



PERPETUAL PAVEMENTS AT THE ILLINOIS TOLLWAY

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OVERVIEW

About the Illinois Tollway

Perpetual pavements

Optimizing asphalt mix performance

ABOUT THE ILLINOIS TOLLWAY

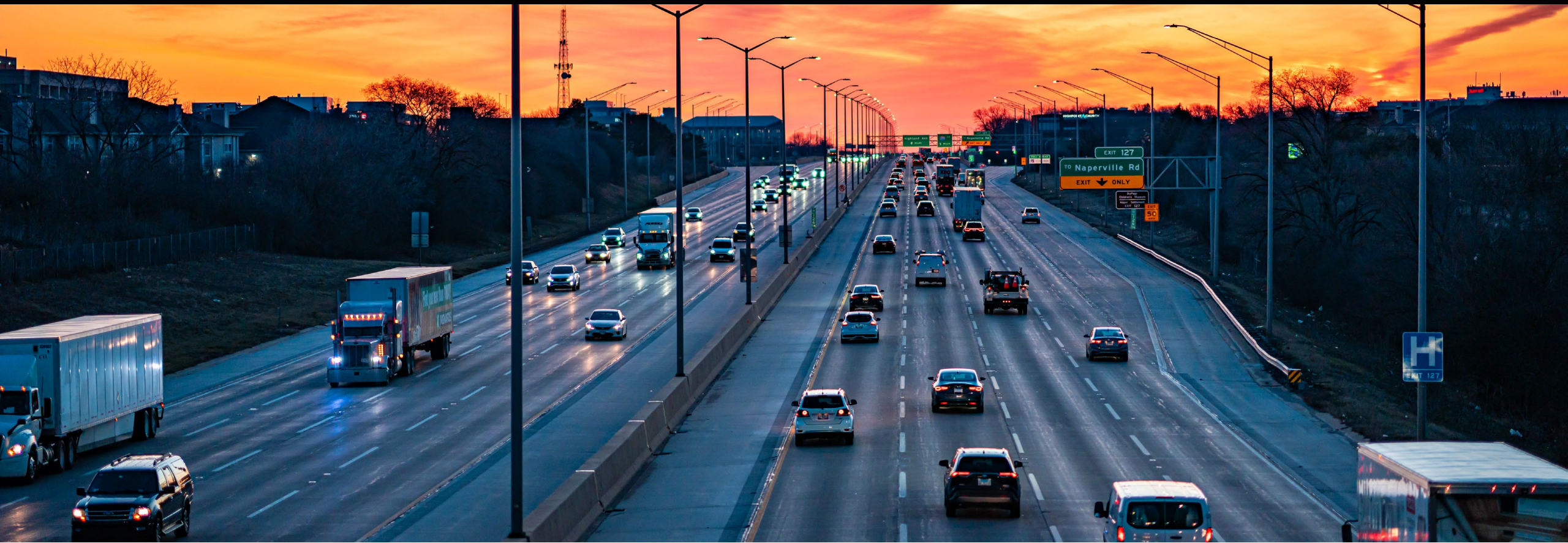
294-mile system throughout 12 counties in Northern Illinois

Five roadways

More than 1.6 million daily drivers

User-fee system





PERPETUAL PAVEMENTS

PERPETUAL PAVEMENTS

Jane Addams Memorial Tollway (I-90)

- By design – 13 centerline miles
- Rockford to Wisconsin state line
- Constructed 2007-2009
- Full-depth asphalt reconstruction

Reagan Memorial Tollway (I-88)

- By conversion – 31 centerline miles
- Stage construction
- Stage 1 – 2005 – 10-inch PCC rubblization plus 6-inch HMA
- Stage 2 – 2015 – Removed 2-inch surface, replaced with 4-6 inches of HMA, including an SMA surface



I-90 PERPETUAL PAVEMENT – FULL-DEPTH ASPHALT

Limiting strain – 70 μm

15-inches mainline HMA over
open-graded aggregate base

12-inches mainline HMA over
rubblized PCC

9-inch shoulders

6-inch shoulders

HOT-MIX ASPHALT PAVEMENT (FULL-DEPTH), 15" (40701981)

- Ⓒ1 2" GTR MODIFIED HMA SURFACE COURSE, SMA, N80
- Ⓒ2 3" GTR MODIFIED HMA SURFACE COURSE, SMA, N80
- Ⓒ3 3.5" HMA BINDER COURSE, IL-19.0, N90
- Ⓒ4 3.5" HMA BINDER COURSE, IL-19.0, N70
- Ⓒ5 3" HMA BASE COURSE, IL-19.0, N50

