

## Accelerated PCCP Construction & Rehab - Highlights from the FHWA/CPTP Atlanta Conference




Shiraz Tayabji  
FHWA CPTP Implementation Team  
Grantville, PA - January 30, 2008

## The Situation

- ◆ Need to repair/rehab AC & PCC pavements "As Quickly As Possible"

- ◆ Vs.
- ◆ Extensive lane closures
- ◆ Durability concerns



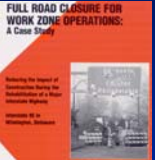

**◆ DOING IT FAST, BUT DOING IT RIGHT**

## Solution: Optimizing Conventional Repair & Rehab Techniques

- Speed of installation – minimize length of lane closures – minimize impact on users – lower overall costs
  - Full closures – nighttime, weekend or extended
  - Optimized partial closures
- Using conventional concrete & established industry procedures


## Presentation Outline

- Background
- Atlanta conference highlights
  - Washington State practices
    - Weekend panel replacements
    - I-5 (Seattle) reconstruction under traffic
  - Georgia practices
    - Nighttime lane construction
    - Weekend AC pavement rehab
  - Michigan project
    - Lodge Freeway – Extended full closure



## FHWA CPTP Conference

- International Conference on Optimizing Paving Concrete Mixtures & Accelerated Concrete Pavement Construction & Rehab, Atlanta, November 7-9, 2007
  - 11 countries
  - ~30 states plus DC
  - ~170 attendees



## Technical Program

- Technical sessions
  - Concrete mixture related
  - Accelerated construction & rehab related
- Forums
  - Partial closures – weekend/night-time closures (Georgia & Washington State case studies)
  - Concrete mixture optimization 0 current practice, issues & future directions
  - Full closures – extended closures (Detroit Lodge Freeway case study)

### Accelerated Rehab Concepts

- Patching
- Joint/crack full-depth repairs
- Panel replacement
- Project level rehab (longer length/larger area) – ramps, intersections, toll plazas and main line sections



### Accelerated Projects - Important Items, But Not Discussed

- Existing pavement evaluation – long-lasting rehab requires good understanding of the condition of the existing pavement and the support condition
- Process control (QC) and acceptance testing requirements
- Early opening to traffic concrete strength requirements & testing (maturity, etc.)
- Agency & contractor partnering

### Rapid Panel Replacement Concerns

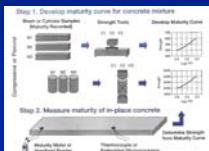
- Adjacent panel breakage
- Base preparation (full support)
- Correct dowel placement & epoxy grouting
- Short working time - requires rapid concrete placement, finishing, and curing
- Acceptable concrete strength @ time of trafficking
- Concrete durability issues

### Early Opening Strength Requirements

- Georgia DOT - Process used since about mid 1970's
  - Accelerated strength concrete - 2,500 psi within 24 hours and 1,500 psi at traffic opening time
  - Concrete mix design contractor developed
  - If, DOT developed – 8 bag mix, w/c ratio < 0.45
  - Minimum cure time 4 hours of after last concrete placement
- Washington State DOT
  - Opening to traffic strengths
    - Compressive strength: Typically 2,000 psi
    - Flexural strength: Typically 300 psi
  - Minimum cure time - Typically 4 hours after last concrete placement

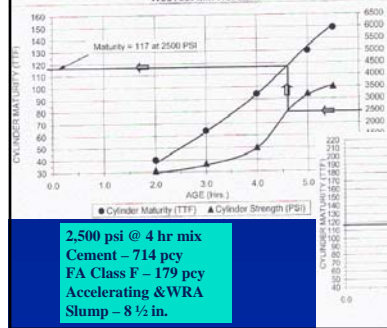
### Strength Testing for Accelerated Projects

- Use Concrete maturity for opening to traffic
  - Monitor concrete temperature and strength
- Use conventional testing for strength acceptance at 14 or 28 days



### Colorado DOT I-25 Rehab - 2006

Varra Companies, CDOT Class E 2500 PSI in 4 hours  
WesTest Mix No. 9394



- Major slab replacement project
- Maturity @ 2,500 psi = 117 F-hr
- Reached at 4.6 hrs in lab/3.7 hrs in slab



**WSDOT concrete pavements are generally old (35+ years) and heavily trafficked.**

**Use rapid panel replacements to put off reconstruction to save money.**

**Rehab Costs are \$17,000 to \$24,000 per panel when using rapid construction but much less when using traditional methods (user costs not included)**

