Development of Rideability (IRI) Based Smoothness Specifications for Bridges

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Pavement Eval & RPUG 2010

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Overview

- Why Rideability on Bridges is Important
- Status 9 years ago
- Experimental Specifications
  - What we learned, results, next steps
- Comprehensive Proposal Note by Spring 2011?
- Questions

What I Won't Cover

- Causes of Bridge Roughness
- Design and Construction Considerations

Impacts of Poor Bridge Ride

User Costs

- ↓ User Satisfaction
- ↑ Vehicle Wear/Damage
- ↑ Cargo Damage
- ↑ Freight Costs
- ↓ Safety
  - ↓ handling/grip

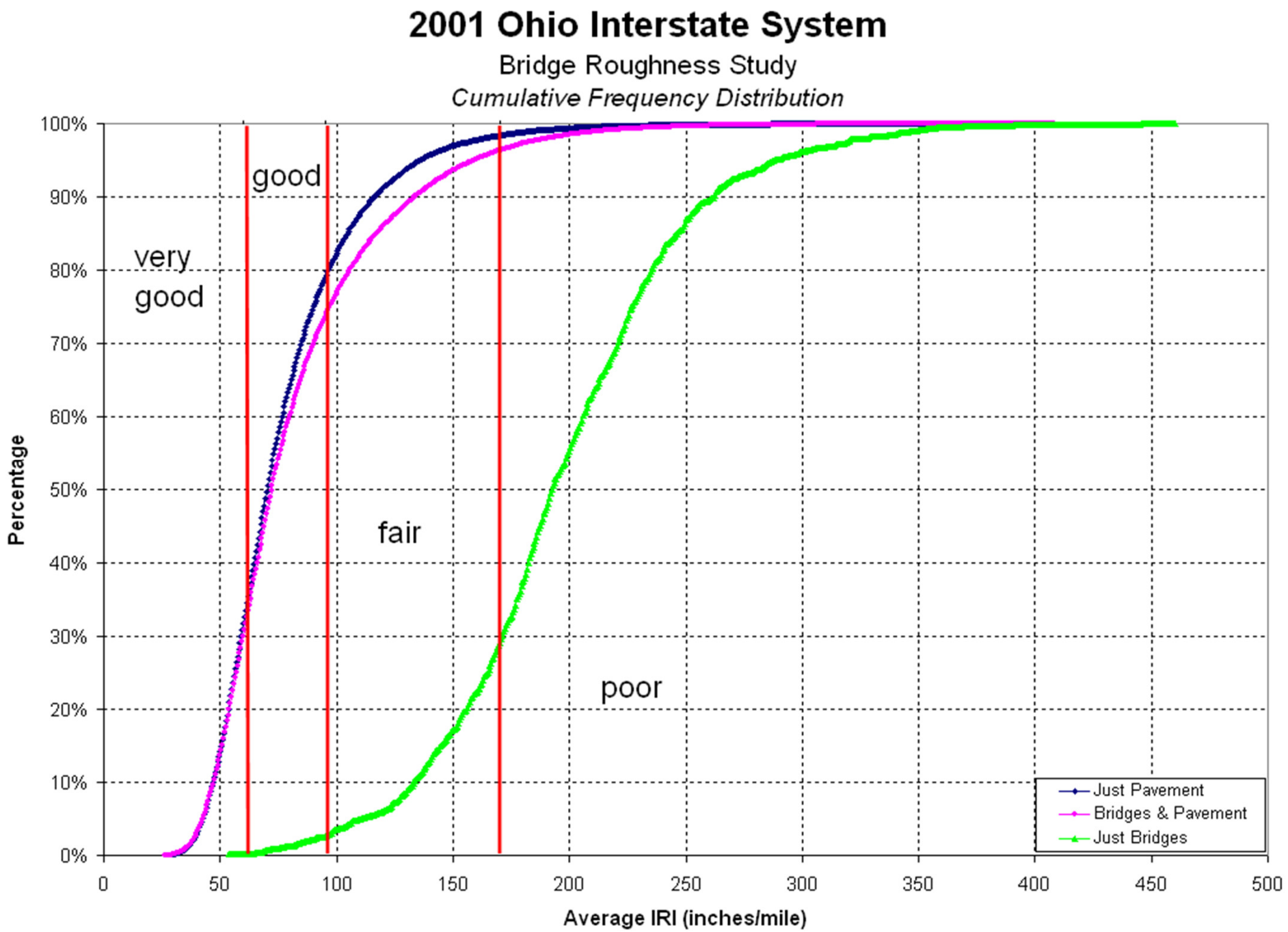
Agency Costs

- ↓ Pavement Life
- ↓ Bridge Life
- ↑ Maintenance Costs

  Snow/Ice Removal
  - ↓ efficiency
  - ↑ costs

2001: Bridge Rideability

- Bridges 2 ½ X rougher than pavements by IRI
- Bridges increase system IRI by 7.5%
  - Bridges are less than 4% of system by length
- Smoothness specs on decks & pavement
  - 1/8” in 10’ Rolling Straightedge on deck and approach slabs
  - CA profilograph on Pavement & a few decks
  - No specs on pave/approach slab or approach slab/deck transitions


2001 Ohio Interstate System
Bridge Roughness Study
Cumulative Frequency Distribution
Percentage
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
50
100
150
200
250
300
350
400
450
500
Average IRI (inches/mile)
very good
good
