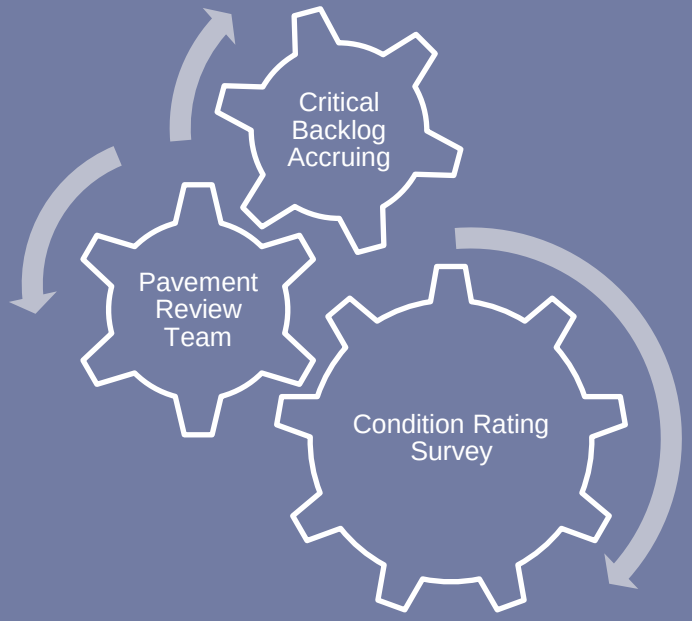
I-39 HMA Overlay & Rubblization

Experimental Work Plan

Project Identification

- Condition Rating Survey
  - Sensor data collection
  - Visual pavement distress identification
- Interstate Pavement Review Team
  - Evaluates Interstate pavement referencing pavement rehabilitation timeframe
- Needs Assessment
  - Prioritizes roadways based on CRS value, Average Daily Traffic and Functional importance



Needs Assessment

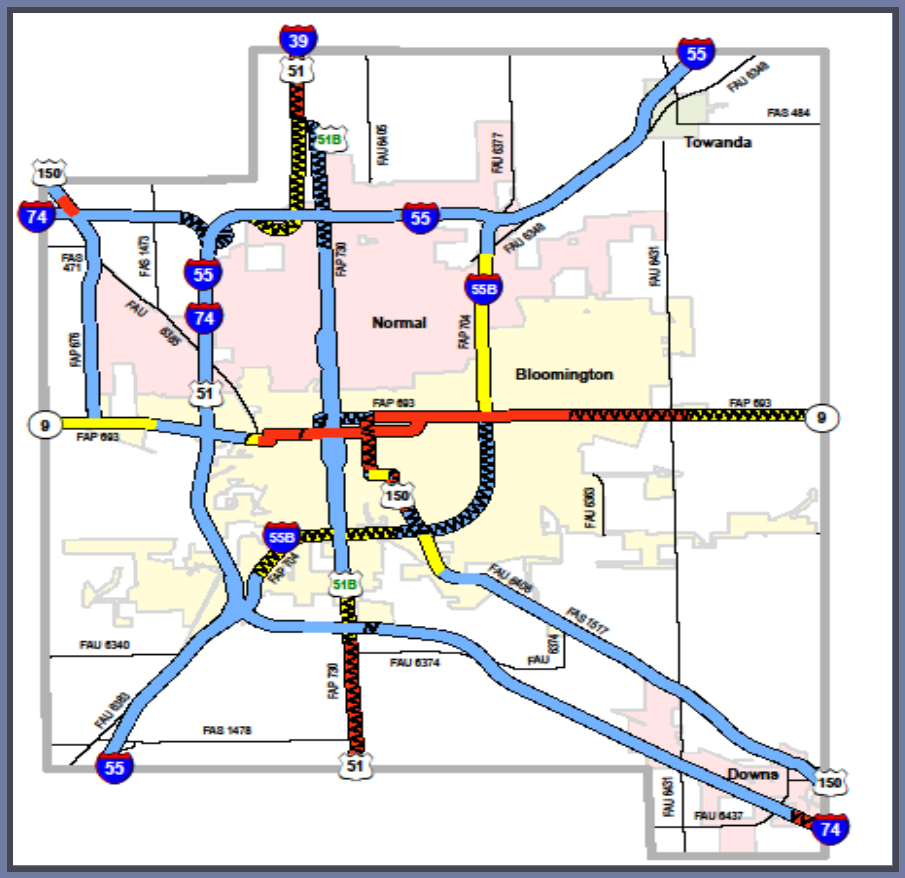
- Prioritizes roadways based on CRS value, Average Daily Traffic and Functional Importance

