2020 ATL Pavement Design
A Case Study

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2016 Purdue Road School
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Outline

- INDOT Project Situation & Business Case
- Original General Plan
- Project History
- Pavement Evaluation
- Pavement Design Approach/Philosophy
- Pavement Treatment Options/MEPDG
- LCCA, Lane/mile/year cost
- Conclusions/ Lessons learned

2020 ATL…..

- **INDOT Project Situation & Business Case……..**

INDOT Goals

Agency Results

- Take care of what we have
- On-time and On-budget
- Customer Satisfaction

INDOT Values

The Value of Values

1. Respect — Treat others fairly. Value the individual skills, experience, diversity and contributions of fellow employees.

2. Teamwork — Share information and seek input from co-workers and agency partners to achieve goals.

3. Accountability — Take personal responsibility for actions and decisions.

4. Excellence — Provide exceptional customer service through individual initiative, innovation and delivery of quality results.

Values are the core behaviors that all employees, as an organization, will support, promote and exhibit to achieve agency goals.

MAJOR MOVES 2020

- **First $200 Million 2020 Funds**
  - I-65 Southport Rd to County Line Rd
  - I-65 County Line Rd Main St Greenwood
  - I-65 Main St to Whiteland Rd
  - I-65 Whiteland Rd to SR 44
  - I-65 SR 38 to SR 26

MAJOR MOVES 2020

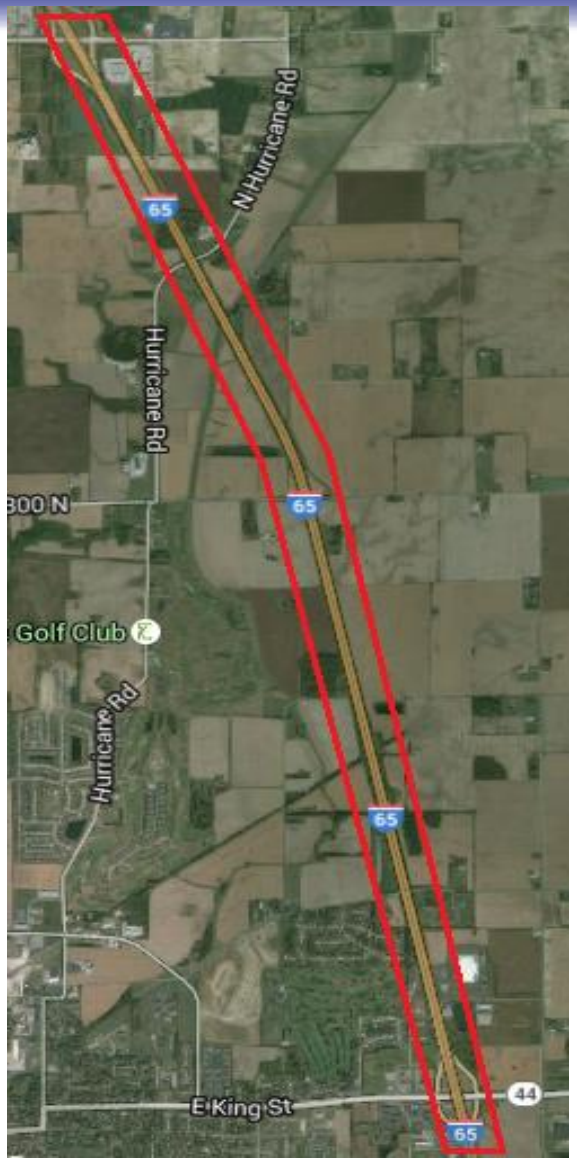
- **Second $200 Million 2020 Funds**
  - I-65 SR 26 to SR 25
  - I-69 SR 37(N. Jct) to SR 13
  - I-65 Old SR 311 to Memphis Rd
  - Lafayette Center Rd/ CR 900(Ft Wayne Dist)


Gary
South Bend
Fort Wayne
CR 900: 10
Lafayette
I-65: 5-6
INDIANA
Muncie
Carmel
I-69: 7-8
Indianapolis
Terre Haute
I-65: 1-4
Bloomington
Columbus
Hoosier
National Forest
I-65: 9
Louisville
Santa Claus
Evansville
Owensboro


