NORFOLK SOUTHERN

Controlling Rail Cant and Lateral Forces By Managing the Wheel/Rail Interface

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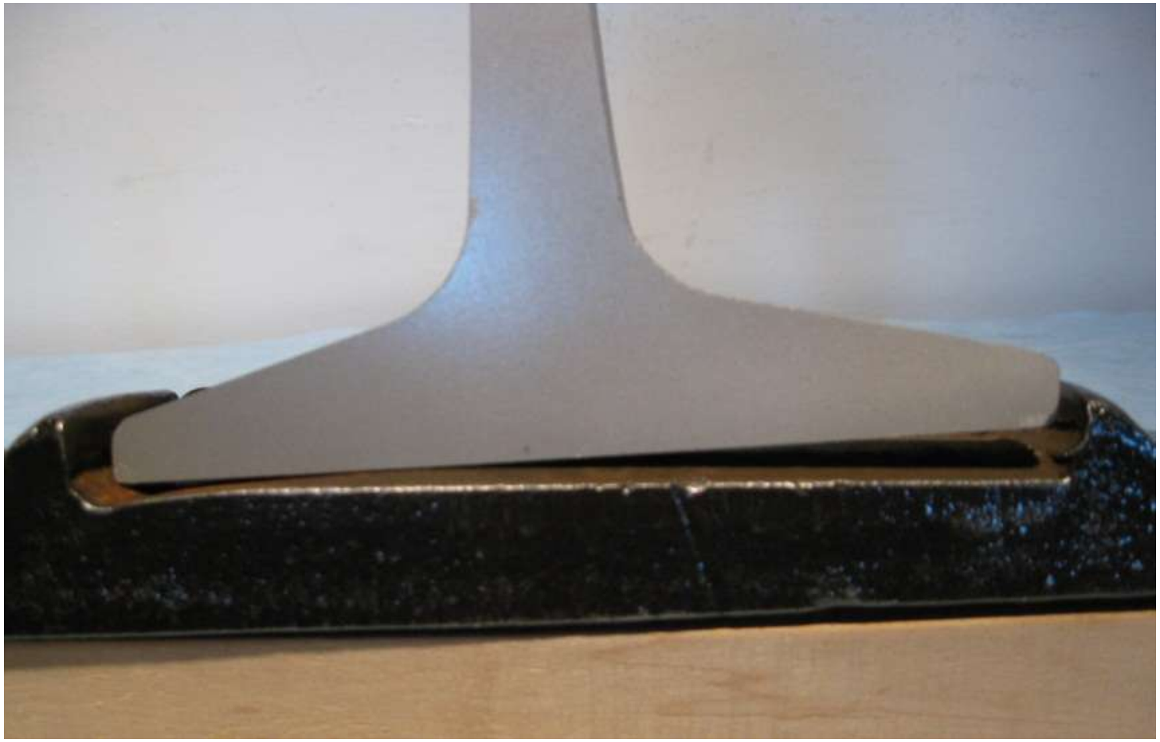
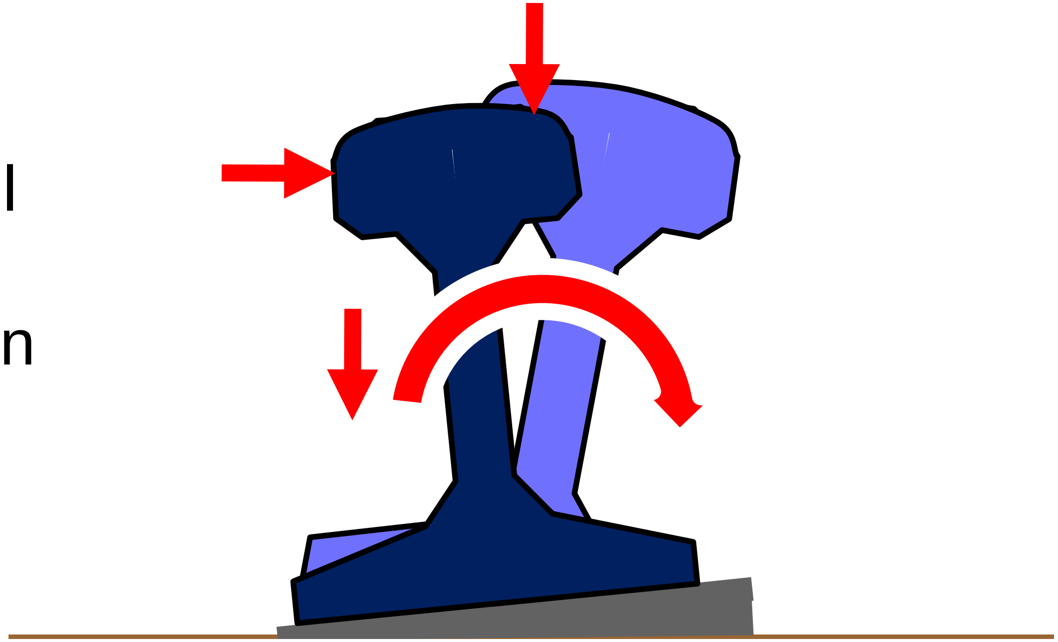
May 9, 2013



