

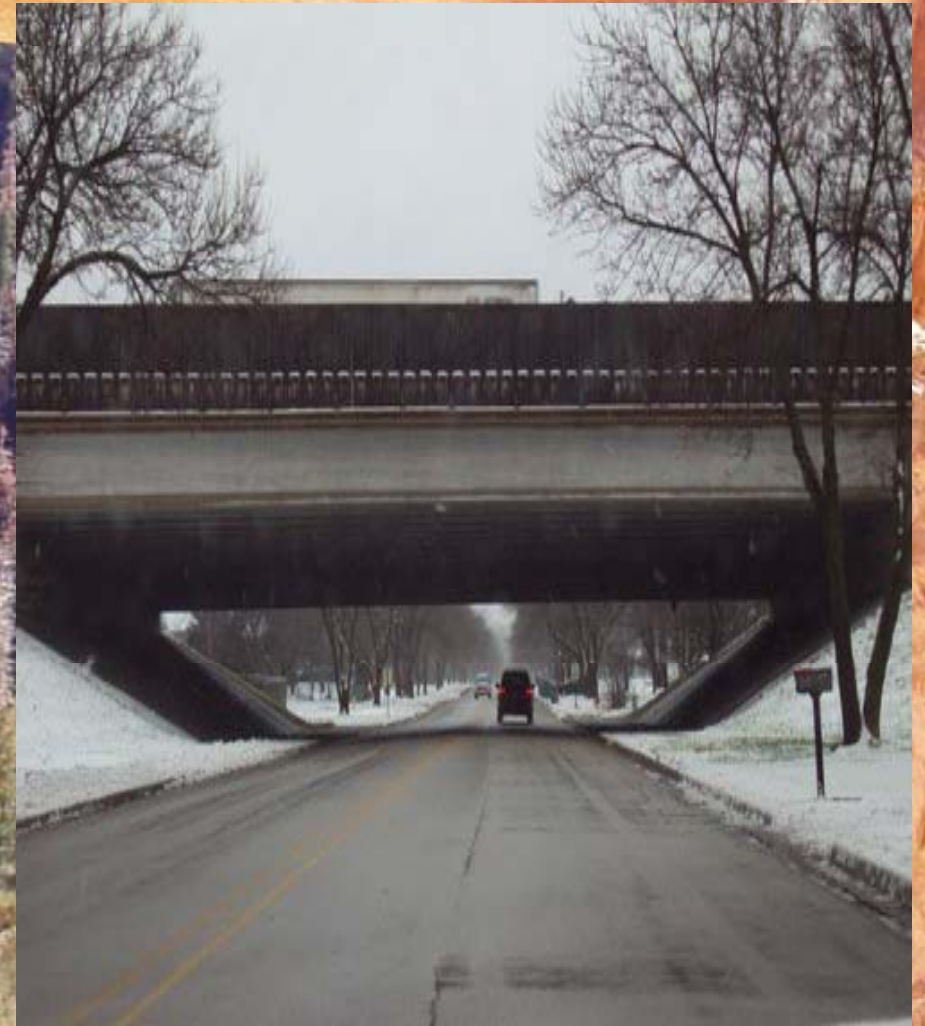
# District Five Concrete Pavement Update: 2010

FTBA/FDOT Construction Conference

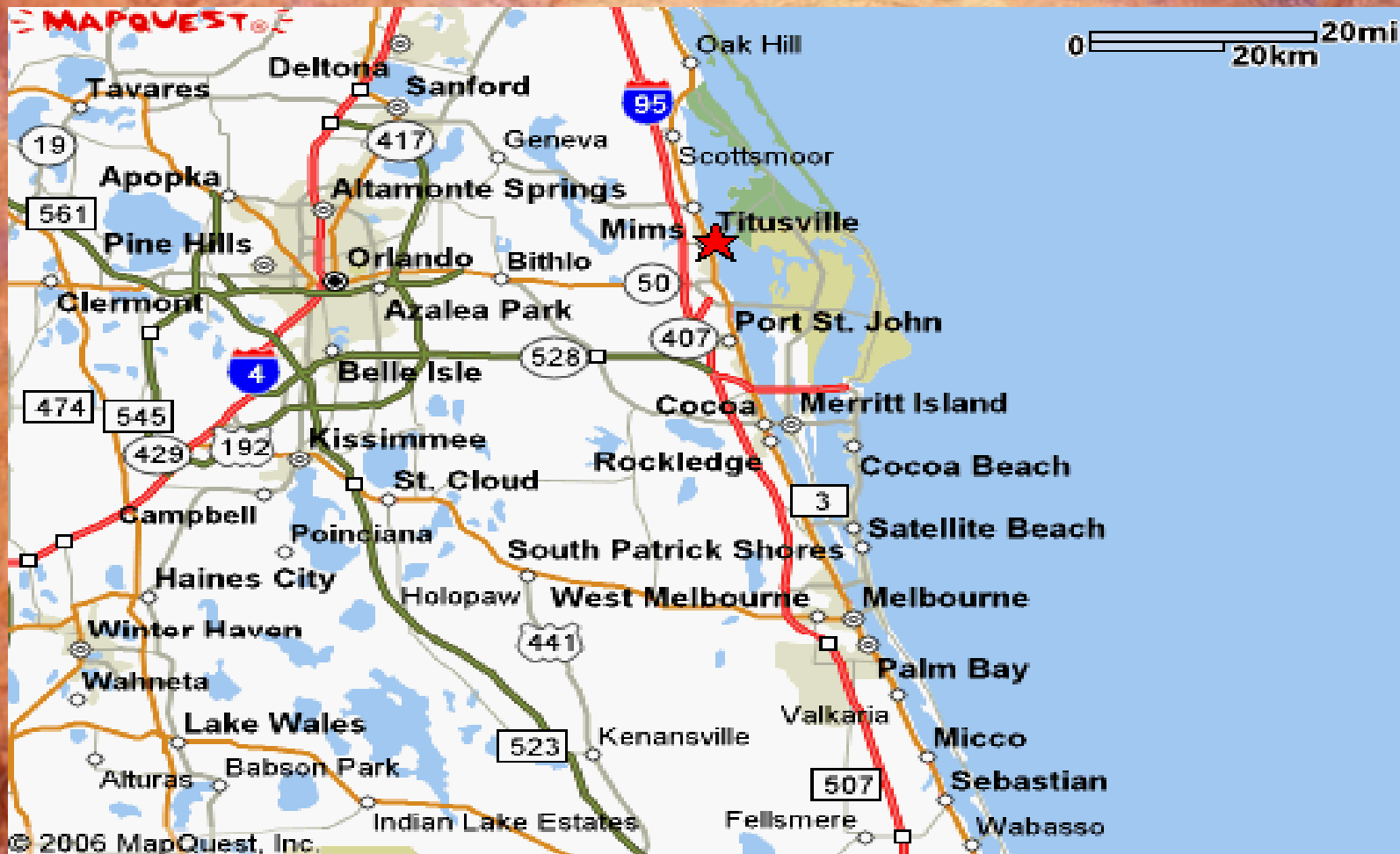
Roger C. Schmitt, P.E.

Orlando February 2010

# Continuously Reinforced Concrete Pavement Constructed in 1968



# I-95 Project Brevard County



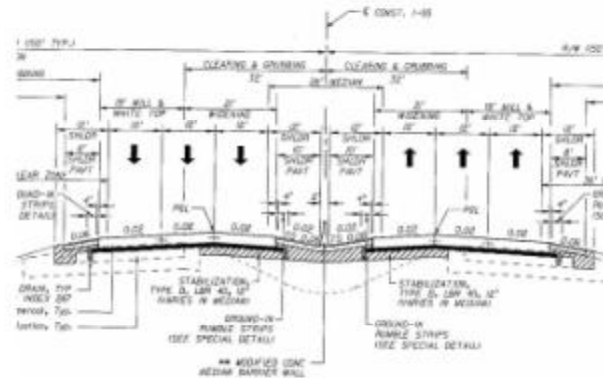
# I-95 Brevard County: Lessons Learned and Areas for Future Improved

- Items to be discussed:
  - Concrete Thickness
  - Stabilized Subgrade
  - 1 inch Asphalt Layer
  - Slag Mix Designs and Time to Saw Cut Joints.
  - Asphalt Treated Permeable Base Stripping
  - Use of DBI: Dowel Bar Insertter
  - Use of TBI: Tie Bar Insertter

# I-95 Brevard County: Lessons Learned and Areas for Future Improvement

- Items to be discussed:
  - Slab Removal and Replacement
  - Drilling and Installing Dowel Bars
  - Drilling and Installing Tie Bars

# Design Typical Section



New lanes were constructed of:

- 13-inches of PCC concrete
- 4-inches of asphalt treated permeable base drainage layer
- 1-inch layer of structural asphalt
- 12-inch stabilized subgrade.