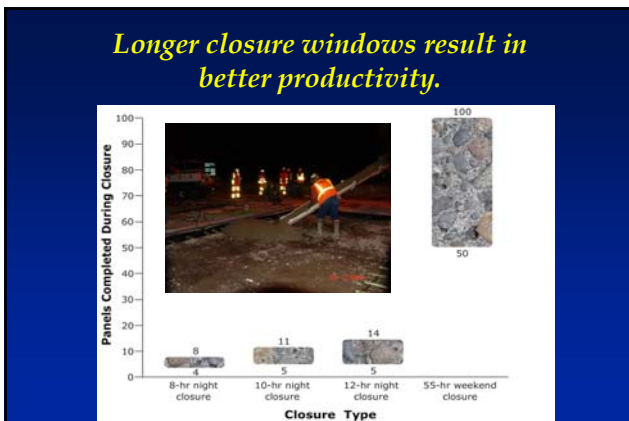
	Rapid	Cost	Lane-miles	Panels Replaced		Rounded Cost/panel
				Number	Percent	
Generic Reconstruction	No	\$2,000,000	1	352	100%	\$5,700
Diamond Grind	No	\$250,000	1	352	100%	\$700
Panel Replacements						
Tacoma (2006)	Yes	\$735,000	10.4	29	0.79%	\$25,300
Federal Way (2006)	Yes	\$1,000,000	11.4	54	1.35%	\$18,500
Bellingham (2003)	No	\$660,000	13.2	265	5.70%	\$2,500
Vancouver (2006)	No	\$1,600,000	16.5	233	4.01%	\$7,000
Spokane (2007)	No	\$300,000	11.1	36	0.92%	\$8,000

15

**LCCA suggests panel replacement is warranted if it can extend life by 10 years or more and less than 10% panels replaced**

	Agency Cost	User Costs	Total Cost
Total Reconstruction	\$2.1 million	\$8.6 million	\$10.7 million
Replace 10% of total (35 panels/mile)			
5 yrs extended life	\$2.4 million	\$9.3 million	\$11.7 million
10 yrs extended life	\$2.1 million	\$8.7 million	\$10.8 million
Replace 5% of total (17.5 panels/mile)			
5 yrs extended life	\$2.1 million	\$9.3 million	\$11.4 million
10 yrs extended life	\$1.8 million	\$8.7 million	\$10.5 million
15 yrs extended life	\$1.5 million	\$8.0 million	\$9.5 million
Replace 1% of total (3.5 panels/mile)			
5 yrs extended life	\$1.8 million	\$9.3 million	\$11.1 million
10 yrs extended life	\$1.5 million	\$8.7 million	\$10.2 million
15 yrs extended life	\$1.2 million	\$8.0 million	\$9.2 million
Replace 0.1% of total (0.35 panels/mile)			
5 yrs extended life	\$1.8 million	\$9.3 million	\$11.1 million
10 yrs extended life	\$1.4 million	\$8.7 million	\$10.1 million
15 yrs extended life	\$1.2 million	\$8.0 million	\$9.2 million

Note: grey areas are where total reconstruction costs less



**Contractors Favor Extended Closures**

Contractor Actions:  
Tacoma HOV Panel Replacement

- 29 concrete panels to replace
- Planned: Twelve 6-8 hr closures over 4 weekends
- Contractor VE
  - 2 closures
  - 12-hr Saturday closure
  - 16-hr Sunday closure

### Washington State Study Findings

- Panel Replacement Cost
  - Rapid: about \$17,000 to \$24,000/panel
  - Traditional: about \$7,000 to \$10,000/panel
- When to replace panels
  - Less than 10% need replacement
  - Improve life by at least 10 years
- Productivity drivers
  - Construction window, panel spacing, mobilization, demolition, dowel bar and tie bar drilling
- Do not damage adjacent panels



### Washington State Accelerated Construction Projects

**Jeff Uhlmeyer**  
Pavement Design Engineer  
Washington State Department of Transportation  
Olympia, WA

**Chris Johnson**  
NW Region Materials Engineer  
Washington State Department of Transportation  
Seattle, WA

**Johnnie Zabel**  
Project Manager  
Salinas Construction Company  
Everett, WA

### Transition to Accelerated Projects

**Former Mindset**

- 28 day strength cure requirement
- Unwillingness to consider other options
- Traffic Office will not allow accelerated projects
- Contractors cannot perform

