

# I-20 Mississippi River Bridge Truss Rehabilitation-Repairs and Monitoring

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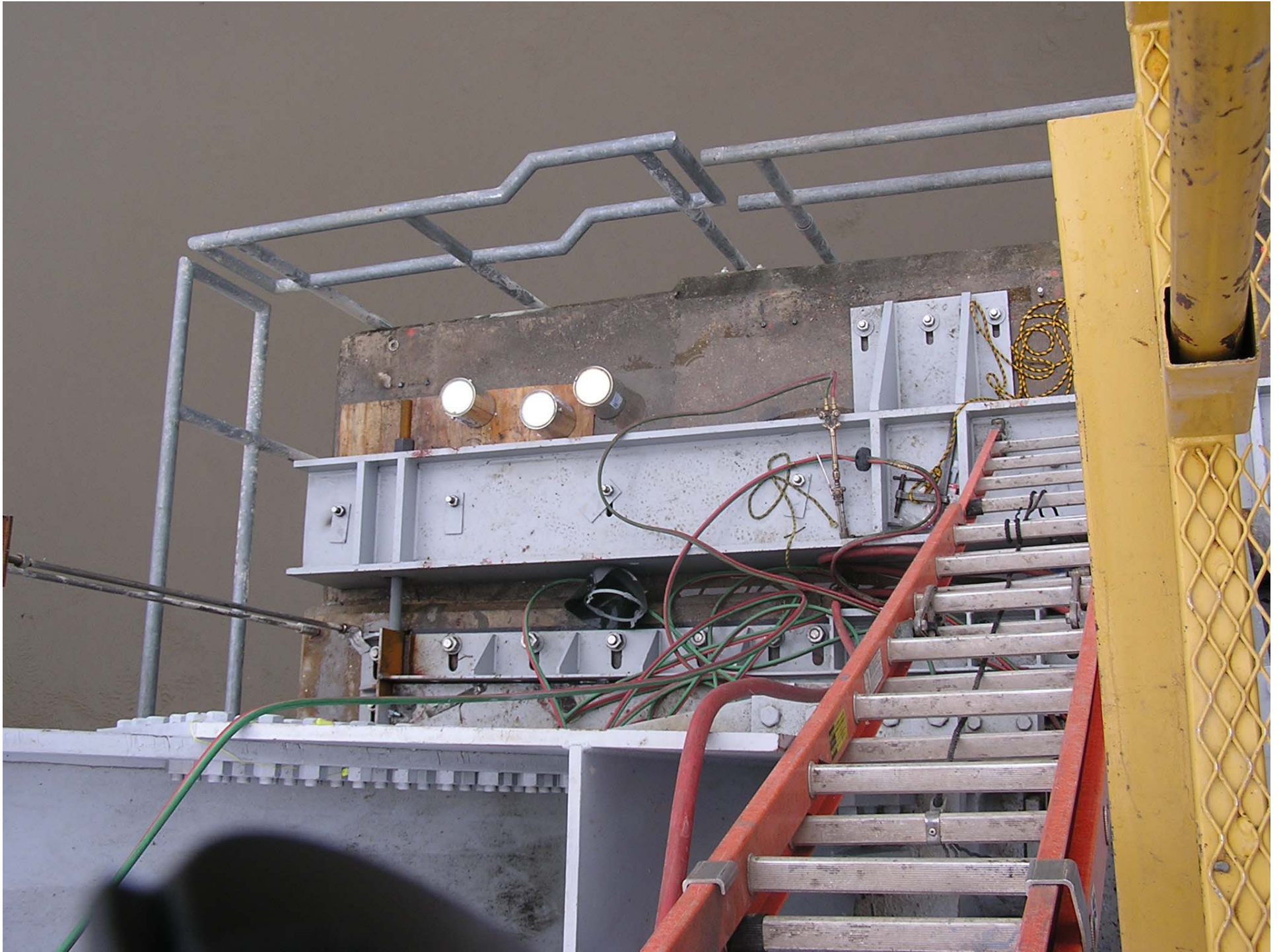
**Annual SASHTO Conference**

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New Orleans, Louisiana









Delta, LA

Vicksburg, MS

US-80 Bridge

I-20 Bridge

## Project Information

- Project started in 2001 in response to the westerly movement of two of its east bank piers of about 6 inches in 2000/2001 .
- The first step was realignment of bearings that reached maximum capacity.
- Since May 2001 the bridge has been monitored for additional movements, and structurally modified in 2004, 2010 and 2014 to accommodate more movements.





Delta, LA

US 80 Bridge

Ameristar Casino

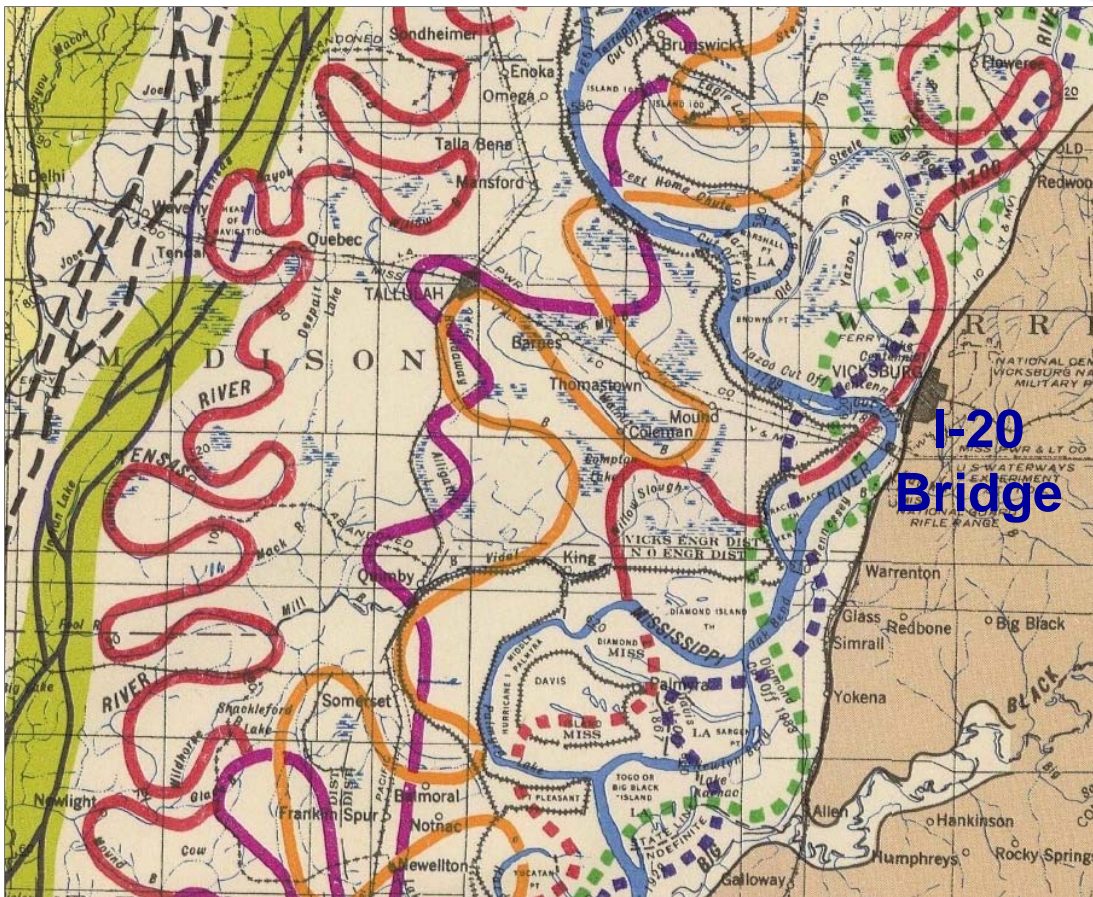
I-20 Bridge

Ground Movements  
at Bridge Site

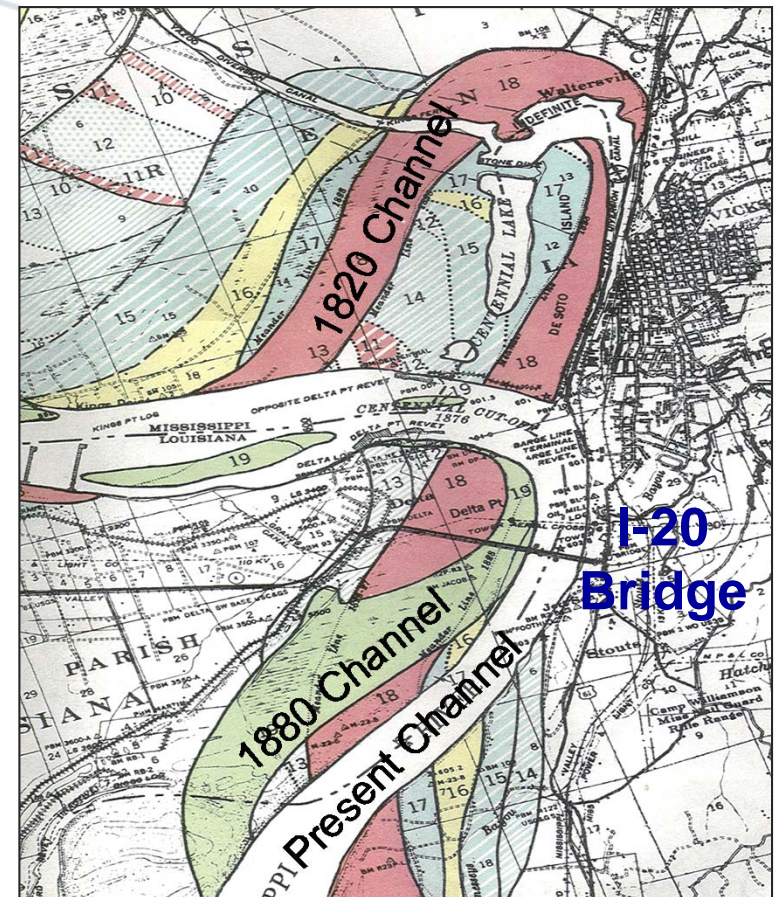
Lady Luck property

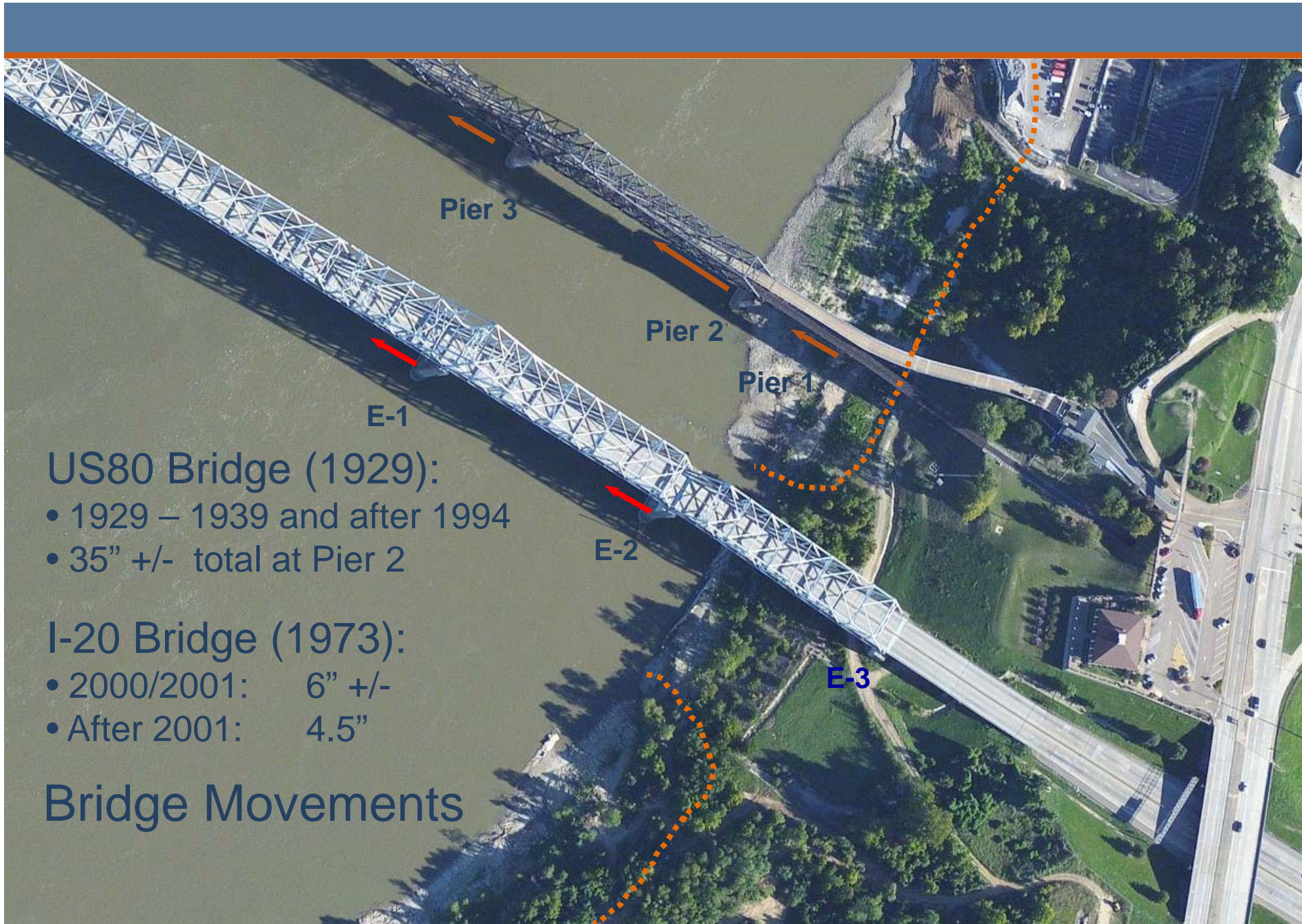
Vicksburg, MS

## Ancient Courses of the Mississippi River in the Vicksburg Region



## Mississippi River Channel Migration at Vicksburg Before and After the Centennial Cutoff of 1876





### US80 Bridge (1929):

- 1929 – 1939 and after 1994
- 35" +/- total at Pier 2

### I-20 Bridge (1973):

- 2000/2001: 6" +/-
- After 2001: 4.5"