Existing lanes were constructed by:

- Mill existing asphalt to match concrete pavement grade
- 1-inch layer of structural asphalt
- 4-inch layer of asphalt treated permeable base drainage layer
- 13-inches of PCC concrete

## **Problem:**

**Truck traffic on the newly constructed stabilized subgrade caused rutting and wheel marks as the subgrade dried out.**

## **Solution:**

The subgrade was brought to optimum moisture and primed. This preserved the moisture content and kept the rutting issue at a minimum.

**Contractors may want to use a graded aggregate to assist in firming up the stabilized subgrade.**



**Problem:**

**One inch of structural asphalt over stabilized subgrade does not provide much support for subsequent operations**

**Solution:**

**The Department has changed its index to increase the thickness of the asphalt layer to 1 ½ inch.**



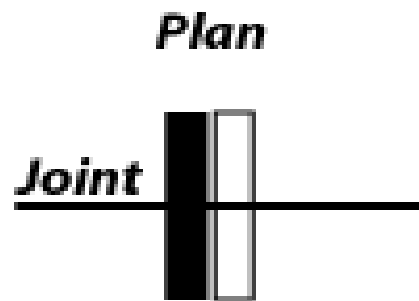
**Problem: Dowel bar insertion and maintaining proper alignment.**

Florida specifications prohibit the use of a dowel bar inserter. The Design build team included this method in their proposal with the condition that all joints would be scanned with a magnetic scanner to insure proper dowel alignment.

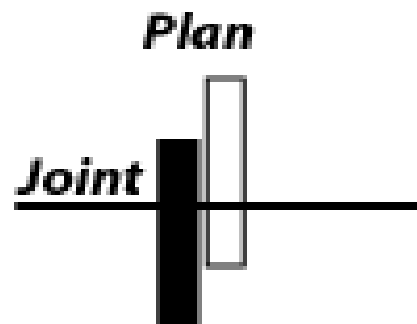


The specification was strict and hard to meet. The design build team hired a consultant to study the joint movement. The study indicated that even moderate misalignment still allowed joint movement and the tolerances were reduced. **District Five is writing a new specification to allow a joint score calculation which is recommended by the FHWA.**

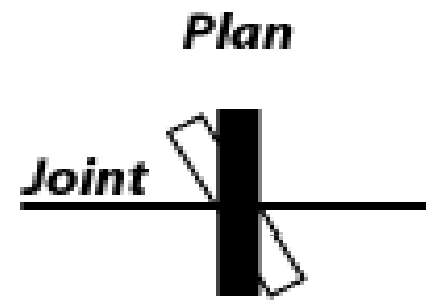
# Dowel Placement Criteria



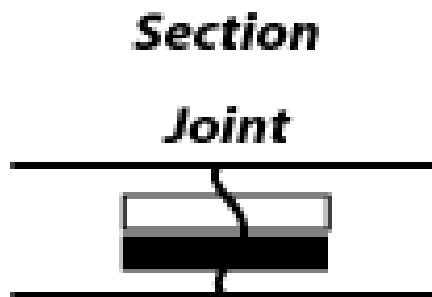
**Horizontal Translation**



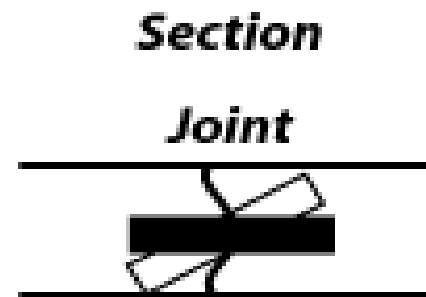
**Longitudinal Translation**



**Horizontal Skew**



**Vertical Translation**



**Vertical Tilt**

**Problem:**

**Establishing the correct time to green cut the transverse joints.**

The specification calls for the initial cut when the concrete was between 4 and 12 hours old.

**Solution:**

The concrete mix that is utilized is a 50% cement and 50% slag mix. This mix is slower to set than normal mixes. Trial batches were made and sent to the lab to establish initial and final set times, and this information as well as the saw cutter Forman's scratch test were used to determine the correct time. Initial saw cut times were around 24 hours. **The Department will change their specifications for slag mixes.**



**Problem: Potential Asphalt Permeable Base Stripping.**

**Solution:**

The Department cored several existing pavements with Asphalt Treated Permeable Base. The results indicated a majority of the existing projects had already stripping of the Asphalt Treated Permeable Base.

**Based on the absorption of the aggregate a greater % of Asphalt Binder was added to the Asphalt Treated Permeable Base that was equal to the absorption rate and in addition anti-stripping additives were added to the mix.**



## Problem:

### Tie Bar inserter malfunction:

During concrete pavement operations, the paving equipment placed two lanes per pass or a lane and a shoulder. The project specifications called for the lanes to have tie bars, number 5 bars at thirty inch spacing placed between lanes.

The paving equipment malfunctioned and the bars were not inserted deep enough in many locations.

## Solution:

Various repair procedures were investigated, but none were thought to match the projected lifespan of the concrete. **The final solution was the replacement of over 1,000 slabs.**



# View of Several Slabs Removed



# Over 1,000 Concrete Slabs Replaced



# Replacement of Adjacent Slabs



# Dowel Bar Installation Problems



# Tie Bar: Installation Problem



# Conclusions:

- I-95 is a very Smooth Concrete Pavement
- Concrete Pavement Installation requires the Project Engineer and Inspector to pay attention to details.
- Dowel and Tie Bar Inserters need close attention and inspection during construction.
- Slab Replacement is not recommended for the Contractor or the Inspector.

# Highways for Life: US 92 Florida



First Seeding Mile of Concrete Pavement  
Lincoln Highway Malta, Illinois

# Project Information

- Project will rehabilitate an existing 4-lane Divided Highway about 10 miles long.
- Approximately 10% of the slabs will be replaced.
- A 1.7 mile section of the WB lanes will be completely reconstructed and the highway will be raised to avoid future flood water overtopping during heavy rainfall.