I-90 PERPETUAL PAVEMENT – FRAP RESEARCH

Advanced research - FRAP

- SMA evaluations
 - Three coarse aggregates
 - GTR binder
 - Fine FRAP
- Dense-graded HMA
- Field trials: Full construction evaluation, rather than lab only
- Total contractor willingness to participate

Conclusions

- FRAP – Good source of sand RAP for SMA
- Softer PG, high FRAP = good performance



I-90 PERPETUAL PAVEMENT – RAS RESEARCH

Advanced research – RAS

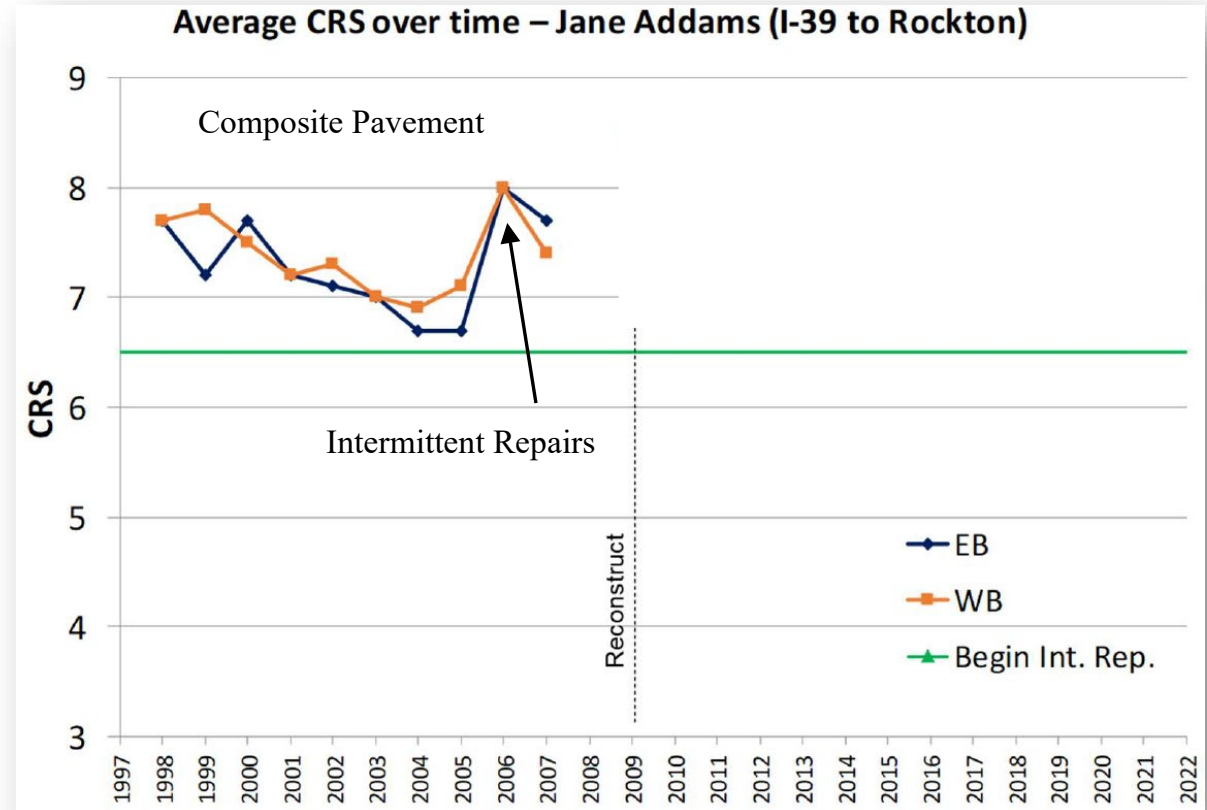
- 2008 – 3.5 miles of permanent shoulder
- RAS from Wisconsin (No Beneficial Use Determination in Illinois, yet)
- Six binder and surface mixtures
- Conclusions
 - Low-temperature cracking is the most critical distress
 - Mixes with 5 percent RAS and greater than 40 percent FRAP may improve with a softer binder