## Bridge Movements





Pier-2

Pier-1

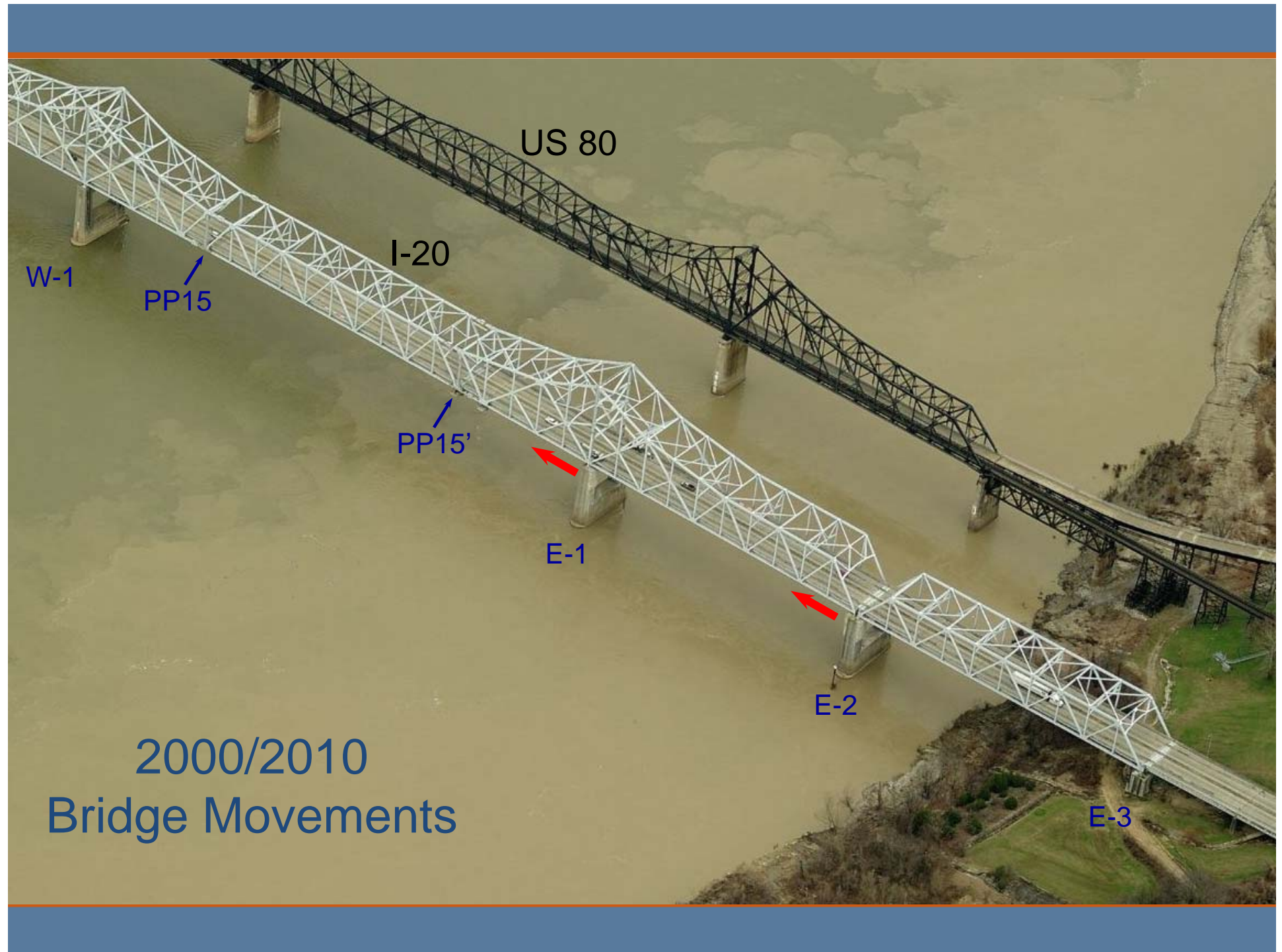


Pier E-2



Casing for  
inclinometer

Limit of separate  
moving masses



US 80

I-20

W-1

PP15

PP15'

E-1

E-2

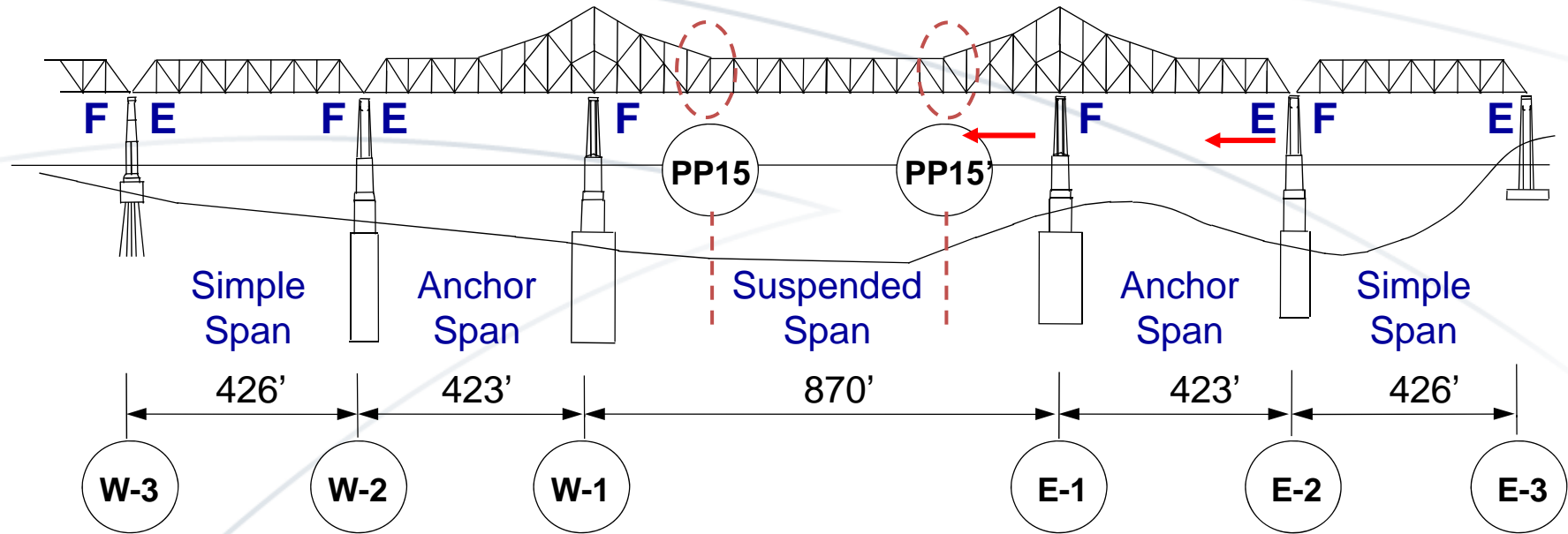
E-3

2000/2010  
Bridge Movements

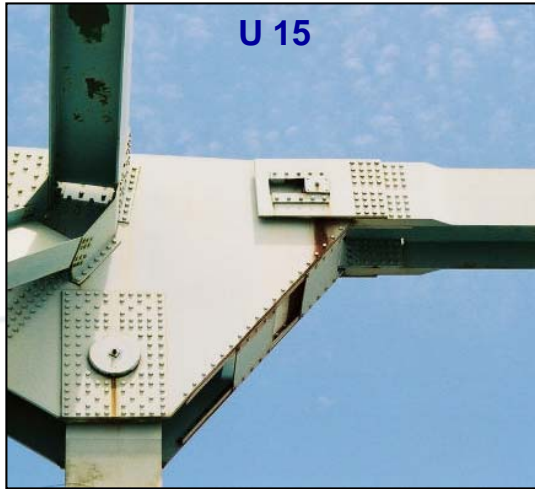
# Bridge Characteristics

West

East



# Bridge Condition After 2000/2001 Pier Movements

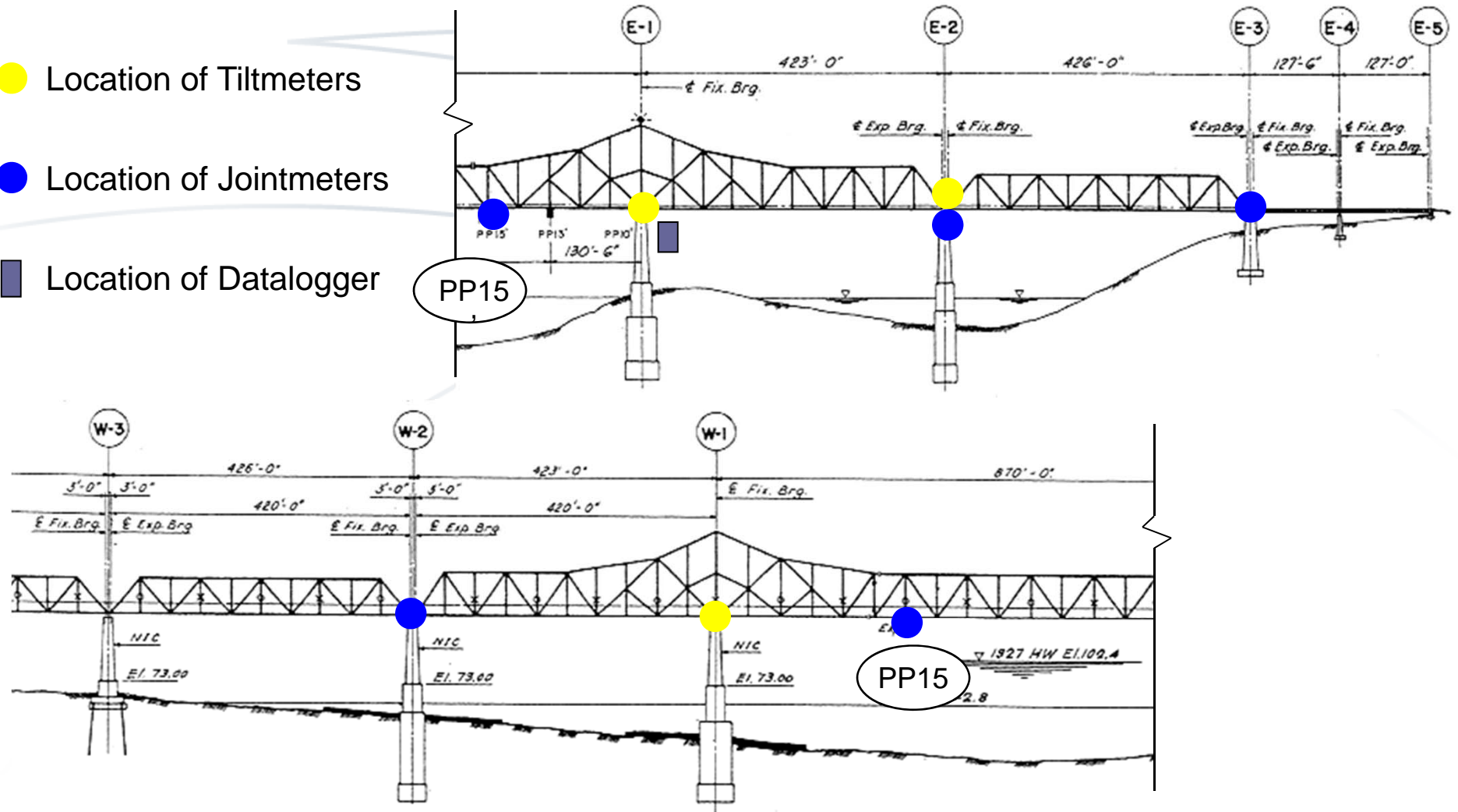


# Bridge Monitoring Program

TYPE	MEASUREMENTS
Survey	Top of Piers - Longitudinal, Lateral and Vertical
Manual Measurements	Deck Joints, Barriers and Bearings
Instrumentation	Top of Piers - Tiltmeters Deck Joints – Jointmeters

# Bridge Instrumentation

- Location of Tiltmeters
- Location of Jointmeters
- Location of Datalogger

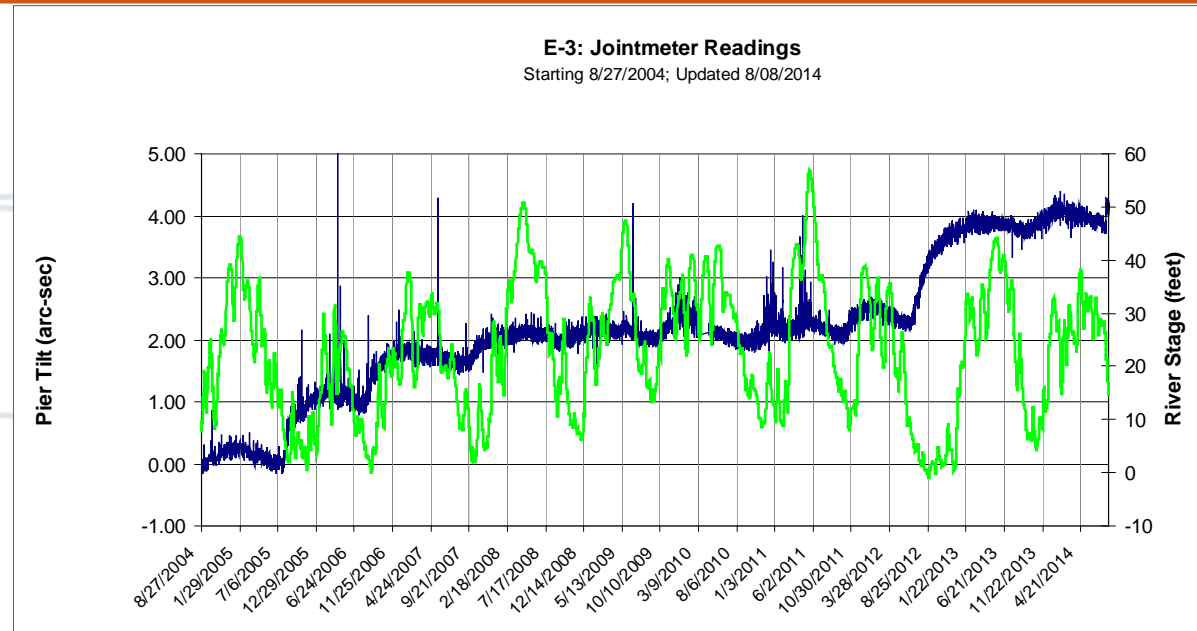




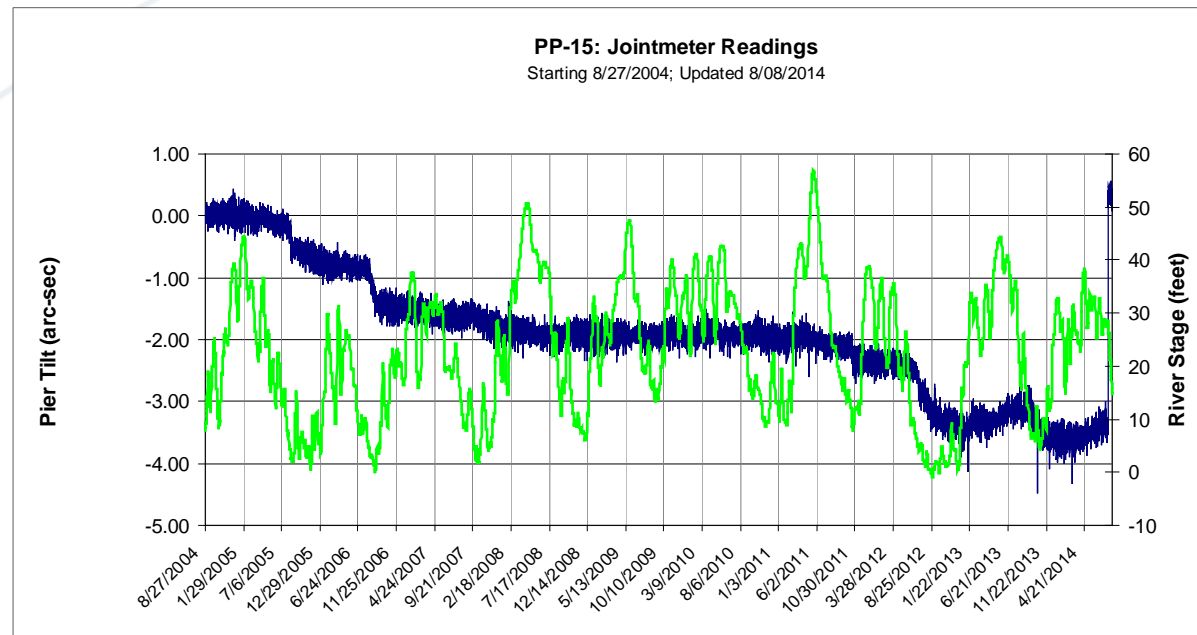
## Summary of I-20 Bridge Pier Movements