- Describes the pavement condition in terms of

  Critical Backlog

  Backlog

  Accruing



Data Collection – Existing Conditions

- I-39 Condition Rating Survey Results

  2012 CRS

  -NB 3.8 / SB 3.0

  -Poor Condition

  Pavement Distresses

  -Durability Cracking

  -High Level Infrequent

  Transverse Cracking

  -Medium to High level

Data Collection – Existing Conditions

- I-39 Condition Rating Survey Results

Joint Deterioration

Frequent / Spalling

Greater than 6 inches

Centerline Deterioration

High Level / Spalling

Greater than 6 inches

Data Collection

- I-39 from I-55 to N of TR 157A in McLean County

Constructed in 1989

15 ft Hinge Jointed PCC Pavement

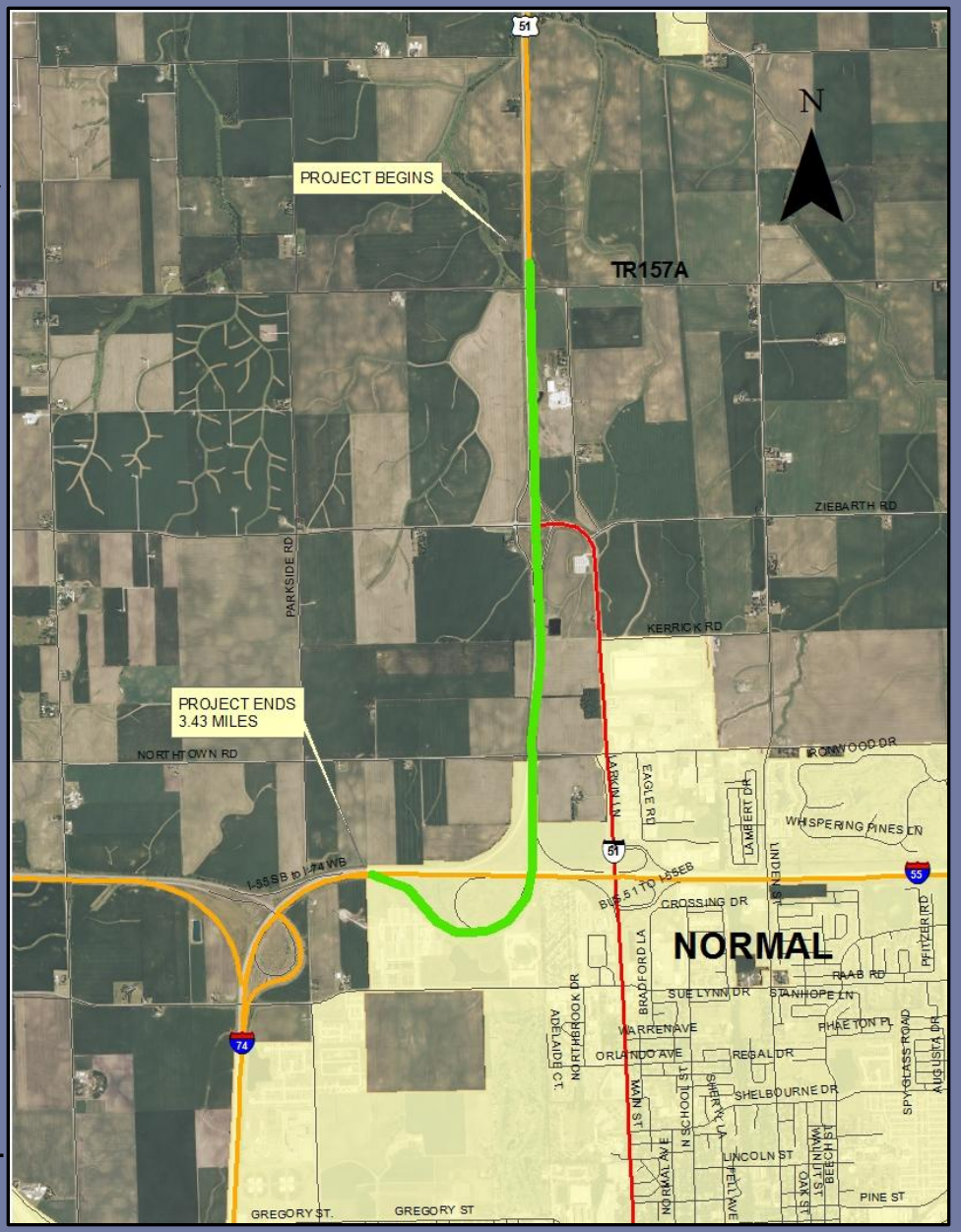
10 ¾ inch

Tied PCC shoulders

4-inch Stabilized Sub-base, CAM II

16-inch Processed Lime Modified Soil

19,000 ADT, 28 % Trucks, 33 Million ESAL



Project Scope

I-39 Pavement Issues

- Extensive existing patching in both NB & SB driving lanes
- Patching survey identified 12% additional patching required
  - -Pavement integrity

- Internal Roughness Index
  - -NBL 127
  - -SBL 193
  - -Ride quality

I-39 Pavement Rehabilitation

- Programmed in the FY2008-FY2013 MYP
  - -I-55 to Woodford Co Line -- 9.55 miles
  - -Concrete Pavement Rehabilitation
  - -$5,700,000

- Revised project scope in the FY2010-FY2015 MYP
  - -Patching and Interstate Policy Resurfacing
  - -$9,100,000

I-39 Pavement Rehabilitation

- Revised project scope in the FY2012-FY2017 MYP
  - -Patching and Structural Overlay
  - -$12,400,000
  - Project scope revised due to rapid pavement deterioration

- Revised project limits and program cost in the FY2013-FY2018 MYP
  - -I-55 to N of TR157A --3.43 miles
  - -Rubblization / HMA Overlay
  - -$6,690,000