I-90 PERPETUAL PAVEMENT

Pavement performance (CRS) – before reconstruction

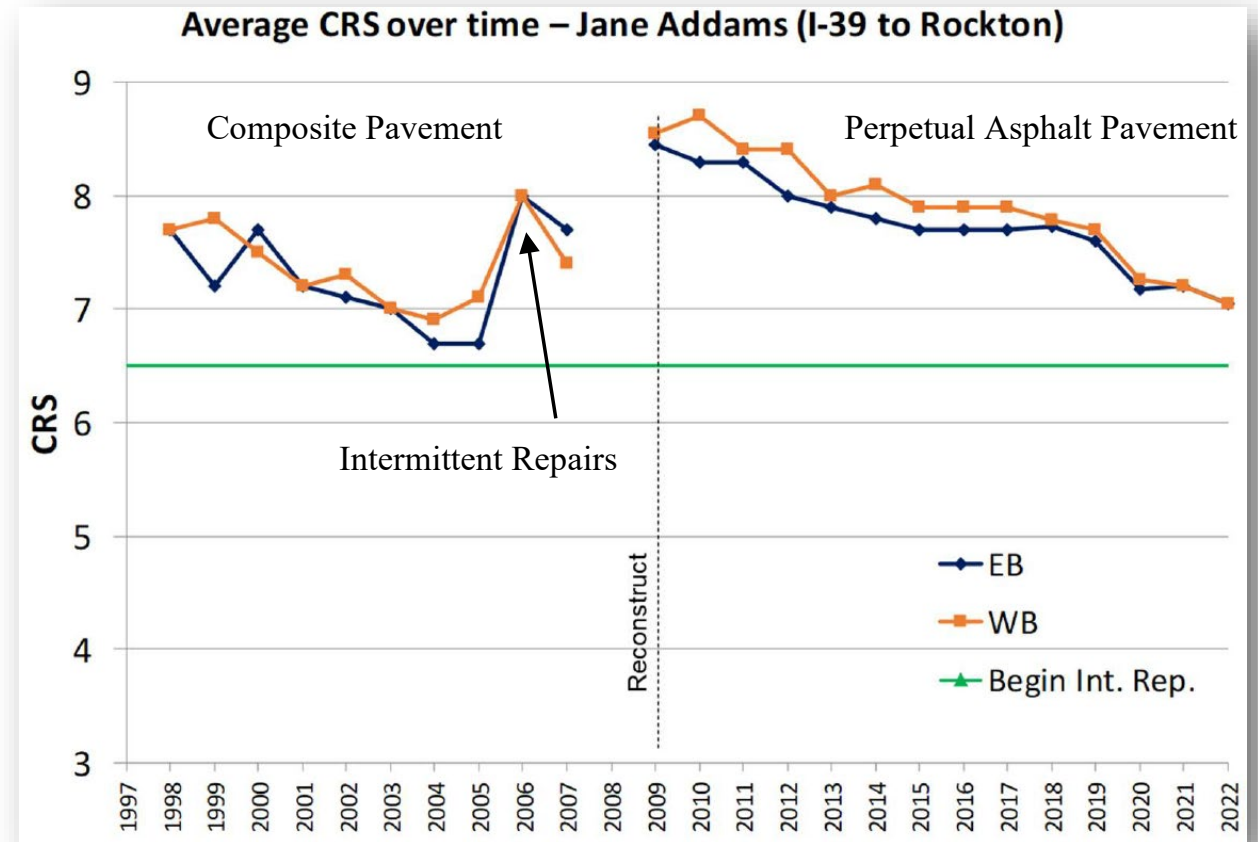
- Early 2000s – overlay mode
- Decreasing life with each overlay