Estimated Time or Time Period		Top of Pier E-2		Top of Pier E-1	
		(in)	(arc-sec)	(in)	(arc-sec)
<b>1. 1999 and 2000</b>	Prior to 5/2001	6.00		6.50	
<b>2. 2003 Feb</b>	2/5/2003 to 2/6/2003	0.50	50	0.50	0
<b>3. 2005 Aug</b>	8/2/2005	0.75	0	0.50	50
<b>4. 2005 Nov</b>	11/17/2005	0.25	0	0.25	0
<b>5. 2006 Aug - Sep</b>	8/13/2006 to 9/21/2006	0.50	50	0.75	75
<b>6. 2007 Sep - Dec</b>	9/21/2009 to 12/19/2007	0.50	50	0.50	25
<b>7. 2009 Sep - Dec</b>	0/28/2009 to 12/22/2009	0.20	25	0.00	20
<b>8. 2010 Nov</b>	11/7/2010 to 11/22/2010	0.20	25	0.00	10
<b>9. 2011 Oct</b>	10/20/2011 to 10/24/2011	0.25	0	0.25	25
<b>10. 2012 June - Dec</b>	6/29/2012 to 12/21/2012	1.50	75	1.25	75
<b>Total Movement (+/-)</b>		<b>10.75</b>	<b>300</b>	<b>10.50</b>	<b>300</b>

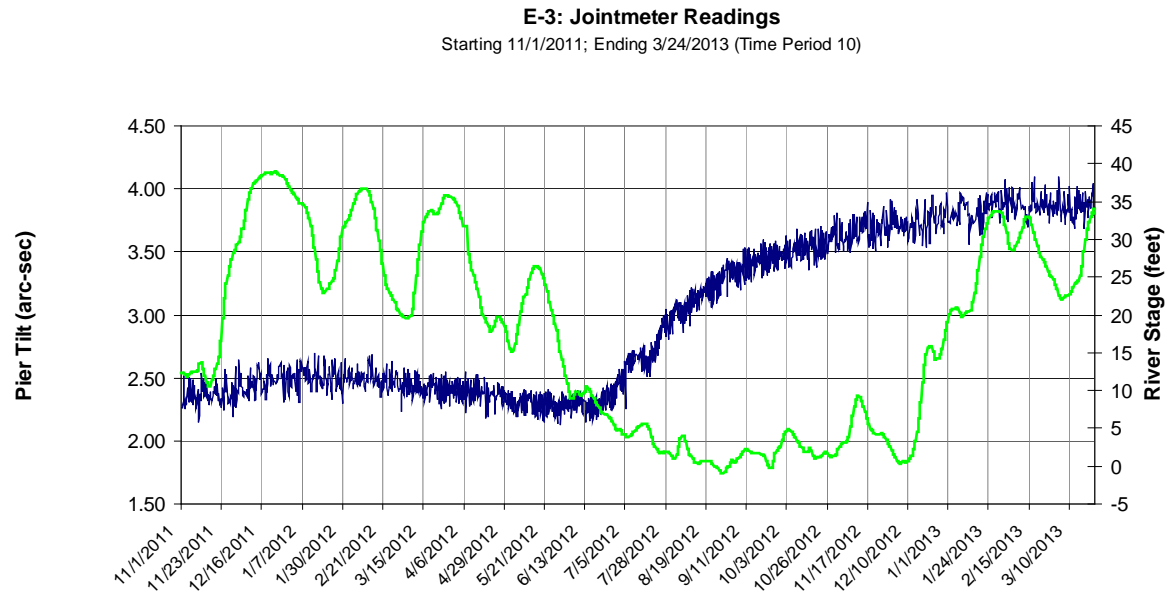
Joint  
Opening at E-3  
(since 2004)



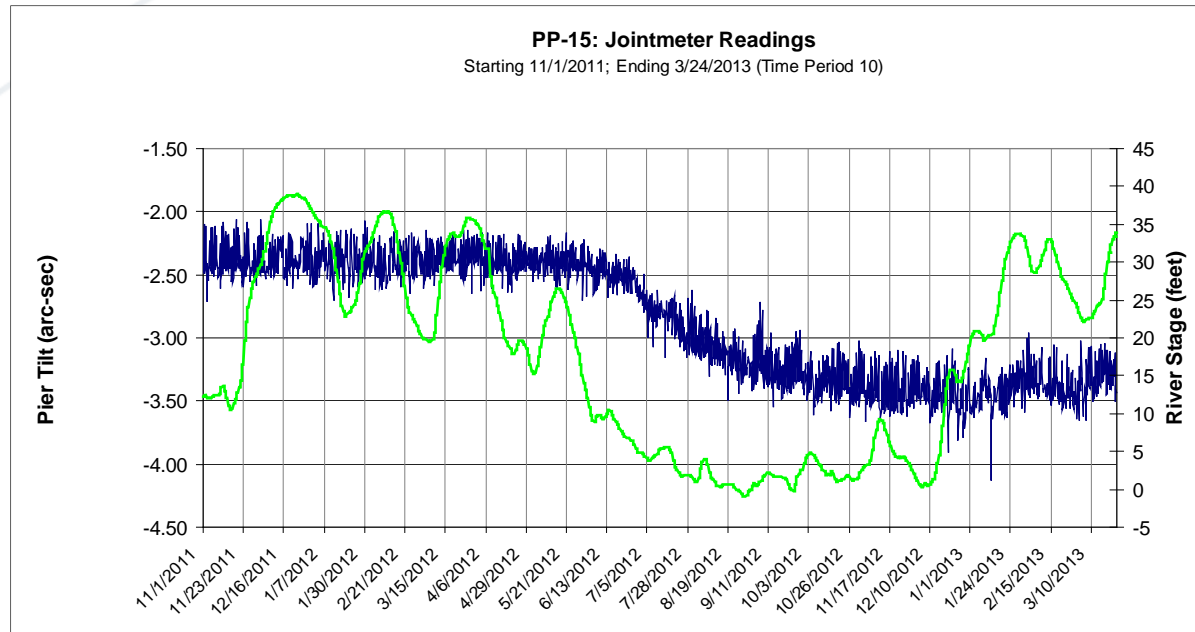
Joint  
Closing at PP15  
(since 2004)



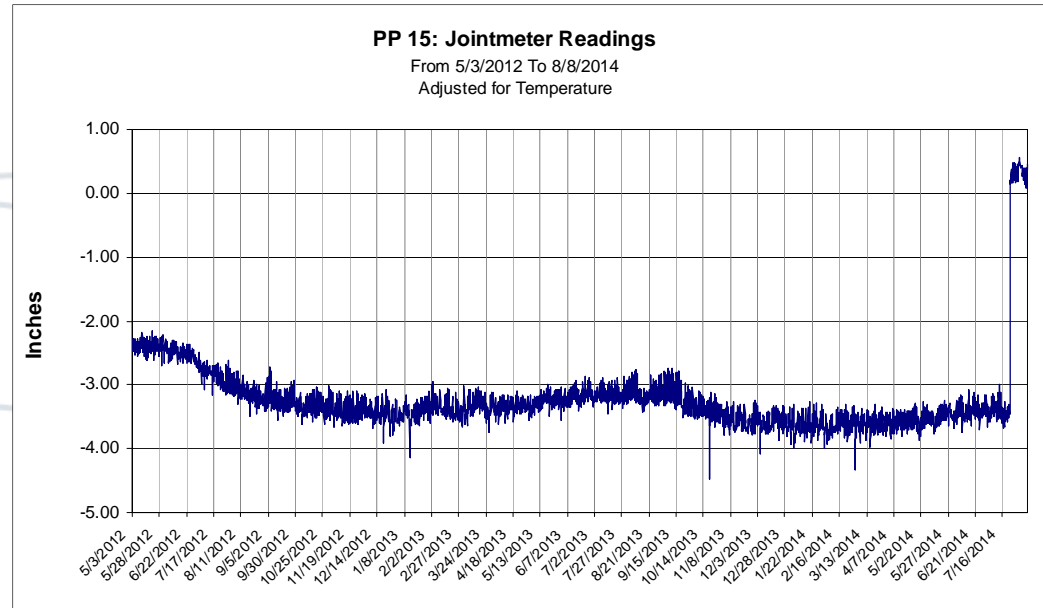
Joint  
Opening at E-3  
(2012 movements)



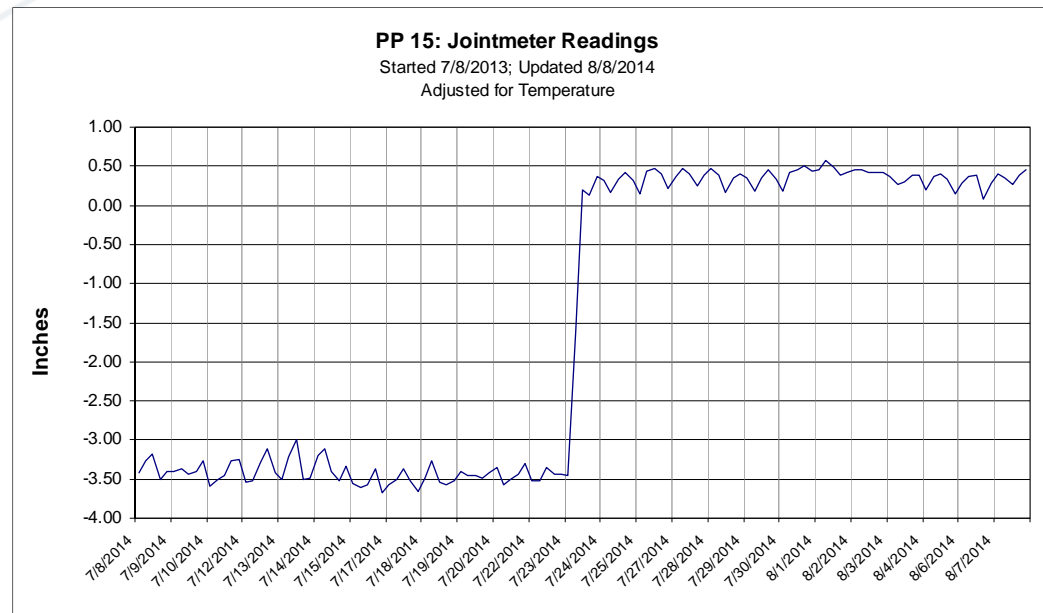
Joint  
Closing at PP15  
(2012 movements)



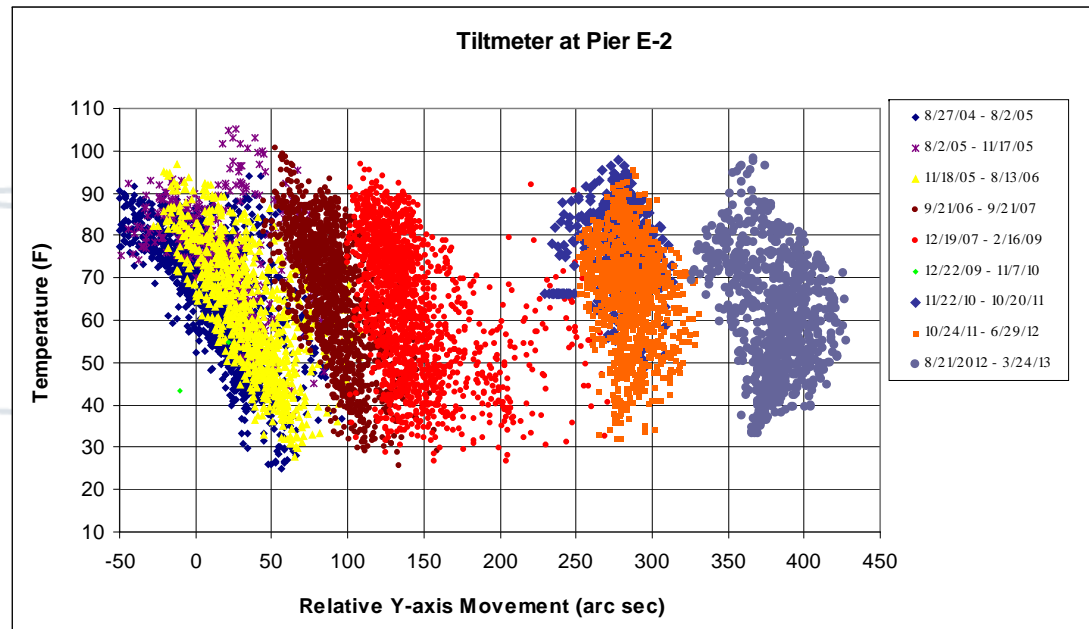
Joint  
Opening at PP15  
(2014 modifications)



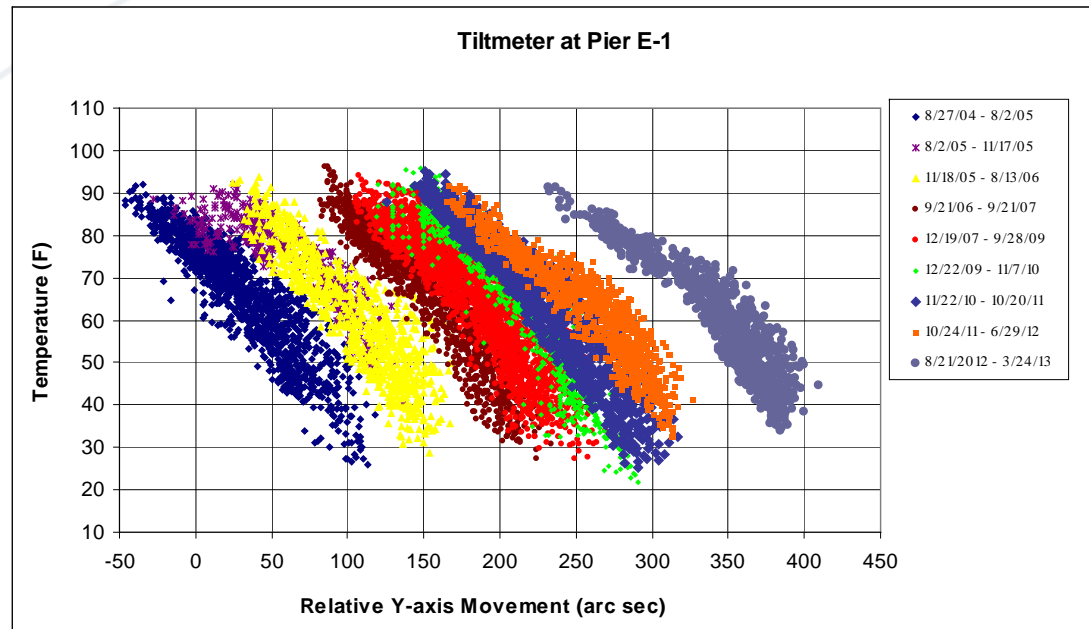
Joint  
Opening at PP15  
(2014 modifications)