fair
poor
Just Pavement
Bridges & Pavement
Just Bridges

2001: Bridge Rideability

- Public expects bridges to ride rough
- Major concern with bridges is structural load capacity
- Highway Industry has a wealth of Civil Engineering Specialists and fewer Generalists

  (maybe we built smoother riding bridges years ago)

New or Re-newed Paradigm

"*Ability to safely carry loads*

and

good rideability

are NOT

mutually exclusive goals

for our structures!"

2006 Experimental Spec

Can we build them smooth to begin with?

- 150 (06) New Divided 4 Lane
  - 4 mainline bridges
  - 1 overpass
- 138 (07) New Divided 4 Lane
  - 4 mainline bridges
  - 2 overpasses
  - 2 side roads

2006 Experimental Spec

- Each lane of encounter must have an IRI below 150 in/mile *(proper threshold?)*

  (25’ pavement, approach slab, deck, approach slab, 25’ pavement) IRI <= 150”/mi

- Incentive – max of 20% with IRI <= 80”/mi

  paid on price concrete in deck

  (carrot the right size?)

2006 Experimental Spec

Considerations

- Length of bridge, (decks & approaches)
- What if bridge encounter isn't below 150 inches/mile?
- Incentive increments

2006 Exp Spec Results
Projects Completed in 2009 & 2010

150 (06) Overpass Bridge IRI "/mile			
	as built	after grinding	
	130	53	

2006 Exp Spec Results
Projects Completed in 2009 & 2010

150 (06) Mainline Bridges IRI "/mile			
	as built	after grinding	
	155	87	
	217	82	
	175	77	
	187	99	