County Line Rd
101
65
99
65
E Main St

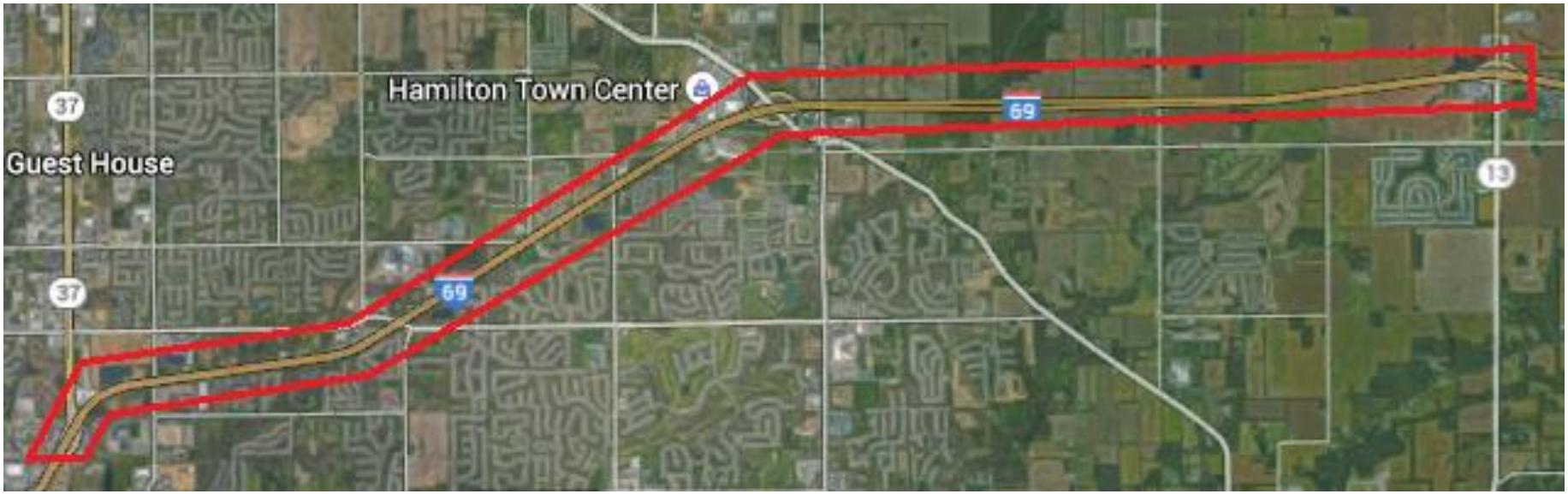

E Southport Rd
65
65
S Sherman Dr
E Stop 11 Rd
Smock Golf Course
County Line Rd
County Line Rd


65
65
Whiteland


N Hurricane Rd
65
Hurricane Rd
300 N
65
Golf Club
Hurricane Rd
65
E King St
44
65


25
65
26


550 E
26
25
65
200
65
38
38


Hamilton Town Center
37
Guest House
37
69
69
13


65
Memphis
31
Perry Crossing
31
65
Speed
Sellersburg


E 900 N
Lafayette Center Rd
Lafayette Center Rd
69
469
Lafayette Center Rd
296A

Original General Plan

- Resurfacing the existing lanes & ATL
- Concrete overlay & ATL
- ATL Inside or Outside

Project History

- Most of these Interstates are 4-lane divided Highways
- Built in 60's-70's and resurfaced in 80's-90's-2000+,
- Old concrete(CRC & JRCP) 40-50 Yrs
- Shoulders were built with thin HMA(3-4")
- Maintenance history.."D"cracking, Patching (Inverted "T")
- Geocomposite Underdrains

Pavement Evaluation

- Field evaluation-Existing pavement pictures
- Core Report
- FWD Report
- Pavement Management data
- Old contracts review

I-65, Greenwood to Whiteland

2006 Pictures


$9995
CALL 866-4-STOUTS NEXT EXIT

I-65, Whiteland to Franklin

2006 Pictures


EXIT 99
Greenwood
1/4 MILE

I-65, SR 44 to I-465(2011)

Pavement Evaluation(2014)


CURRENT TRAVEL TIME TO
465
6 MILES
6
MIN
70
10 MILES
10
MIN
Bridal Show

I-65, Southport Rd to Main St.


HALF TIME
FOR SALE


Marion Co.
FRONTIER

I-65 Main St to SR 44(2014)


EXIT 95
Whiteland
1 MILE


Pollywog

Major Distresses

Reflective Cracking

D cracking of Concrete

Pavement edge cracking

Underdrain failure

Pumping

Direction	**IRI** (inches/mi)	**Rutting** (inches)
Northbound	86	0.14
Southbound	111	0.14

2014
I-65 Pavement Management data
SR 44 to Southport Rd

Pavement Design Analysis

- Pavement Design Approach/Philosophy
- Pavement Treatment Alternatives(MEPDG)
- Pavement design challenges
- LCCA
- Cost/lane mile/year
- ALT-BID option & Assumptions
- Recommendation: Reconstruction

Construction…..(Fall 2015)


We're Always There For You!


INDOT 2015


Love's


ANTIGO


KOBELCO

Thank You!

Pankaj Patel….

Project Scope for I-65 Added Travel Lane

Des. No.	Location	Project Scope/Intent
1383343 & 1383354	SouthPort Rd to Main St (Greenwood)	Unbounded concrete overlay. New pavement for ATL and under overpasses.
1383341 & 1383342	Main St to SR 44	Unbounded concrete overlay. New pavement for ATL and under overpasses.
1383339 & 1383340	SR 38 to SR 25	Preventive Maintenance HMA overlay. New pavement for ATL and under overpasses.
1400597	SR 311 to 2.8 mi S of SR 160	2 lifts HMA Overlay. New pavement for ATL and under overpasses.