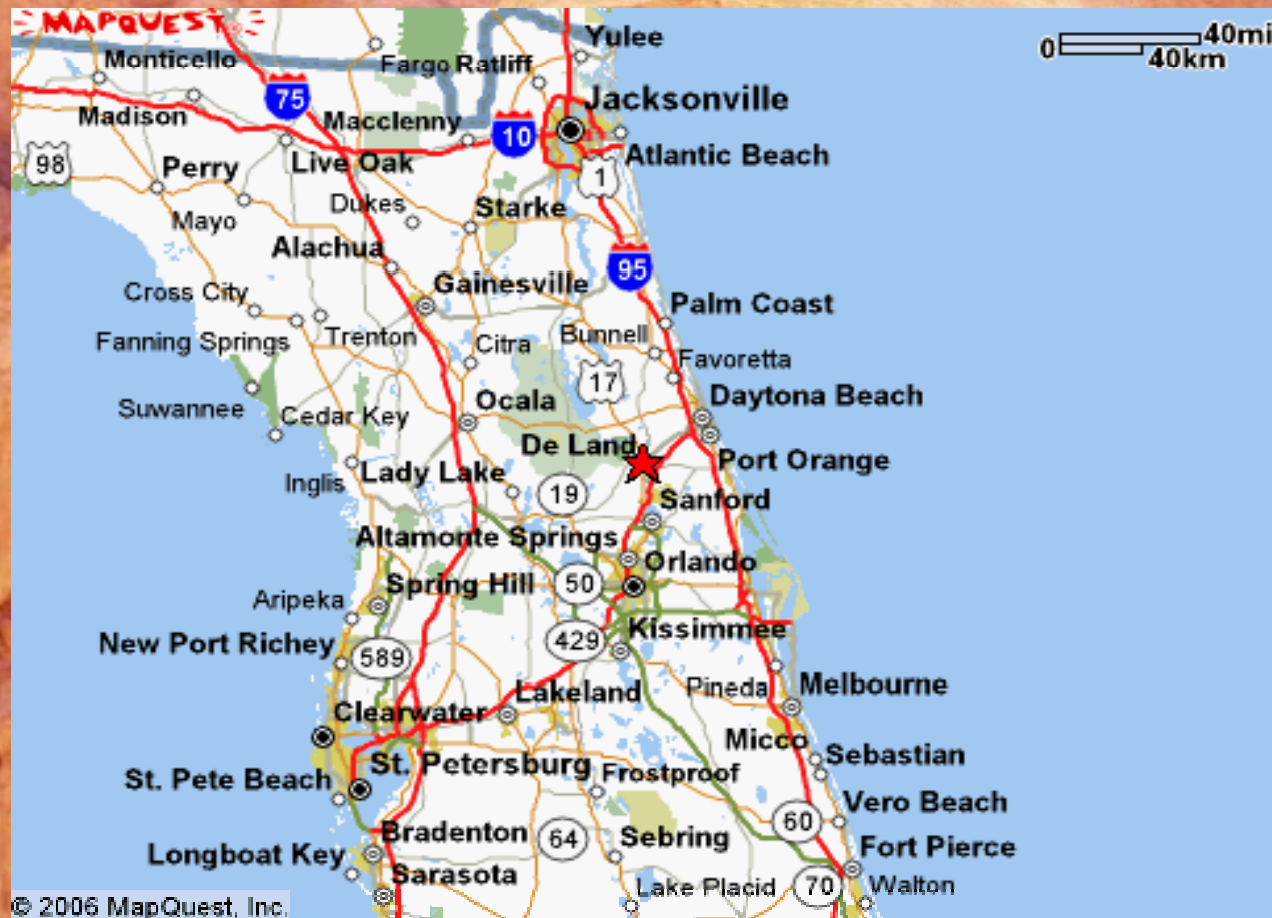
# Project Information

- The 1.7 mile long Raised Section will consist of:
  - Removal and crushing of the existing trapezoidal concrete section about 8" thick.
  - The concrete will be recycled into a 8" thick graded aggregate base.
  - Except in the Highways for Life section: the design calls for a 9" thick Jointed Concrete Pavement.

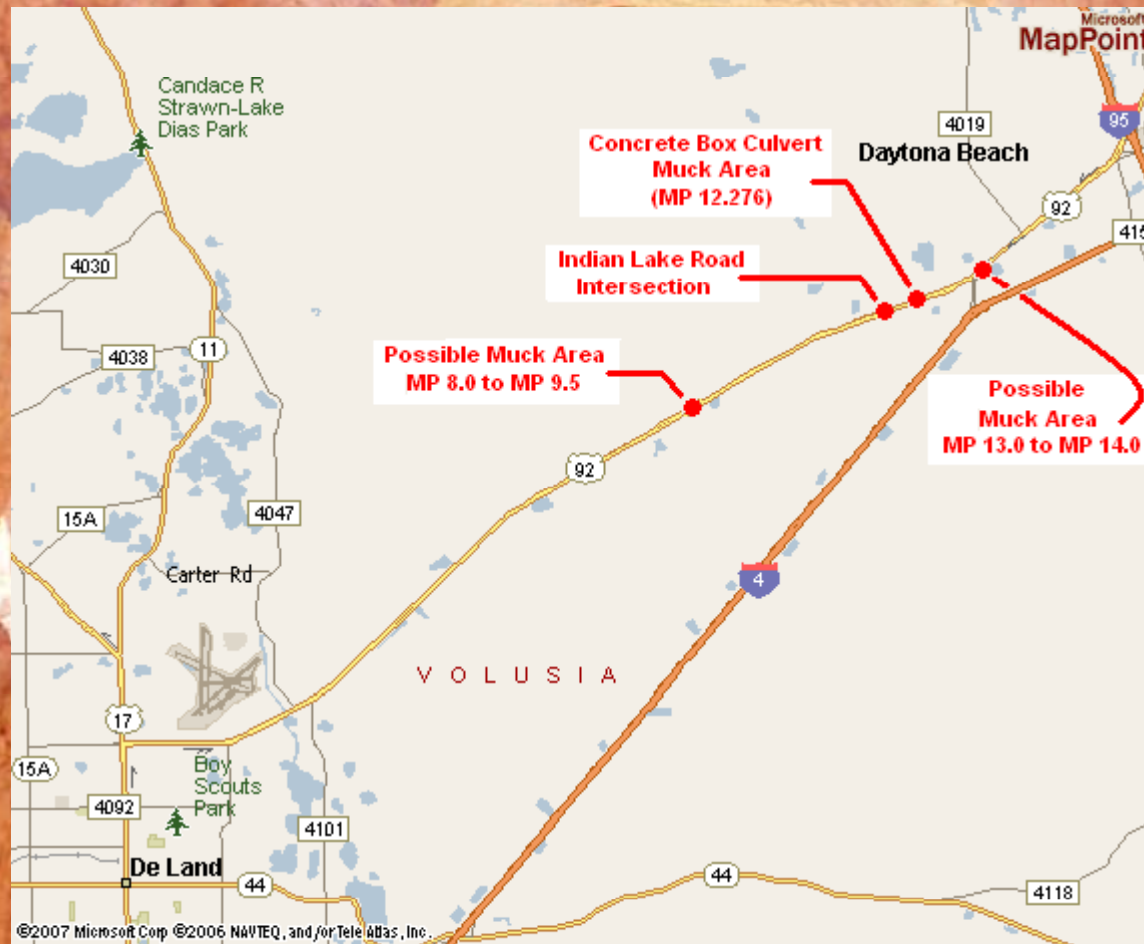
# Project Information

- The Highways for Life Section will consist of a Precast Post-Tensioned Concrete Panels about 9 ½ " thick.
- The entire concrete pavement will be ground after slab replacement and pavement construction.