**Current Mindset**

- Regions have seen it work
- Use on selected projects where it makes sense
- Design Offices – “We will be using accelerated practices”
- Additional training is always necessary to share successes
- Expertise is being developed

21

### Accelerated Construction Projects Traffic Volumes (Seattle Area)

Project	<u>Directional</u> ADT
I-5 James Street to Olive Way	122,000
I-5 Pierce Co. Line to Tukwila Stage 2	95,000
I-5 Pierce Co. Line to Tukwila Stage 4	86,000
I-5 Tacoma Panel Replacements	70,000
I-5 36 <sup>th</sup> St. to Slater Road	40,000
Kennewick Intersections	15,000

22

### I-5 Panel Replacement Projects



Typically weekend closures

### I-5 Panel Replacement Projects

I-5 Pierce County Line to Tukwila – Stage 4

- Bid required 12 overnight closures
- Contractor submitted “short” closure scenario to shorten the project
- Final result was 55 panels completed in 29 hours

I-5 Tacoma Project

- Bid required 12 overnight closures
- Contractor submitted “short” closure scenario to shorten the project – base on previous success
- Final result was 27 panels completed in 19 hours



### Future I-5 Construction Projects

I-5 Pierce County Line to Tukwila – Stage 2

- Replaces two lanes (3 mile section)
- Two 55 hour weekend closures planned
- Ready for construction once funding is established

I-5 36<sup>th</sup> Street to Slater Rd.

- Replaces 200 concrete panels (three mile section)
- Several 55 hour closures are included in the contract
- Region requested weekend closures at design inception to lessen traffic impacts

### I-5, James Street to Olive Way

Four 55-hour weekend closures  
Composite lane reconstruction  
& PCC panel replacements  
122,000 directional vpd

### Project Location

- Southbound Interstate 5
- Downtown Seattle
- 122,000 Directional ADT
- Extremely Congested Area
- Required noise mitigation

### The Project

Southbound Interstate 5 - Downtown Seattle

122,000 directional vpd, congested area


Poor composite lane      Cracked PCC Panels

### Public Notification

-Required noise mitigation

- 36,000 Informational Fliers
- 750 Construction and Noise Information Fliers handed out to residences and businesses within 500' of the project
- TV and Radio Announcements
- E-mail notification and website updates

### Traffic Control



10 pm Friday to 5 am Monday

13 in. JCP over 3 in. HMA base; opening strength = 2,500 psi

### Construction & Traffic Control




10 pm Friday to 5 am Monday




### Construction Process







33  
33

### Challenges

- Mother Nature
- Nine "Go – No Go" Decisions
- Noise variance
- Walls & structures
- Undefined objects
- Grade breaks

### Outcome

### What Has Worked Well for WSDOT

- Experienced Crews
- Standby Equipment & slipform paving
- Project Access
- Defined Staging Area in Plans
- Complete Scheduling
- Intense Public Notification
- Well Thought Out Back-Up Plans
- Cooperation of WSDOT Specialty Groups & Contractors





### Project Overview

- 235,000 VPD Section of I-75
- 655,000 SY PCC = 240,000 CY BATCHED
- 95 Lane – Miles of PCC Reconstruction
  - 12 in. JCP over min. 3 in. AC: 2,500 psi @ 24 hrs
- 6 Major Traffic Switches
- 4 Zones of Differing Lane Closure Restrictions
- Extended Holiday Shut Downs (6 weeks from Thanksgiving to New Year's)
- 100% Grind on ALL Completed PCC Pavement

### Project History

- ORIGINALLY DESIGNED AS ASPHALT MILL & INLAY REHAB
  - GDOT OFFICE OF MATERIALS DISCOVERED A DEFICIENT "DEEP" LAYER OF ASPHALT
- REDESIGNED ON FAST TRACK AS DEEP MILL AND PCC INLAY
- LET IN MARCH 2006; NTP APRIL 26, 2006
- ORIGINAL PROPOSAL - CONTRA-FLOW TRAFFIC CONTROL OVER 32 WEEKENDS ONLY
- AWC & GDOT AGREED ON V.E. PROPOSAL TO ELIMINATE CONTRA-FLOW METHOD OF M.O.T.
- 8 MONTH NEW BATCH PLANT PROCUREMENT
- FIRST POUR MARCH, 2007

