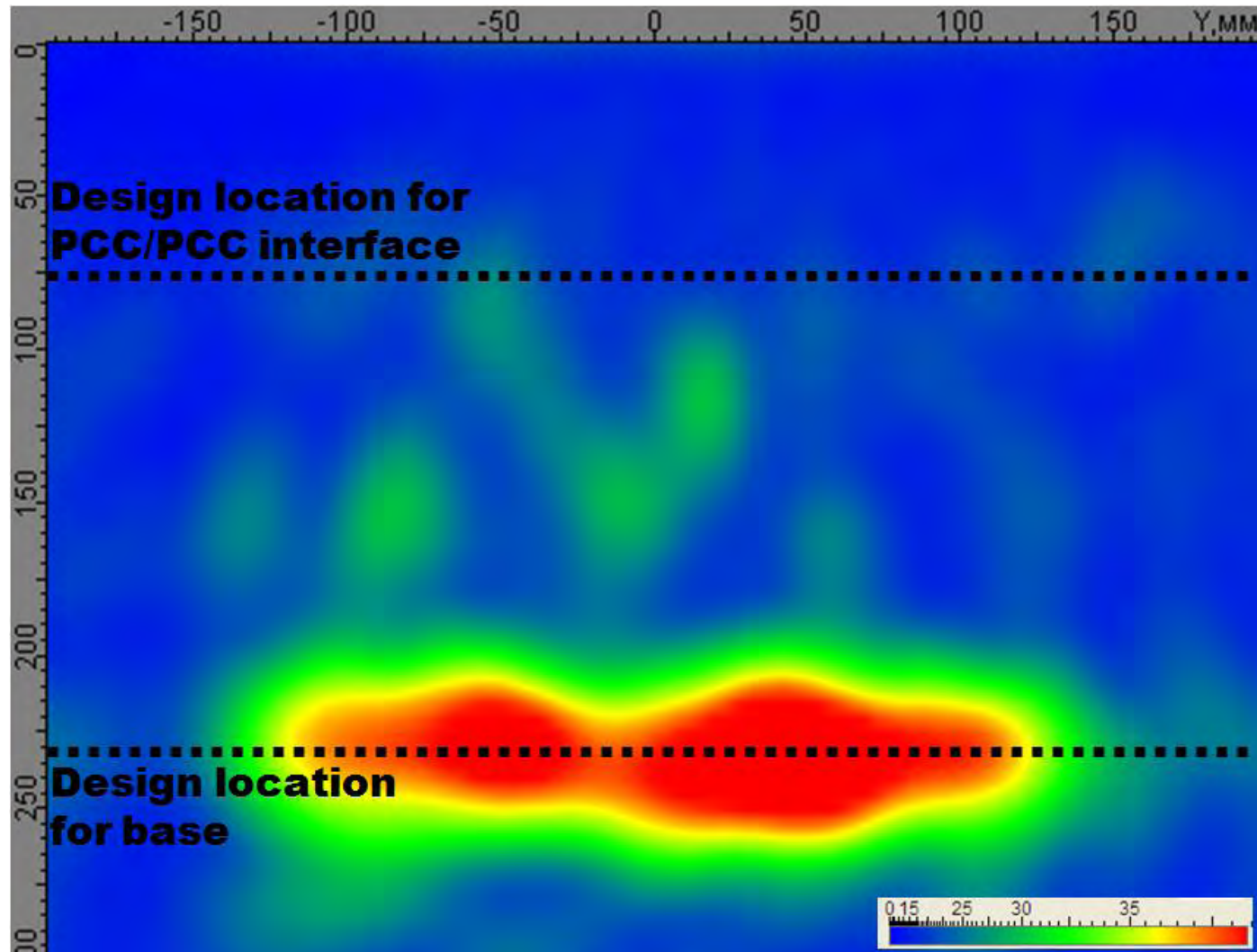


R21. NDT evaluation, Ultrasound imaging

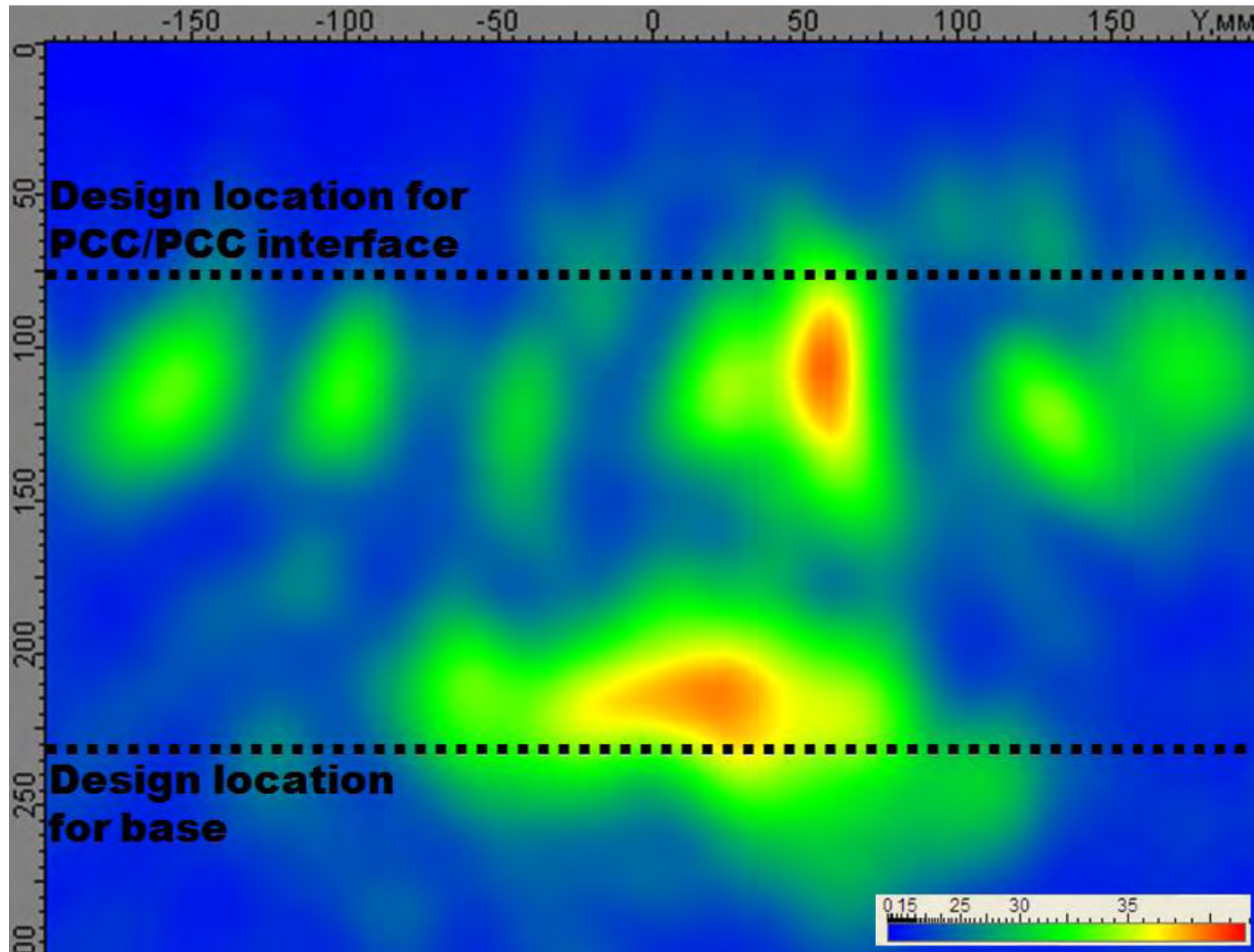
- Ultrasonic tomography used to evaluate PCC-PCC non-destructively
- Device uses “dry point contact” transducers to make evaluation in seconds
- Device used on R21 MnROAD demo slabs and mainline section



R21. Tomogram of sound PCC-PCC interface



R21. Tomogram of poor PCC-PCC interface



R21. EAC texture overview

- EAC gradation top-size was 12.7 mm (100% passing 1/2" sieve, 96% passing 3/8" sieve)
- Specified texture depth was 0.8 - 1.2 mm; final reported uniform texture depth was 0.76 mm
- QC measures used behind brush were aggregate peak picking and sand patch