I-90 PERPETUAL PAVEMENT

Pavement performance (CRS) – after reconstruction

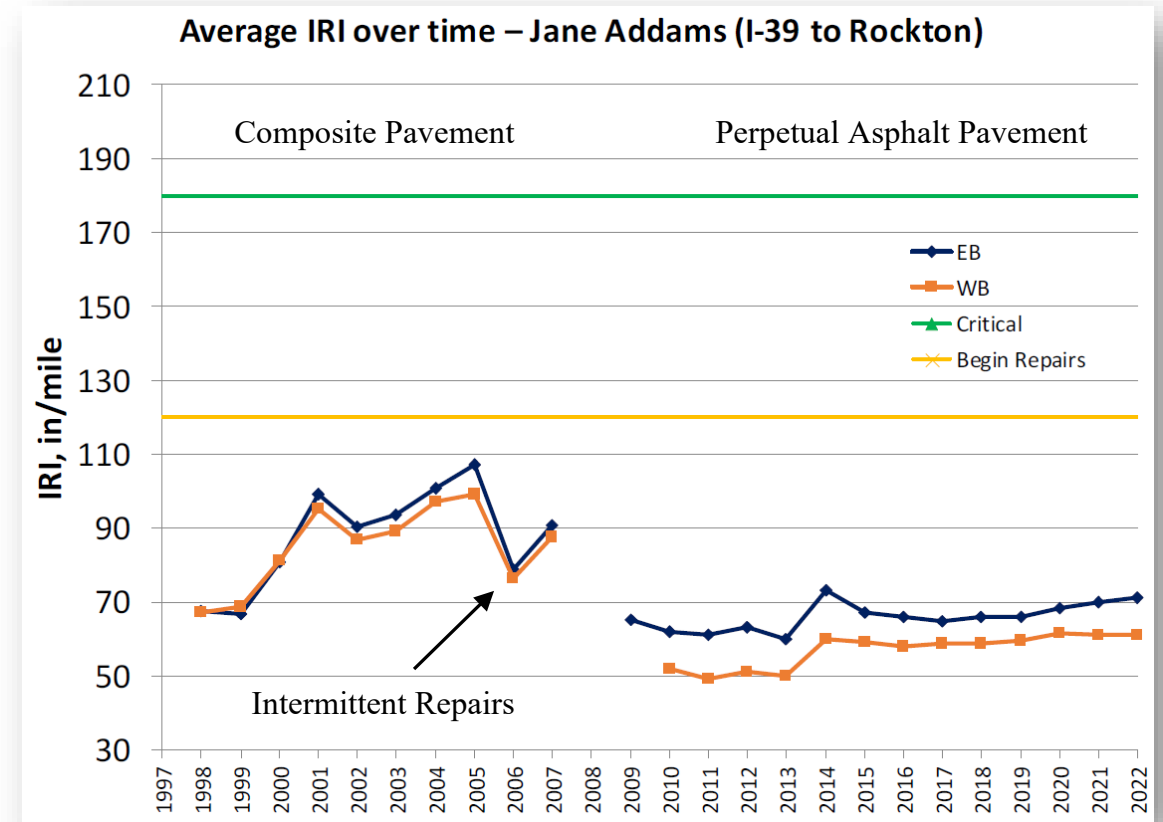
- Initial design life of the perpetual pavement – 15 years
- No full-depth patching
- Generally, only longitudinal joint maintenance



I-90 PERPETUAL PAVEMENT

Pavement performance – smoothness

- Very little change since reconstruction



REAGAN MEMORIAL TOLLWAY (I-88)

Pavement Conditions – 2004



REAGAN MEMORIAL TOLLWAY (I-88)

Pavement Conditions – 2004

Severe D-cracking of
underlying PCC



ISSUE/SOLUTION

The real issue

- Intermittent repairs
- Shoulders coming apart
- Blow-ups more common
- Estimate: Unmaintainable in winter
- Programmed for mill-overlay in 2007

Stage construction

- Build initial pavement cross section
- Monitor performance
- Complete the pavement at the right time

Illinois Tollway solution: Rubblization and overlay



STAGE 1 CONSTRUCTION – 2005

Rubblize existing pavement

Install underdrains

6-inch new HMA pavement

- 4-inch dense-graded binder mix with SBS polymer
- 2-inch dense-graded surface mix with SBS polymer