# Relative Project Location



# US 92 Project



# Existing Concrete Pavement

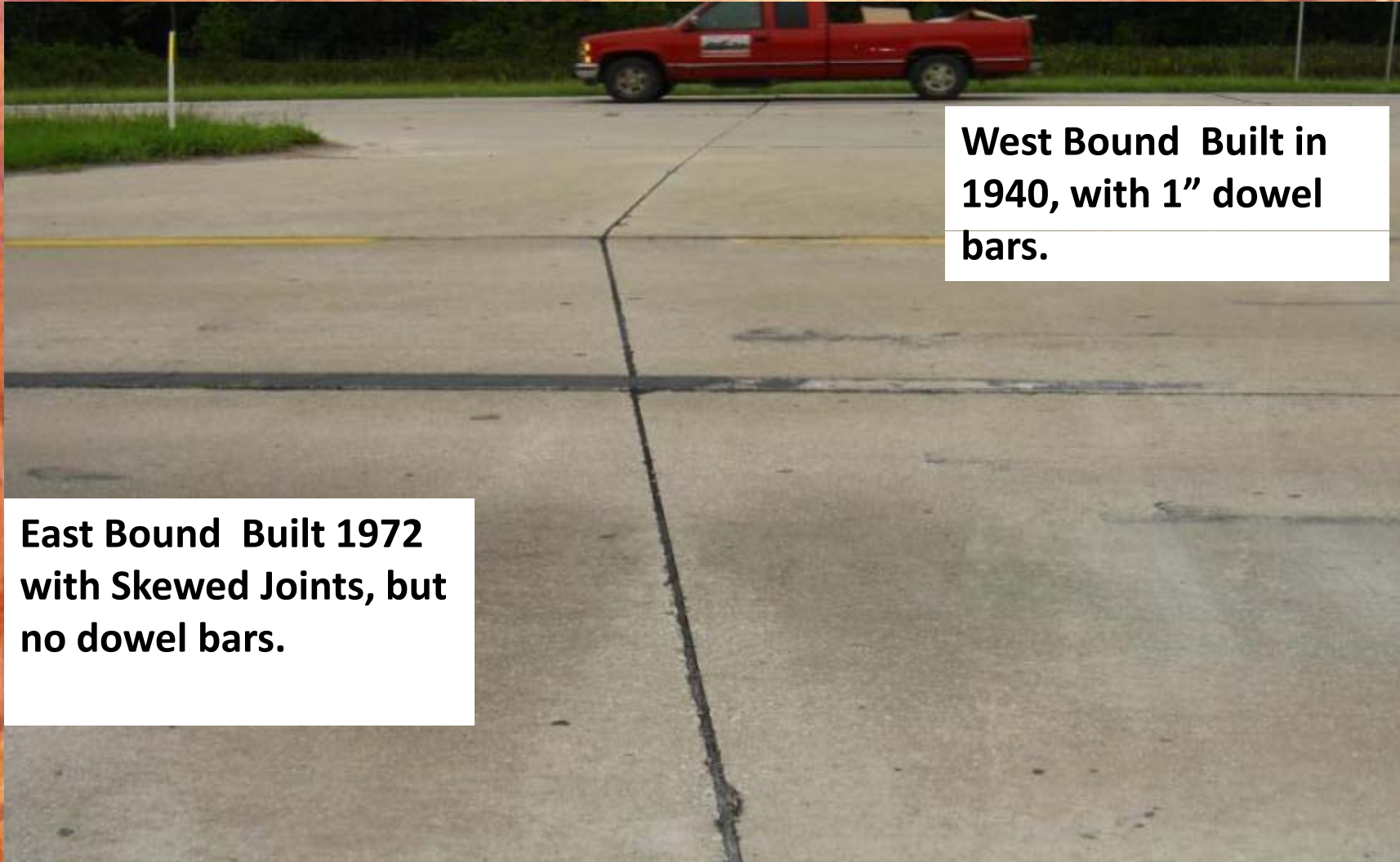
**US 92 EB and WB Joints**



**US 92 WB Highways for Life**



# US 92 Typical Joints



**West Bound Built in 1940, with 1" dowel bars.**

**East Bound Built 1972 with Skewed Joints, but no dowel bars.**

# Slab Removal and Replacement



# Finishing



# Concrete Pavement Grinding

**Typical