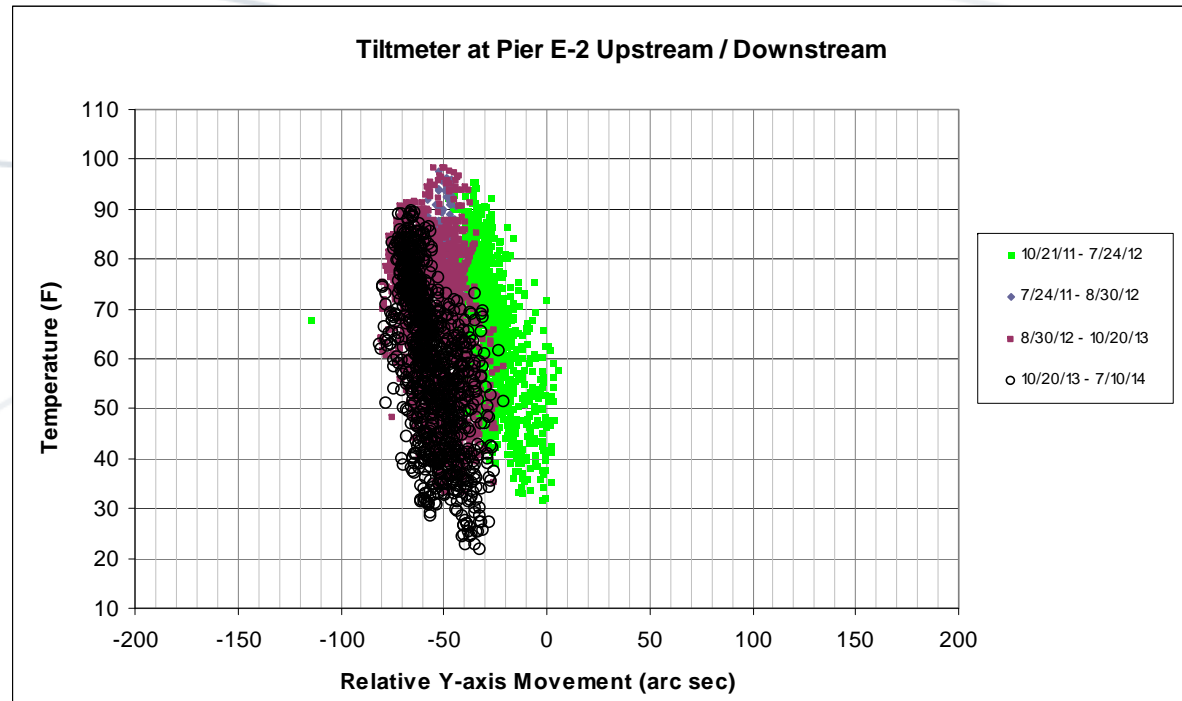
Pier E-2 Tilt  
(since 2004)



Pier E-1 Tilt  
(since 2004)



# 2012 Pier E-2 Tilt Perpendicular to Bridge



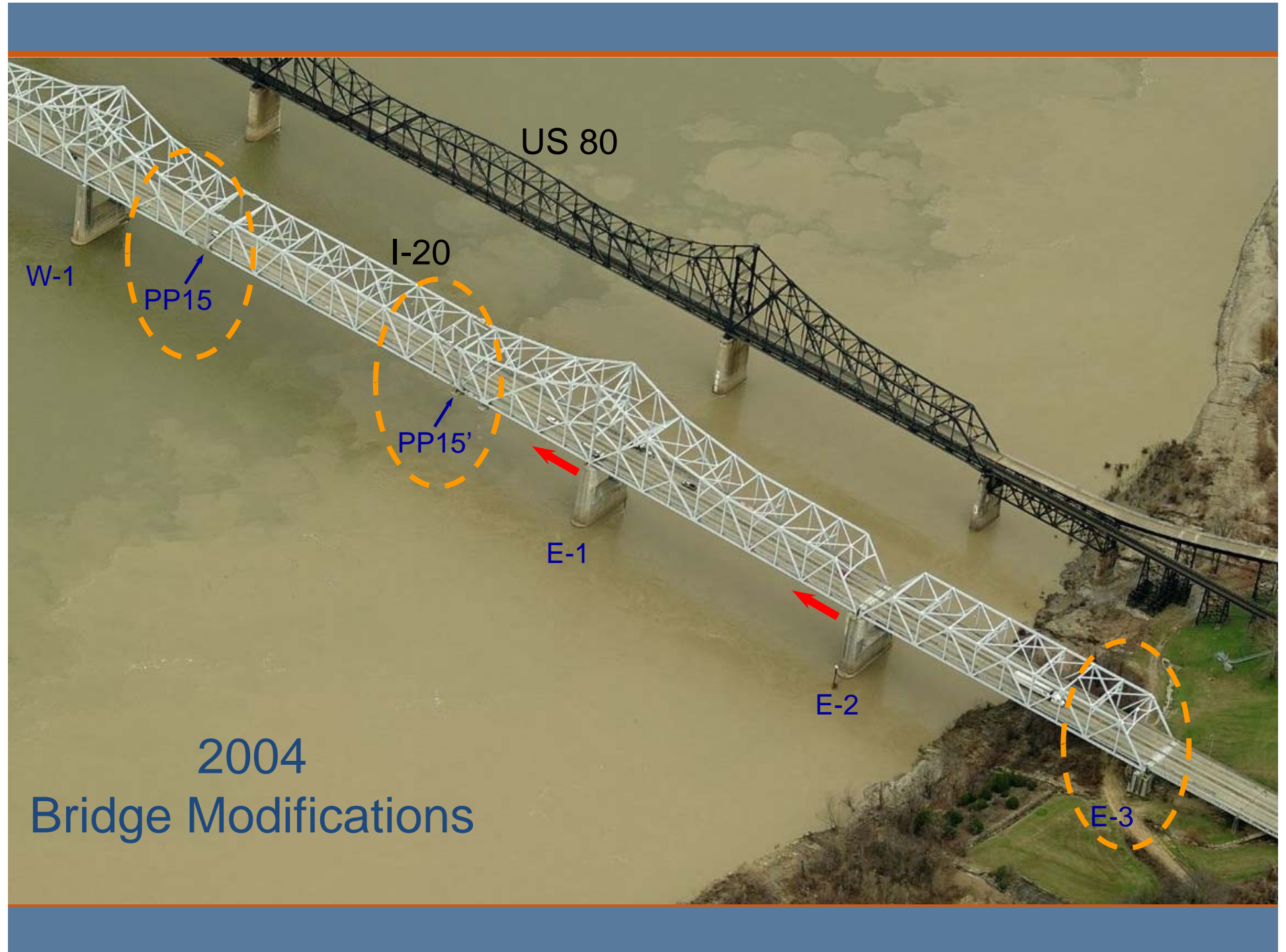
# Bridge Modifications

2004 Remedial Structural Modifications

2010 Proactive Structural Modifications for  
Anticipated movements  
Extreme scenarios

2014 Structural Modifications for Transverse  
Pier Movement Capacity and Resetting  
of Suspended Span





US 80

I-20

W-1

PP15

PP15'

E-1

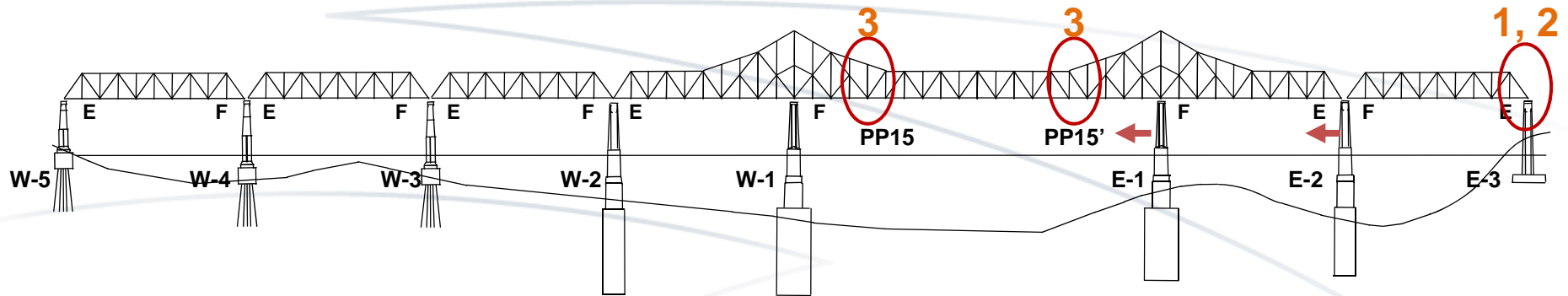
E-2

E-3

2004  
Bridge Modifications

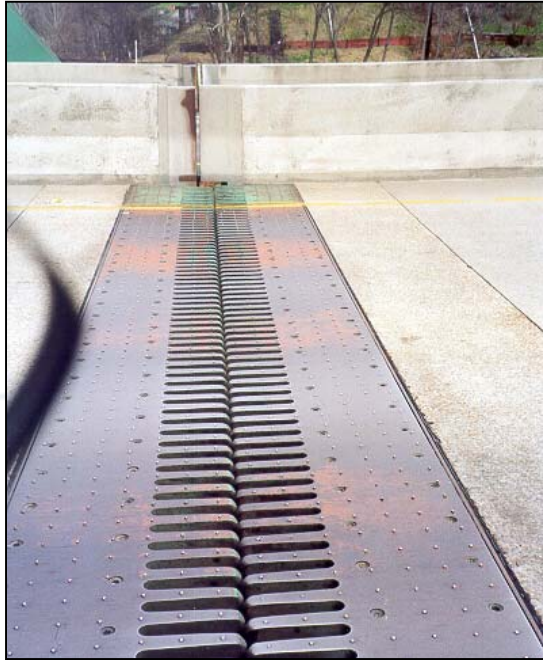


## 2004 Bridge Modifications (Remedial)

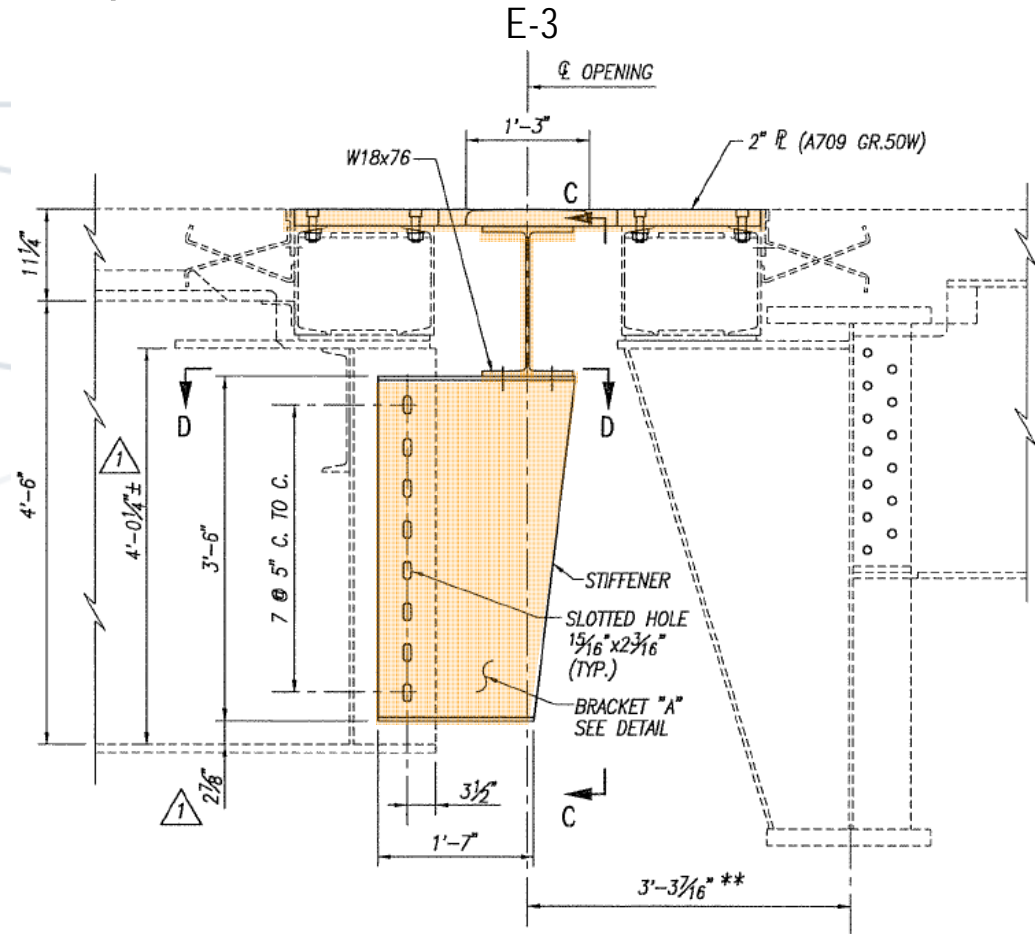


Measure	Objective	Retrofit
1	Prevent roadway traffic hazard at expansion dam at Pier E-3.	Replace expansion dam at Pier E-3.
2	Prevent Span Drop at Pier E-3.	Widen top of pier area. Add catch blocks under the trusses.
3	Eliminate locked-in stresses between Piers E-1 and W-1.	Shorten span between Piers E-1 and W-1. Repair longitudinal strut L15'-L14'.