  - Project limits reduced due to limited funding

I-39 Pavement Structure and Field Testing

Region 3/ District 5 Acting Materials Engineer

Steve Robinson, P.E.

I-39 Pavement Structure and Field Testing

- Existing Pavement
  - 20 year pavement design!!! We're there!!!
  - Good pavement between bad joints
  - 6' patch needed at all D.L. joints in some areas
  - Accelerated distress present in past 3 years
  - Beyond point where patching is feasible

I-39 Patching Survey

Existing Patching

Six Patching Contracts since 2009 totaling $2,090,000

-10% Total Patching

-Patching concentrated in the driving lanes

New Patching

Estimated 12% Patching

I-39 Pavement Structure and Field Testing

- Subgrade investigation Nov. 2011
  - In place moisture samples (highly variable)
  - Soil Classification
  - IBV with DCP testing (2-100 highly variable)
- Pavement cores: 13 ¼” max (plan thickness 10 3/4”)
- CAM II cores: 6” max (plan thickness 4”)
  - No thin sections

Core Analysis

- Alkali Silica Reactivity (ASR) possible culprit

  Reaction of Alkali (Na, K, OH) in cement with reactive silicas in fine aggregates

  Reaction forms a hygroscopic gel

  Gel absorbs water, expands into void structure and cracks paste/aggregates

  Process continues until one of the three elements is used up or eliminated

Core Analysis

- BMPR assistance

  -Cores to consultant lab for petrographic analysis

- Analysis determined "**distress is primarily, if not wholly due to the effects of expansion associated with ASR**"

- D-3 Researched Existing Materials

  -High Alkali cement, no fly ash

  -Expansive sand source

  -F/T durable coarse aggregate

The Fix

- No economical fix for existing ASR distress
- Subgrade investigation showed rubblization an option using Multi-Head Breaker