### DISINCENTIVES/INCENTIVES

- FAILURE TO REOPEN ALL LANES AT TIMES SPECIFIED (Weekdays)
  - \$ 10,000 PER HOUR
- CONTRA-FLOW WEEKENDS (2 lanes open) USED BEYOND 32 ALLOWED
  - \$ 250,000 PER WEEKEND
- FAILURE TO REOPEN RAMPS
  - \$ 10,000 PER CALENDAR DAY
- FAILURE TO COMPLETE ALL WORK BY APRIL 30, 2009
  - \$ 500,000 LUMP SUM + \$10,000 PER DAY
- COMPLETE PROJECT 100 DAYS EARLIER THAN 4/30/09
  - +\$ 1,000,000

32 Weekend closures only

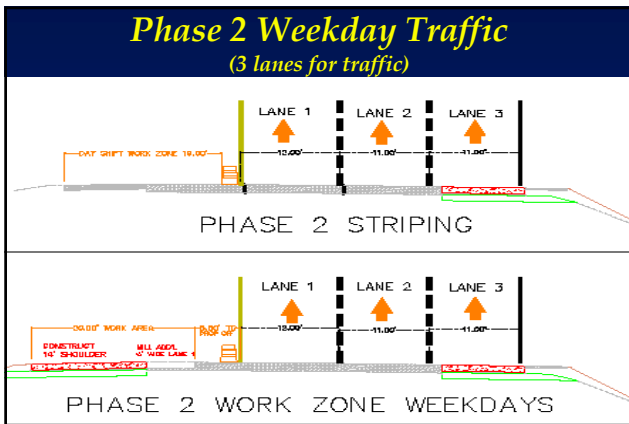
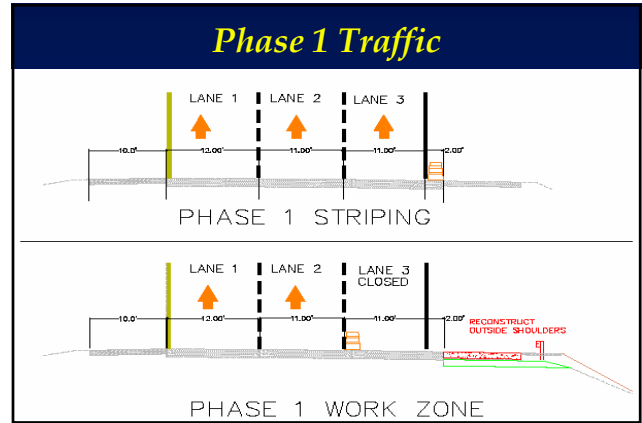
### Value Engineering Summary

- Eliminated weekend only contra-flow as MOT method (2 lanes open all times)
  - VE Revised staging plans.
- Perform all work utilizing only single lane closures – eliminate all double lane closures
- Total Contract cost savings of \$2.3 Million

### Archer Western Plant Facilities

- Two Erie Strayer MG-12CP Plants
  - Primary plant – new
  - Secondary plant – emergency/maintenance
- 3 Mix Designs
  - Class 1 – Mainline shoulders, Lane 3
    - 28 day requirement – 3000 psi
  - Class 3 – Ramps
    - 28 day requirement – 3000 psi
  - HES – Ramps, Lanes 1 and 2 (weekends)
    - 24 hour requirement – 2500 psi
    - 72 hour requirement – 3500 psi