2006 Exp Spec Results
Projects Completed in 2009 & 2010

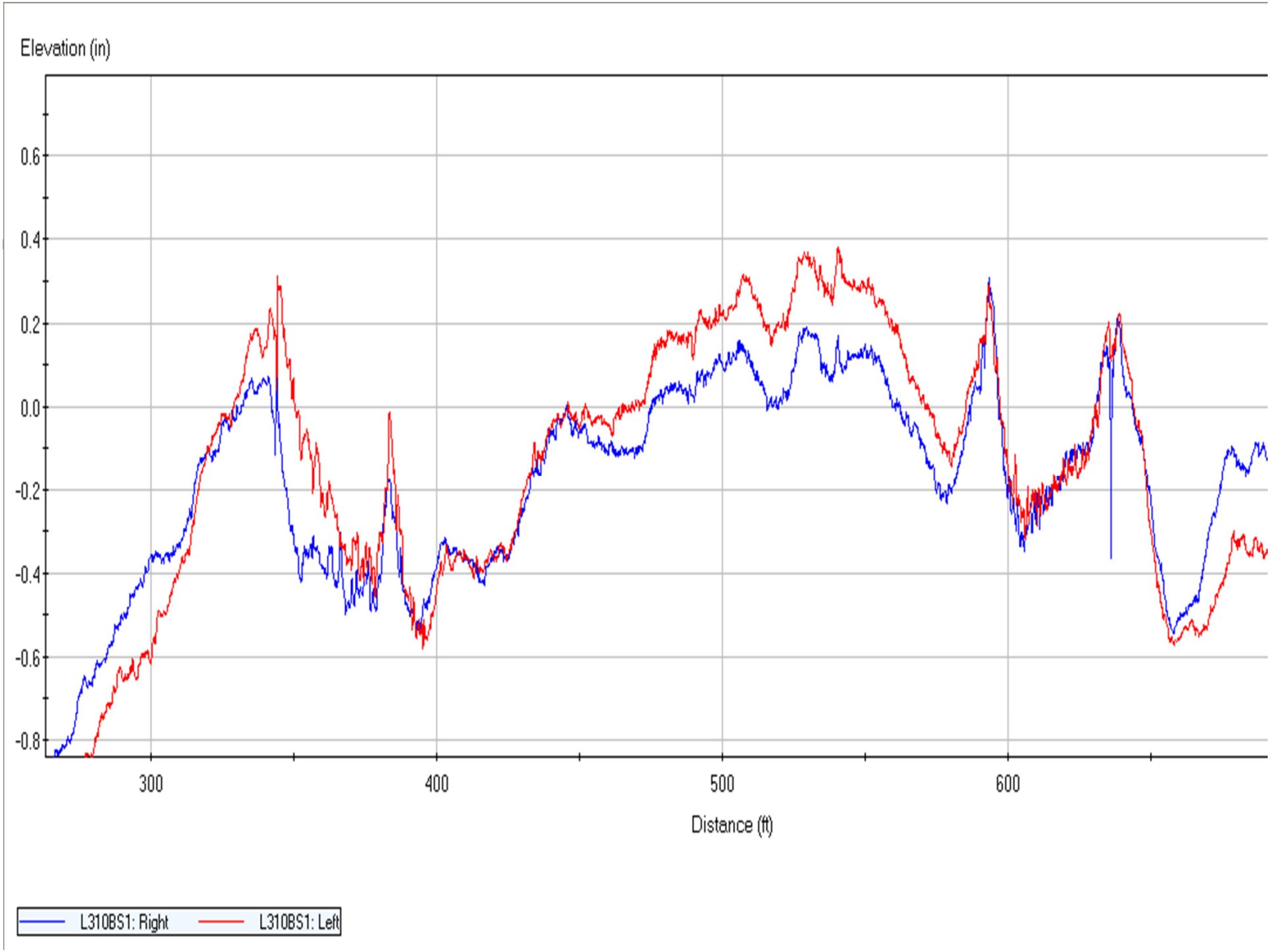
138 (07) Mainline Bridges IRI "/mile			
	as built	after grinding	
	206	91	
	134	64	
	143	70	
	165	70	