# Expansion Dam Modifications at Pier E-3



EXISTING CONDITION

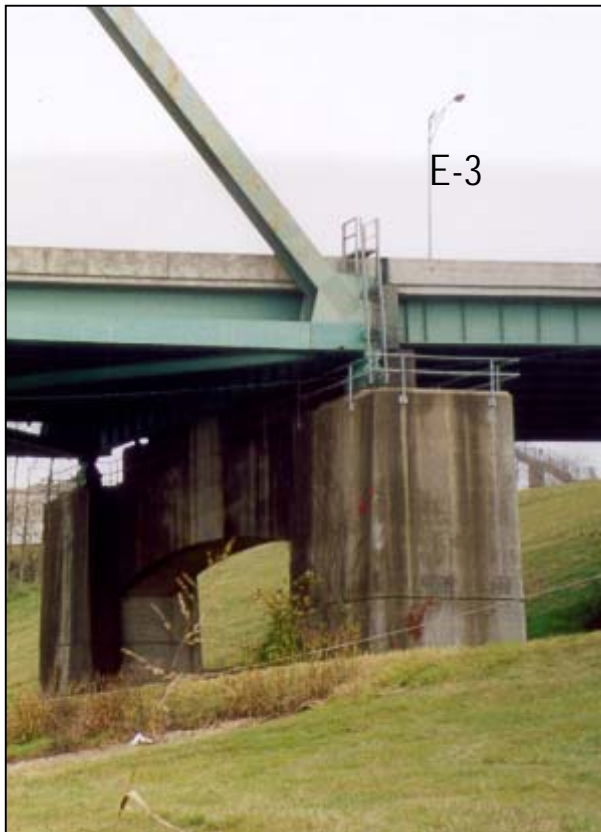


EXPANSION DAM MODIFICATION

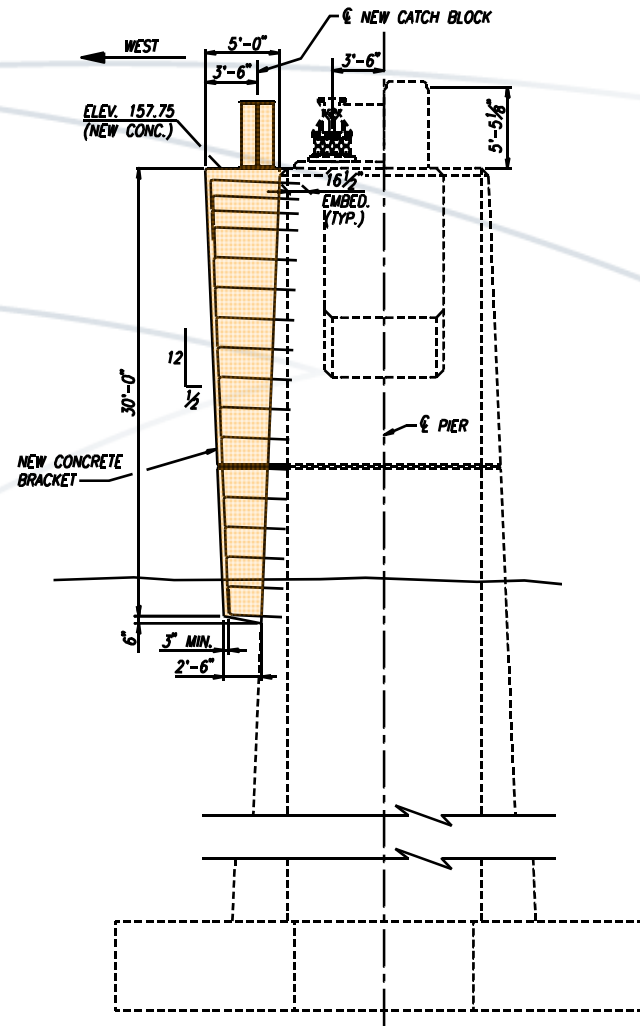
## Expansion Dam at Pier E-3 After Modifications



# Pier Top Widening and Catch Block at Pier E-3



EXISTING CONDITION



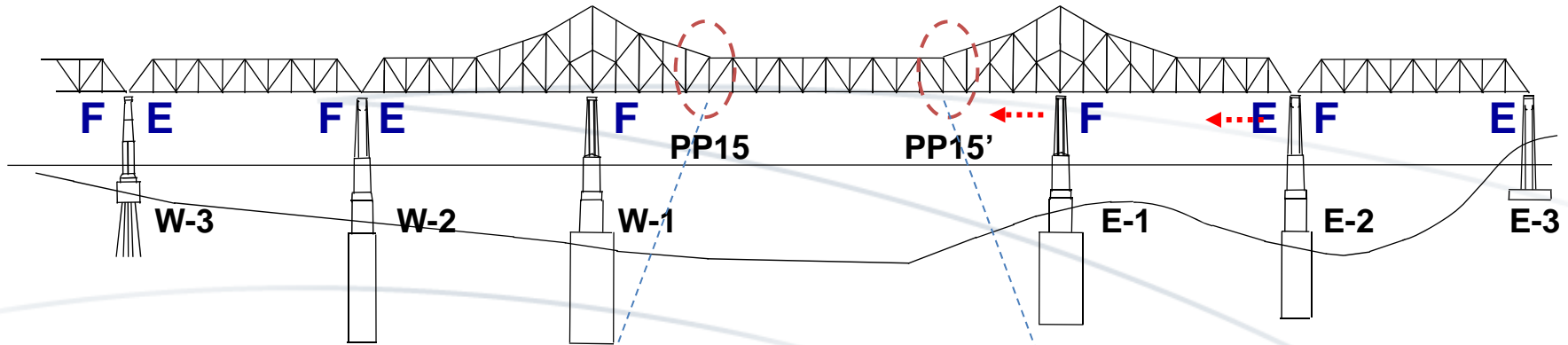
MODIFICATION OF PIER E-3



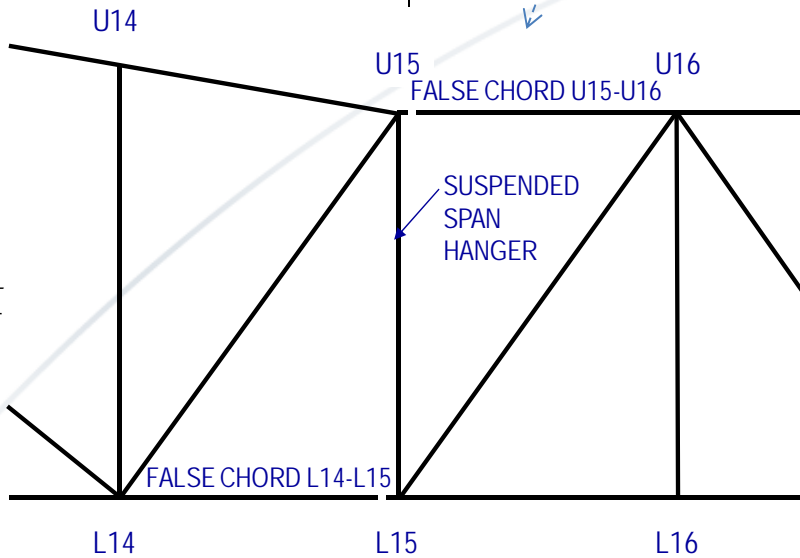
AFTER MODIFICATIONS

West

East

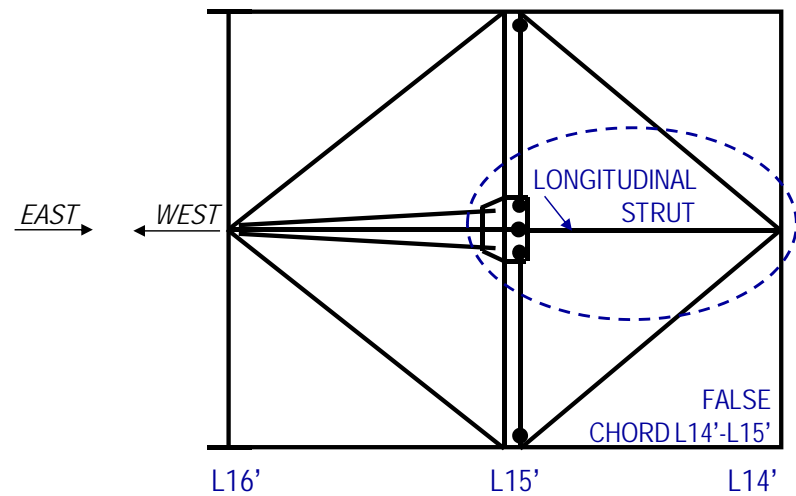


CANTILEVER SPAN | SUSPENDED SPAN



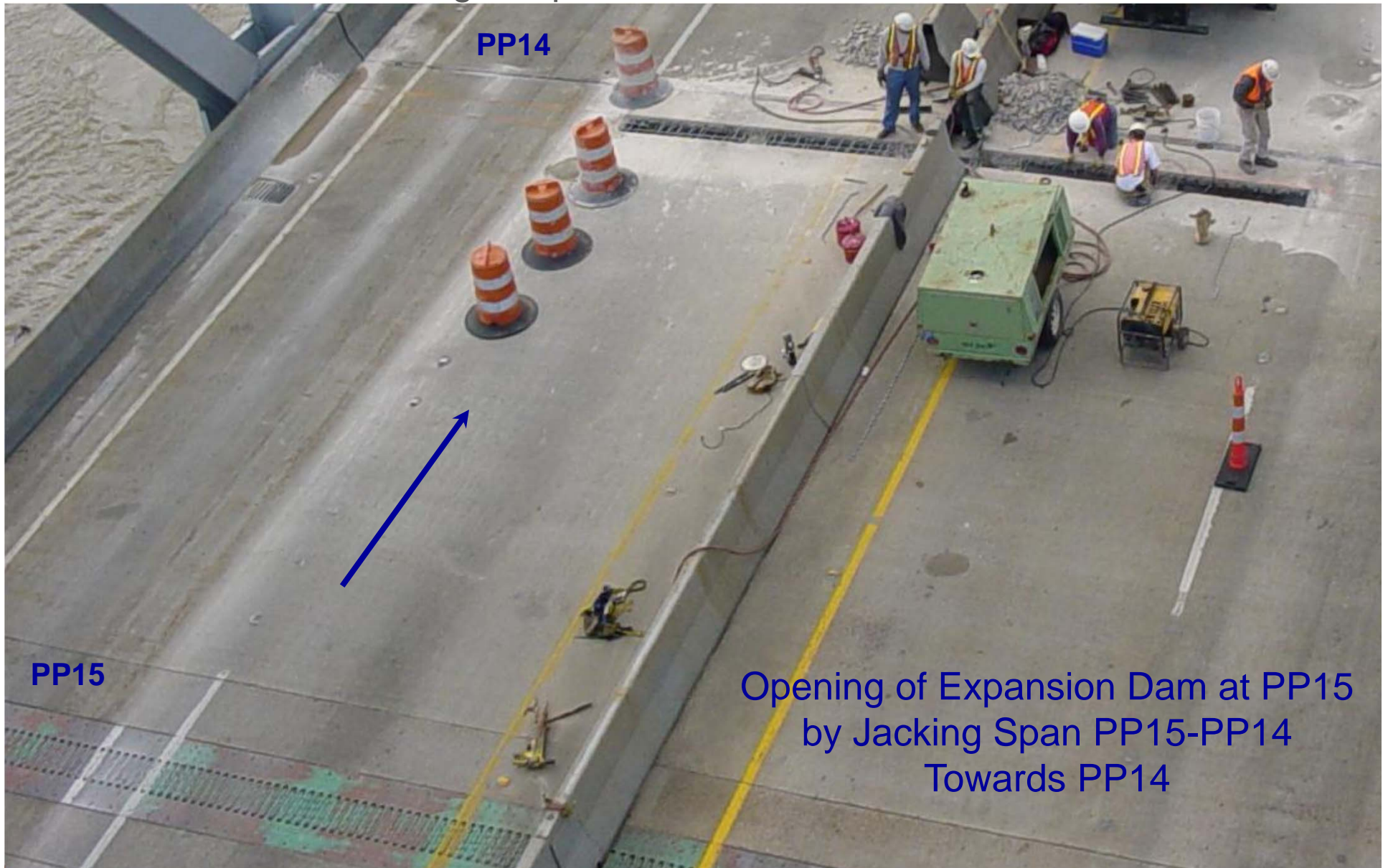
PP15'

SUSPENDED SPAN | CANTILEVER SPAN



BOTTOM LATERAL SYSTEM AT PP15'