Existing Geometry I-65

Project	Existing Travel Lanes	Existing Shoulders
SouthPort Rd to Main St	6 lanes – 12 feet	4 feet Inside + 10 feet Outside
Main St to SR 44	4 lanes – 12 feet	4 feet Inside + 10 feet Outside
SR 38 to SR 25	4 lanes – 12 feet	4 feet Inside + 10 feet Outside
SR 311 to 2.8 mi S of SR 160	4 lanes – 12 feet	4 feet Inside + 10 feet Outside

Proposed Geometry I-65

Project	Proposed Travel Lanes	Proposed Shoulders
SouthPort Rd to Main St	8 lanes – 12 feet	8 feet Inside + 10 feet Outside
Main St to SR 44	6 lanes – 12 feet	8 feet Inside + 10 feet Outside
SR 38 to SR 25	6 lanes – 12 feet	8 feet Inside + 12 feet Outside
SR 311 to 2.8 mi S of SR 160	6 lanes – 12 feet	8 feet Inside + 10 feet Outside

Added Travel Lane I-65

Project	Added New Lane
SouthPort Rd to Main St	Outside
Main St to SR 44	Inside
SR 38 to SR 25	Inside
SR 311 to 2.8 mi S of SR 160	Inside

Detail Case Study For
I-65 (Main St to SR 44)
Project length – 11.5 miles

Project History

- I-65 is a 4-lane divided highway
- 2015 Traffic: 55,290 (AADT)
  - 33% trucks (17,900)
- Mainline Composite Pavement (A/C) with Asphalt Shoulders
- Average Thickness
  - Mainline 5.5” Asphalt over 9” Concrete
  - Shoulders 8.5” Asphalt

Project History Cont.

- 1969 – Original Construction
  - 9” JRCP with 3” Asphalt Shoulder over CA
- 1984 – Inverted “T” Concrete Patch
- 1986 – 4.5” HMA Overlay and Geocomposite Edge drain
- 1996 – HMA Overlay
- 2002 – HMA Overlay
- 2007 – HMA Overlay

Pavement Evaluation

- Field evaluation-Existing pavement pictures
- Core Report
- FWD Report
- Pavement Management data
- Geotechnical Report

Pavement Evaluation


Pollywog

Major Distresses

Composite Section

- High Severity Reflective Transverse Cracks
- Edge Cracks
- Fatigue Cracks
- Pumping

Concrete Section

(under Overpasses)