Fine Graded IL 19.0 Mix

HMA

- Fine Graded IL 19.0 used in 2010, 2011,2012

  140,000 tons between 5 different Interstate projects

  Better density

  Reduced permeability

  Reduced segregation

  Excellent Hamburg results

- Dense Graded Polymer Surface

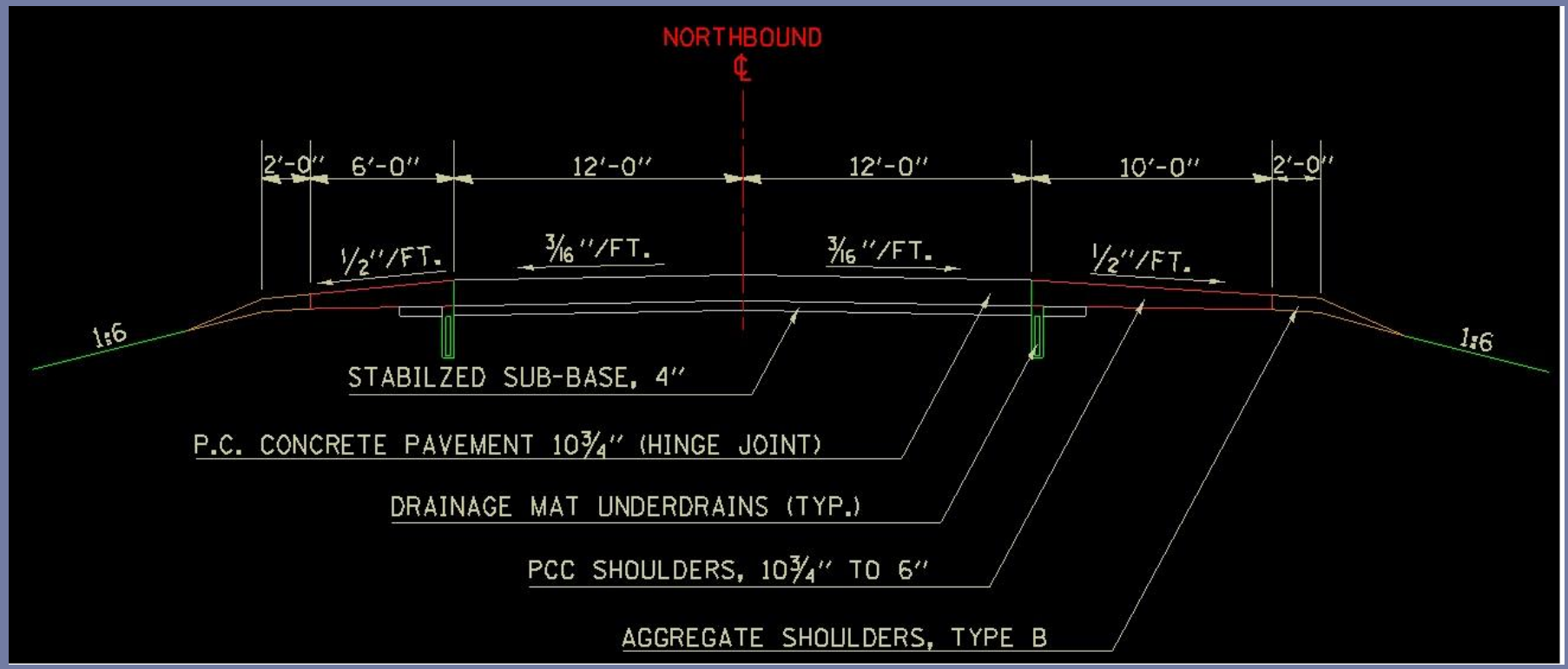
HMA

- Bottom lift: Neat IL 19.0 Fine Graded, N90
- Top Binder: Polymer IL 19.0 Fine Graded, N90
- Surface: Polymer Mix D, N90

- Pay for Performance specification for mainline mixes

I-39 Design Challenges

- Region 3/District 5 Program Development Project Engineer Nancy Fasig, P.E.