R21. EAC evaluation

- According to European practice, aimed for 40-50 points per 25 cm² in brushing



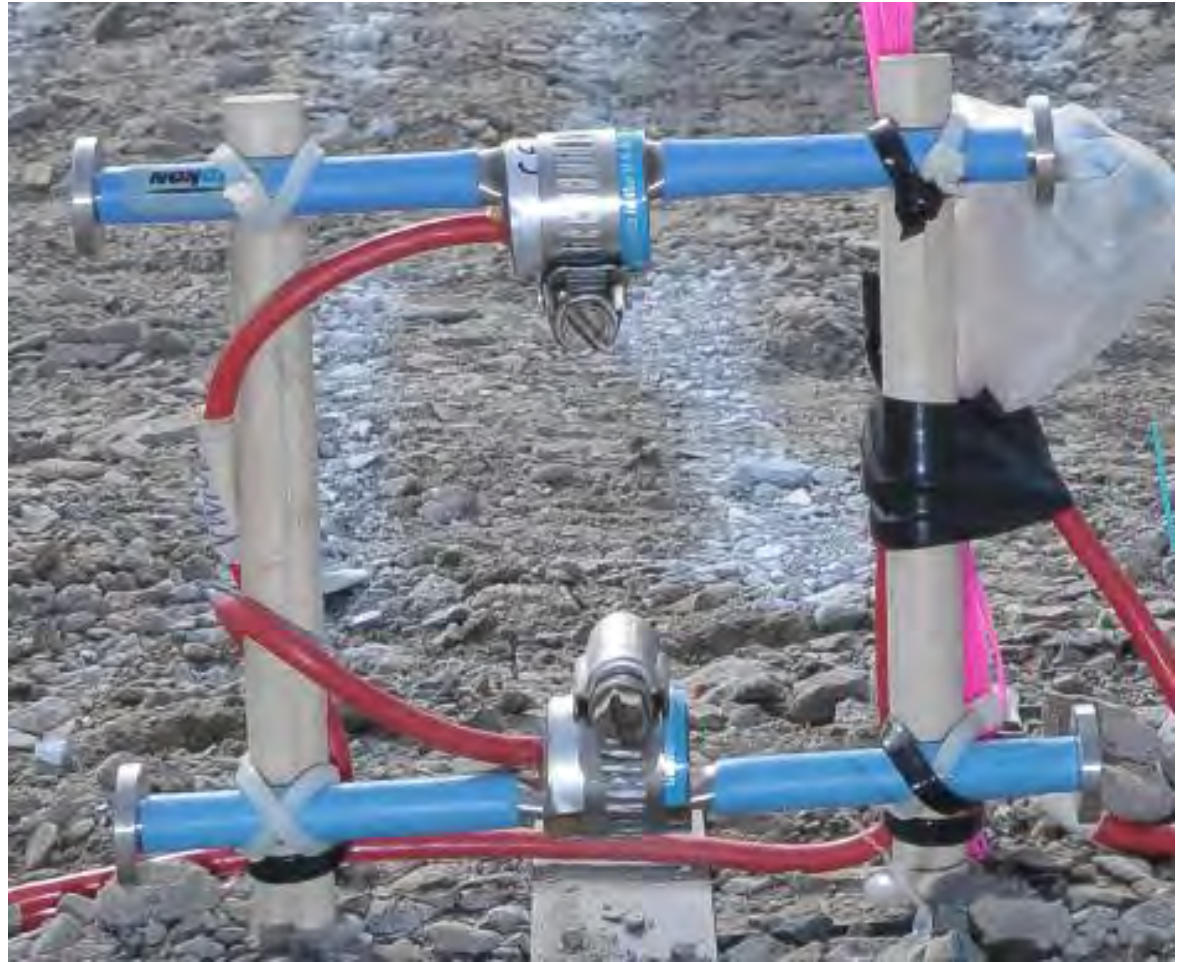
R21. EAC evaluation (2)

- Sand patch conducted regularly to achieve texture 0.8-1.2 mm according to spec
- Test protocol was ASTM E965



R21. PCC-PCC instrumentation

- Instrumentation was helped by use of demo slab construction
- Mainline instrumentation suffered very few casualties, currently online
- Data will be available soon



R21. PCC-PCC instrumentation (2)

- Instrumentation will provide strains, joint opening, temperature, and moisture data
- Will use this response data to validate MEPDG models for PCC-PCC
- Other useful data will be noise and surface friction data from EAC and diamond grind surfacing



R21. PCC-PCC evaluation in summary

- Three concretes used in PCC-PCC composites all perform well in compressive and flexural strength
- Complications from material properties should only arise due to inconsistencies from batch to batch (highly variable slump observed in both RCA and EAC concretes on site)
- QA/QC used to assess interface and EAC provided quick, reliable results
- More data to come from installed sensors and from EAC noise/texture