Grinding Equipment**



**Before and After Grinding**



# Typical from Texas Pilot Project



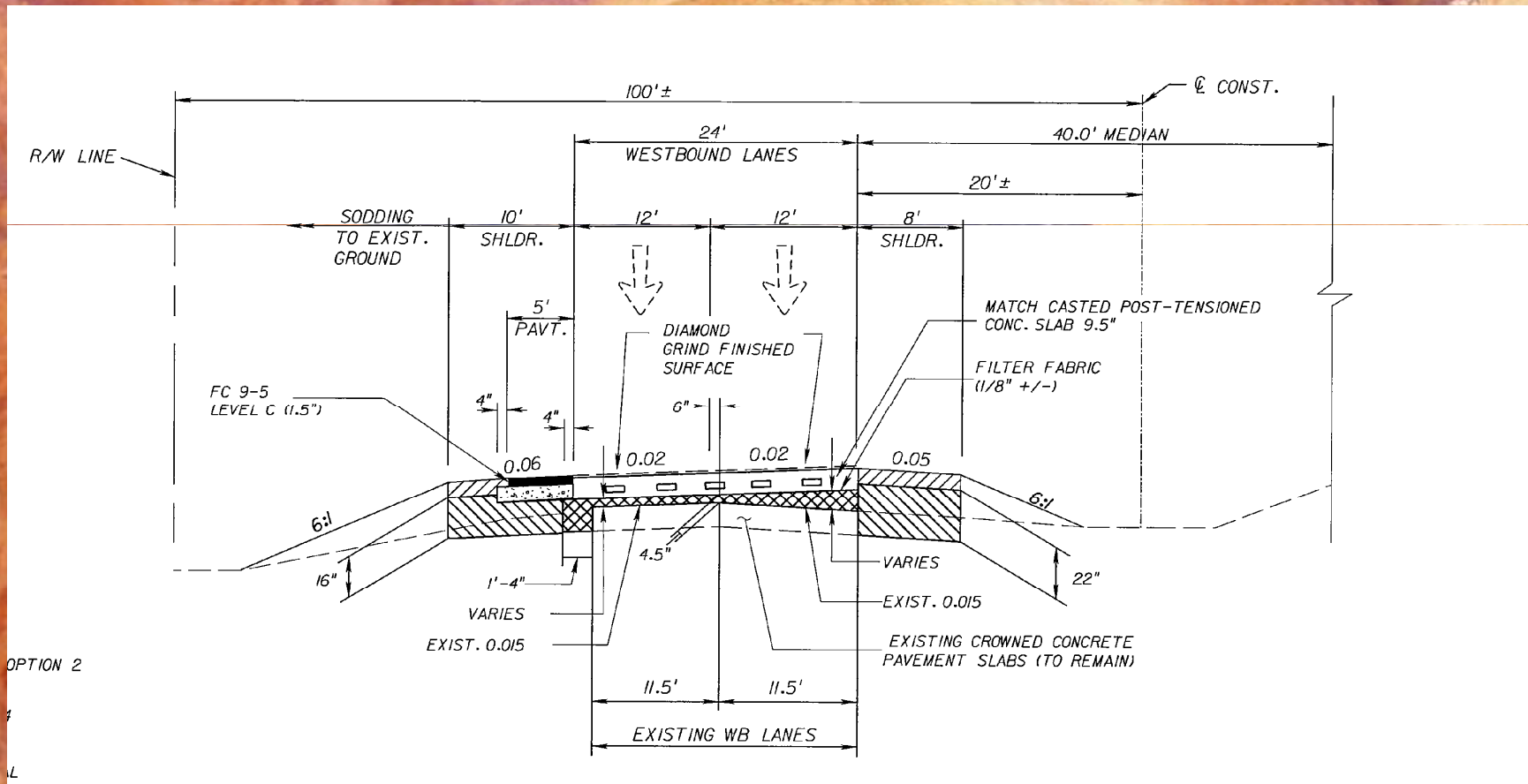
# Precast Pavement Panels



# Precast Pavement Panels

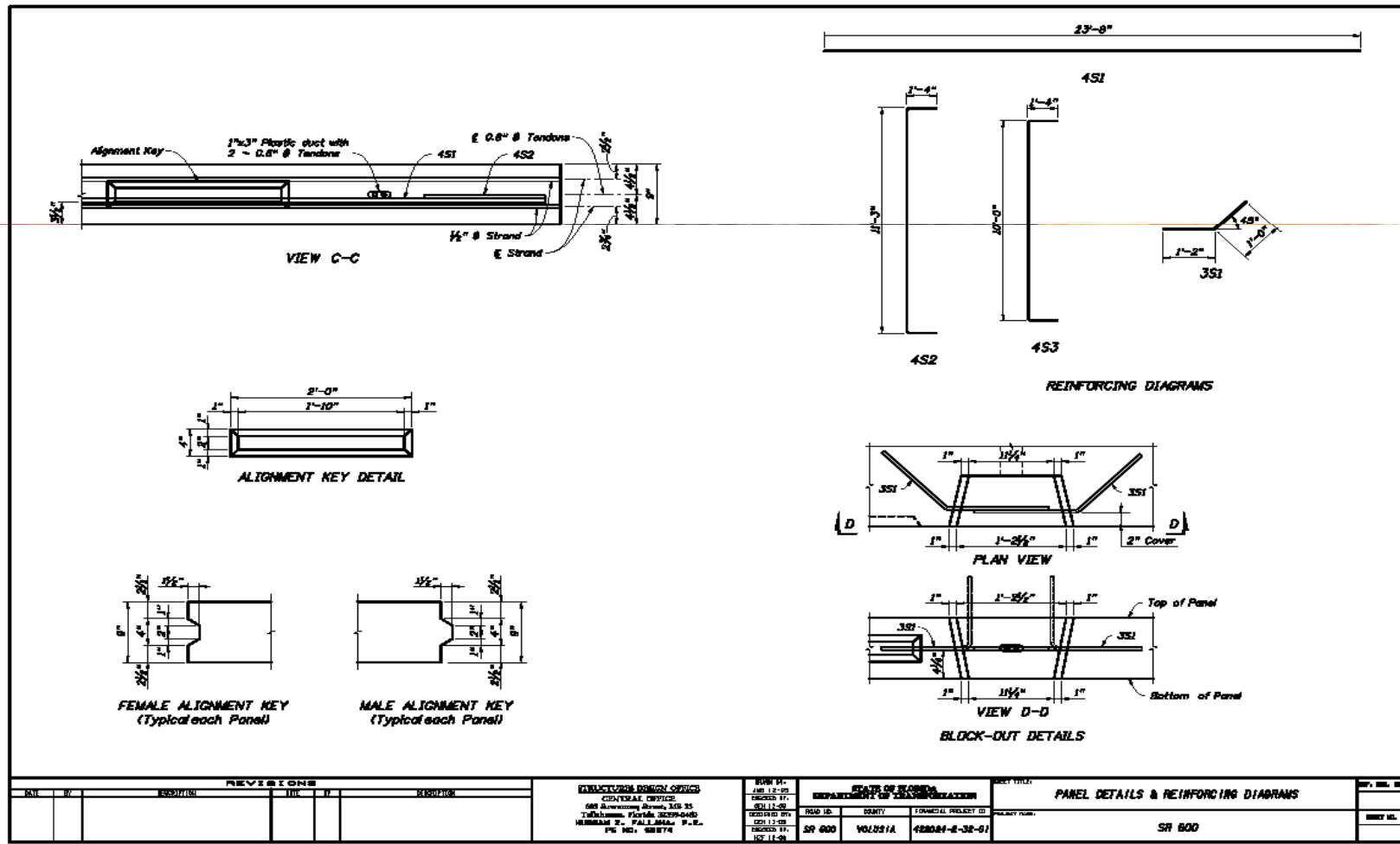


# Highways for Life Details

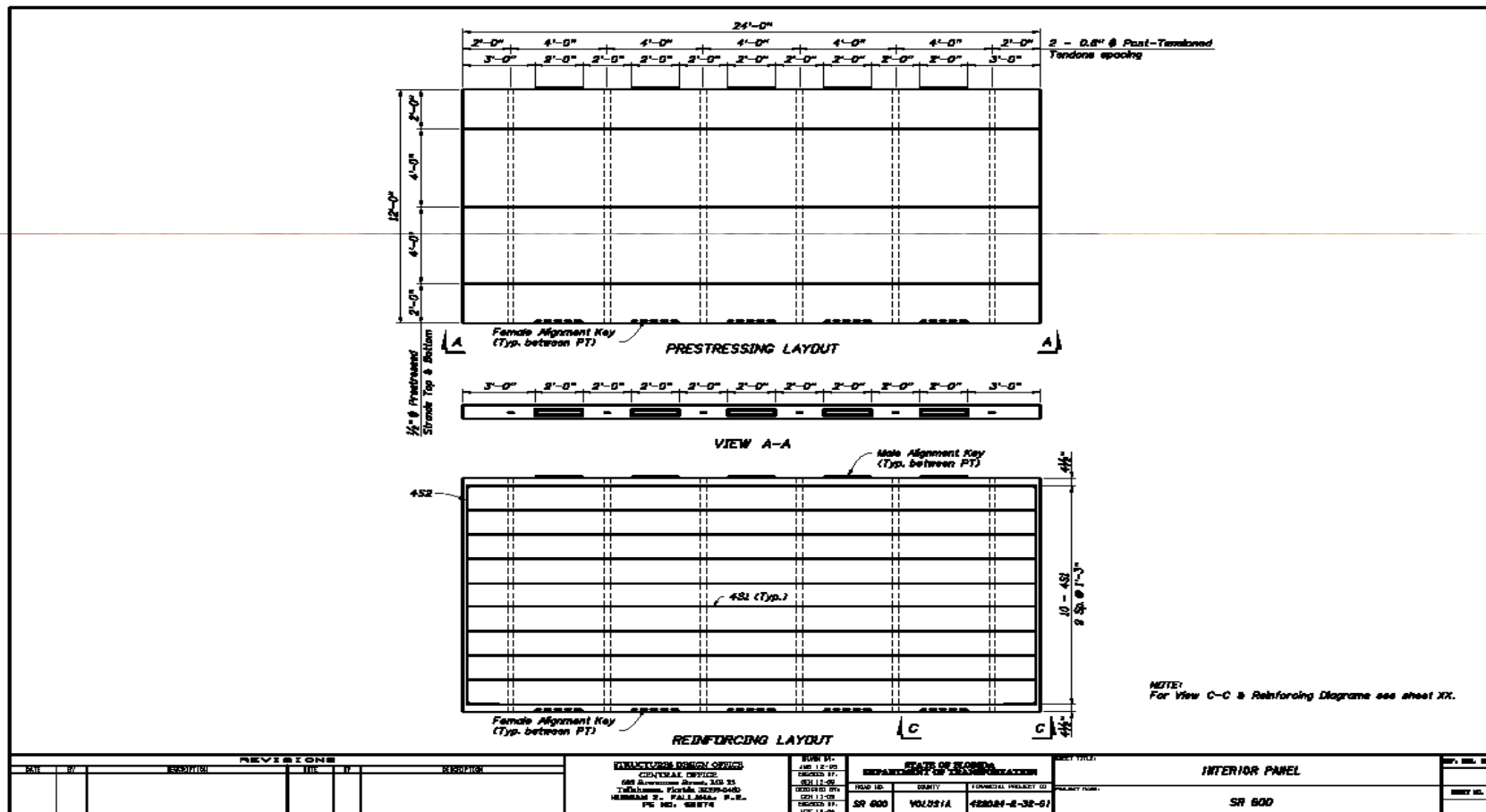


TYPICAL SECTION DETAIL  
 SR 600 PRECAST PAVEMENT TEST SECTION  
 STA. 1504+75.16 TO STA. 1512+75.16 (WESTBOUND)