I-39 Design Challenges

- Evolving project scope
- Funding Limitations
- Profile Grade Considerations
- Traffic Control And Staging

Sample of Alternatives Analyzed

- Patching and 6 inch HMA Overlay
  - $6,690,000 Estimated cost
  - Anticipated Service Life 10-12 years
  - Disadvantages

    Pavement integrity

    Reflective cracking

    Ride Quality

Sample of Alternatives Analyzed

- Rubblization and HMA Overlay, 11 ¼ inches
  - $13,880,000 Estimated cost
  - Anticipated Service Life 20 years
    - Advantages

      Improved Drainage

      Mitigation of ASR pavement
    - Disadvantages

      Project Cost

      Profile Grade issues

Final Project Scope and Budget

- Rubblization and HMA Overlay, 8 inches
  - Experimental Work Feature
  - $11,500,000 Estimated Cost
  - Anticipated Service Life 15 years
  - Advantages

    Improved Drainage with new pipe underdrains

    Mitigation of ASR pavement

    Reduction in Construction Cost
  - Disadvantages

    Possible Shorten Service Life

I-39 Design Challenges

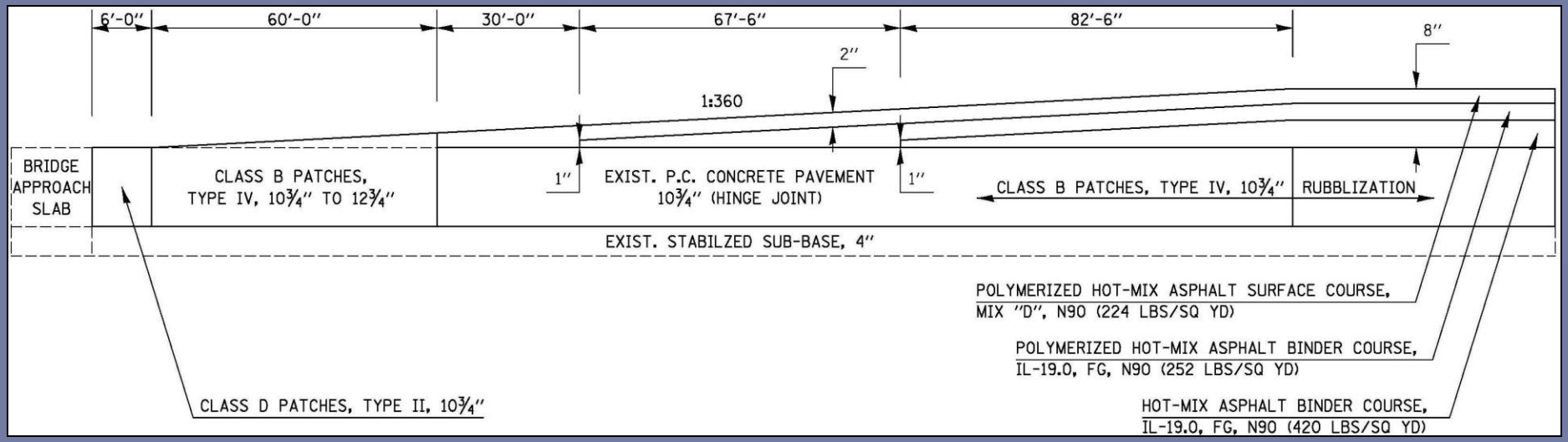
- Profile Grade Considerations
  - Typical rubblization project has significant existing HMA overlay
  - Rubblization of bare PCC pavement has a greater net profile grade change with unique issues
- Effect of Profile Grade Change of various alternatives
  - Greater grade changes greatly affect transition locations and costs
  - Design transition details prepared for all alternatives

I-39 Design Challenges

- Additional options reviewed
  - Unbonded PCC Overlay – 14” Grade Change
  - Patching and 3-3/4”, 5”, and 6” HMA overlays
  - Rubblizing and 11-1/4” HMA
  - Pavement Replacement – 15-1/2” HMA /11” Jointed PCC
  - Experimental Features with Rubblizing and 8” HMA