Extended fatigue life

Competitive bids



STAGE 2 CONSTRUCTION – 2015

Mill the deteriorated 2-inch surface course

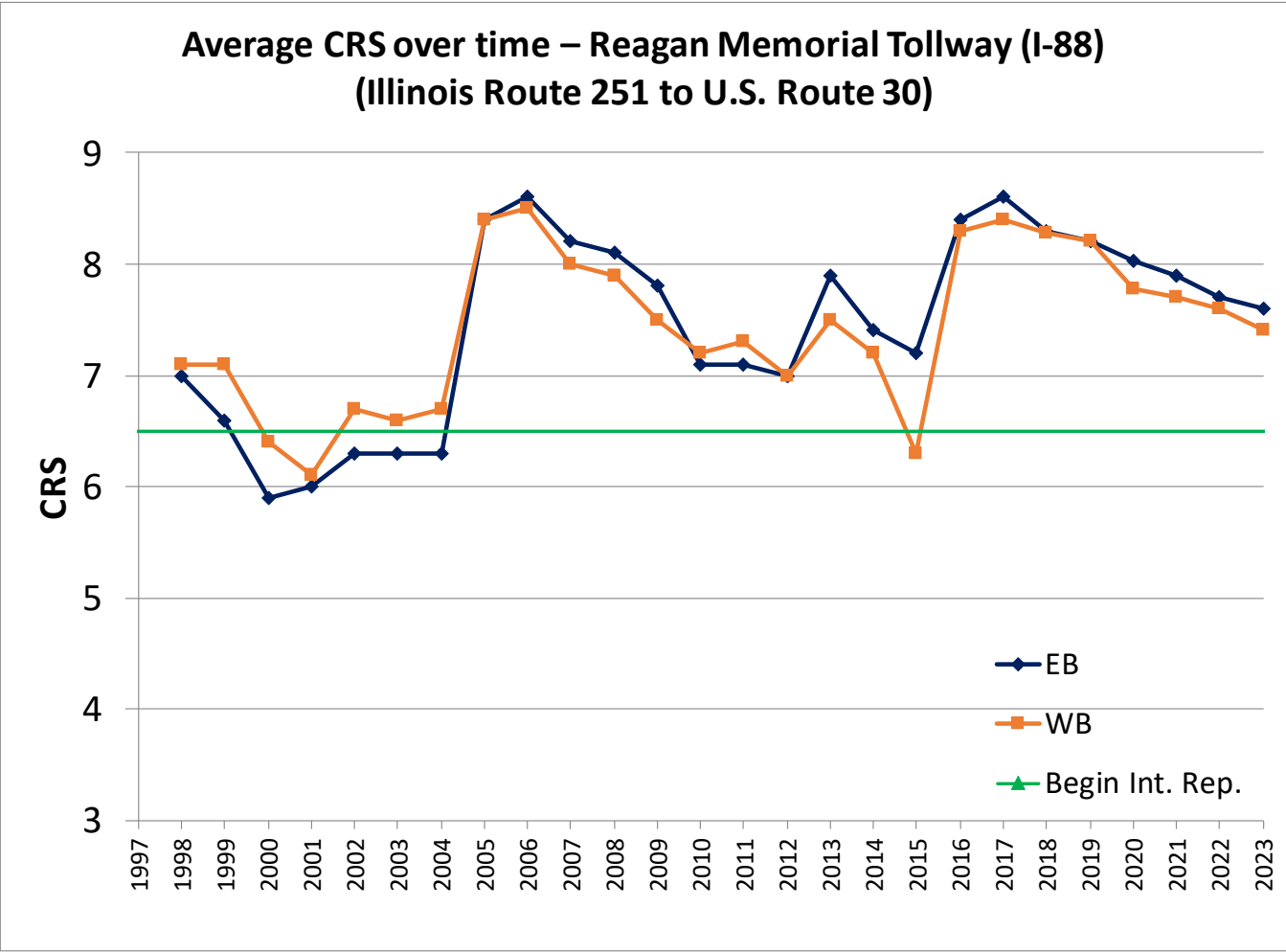
Add 6 inches of new HMA pavement

- 2-inch dense-graded N70 19mm binder mix
- 2-inch dense-graded N90 19mm binder mix
- 2-inch modified SMA 12.5mm surface mix