## Shortening of Span Between Piers E-1 and W-1



# Shortening of Span L14 – L15

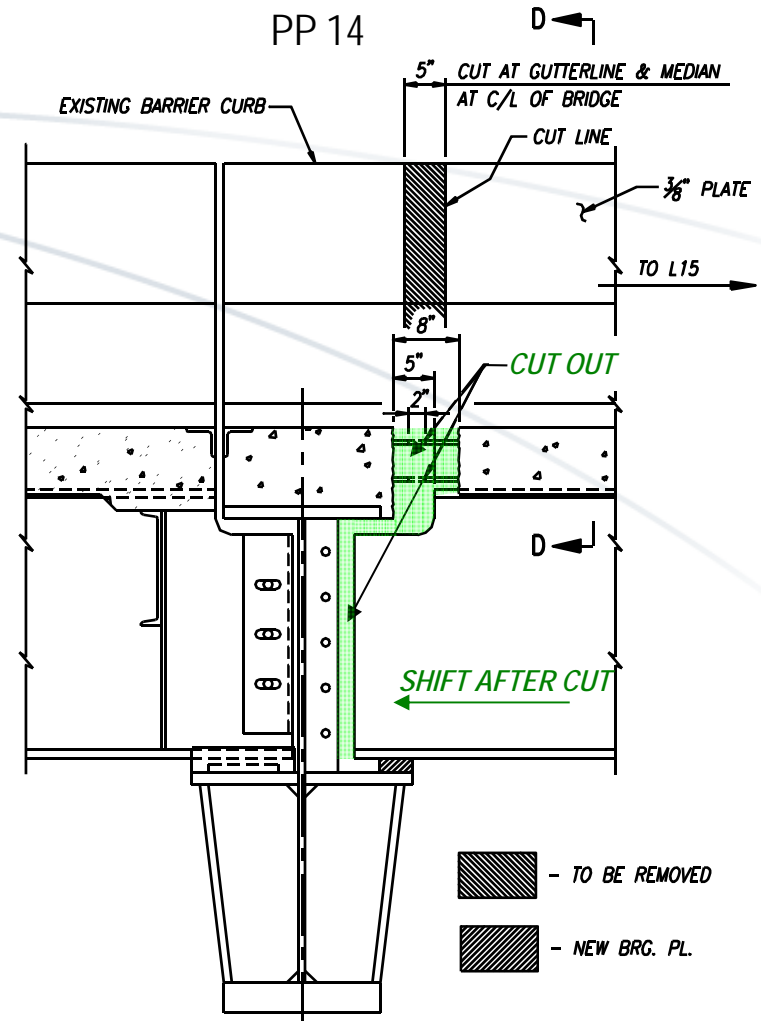
PP 15



PP 14



EXISTING CONDITION



SHORTENING OF STRINGERS  
BETWEEN L14 AND L15





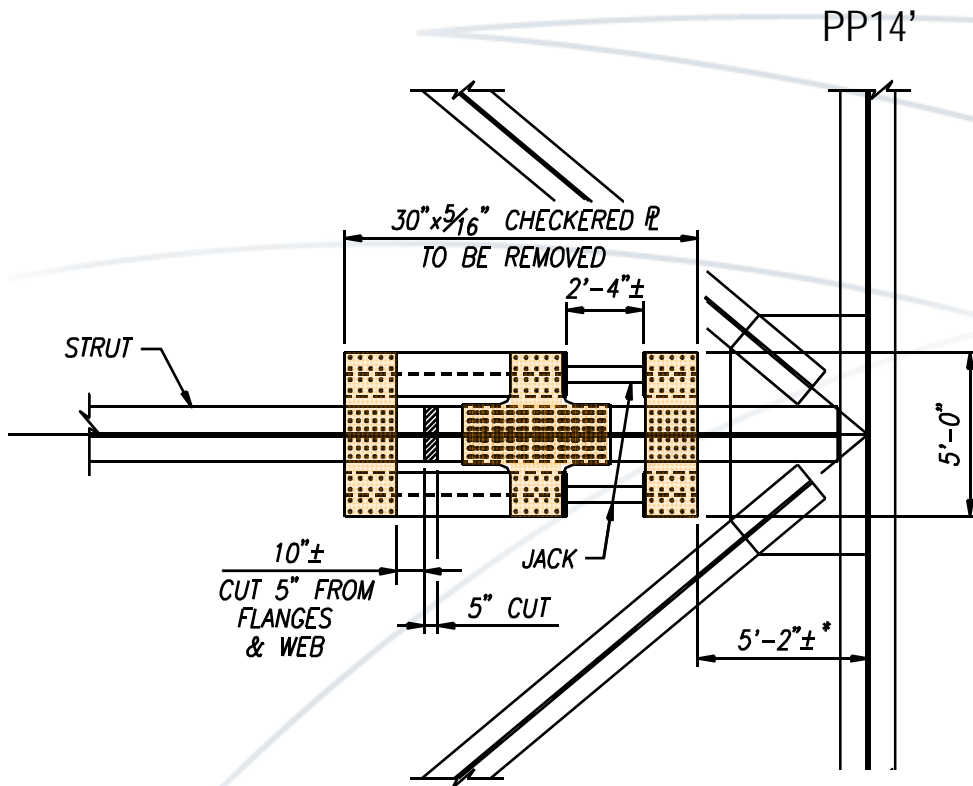
PP 14 AFTER SPAN SHORTENING



EXPANSION DAM AT  
PP 15 AFTER SPAN SHORTENING



## Longitudinal Strut Shortening at Span L14' – L15'



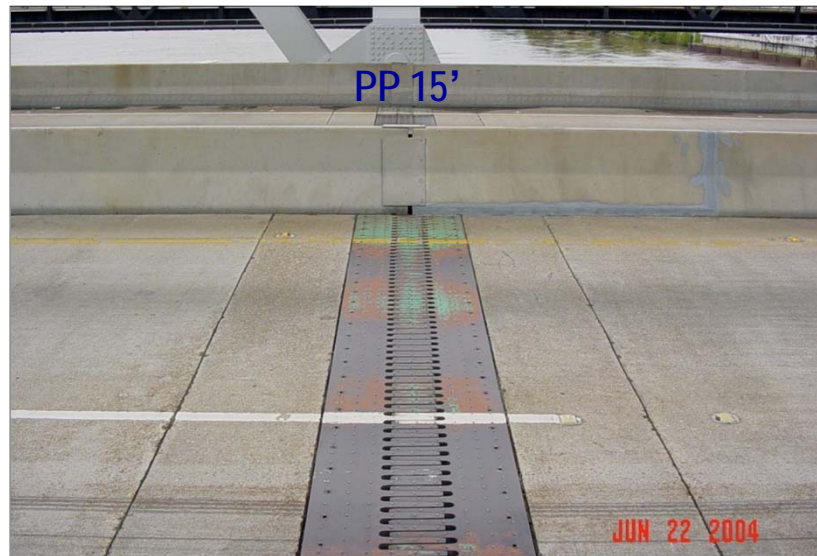
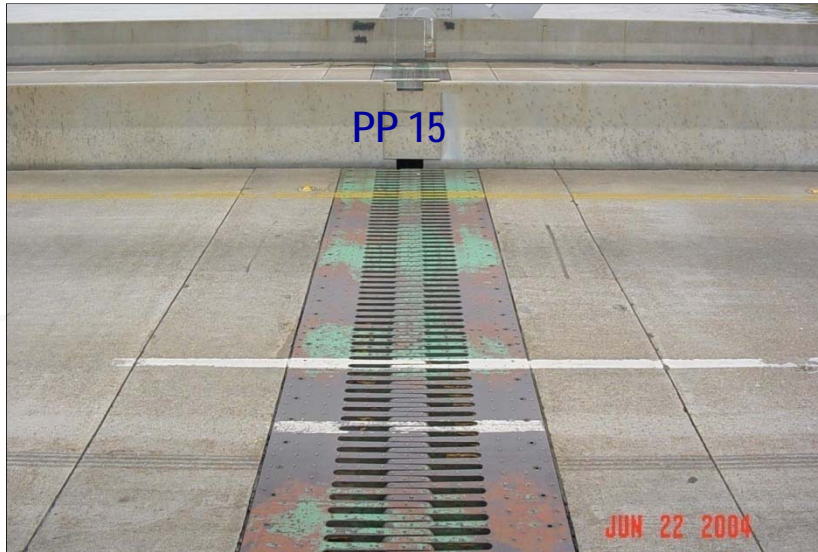
PLAN - PANEL POINT 14'

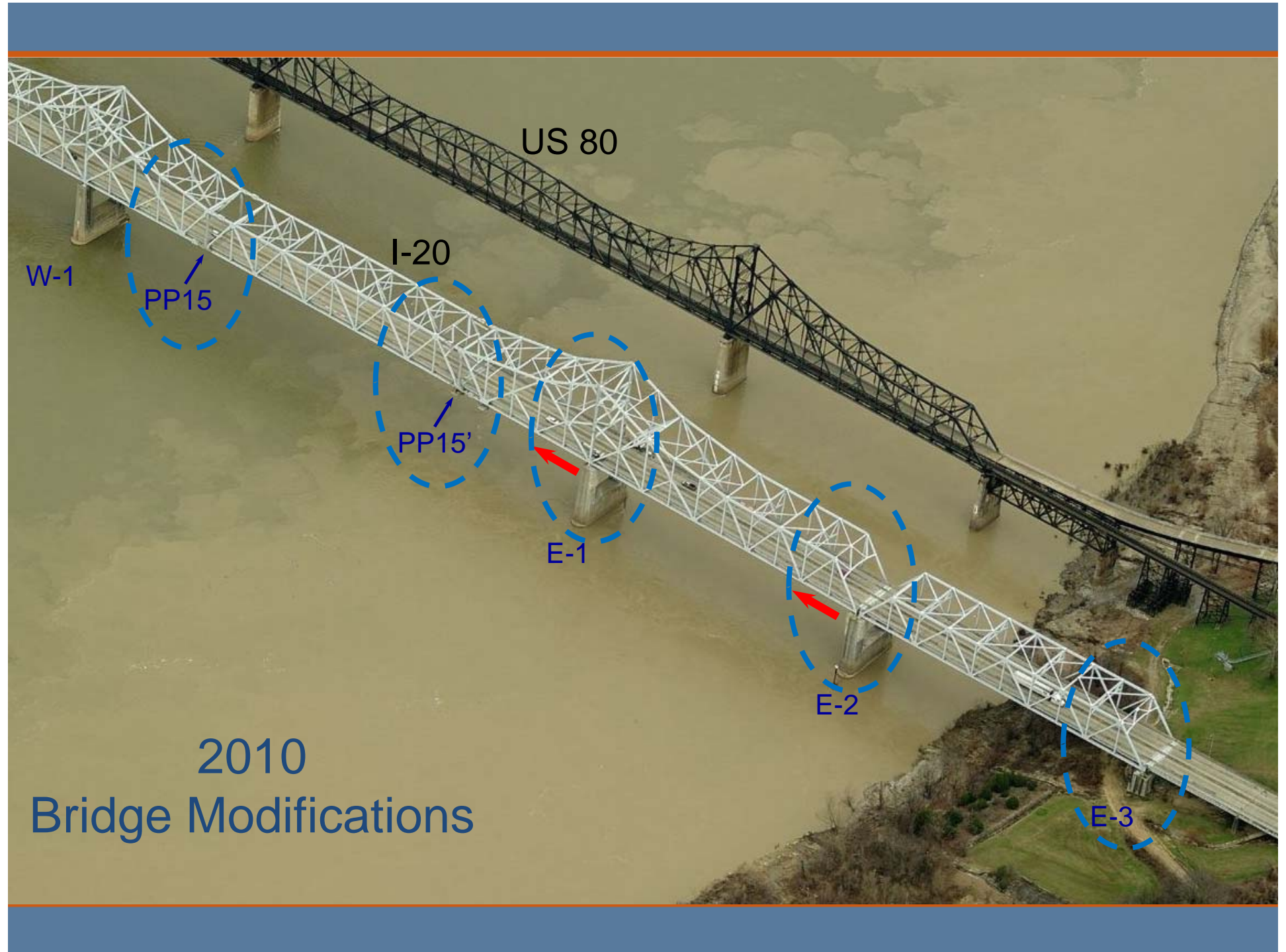
MODIFICATION OF LONGITUDINAL STRUT





## Deck Joints After 2004 Repairs





US 80

I-20

W-1

PP15

PP15'

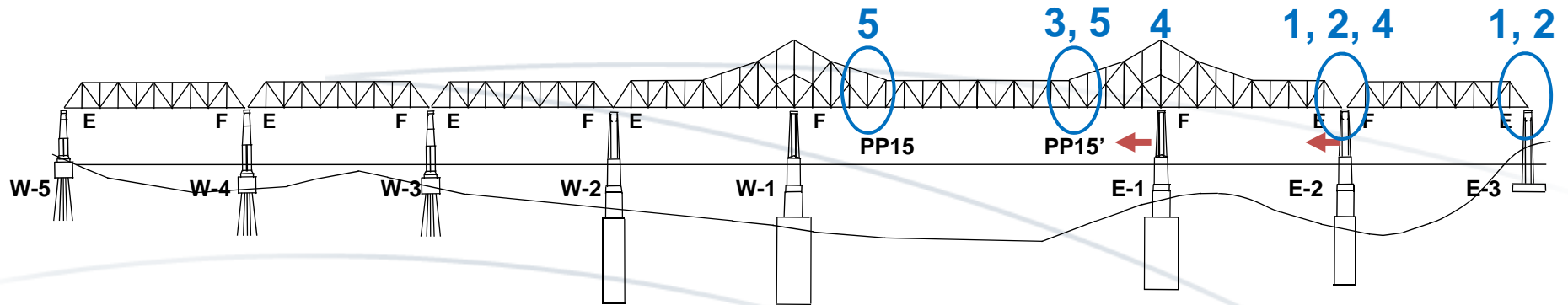
E-1

E-2

E-3

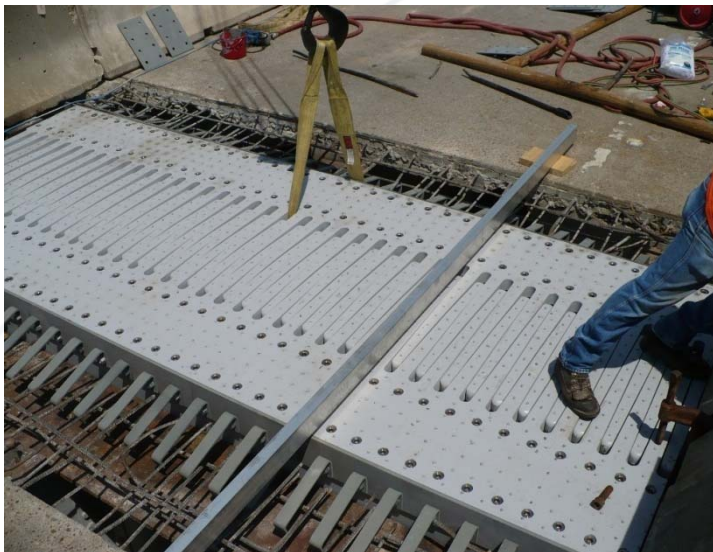
# 2010 Bridge Modifications

## 2010 Bridge Modifications (Proactive)



Measure	Objective	Retrofit
1	Increase movement capacity of expansion dam at Pier E-3 and E-2	Replace expansion dam at Pier E-3 and Pier E-2.
2	Increase movement capacity of bearings at Piers E-3 and E-2.	Replace bearings at E-3 and E-2 with inverted sliding disc bearings.
3	Increase movement capacity within the deck, between Pier E-1 and W-1.	Shorten span PP14'-15' and replace expansion dams at PP15'.
4	Prevent span drop at Pier E-2 and E-1.	Widen top of pier area at E-2 and E-1. Add bearing blocks at E-2 and E-1.
5	Provide redundancy to the suspended span hangers.	Add eyebars at the suspended span hangers.