- Mid Panel Cracks
- Spalling

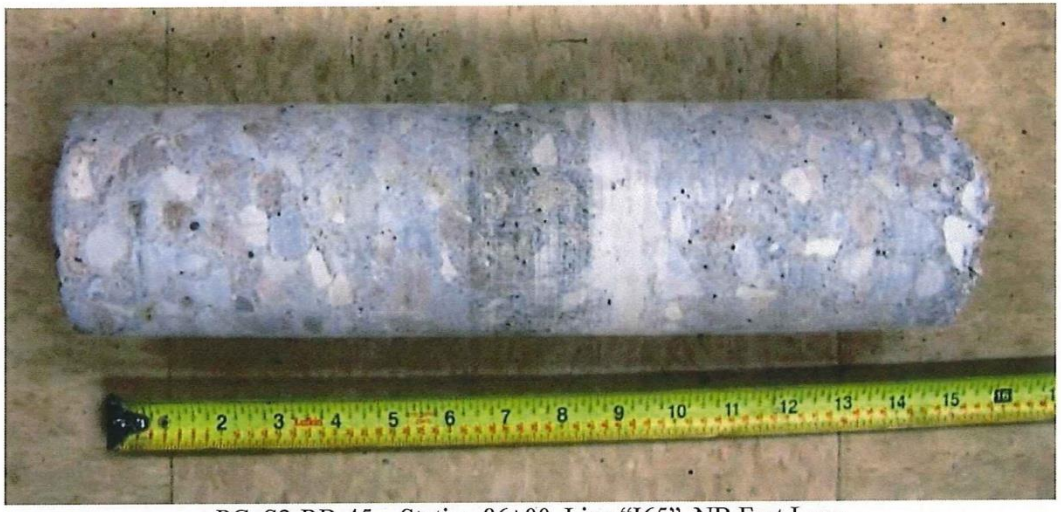
Pavement Cores - Mainline

PC_S2-RB-1 – Station -2+00, Line "I65", NB Slow Lane

PC_S2-RB-11 – Station 18+00, Line "I65", SB Slow Lane

PC_S2-RB-25 – Station 46+00, Line "I65", NB Slow Lane

PC_S2-RB-35 – Station 66+00, Line "I65", SB Slow Lane



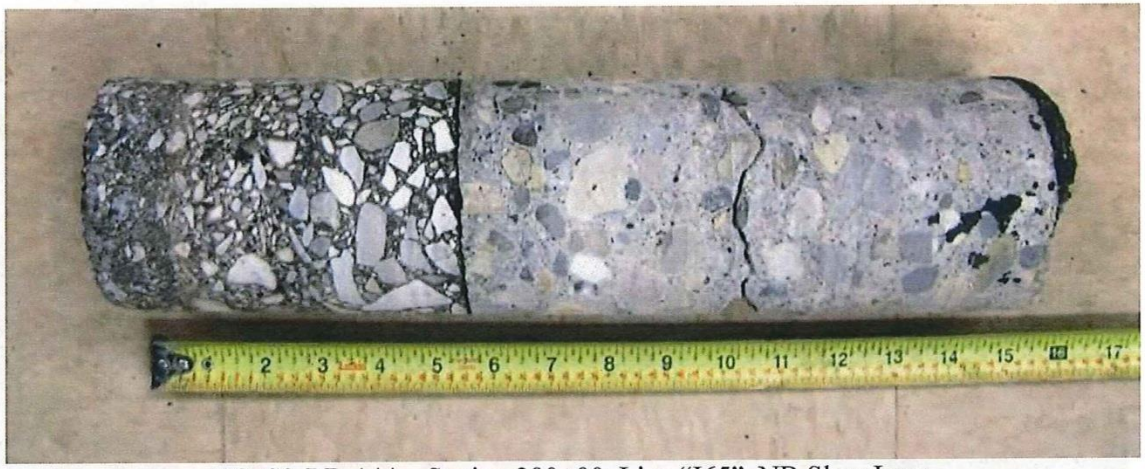
PC_S2-RB-45 – Station 86+00, Line "I65", NB Fast Lane

PC_S2-RB-59 – Station 114+00, Line "I65", SB Slow Lane

PC_S2-RB-77 – Station 150+00, Line “I65”, NB Fast Lane

PC_S2-RB-87 – Station 170+00, Line “I65”, SB Fast Lane

PC_S2-RB-141 – Station 278+00, Line "I65", SB Slow Lane



PC_S2-RB-144 – Station 290+00, Line "I65", NB Slow Lane

Pavement Cores - Shoulders

PC_S2-SB-13 – Station 178+00, Line "I65", NB Shoulder

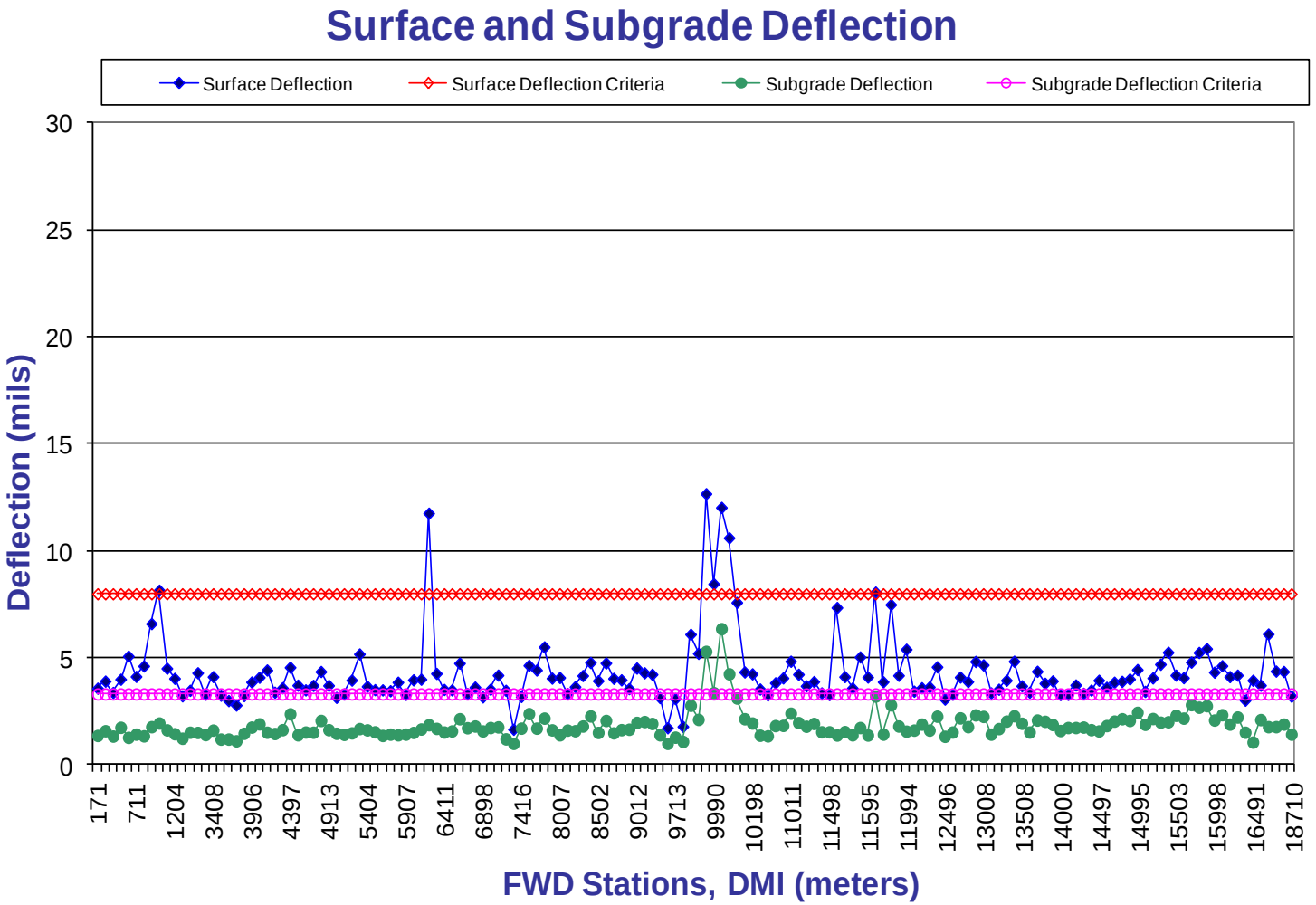
PC_S2-SB-20 – Station 286+00, Line "I65", NB Shoulder