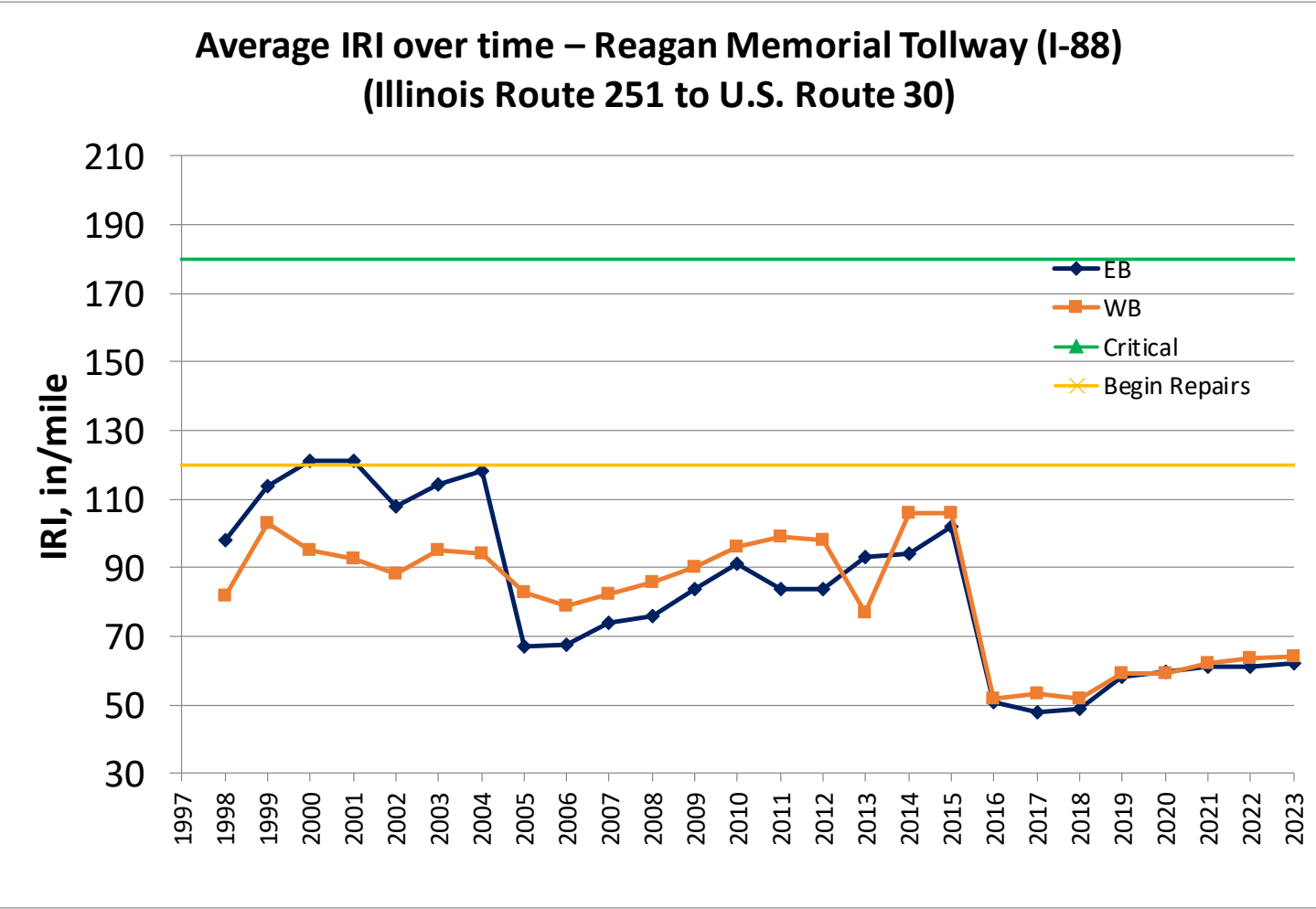
Pavement reconstruction under bridges – 11-inch full-depth asphalt