Description of rail cant

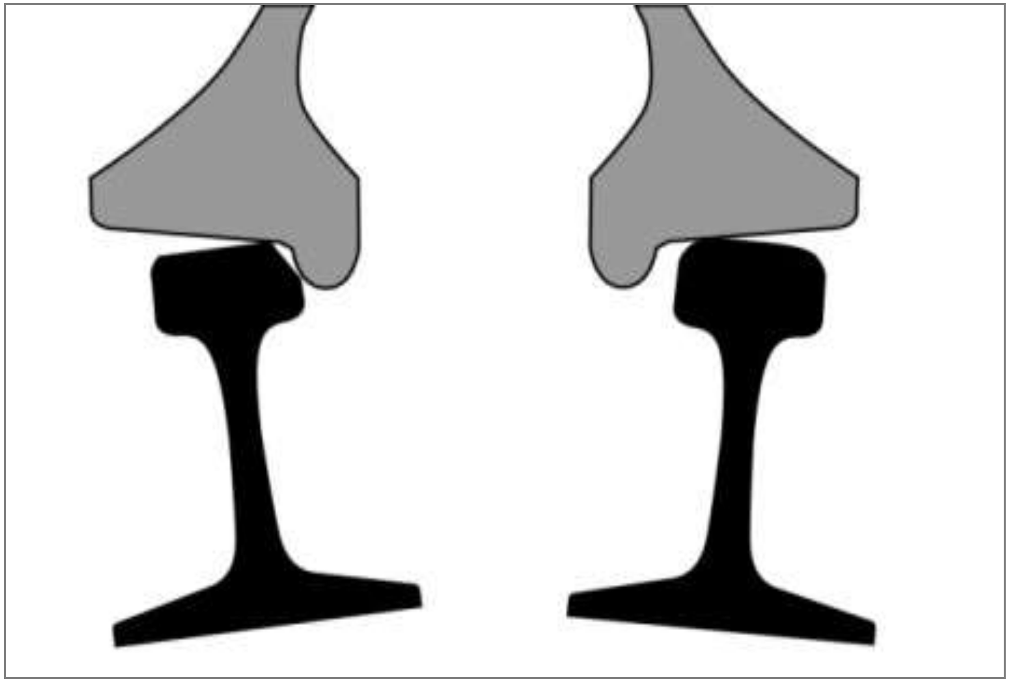
Cant is the amount of rail rotation referenced from standard tie plate position (typically 1:40 inward)



Outline

- Review results from the Wills test site (2011)
- Describe work done at the Hardy test site (2012 – 2013)