PC_S2-SB-40 – Station 298+00, Line "I65", SB Shoulder

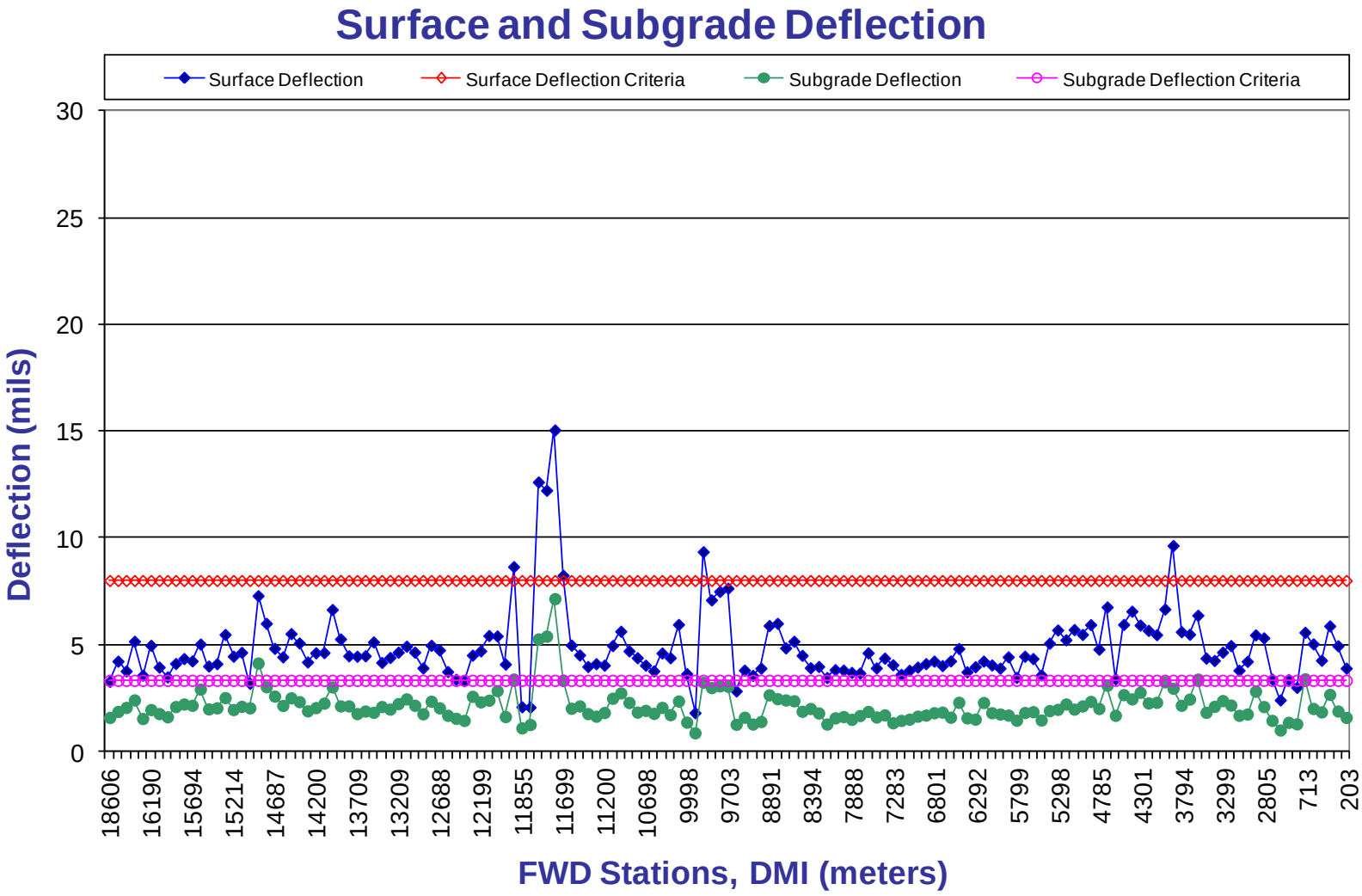
Pavement Evaluation - FWD

- FWD Report (2014)
- High deflection > 8 mils, 10% Areas
- Pavement strength Sn= 5.0
- Remaining ESAL=9.6 million
- Elastic modulus of concrete=3.8 m psi
- Elastic Modulus of HMA=400,000 psi
- CBR=5.3 , K-value= 291 pci

North Bound Driving Lane



South Bound Driving Lane



Pavement Management data

Direction	IRI	Rutting
Northbound	142	0.21
Southbound	172	0.22

2014 Data

Pavement Treatment Alternatives

- HMA (SMA Surface) Overlay
- Unbounded Concrete Overlay
- Rubblized Existing JRCP and HMA (SMA Surface) Overlay
- JPCP Reconstruction
- HMA (SMA Surface) Reconstruction
- CRC Reconstruction

Design Data

Traffic -2015

- Construction Year AADT – 55,290
- Design Year AADT – 73,280
- Truck - 33%
  - AADTT (Trucks) – 17,900
- Growth – 1.74%
- Speed Limit – 70 mph

Design Data Cont.