PAVEMENT CONDITION – CRS



SMOOTHNESS – IRI



STAGE CONSTRUCTION – CONCLUSIONS

Viable option for pavement rehabilitation

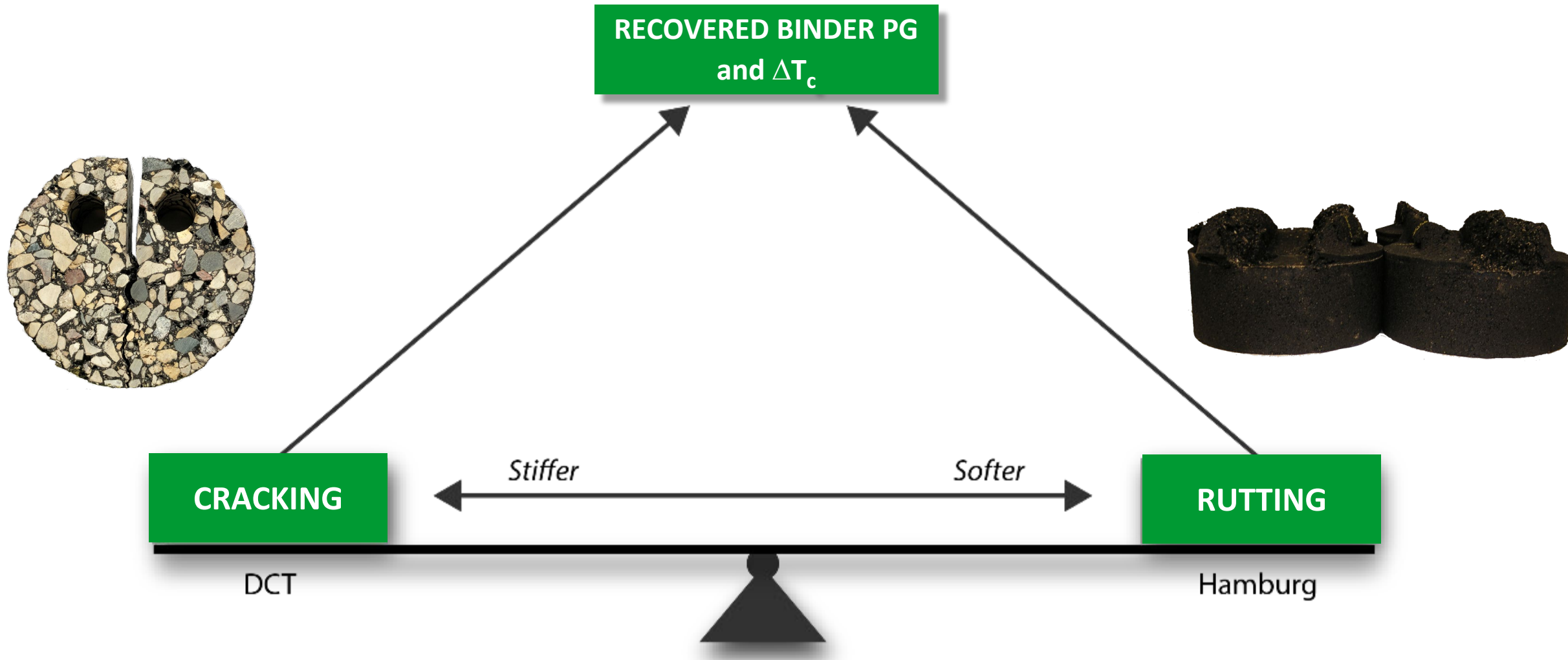
Able to monitor actual conditions, versus design assumption of pavement strength

Can take advantage of materials and construction improvements

- SMA
- Paver improvements
- (And now, longitudinal joint sealant and other technologies)

PERFORMANCE-BASED MIX DESIGN

Recovered Binder PG



PG BINDER SELECTION

Reclaimed Asphalt Material		RAP/FRAP/RAS	FRAP/RAS	Category 1/FRAP with RAS
ABR		0-17%	18-33%	34-50%
Allowable Mix Options	SMA and IL-4.75	SBS/SBR 70-28 GTR PG 70-28 PG 58-28 10% Dry GTR		SBS/SBR 64-34 GTR PG 64-34 PG 52-34/ 10% Dry GTR PG 46-34/ 10% Dry GTR
	Unmodified SMA and Binder & Surface Course	PG 58-28		PG 52-34 PG 46-34
	Asphalt Stabilized Subbase	PG 58-28		

CONTRACTOR OPTIONS

PG binder modification

- All three binder choices (SBS polymer, terminal blend GTR, dry crumb rubber) are being used in Tollway SMA

ABR – can tailor FRAP and RAS to their situation

Warm-mix asphalt – must use



DCT REQUIREMENTS

Performance-Based Balanced Mix Design



Tollway Table 11 – DCT Requirements

Mixture Type		Minimum Fracture Energy
SMA	Friction Surface	775 J/m ²
	Surface	700 J/m ²
	Binder	650 J/m ²
	Unmodified	500 J/m ²
Mainline Binder Course	N _{design} > N50	425 J/m ²
	N _{design} = N50	450 J/m ²
Surface Course N _{design} ≤ N70		450 J/m ²
Shoulder Binder Course		425 J/m ²
Asphalt Stabilized Base		N/A
IL 4.75		450 J/m ²