1. Track conditions
2. Video
3. Graph of lateral forces



Wills rail cant test site, 2011

Established April, 2011

- Wills, WV
- 7.8° curve, 4” elevation, 25 mph
- Strain gages for L & V forces

Track Conditions

- Cut spikes , 8x18” plates
- Gage > 57-1/4”
- Cant 2°high rail, 3°low rail

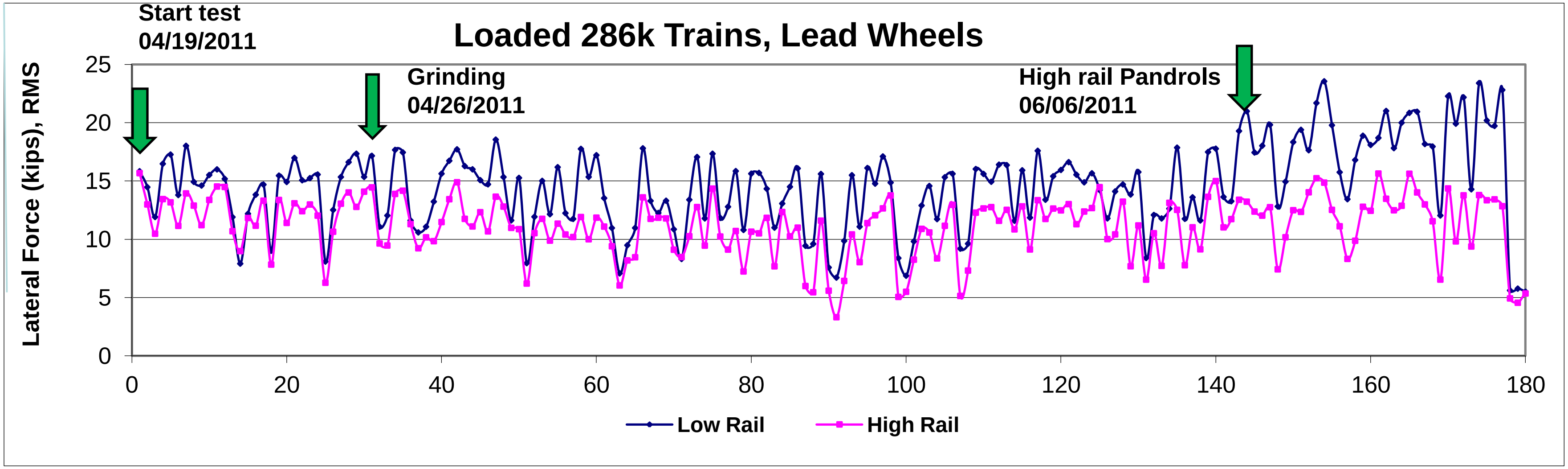
Wills – track conditions

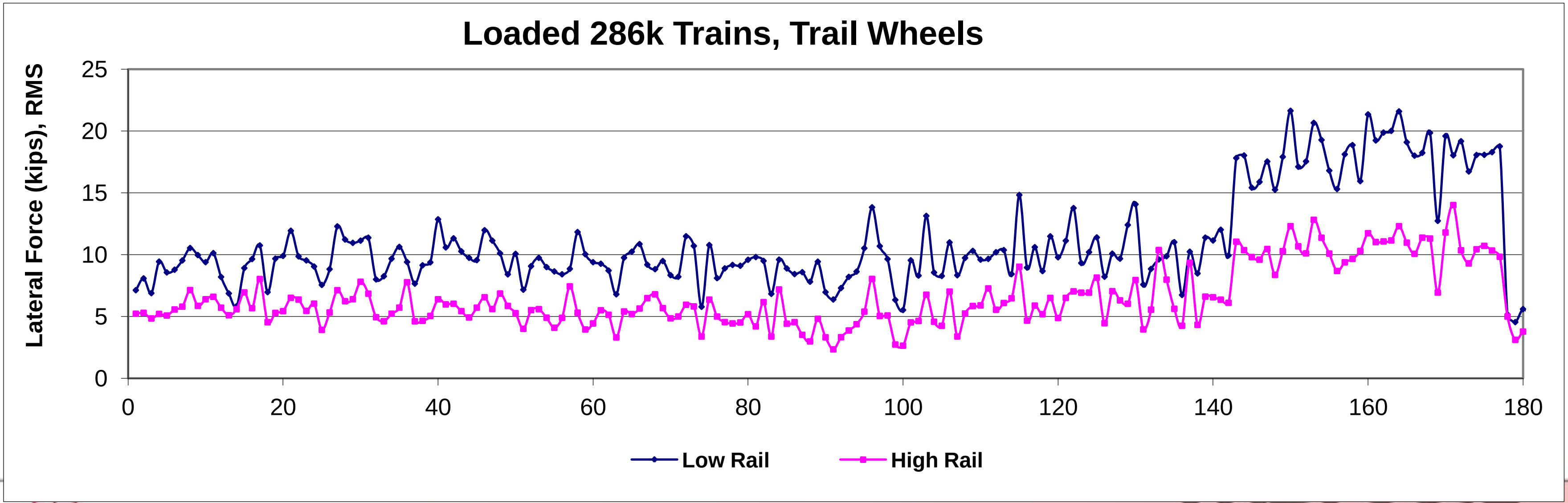