I-39 Design Challenges

- Profile Grade Considerations
  - Maintain Existing Vertical clearance at all overhead structures
    - Three Span with vertical tie-down abutments that are not feasible to raise
    - Transition with variable thickness Class B Patch
  - Meet existing profile grade at all mainline structures
    - Vaulted approach pavements
    - Transition with variable thickness Class B Patch



I-39 Design Challenges

- Profile Grade Considerations
  - Maintain Existing Drainage ditches and elevations
    - Minimize reconstruction or replacement of existing drainage structures
    - Accomplished by use of 1:5 foreslopes until touchdown with existing 1:6 foreslopes
    - Reduces earthwork
    - Ensures positive pipe underdrain outlet in median
    - Eliminates ROW impacts

I-39 Design Challenges

- Traffic Control And Staging
  - Staged construction selected over median cross-over
    - High cost of median cross-over and need for multiple access or cross-over locations
  - Queuing analysis performed as part of Traffic Management Analysis
    - No queuing expected
    - Average user delay less than 2 minutes
  - Staged construction worked well on recent similar project
  - Offset Stage 1 traffic 3’ onto shoulder to comply with work zone drop-off policies
    - Patching required to put Stage 1 traffic onto DL shoulder
    - Success of shoulder inlay questionable
  - Stage 2 traffic to use overlaid PL shoulder for required 3’ lane shift

I-39 Pavement Rehabilitation Strategy – Experimental Work Feature

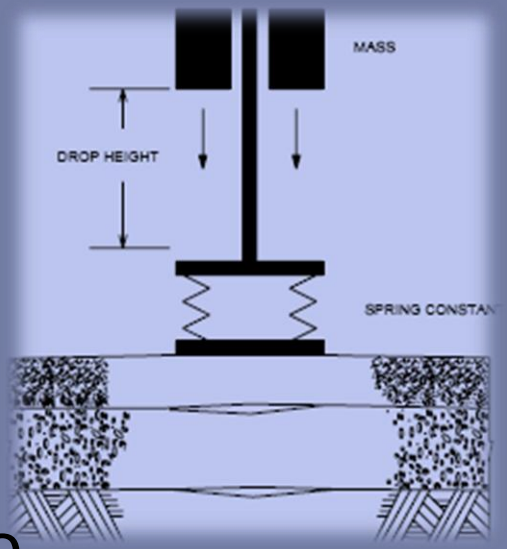
- Case Studies
  - I-57 north of Pesotum in Champaign County
    - 6 and 8 inch Hot Mix Asphalt Overlay on rubblized PCC pavement
    - Constructed in 1990
    - Resurfaced in 2010
    - 20 year service life
  - I-57 in Effingham County
    - 8 inch Hot Mix Asphalt Overlay on rubblized PCC pavement
    - Constructed in 1996
    - Resurfaced in 2011
    - 15 year service life

I-39 Pavement Rehabilitation Strategy – Experimental Work Feature

- Rubblize PCC Pavement and Experimental Design Thickness Hot Mix Asphalt Overlay
  - Propose HMA thickness of 8 inches in lieu of 11 ¼ inches derived from the limiting strain criterion in the design procedure
- Objectives of the experiment
  - Evaluate the performance of a thinner HMA Overlay on a lower-volume interstate route
    - Establish recommendations for the rehabilitation of the ASR-distressed, 15ft hinge jointed pavements

Experimental Work Plan

- Plan of Study and Evaluations
  - Annual inspections as visual distress surveys, rutting measurements, and falling weight deflectometer testing



- Field checks to watch for early
  - signs of fatigue cracking in the
  - wheelpaths or unusual signs of distress

Experimental Work Plan

- Monitor Overall Performance
  - Additional policy overlay, 3 ¾ inches will be placed
  - Resulting in a total overlay thickness of 11 ¾ inches
  - Monitored by District Bureau of Operations

Experimental Work Plan

- Evaluation Timeframe
  - Evaluated for both performance and maintenance for a period of at least 5 years

Control Section

- I-57 SB from south of Olympian Drive to 2 miles south of Thomasboro
  - Similar Average Daily Traffic and Truck Volumes
  - HMA Overlay on Rubblized PCC Pavement, 11 ¼ inches
  - Pipe Underdrain Removal and Replacement
    - Completed Fall 2012