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