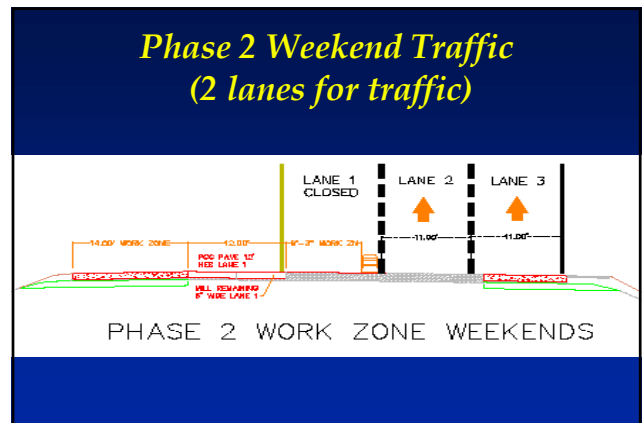


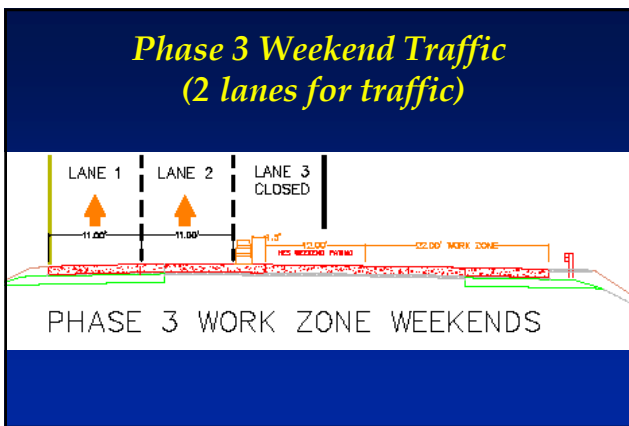
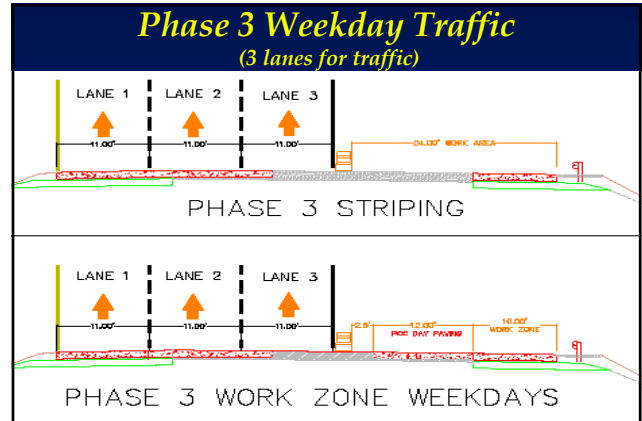


### Phase 2 PCC Paving - 14' Inside Shoulder

Solution

- Gomaco 2600 Placer/Spreader
- No truck egress problems
- Better finished product
- Better production = less traffic exposure





### Project Challenges

➤ CHALLENGE:

- Fast Traffic, Drunk Traffic, Frustrated Traffic, Out of State Traffic, Local Traffic, Reckless Traffic, Sleepy Traffic, Stoned Traffic, Lots of Traffic, Crazy Traffic, Long Haul Traffic, Rubber-necking Traffic

➤ SOLUTION(S):

- Reduced speed limit from 65 mph to 55 mph
- Work zone police patrols
- Accelerated schedule



### Summary

- Conventional rapid rehab technology has improved
- Construction is very effective with short or extended full or partial lane closures
- Effective construction traffic management is a key to project success
- Rapid re-opening to traffic is possible

**FULL ROAD CLOSURE FOR WORK ZONE OPERATIONS: A Case Study**

Reducing the Impact of Construction During the Rehabilitation of a Major Interstate Highway

Interstate 95 in Washington, Delaware



## Fast Track Reconstruction of an Urban Freeway Corridor

The Michigan Department of Transportation's Rehabilitation of 14 Miles of M-10 (LODGE EXPRESSWAY) in Detroit

## Detroit Metro Region freeways

- I-75
- I-69
- I-94
- I-96
- I-696
- M-5
- M-8
- M-10**
- M-14
- M-39
- M-53
- M-59

**John C. Lodge Freeway**

- Major interchanges

## History of the Lodge Freeway

- Originally constructed in the early 1960's; Existing pavement in 2004

## Existing Roadway Section

- Low-grade freeway with walls, slopes and under existing bridge

## Bridge Corridor Considerations

- 50 bridges spread across 17 miles
- 4 bridge replacements
- 1 superstructure replacement
- 14 deck replacements
- 2 deep overlays
- 29 bridge rehabilitations

## Challenges

- Maintaining traffic

# To Close or Not to Close?



## To Close or Not to Close?

- Part-width construction with two lanes each way

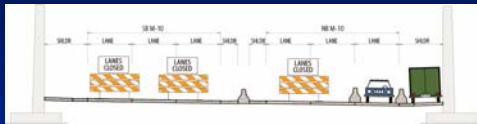


### Why not?

- Not possible in all locations
- Intermixes construction and public traffic
- Longest construction duration
- Work zone safety concerns

## To Close or Not to Close?

- Directional crossover with one lane each way



### Why not?

- Significant travel delays
- Full ramp access not possible
- Increased construction duration
- Work zone safety concerns

## To Close or Not to Close?

- Closed – the preferred alternative** – allows contractor full access to the work site



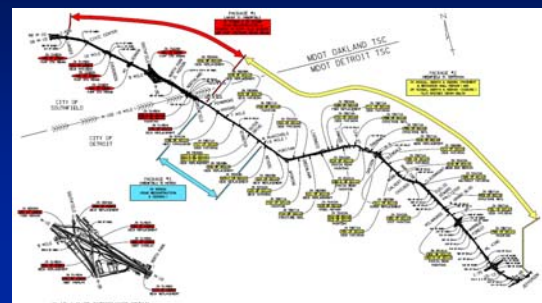
## Why was Closure Possible?