# Highways for Life Details



# US 92 Details: 24' x 12' Panels



# US -1 Pavement Performance: 21 Years after Construction



FLORIDA  
DEPT. OF TRANSPORTATION  
EXPERIMENTAL  
CONCRETE PAVEMENT OVERLAY  
NEXT 2 MILES

# Edgewater, Florida



# Project Information

❖ **Location:**

**US 1, South of Edgewater – District 5**

❖ **Length:**

**1.9 miles**

❖ **Type:**

**Experimental Whitetopping (1.9 miles section of an 8 mile asphalt resurfacing project).**

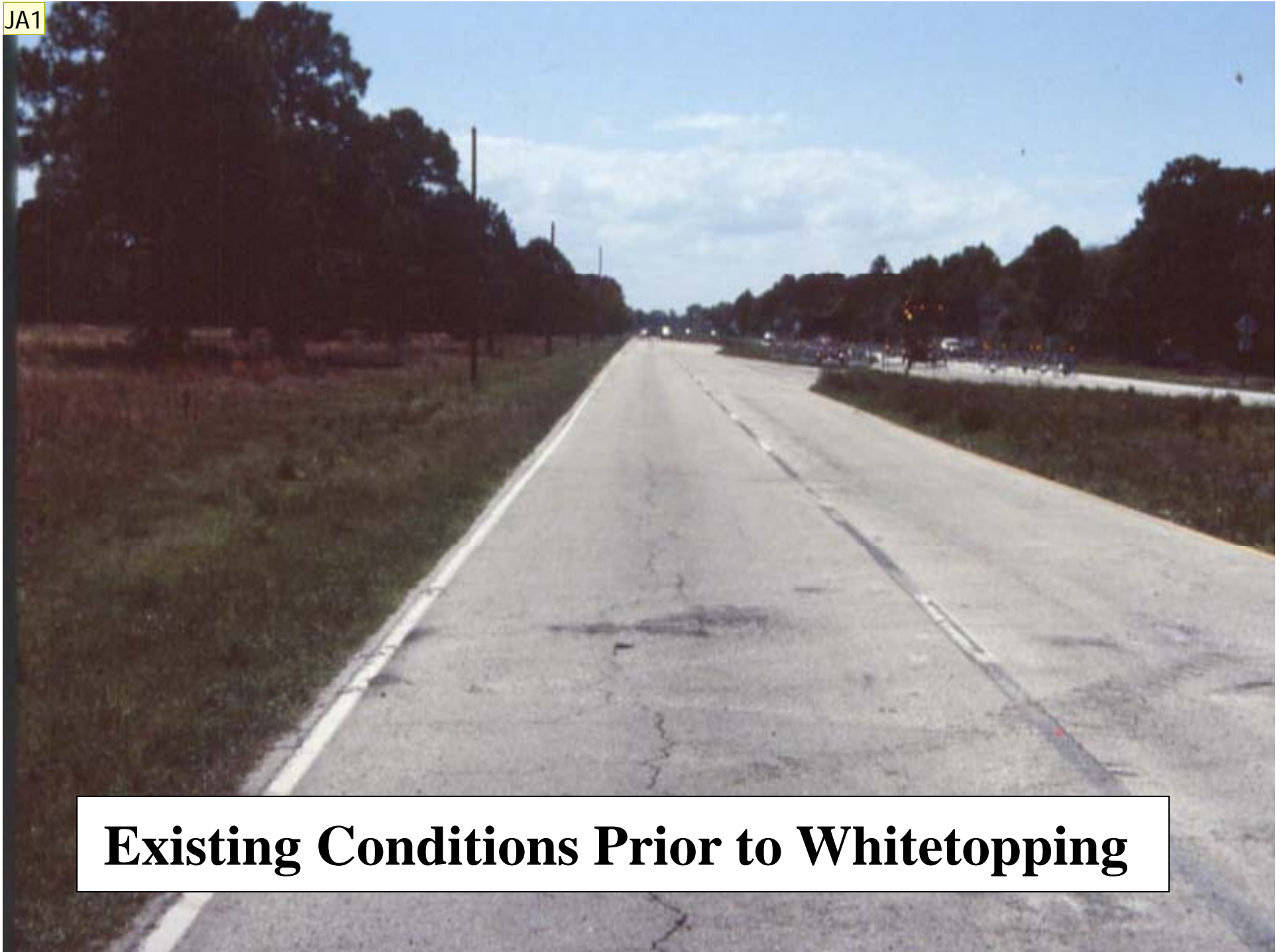
❖ **Construction Completion:**

**1989**

❖ **Traffic 2004:**

**14,000 AADT - 5% Trucks**

JA1



**Existing Conditions Prior to Whitetopping**

Slide 40

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JA1 the original asphalt suffered from significant cracking and some rutting>

the FDOT decided to use whitetopping as an experimental feature on 1.9 miles of the south bound of us 1.

Jamshid Armaghani, 4/4/2005

JA2

## US 1 Whitetopping Project 1999



## Slide 41

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**JA2**

This the US 1 south of Daytona beach Florida. It is the first whitetopping project in Florida and one of the very few early wt projects in the country. It was built between 1987-1988.