Geotechnical Report

- Existing Subgrade soil – Silty Loam (A-7-6)
- Resilient Modulus for improved subgrade soil – 7,500 psi
- Resilient Modulus for natural subgrade soil – 3,000 psi
- Subgrade Treatment – 14” Chemical soil modification
- Water Table – 3 feet
- Foundation soil improvement – 15%

Pavement ME Input

Performance Criteria	Performance Limit	Reliability
Terminal IRI (in/mi)	160	90%
AC Bottom-up Cracking (% lane area)	10	90%
AC Thermal Cracking (ft/mi/lane)	500	90%
Permanent Deformation – AC only (in.)	0.40	90%

HMA Pavement

Pavement ME Input

Performance Criteria	Performance Limit	Reliability
Terminal IRI (in/mi)	160	90%
Transverse Slab Cracking (%)	10	90%
Mean Joint Faulting (in.)	0.15	90%

Concrete Pavement

Pavement ME Cont.

- Traffic Group – C , (6,000 < AADTT ≤ 20,000)
- Weather Station (Climate Data) – Indianapolis
- LTPP Bind PG 76-22

Pavement Areas

- Total Areas.....729,000 sq yd.
- Overlay (Existing Mainline + OS) .....283,500 sq yd.
- New Pavement (ATL+ IS).....284,200 sq yd.
- Pavement Recon. .....161,300 sq yd.
  - Before & after bridge + Under Overpasses
- New + Reconstruction Areas .....445,500 sq yd.
  - 61%
- Mill/Overlay Areas.....283,500 sq yd.
  - 39%

Alternative 1 – 7.5” HMA Overlay

Existing Mainline Pavement

- 7.5” HMA (SMA Surface) Overlay after mill off the existing asphalt
- Design Life – 15 years

New Pavement for ATL & Under Overpasses

- 16.5” HMA (SMA Surface)
- Design Life – 25 years

Alternative 1 – 7.5” HMA Overlay

Existing Mainline Pavement

- Removal of the existing Geocomposite Pavement Edge Drain and install new Retrofit Underdrain
- Full depth concrete patch approximate 5-7% of areas

Alternative 1 – 7.5” HMA Overlay

Pros

- Lowest Initial Construction Cost

Cons

- Different Rehabilitation and Maintenance Cycle
- Higher Life Cycle Cost (cost/lane/mile/year)
- Two Underdrain system (new lane and retrofit)

Alternative 2 – 12.5” HMA Overlay

Existing Mainline Pavement

- 12.5” HMA (SMA Surface) Overlay after mill off the existing asphalt
- Design Life – 18 years

New Pavement for ATL & Under Overpasses

- 16.5” HMA (SMA Surface)
- Design Life – 25 years

Alternative 2 – 12.5” HMA Overlay

Existing Mainline Pavement

- Removal of existing Geocomposite Pavement Edge Drain and install new Retrofit Underdrain
- Full depth concrete patch approximate 5-7% of areas

Alternative 2 – 12.5” HMA Overlay

Pros

- Lower Initial Construction Cost

Cons

- Different Rehabilitation and Maintenance Cycle
- Higher Life Cycle Cost (cost/lane/mile/year)
- Two Underdrain system (new lane and retrofit)

Alternative 3 – 12” JPCP Overlay

Existing Mainline Pavement

- 12” Unbounded Concrete Overlay after mill off the existing asphalt
  - 1” new HMA layer top of existing concrete before concrete overlay
- Design Life – 18 years

New Pavement for ATL & Under Overpasses

- 13” JPCP at 15’ D-1 Joint Spacing
- Design Life – 27 years

Alternative 3 – 12” JPCP Overlay

Existing Mainline Pavement

- Removal of the existing Geocomposite Pavement Edge Drain and install new Retrofit Underdrain
- Full depth concrete patch approximate 5-7% of areas

Alternative 3 – 12” JPCP Overlay

Pros

- Lower Initial Construction Cost

Cons

- Different Rehabilitation and Maintenance Cycle
- Higher Life Cycle Cost (cost/lane/mile/year)
- Two Underdrain system (new lane and retrofit)

Alternative 4 – Rubblized & HMA Overlay

Existing Mainline Pavement

- Mill off asphalt then Rubblize Concrete
- Overlay 14” HMA (SMA Surface)
- Design Life – 17 years

New Pavement for ATL & Under Overpasses

- 16.5” HMA (SMA Surface)
- Design Life – 25 years

Alternative 4 – Rubblized & HMA Overlay

Existing Mainline

- Removal of the existing Geocomposite Pavement Edge Drain and install new Underdrain before Rubblized the concrete

Alternative 4 – Rubblized & HMA Overlay

Pros

- Lower Initial Construction Cost then reconstruction of the entire section.