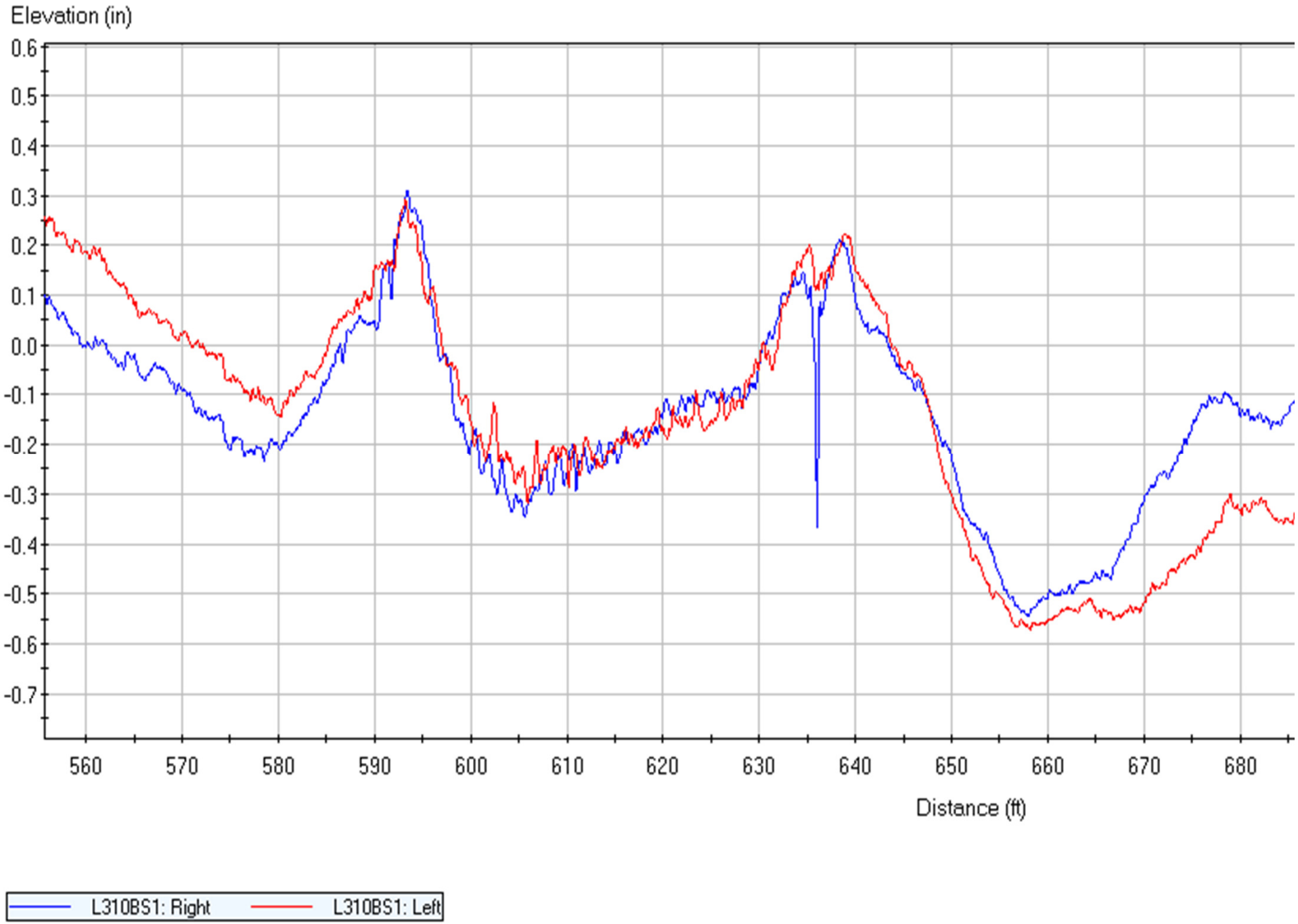
2006 Exp Spec Results
Projects Completed in 2009 & 2010

138 (07) Overpass Bridges IRI "/mile			
	as built	after grinding	
	142	62	
	153	62	
138 (07) Service Road Bridges IRI "/mile			
	as built	after grinding	
	195	101	
	213	98	

2006 Experimental Spec What We Learned

- Contractors understand “general profile” well, road profiles not so well
- Most all approach slabs are “sow bellied”
- Localized roughness limit needed
- May not want overall limit on short bridges
- “Blanket” grinding greatly improves ride


Elevation (in)
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
300
400
500
600
Distance (ft)
L310BS1: Right
L310BS1: Left


Elevation (in)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
560
570
580
590
600
610
620
630
640
650
660
670
680
Distance (ft)
L310BS1: Right
L310BS1: Left

Cleveland Innerbelt Design Build Project

- Overall IRI limit of 130 in/mi for each lane of a bridge encounter
- Localized IRI limit of 300 in/mi for any 25’ within bridge encounter
- 50’ approach slabs at new embankments
- No incentives or pay adjustments

Dayton I-75 Reconstruction

- Overall IRI limit of 130 in/mi for each lane of a bridge encounter
- Localized IRI limit of 400 in/mi for any 25’ within bridge encounter
- 50’ approach slabs at new embankments
- No incentives or pay adjustments

Comprehensive Proposal Note for Bridge Rideability

- Target Spring 2011
- Blanket diamond grinding planned?

  (1/2” extra/sacrificial deck thickness)
- Overall IRI limit of 130 in/mi for each lane of a bridge encounter
- Localized IRI limit of ??? in/mi for any 25’ within bridge encounter

Comprehensive Proposal Note for Bridge Rideability

- Incentives? – "smooth as I can get it" vs. "smooth enough to pass spec"
- If overall limit of 130 in/mi not met then correct to 80 or 90 in/mi
- If localized limit of X in/mi not met then correct to X-100 in/mi
- Waive overall limit is encounter < 200'

Questions ???????

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THANK YOU