## Expansion Dam Replacement at Pier E-3



# Bearing Replacement at Pier E-3





# Bearing Replacement at Pier E-2



## Completed Bearing Replacements at Piers E-2 and E-3

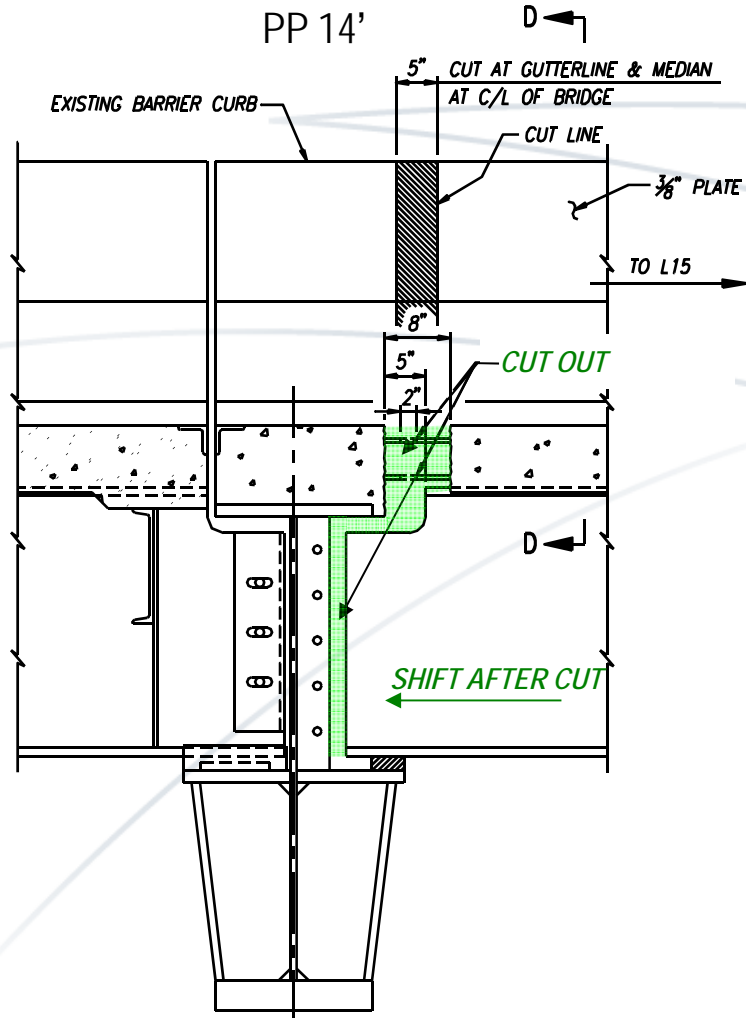
E-2



E-3



# Shortening of Span L14' – L15'



SHORTENING OF STRINGERS  
BETWEEN L14' AND L15'



## Stringer Incremental Cutting at PP14'



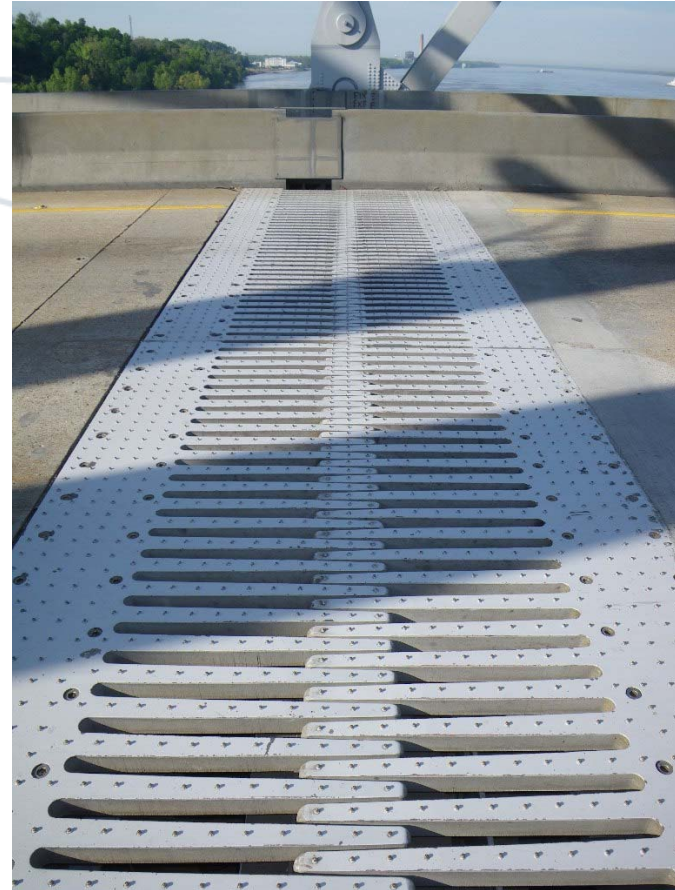
Jacking of Span L14'-L15' from PP14'



## Stringer Seat Extensions at PP15'



## Expansion Dam Replacement at PP15'



PP 14' AFTER SPAN SHORTENING



EXPANSION DAM AT  
PP 15' AFTER SPAN SHORTENING

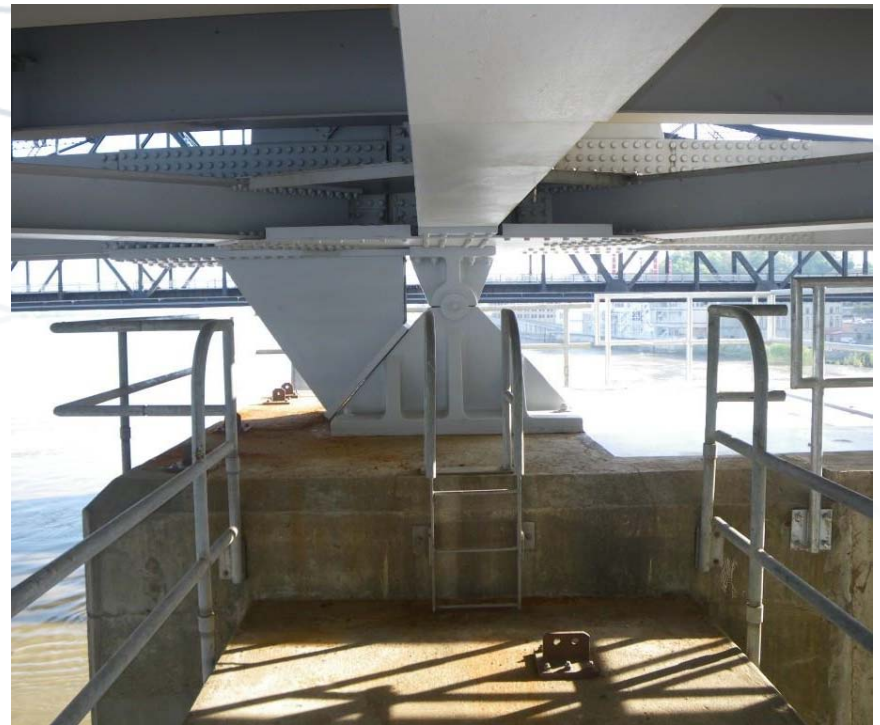




## Widening of Pier Top Area at Pier E-1



## Pier Top Area Widening and Bearing Blocks at Pier E-1

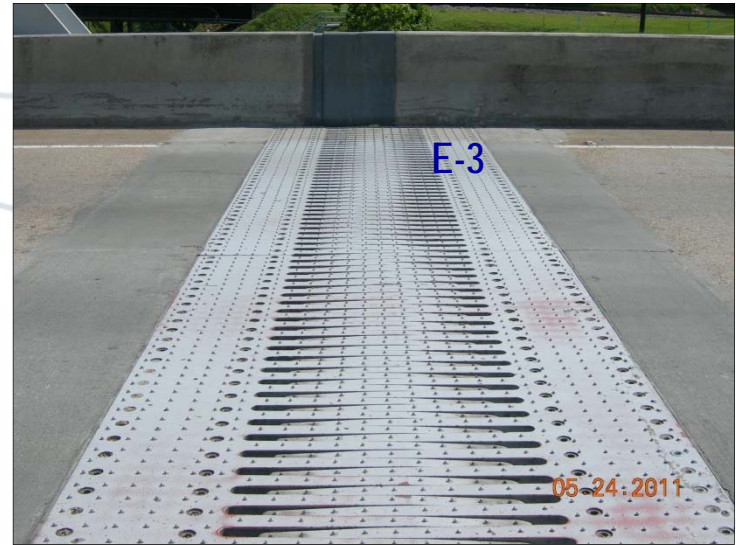


## Addition of Eyebars to the Suspended Span Hangers at PP15 and PP15'



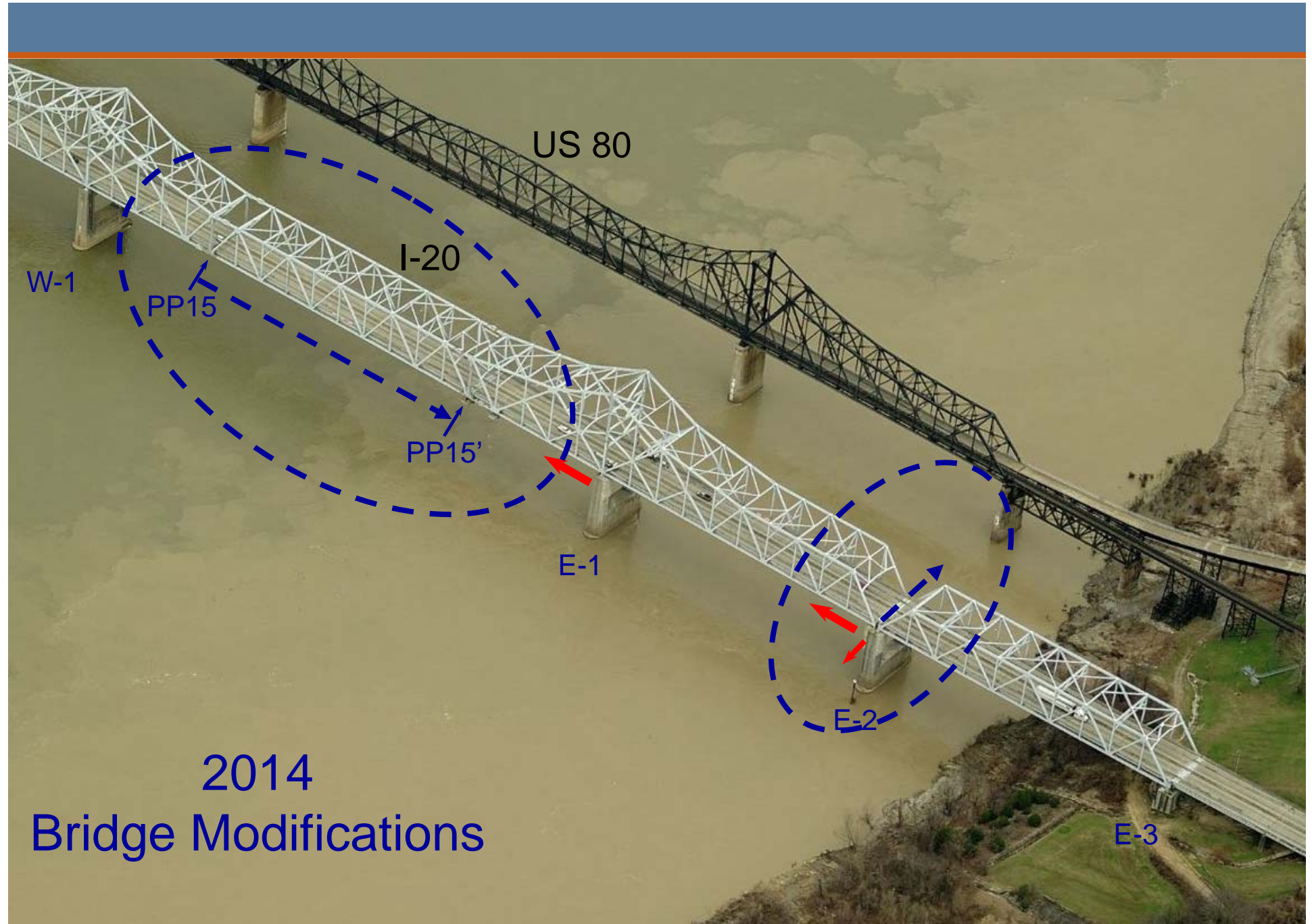


## Deck Joints After 2010 Modifications



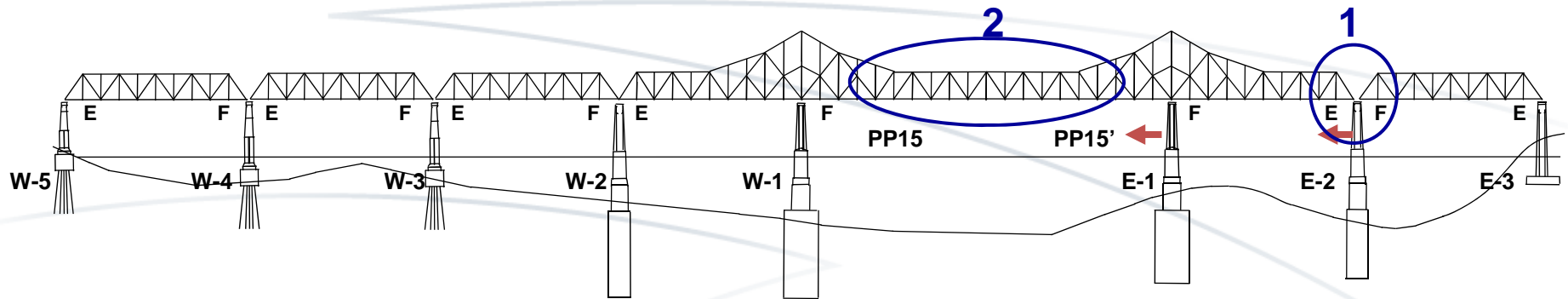
## Bridge Piers After 2010 Modifications





2014  
Bridge Modifications

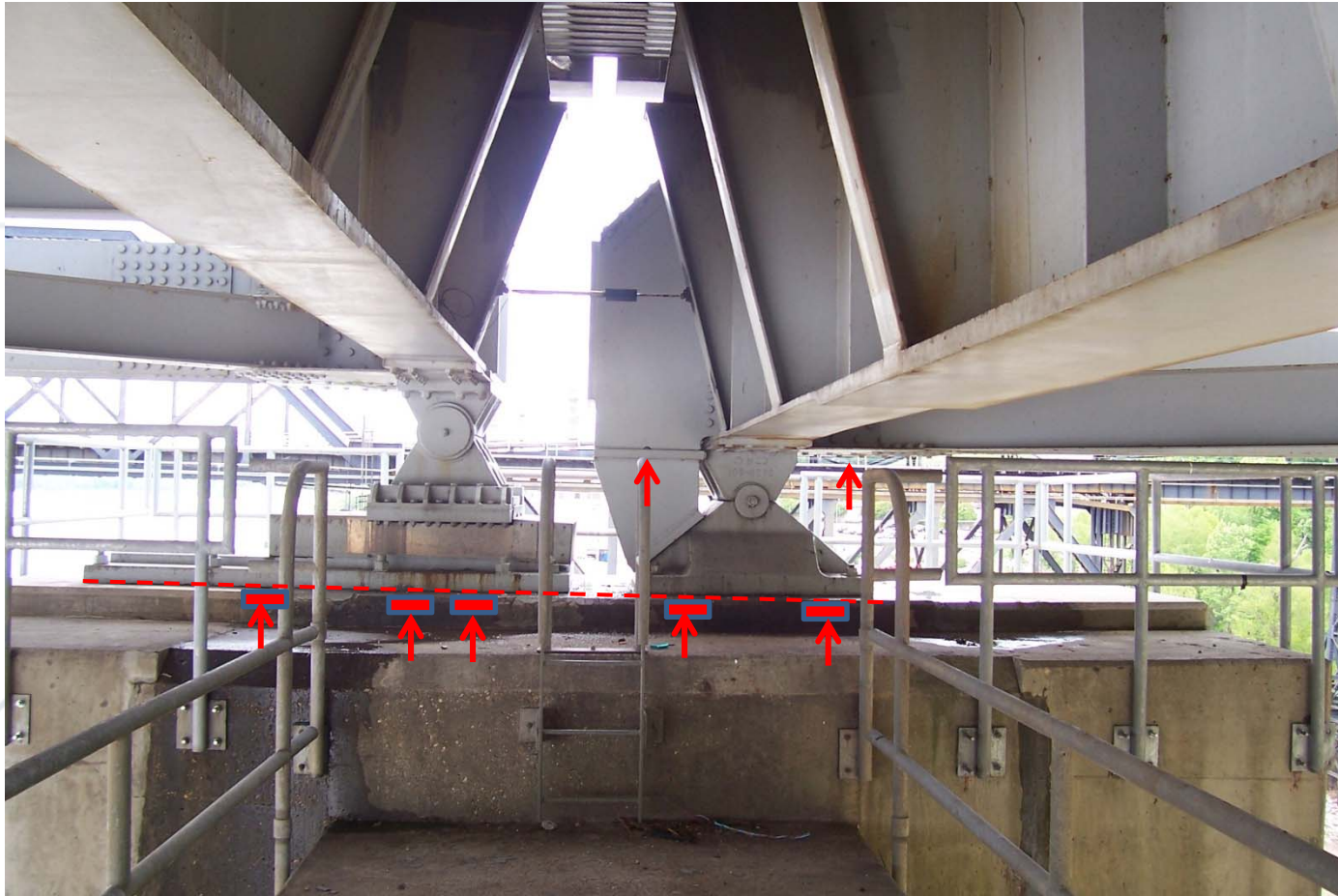
## 2014 Bridge Modifications (Transverse Capacity)