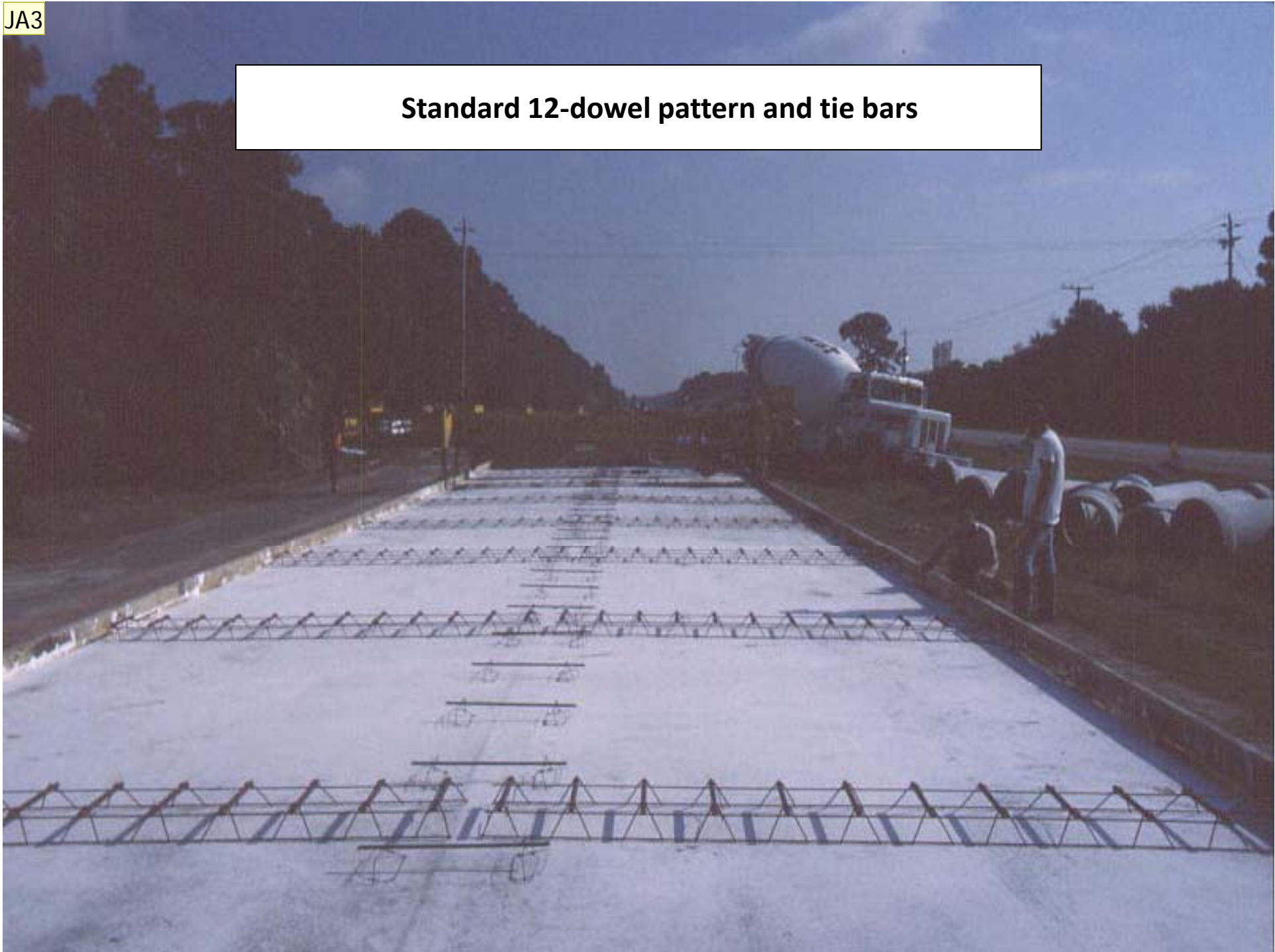
Jamshid Armaghani, 4/4/2005

# US – 1 Today



JA3

**Standard 12-dowel pattern and tie bars**



## Slide 43

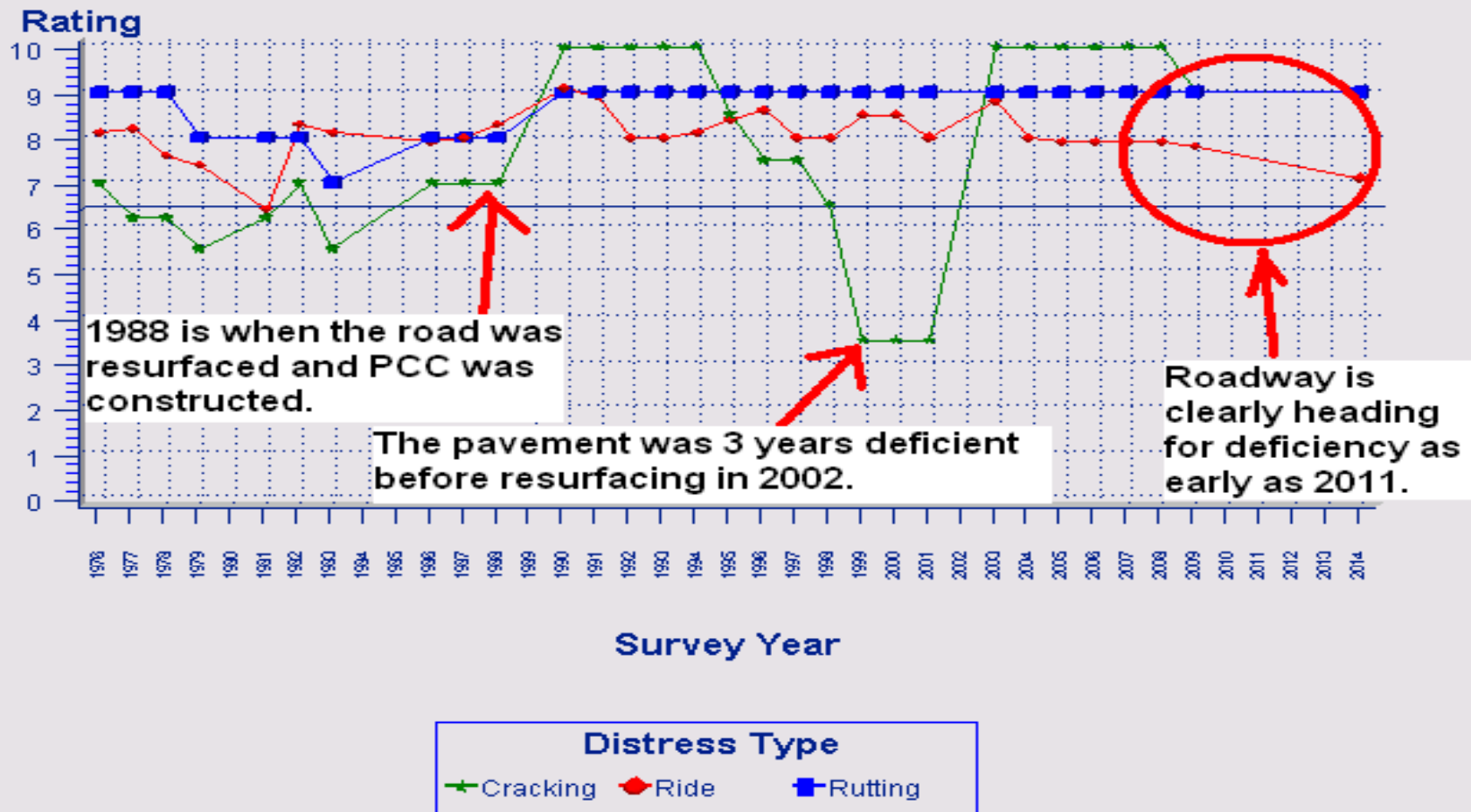
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**JA3**

the standard dowle patern is shown here. the first dowel is 6" from the edge of the lane . all other dowels are spaced at 12" O/C. the tie bars were spaced at 3 ft o/c.

Jamshid Armaghani, 4/4/2005

# PCS Chart US 1 Southbound near PCC roadway



# Initial Construction Costs for 1988

- Based on the Bid Tab for Project 79010-3525 provided by the State Pavement Management Office.
- Only initial material costs were compared, since the overhead and MOT costs would be the same per lane mile.
- Initial Concrete costs were significantly more expensive than a deep mill asphalt resurfacing.
- Over time the Whitetopping Project will be more cost effective than Multiple Mill and Resurface Rehabilitation.
- Let's look at the costs.

# Project Costs to Date

## Project Cost Analysis PCC versus Asphalt 1988-2024

Initial Construction in 1988

Figures from Plans 79010-3525

### 6" PCC

Description	Unit	Amount	Cost	Cost/Mile
Mill 4.5 Inches	SY	7040.00	1.16	8166.40
PCC 6 inches	SY	7040.00	18.60	130944.00
1 inch Type S	TN	7040.00	23.87	8402.24
			<b>Total</b>	<b>147512.64</b>

### Asphalt

Description	Unit	Amount	Cost	Cost/Mile
Mill 4.5 Inches	SY	7040.00	1.16	8166.40
4 inches Type S	TN	7040.00	23.87	33608.96
5/8 inch of FC-2	SY	7040.00	0.90	6336.00
Tack	GA	887.23	1.00	887.23
			<b>Total</b>	<b>48998.59</b>

### 7" PCC

Description	Unit	Amount	Cost	Cost/Mile
Mill 4.5 Inches	SY	7040.00	1.16	8166.40
PCC 7 inches	SY	7040.00	19.35	136224.00
1 inch Type S	TN	7040.00	23.87	8402.24
			<b>Total</b>	<b>152792.64</b>

### 8" PCC

Description	Unit	Amount	Cost	Cost/Mile
Mill 4 Inches	SY	7040.00	1.08	7603.20
PCC 8 inches	SY	7040.00	20.35	143264.00
1 inch Type S	TN	7040.00	23.87	8402.24
			<b>Total</b>	<b>159269.44</b>

### PCC/Asp Cost Per Year Difference

Cul. Total*	PCC	Asphalt	Difference	Diff. (%)
147512.64	6"	48998.59	98514.05	301.05%
152792.64	7"	48998.59	103794.05	311.83%
159269.44	8"	48998.59	110270.85	325.05%

# First Concrete Rehab: 2010

## Asphalt Cost/Mile is Still More Cost Effective

PCC/Asp Cost Per Year Difference						Slab Repair in 2009 Flating Average's Used					
Cul. Total*	Cost/Year	PCC	Asphalt	Difference	Diff. (%)	Description	Unit	Amount	Cost	Cost/Mile	
160109.40	7624.26	6"	4641.76	2982.50	164.25%	PCC 6 inches	CY	23.82	327.32	7796.76	
152792.64	7275.84	7"	4641.76	2634.08	156.75%	PCC 8 inches	CY	24.89	327.32	8146.99	
172216.43	8200.78	8"	4641.76	3559.02	176.67%	Design	EA	LS	3000.00	3000.00	
*-Total PCC Cost 1989-2010						In-House Inspection	EA	LS	3000.00	3000.00	
<b>Asphalt</b>						MOB, MOT, Other	EA	LS	3600.00	3600.00	
Cul. Total*	Cost/Yr					Cul. Total	Cost/Yr			Total	25543.76
97476.95	4641.76					Total Slabs Replaced: 6 (3-6 inch & 3-8 inch )					
*-Total Asphalt Cost 1989-2010						1/2 of 1 percent of all slabs (1262 total)					

ESAL Life Estimate			
	PCC	ASPHALT	
1988-2010	1,910,000	693,000	2002-2010

PCC EF/LF Factors From Rigid Design Manual  
 Asphalt EF/LF Factors from Flexible Design Manual

# First Mill and Resurface 2002

## Asphalt Cost/Mile is Still Cost Effective

PCC/Asp Cost Per Year Difference						Figures from Plans to 404118-1				
Cul. Total*	Cost/Year	PCC	Asphalt	Difference	Diff. (%)	Description	Unit	Amount	Cost	Cost/Mile
147512.64	10536.62	6"	6962.64	3573.98	151.33%	Design	EA	1 LM	6671.63	7541.35
152792.64	10913.76	7"	6962.64	3951.12	156.75%	In-House Inspection	EA	1 LM	5775.20	5775.20
159269.44	11376.39	8"	6962.64	4413.75	163.39%	Tack	GA	887.20	1.20	1064.64
<b>ESAL Life Estimate</b>						Milling 2 inches	SY	7040.00	0.80	5632.00
	PCC	ASPHALT				MOB, MOT, Other	EA	1 LM	25182.35	28465.17
1988-2002	<b>989,000</b>	<b>679,000</b>	1988-2002			Cul. Total*	Cost/Yr		Total	<b>48478.36</b>
PCC EF/LF Factors From Rigid Design Manual						97476.95	6,962.64			
Asphalt EF/LF Factors from Flexible Design Manual						*-Total Asphalt Cost 1989-2002				