Cons

- Different Rehabilitation Cycle
- Highest Life Cycle Cost (cost/lane/mile/year) among all Alternatives
- Two Underdrain system (new lane and retrofit)
- Potential problem with the rubblized existing concrete during construction

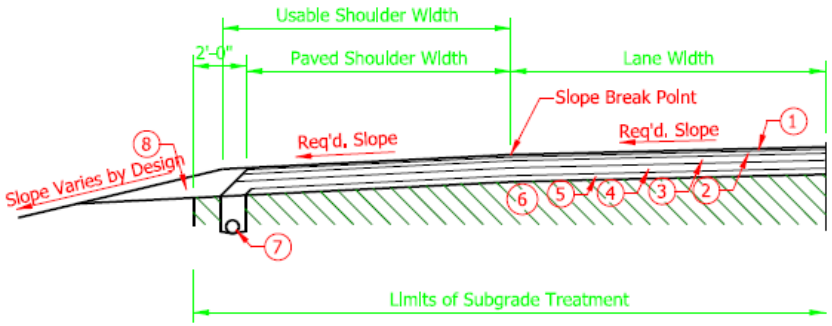
Alternative 5 – HMA Reconstruction

Reconstruction of existing Mainline Pavement and New Pavement for ATL & Under Overpasses

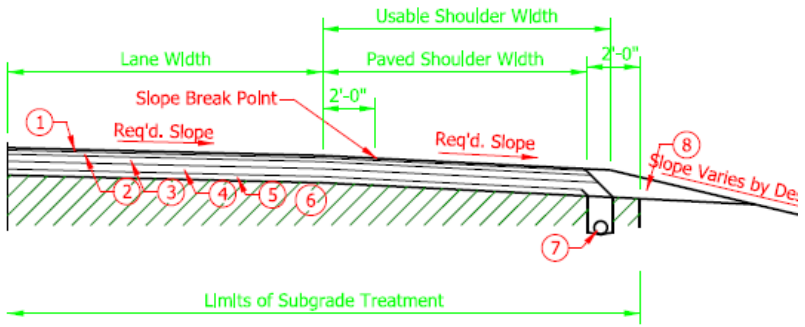
- 16.5” HMA (SMA Surface)
- Design Life – 25 years

Alternative 5 – HMA Reconstruction

INSIDE SHOULDER



OUTSIDE SHOULDER



NOTES:

Mainline & Shoulders

*
1. 165 lb/yd² HMA Surface 9.5 mm
2. ___ lb/yd² HMA Intermediate
3. ___ lb/yd² HMA Base
4. ___ lb/yd² QC/QA-HMA Intermediate OG
5. ___ lb/yd² HMA Base
6. Subgrade Treatment, Type _____
7. Underdrain. See Figure 304-21I for detail.
8. Variable-Depth Compacted Aggregate, No. 53

* See Figure 304-21D for lay rate.

9. Safety edge as required for Surface and Intermediate layers. See Figure 304-21X for detail.
10. Longitudinal joint adhesive required for Surface and Intermediate layers.
11. Liquid Asphalt Sealant required on Surface layer over longitudinal joint, 24" width.
12. Base seal is required under all open-graded HMA layers.

Alternative 5 – HMA Reconstruction

Pros

- Same Maintenance and Rehabilitation Cycle
- Only one underdrain system for entire section and away from the travel lane
- Reset the pavement life for 50+ years
- Lower cost/lane/mile/year
- Can be let as Alternate Pavement Type Option with new JPCP reconstruction alternative