Measure	Objective	Retrofit
1	Provide transverse movement capacity at Pier E-2	Install transverse sliding assembly at Pier E-2: <ul style="list-style-type: none"> <li>• jack bearings vertically</li> <li>• install PTFE assembly underneath</li> <li>• perform horizontal jacking</li> </ul>
2	Reset expansion dam at PP15	Push (and pull) the suspended span towards PP15'



## Installation of Transverse Jacking System at Pier E-2



## Vertical Bearing Jacking of Expansion Bearing at Pier E-2



## Vertical Bearing Jacking of Fixed Bearing at Pier E-2



## Installation of PTFE Assembly Under Bearings at Pier E-2





## Horizontal Bearings Jacking Assembly at Pier E-2



## Horizontal Jacking of Bearings at Pier E-2

Upstream Bearings



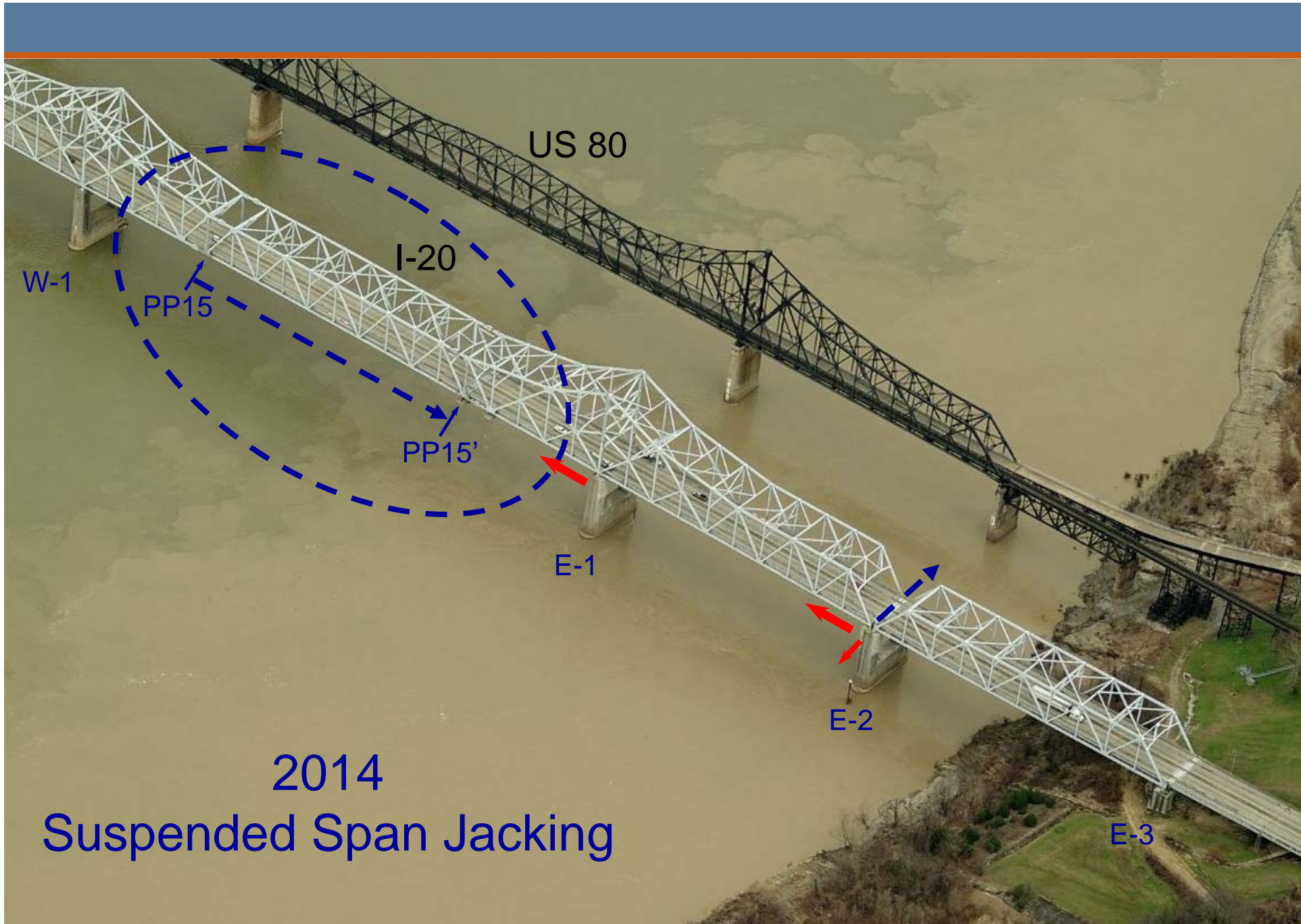
Downstream Bearings



## Completed Horizontal Jacking Assembly at Pier E-2







US 80

I-20

W-1

PP15

PP15'

E-1

E-2

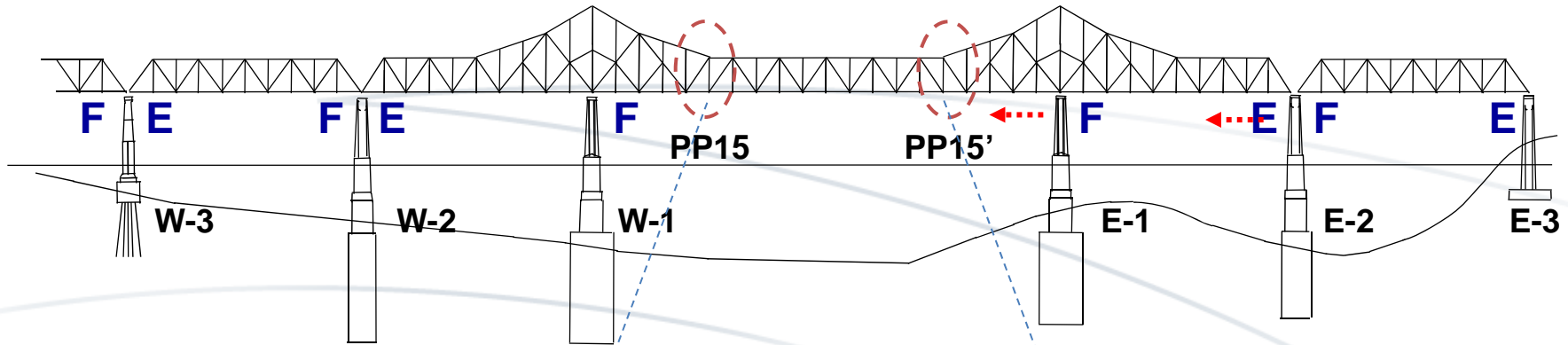
E-3

2014

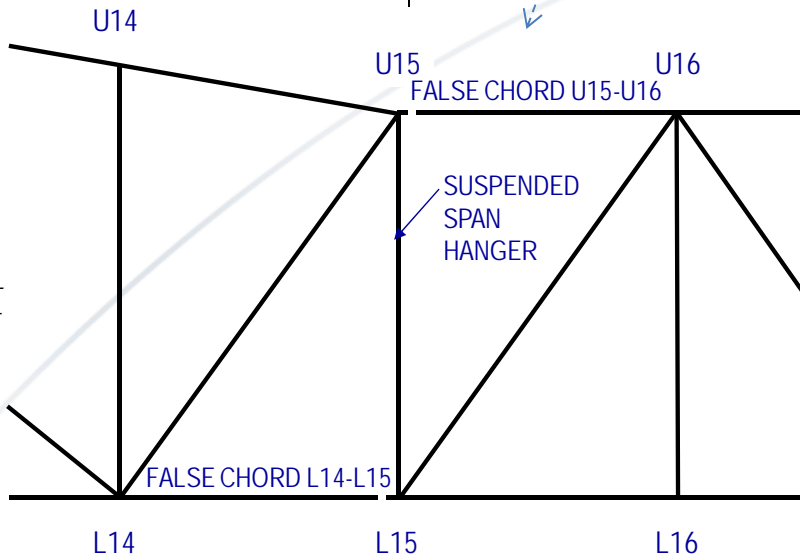
Suspended Span Jacking

West

East



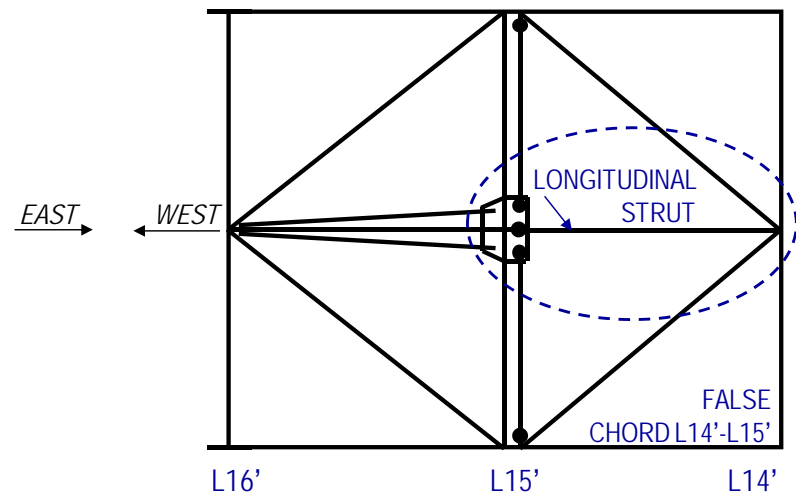
CANTILEVER SPAN | SUSPENDED SPAN



TRUSS ELEVATION VIEW AT PP15

PP15'

SUSPENDED SPAN | CANTILEVER SPAN



BOTTOM LATERAL SYSTEM AT PP15'

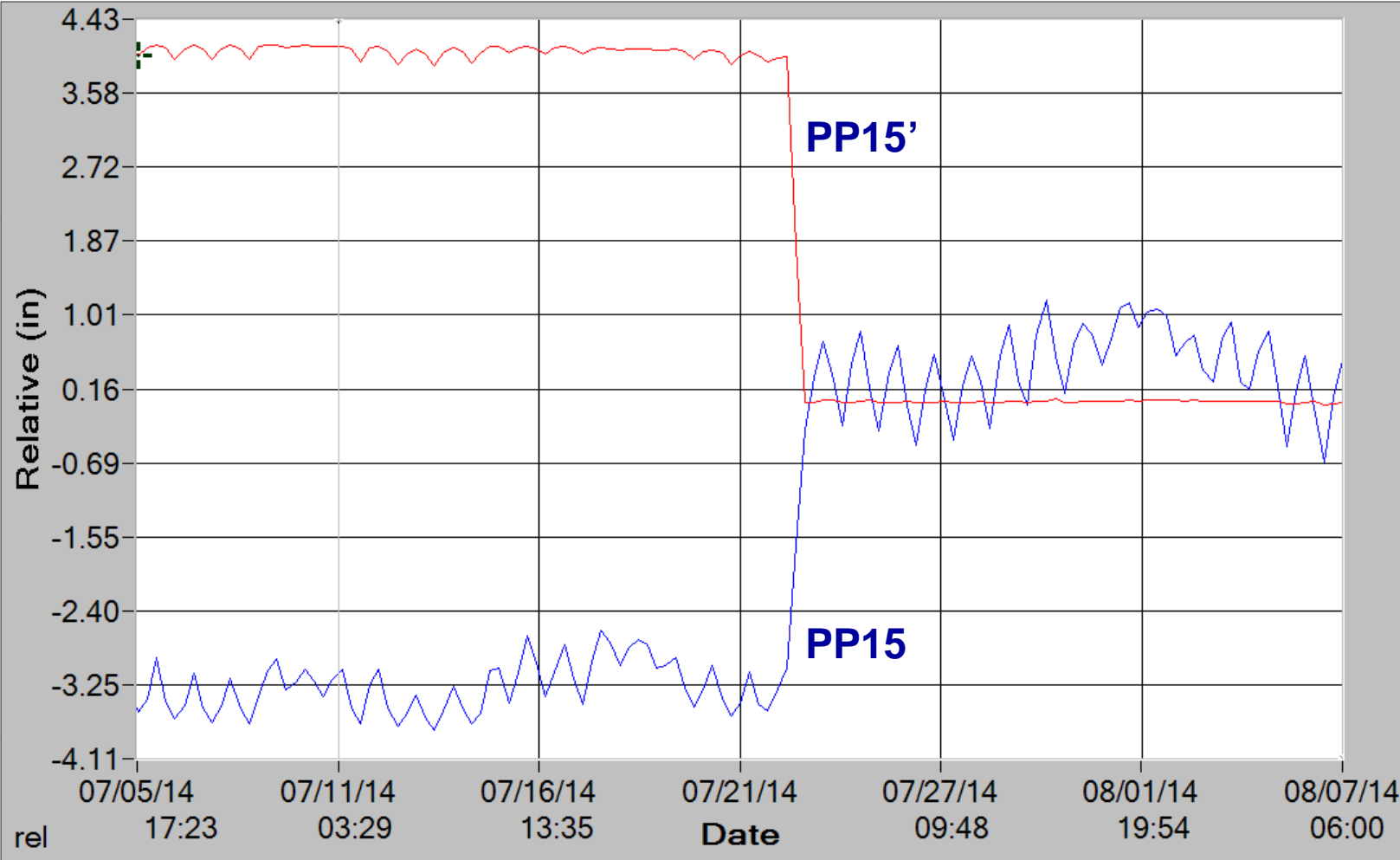
## Pushing of Suspended at PP15



## Pulling of Suspended at PP15'



# Suspended Span Jointmeter Measurements Before and After Jacking



# Summary

2001 Start of Bridge Monitoring Program

2004 Remedial Structural Modifications

2010 Proactive Structural Modifications for:  
Anticipated movements  
Extreme scenarios

2014 Proactive Structural Modifications for  
Transverse Pier Movement  
Capacity



# Acknowledgements

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Joshua Moore, P.E.

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CEC, Inc.

OCCI, Inc.



Thank you!