HAMBURG REQUIREMENTS

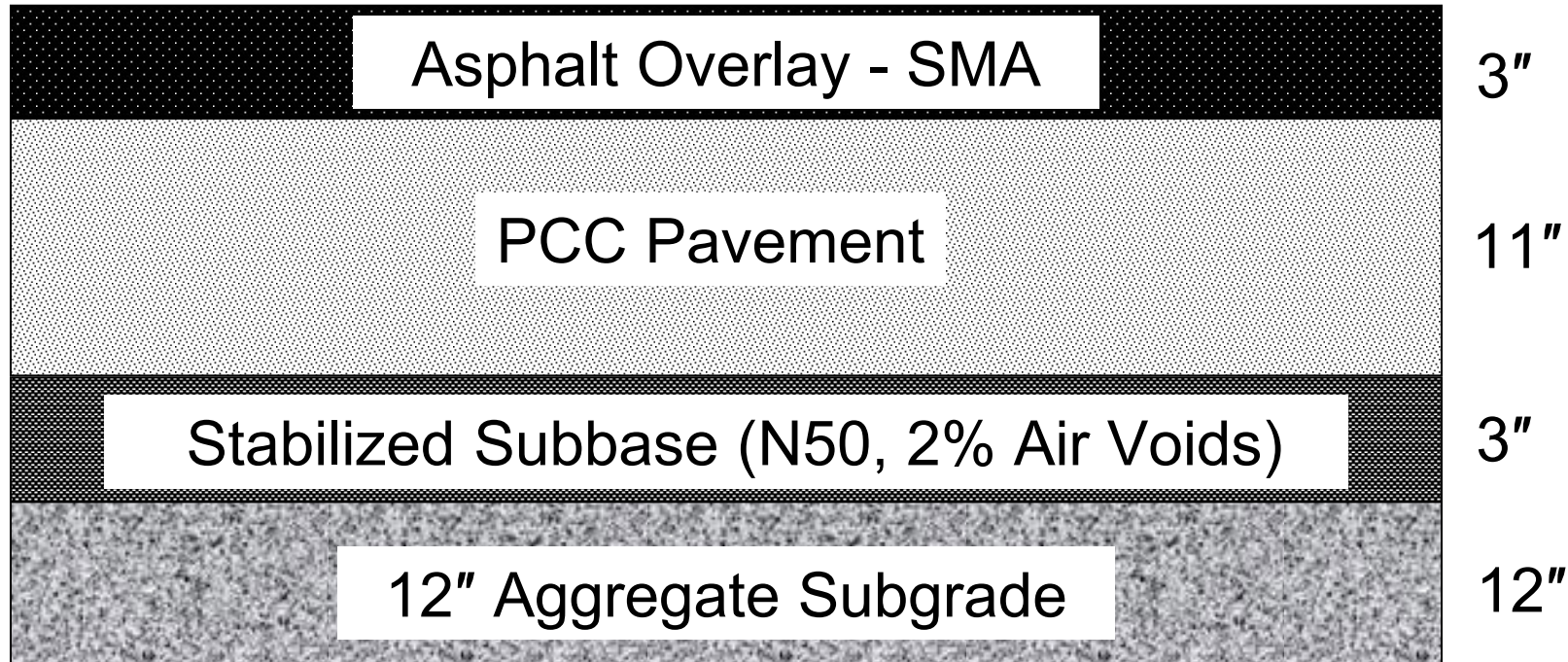
Performance-Based Balanced Mix Design

<i>Tollway Table 10 – Hamburg and Stripping Inflection Point Requirements</i>			
Mixture Type	Maximum Rut Depth	Max. Rut Depth Recorded at # Wheel Passes	Min. # of Wheel Passes at Stripping Inflection Point ¹
SMA ²	6 mm	20,000	15,000
Unmodified SMA	9 mm	15,000	10,000
IL -4.75	12.5 mm	15,000	10,000
Mainline Binder Course N _{design} > N50	12.5 mm	15,000	10,000
Mainline Binder Course N _{design} = N50	12.5 mm	10,000	7,500
Surface Course N _{design} ≤ N70	12.5 mm	10,000	7,500
Shoulder Binder Course	12.5 mm	7,500	5,000
Asphalt Stabilized Subbase	12.5 mm	7,500	5,000

1. If the stripping inflection point does not meet minimum requirements, the designer has the option to perform the Tensile Stripping Ratio (TSR) test per article 1030.04 (c)

2. Calculation of the stripping inflection point is not required for SMA with less than 4.0 mm rut depth at 20,000 passes

CENTRAL TRI-STATE TOLLWAY (I-294) MAINLINE



- Stabilized Subbase for dowel support, pavement stability, prevention of aggregate egress into concrete pavement joints.
- Subgrade Aggregate is open graded to allow water to drain away from the pavement.



THANK YOU