Cons

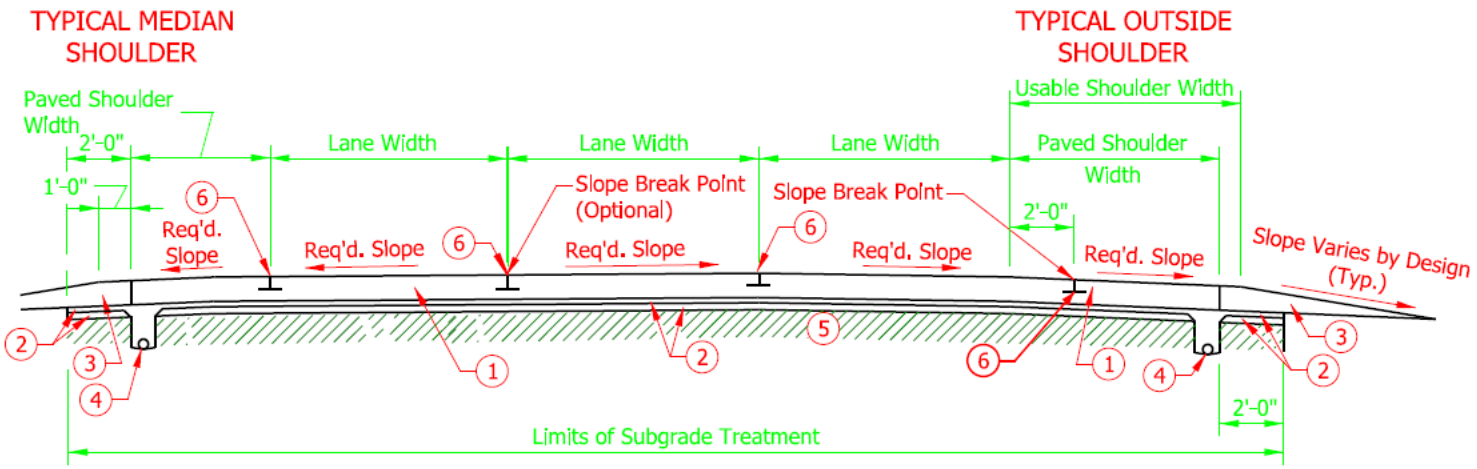
- Higher Initial Construction Cost

Alternative 6 – JPCP Reconstruction

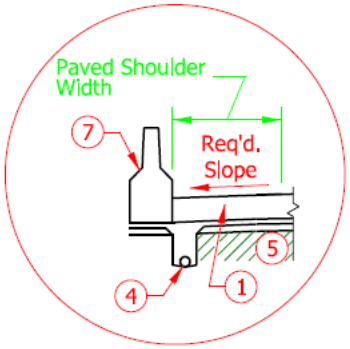
Reconstruction of existing Mainline Pavement and New Pavement for ATL & Under Overpasses

- 13” JPCP at 15’ D-1 Joint Spacing
- Design Life – 27 years

Alternative 6 – JPCP Reconstruction



TYPICAL MEDIAN SHOULDER WITH BARRIER WALL



Mainline and Shoulders

1. PCCP
2. * Subbase for PCCP (3 in. Coarse Aggregate No.8 on 6 in. Coarse Aggregate, No. 53)
3. Variable-Depth Compacted Aggregate, No. 53
4. Underdrain. See Figure 304-21T for detail.
5. Subgrade Treatment, Type _____
6. Longitudinal Joint or Longitudinal Construction Joint. See Figure 304-21W for detail.
7. Concrete Median Barrier
8. Safety edge as required. See Figure 304-21X for detail.

* Where underdrains are not required, Dense Graded Subbase should be used.

PCCP SECTION WITH PCC SHOULDER

Alternative 6 – JPCP Reconstruction

Pros

- Same Maintenance and Rehabilitation Cycle
- Only one underdrain system for entire section and away from the travel lane
- Reset the pavement life for 50+ years
- Lower cost/lane/mile/year
- Can be let as Alternate Pavement Type Option with new HMA reconstruction alternative

Cons

- Higher Initial Construction Cost

Alternative 7 – CRC Reconstruction

Reconstruction of existing Mainline Pavement and New Pavement for Added Lane & Under Overpasses

- 11.5” CRC
- Design Life – 50 years

Alternative 7 – CRC Reconstruction

Pros

- Same Maintenance Cycle
- Only one underdrain system for entire section and away from the travel lane
- Pavement Design life 50 years
- Lowest cost/lane/mile/year

Cons

- Very High Initial Construction Cost

Economic Analysis Summary

Alternatives	Initial Pavement Cost	Cost/Lane/Mile/ Year
7.5” HMA (SMA Surface) Overlay	$40,600,000	$40,500
12.5” HMA (SMA Surface) Overlay	$45,200,000	$33,800
12" JPCP Overlay	$44,000,000	$32,900
Rubblized Existing JRCP and 14” HMA (SMA Surface) Overlay	$46,000,000	$43,000
16.5” HMA (SMA Surface) Reconstruction	$49,500,000	$30,000
13” JPCP Reconstruction	$50,300,000	$27,500
11.5” CRC Reconstruction	$68,500,000	$20,500

Life Cycle Cost Analysis

Compare LCCA for 50 years Pavement life

- 16.5” HMA Reconstruction
- 13” JPCP Reconstruction

LCCA between these two reconstruction Alternatives was within 10%

Recommendation

Pavement Reconstruction Bid as Alternate Pavement Type Options

- 16.5” HMA Reconstruction
- 13” JPCP Reconstruction

Bid Review for I-65 Added Travel Lane Projects

Contract	Location	Low Bid Amount	Engineer's Estimate	% below Engineer's Estimate
R-37075	SouthPort Rd to Main St (Greenwood)	$35,816,694.00	$41,100,00.00	13%
R-37096	Main St to SR 44	$84,030,501.00	$97,000,000.00	14%
R-37115	SR 38 to SR 25	$82,813,411.00	$83,950,000.00	1.5%
R-37383	SR 311 to 2.8 mi S of SR 160	$67,055,136.00	$70,200,000.00	5%

Conclusion & Lessons Learned.....

- Pavement Evaluation is important
- Need to explore all possible options
- Cost/lane-mile is good exercise
- Plan for future
- Pavement Reconstruction with Alt-Bid saved $22.5 Millions.

Questions?