- Availability of alternate routes on existing system



## Project Packaging

- One Project – Three Contracts



## Contractors and low bids

<u>Package 1 – Greenfield to Lahser</u>	
Dan's Excavating, Shelby Twp, Michigan:	\$60,000,000
<u>Package 2 – Jefferson to Greenfield</u>	
Posen Construction, Utica, Michigan:	\$55,000,000
<u>Package 3 – Meyers to Greenfield</u>	
Dan's Excavating, Shelby Twp, Michigan:	<u>\$25,000,000</u>
<b>Total for Project Corridor:</b>	<b>\$140,000,000</b>

**New Pavement: 10 in. JPC over 6 in. base**  
**First Contract Awarded: Early February 2007**  
**Planned Opening to Traffic: November 2007**  
**Many Sections Opened to Traffic: September 2007**

## Package 1 (Oakland Office)



- 5.0 miles reconstruction
- 11 bridge rehabs
- \$55 million construction cost
- 3-month A+B construction schedule
- \$1.0 million max incentive



## Package 1 Challenges

- Completed in 80 Calendar Days = 075 Working Days + 5 Safety/ Holiday Breaks
- 360,000 syd of Pavement Removal
- 310,000 cyd of Earth Excavation
- 300,000 ton of Agg Base Placed
- 119,300 cyd of Concrete Produced at On Site Portable Concrete Batch Plant
- 366,000 syd of Concrete Pavement & Shoulders
- 53,000 lft of Slip-Formed Barrier Wall
- 22 Ramps and 11 Bridges Reconstructed
- \$4 Million Dollars of Additional Contract Work
- \$750,000 of Earned Incentive of \$1 Million Possible



## Package 2 (Detroit Office)



- 11.5 miles road & ramp rehab
- 40 bridge rehabs/replacements
- \$60 million construction cost
- 9-month expedited construction schedule
- \$1.5 million incentive/disincentive



## Package 2 Challenges

- Completed in 179 Calendar Days
- 40 Bridges Reconstructed
- 602 Separate Bridge Concrete Pours
- 11.5 miles of Freeway Rehab, while maintaining at least one lane of traffic in each direction
- Earned Full Incentive of \$1,500,000



## Package 3 (Detroit Office)



- 2.0 miles reconstruction
- Corridor concrete surface coating
- \$25 million construction cost
- 3-month expedited construction schedule
- \$900,000 incentive/disincentive



## Package 3 Challenges



- Completed in 89 Calendar Days
- Started work 5 Minutes after Award issued by MDOT
- Project Built within a Depressed / Walled Freeway
  - 104 ft Wide
  - 2 Access Points
- 36,400 cyd of Concrete Produced from Same On Site Concrete Plant Concurrent with Phase One
- Earned Full Incentive of \$900,000

## Quality Challenges



- 214,000cyd of Concrete Tested for QA/QC
  - 11,000 QA Cylinders & 5,000 QC Cylinders
  - 650 Beams for Allowing Construction Traffic
  - Most Days Required 10 Concrete Techs On Site
- Concrete Production
  - Shilstone Type Mix – High Rate of Agg Testing
  - Optimizing Mix
- Economics, Weather and Scheduling - Extreme Hot Weather
- Ride Quality - 28.04 inch/ mile (PI0) Achieved on 39 lane miles
- Concrete Pavement Warranty - 5 Year Material and Workmanship

## Bridges – before and after



## Barriers and slopes – before and after

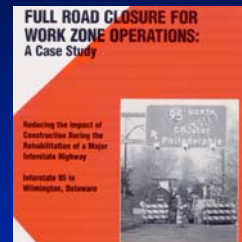


## Happy Ending - Before and after



## Summary

- Conventional rapid rehab technology has improved
- Construction is very effective with short or extended full or partial lane closures
- Effective construction traffic management is a key to project success
- Rapid re-opening to traffic is possible





**URBAN ACCELERATED RECONSTRUCTION**

- Possible to do fast-track full-closure reconstruction in an urban setting
- Need alternate viable routes
- Extensive communications plan
- Delivering the project sustainably!

*Thank You!*