# Second Mill and Resurface:2013

- Whitetopping Cost/Mile is more Cost Effective

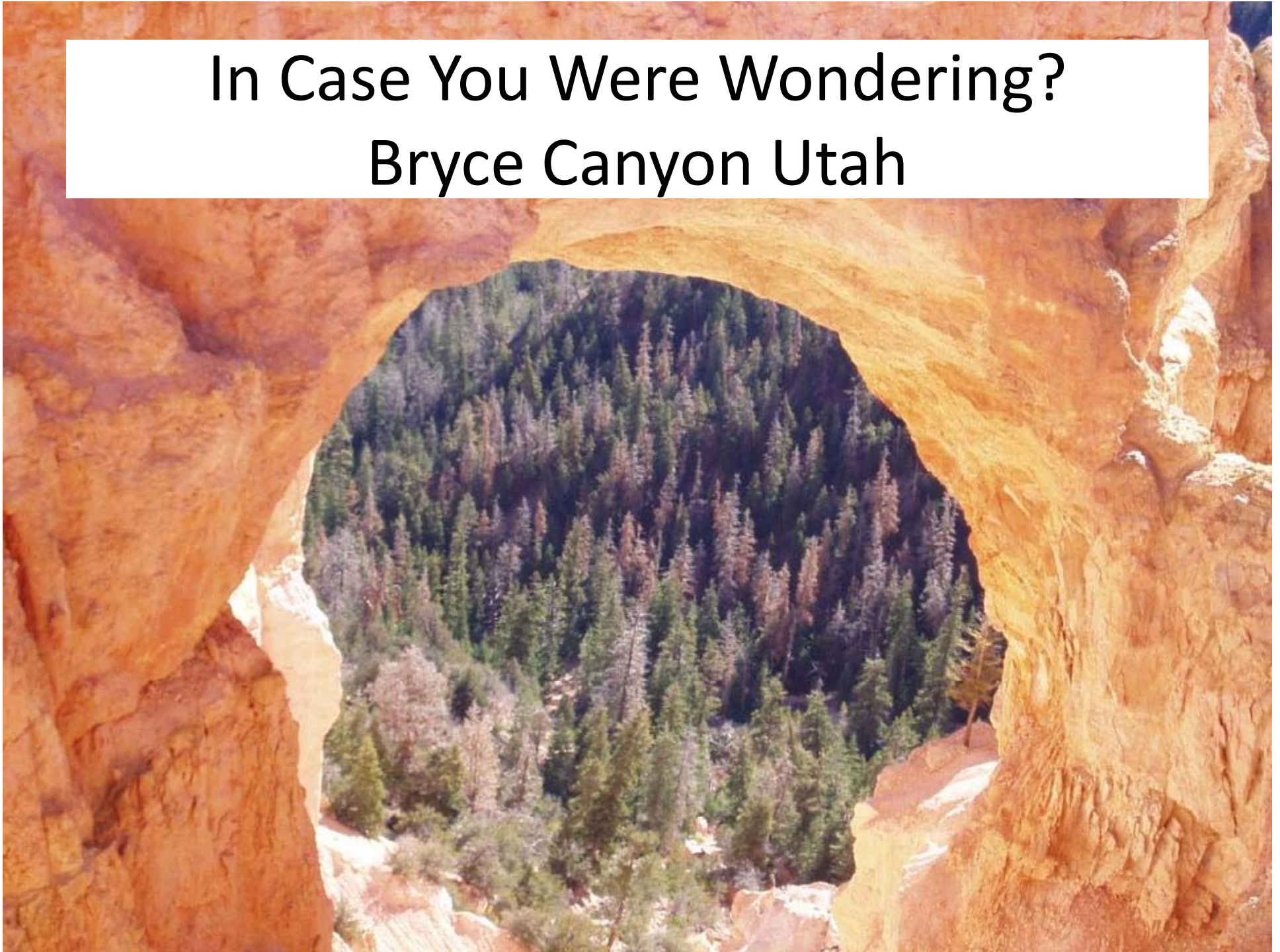
Second Resurface in 2013																		
PCC/Asp Cost Per Year Difference						2009 Floating Averages Used												
Cul. Total*	Cost/Year	PCC	Asphalt	Difference	Diff. (%)	Description	Unit	Amount	Cost	Cost/Mile								
160109.40	6671.23	6"	12972.84	-6301.61	51.42%	In-House Design	EA	LS	20000.00	20000.00								
152792.64	6366.36	7"	12972.84	-6606.48	49.07%	In-House Inspection	EA	1 LM	6000.00	6000.00								
172216.43	7175.68	8"	12972.84	-5797.15	55.31%	.75 inch FC-5	TN	277.20	104.17	28875.92								
*-Total PCC Cost 1989-2013						3 inches TL-D	TN	1108.80	91.43	101377.58								
<b>ESAL Life Estimate</b> <table border="1"> <thead> <tr> <th></th> <th>PCC</th> <th>ASPHALT</th> <th></th> </tr> </thead> <tbody> <tr> <td>1988-2013</td> <td>2,416,000</td> <td>980,000</td> <td>2002-2013</td> </tr> </tbody> </table> <p>PCC EF/LF Factors From Rigid Design Manual Asphalt EF/LF Factors from Flexible Design Manual</p>							PCC	ASPHALT		1988-2013	2,416,000	980,000	2002-2013	Milling 3 inches	SY	7040.00	1.37	9644.80
							PCC	ASPHALT										
						1988-2013	2,416,000	980,000	2002-2013									
MOB, MOT, Other	EA	1 LM	35000.00	35000.00														
						Cul. Total*	Cost/Yr	Total		200898.31								
						298375.26	12972.84											
						*-Total Asphalt Cost 1989-2013												
						Tack costs for 2013 and 2028 included with asphalt												

# 3% Slab Replacement and Third Resurfacing: 2024

- Whitetopping Cost/Mile is more Cost Effective

2024 3% Slab Replacement						Third Resurface in 2024					
2009 Floating Averages Used			LM=3.716			Third Resurface in 2024			2009 Floating Averages Used		
Slabs	Length	Width	Depth	CY's	All Cost	Description	Unit	Amount	Cost	Cost/Mile	
38	14	24	0.5	236.44	77393.00	In-House Design	EA	LS	20000.00	20000.00	
Description		Unit	Amount	Cost	Cost/Mile	In-House Inspection	EA	1 LM	6000.00	6000.00	
In-House Design		EA	LS	25000.00	25000.00	.75 inch FC-5	TN	277.20	104.17	28875.92	
Slab Replacement		CY	63.63	327.32	5604.67	3 inches TL-D	TN	1108.80	91.43	101377.58	
Seal Joints		LF	16070.7	1.90	30534.33	Milling 3 inches	SY	7040.00	1.37	9644.80	
Diamond Grind		SY	7040	1.97	13868.80	MOB, MOT, Other	EA	1 LM	35000.00	35000.00	
MOB, MOT, Other		EA	1 LM	35000.00	35000.00	<b>Cul. Total*</b>	<b>Cost/Yr</b>		<b>Total</b>	<b>200898.31</b>	
					<b>Total</b>	<b>499273.57</b>	<b>13868.71</b>				
<b>PCC/Asp Cost Per Year Difference</b>						<b>*-Total Asphalt Cost 1989-2024</b>					
<b>Cul. Total*</b>	<b>Cost/Year</b>	<b>PCC</b>	<b>Asphalt</b>	<b>Difference</b>	<b>Diff. (%)</b>	<b>Tack costs for 2013 and 2028 included with asphalt</b>					
271317.20	7669.92	6"	13868.71	-6198.79	55.30%	<b>ESAL Life Estimate</b>					
268800.44	7466.68	7"	13868.71	-6402.03	53.84%	1988-2024	PCC	ASPHALT	2013-2024		
288224.24	8006.23	8"	13868.71	-5862.48	57.73%		<b>4,067,000</b>	<b>1,134,000</b>			
<b>*-Total PCC Cost 1989-2024</b>						PCC EF/LF Factors From Rigid Design Manual					
						Asphalt EF/LF Factors from Flexible Design Manual					

In Case You Were Wondering?  
Bryce Canyon Utah



# Any Questions