<u>Track conditions on June 6</u>

- High rail – Victor plates with Pandrol fasteners (strong restraint)
- Low rail – worn 8x18” tie plates with cut spikes (weak restraint)
- Gage – 56-3/8”
- Abundant gage face lube
- No top of rail FM

Wills - video of low rail

Wills 2011 - lateral forces





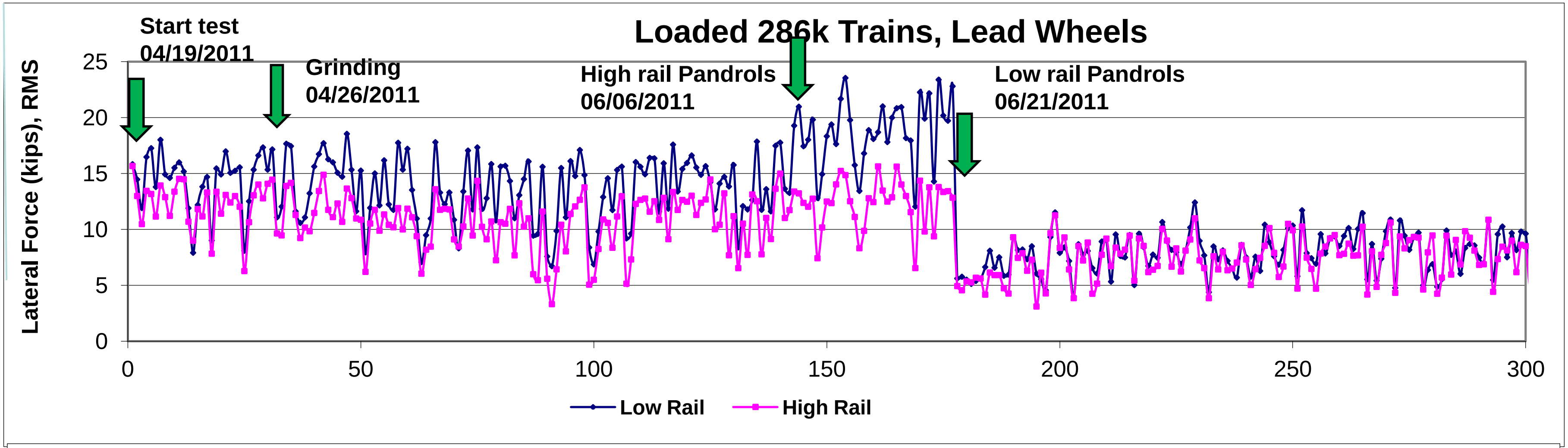
Wills - track conditions

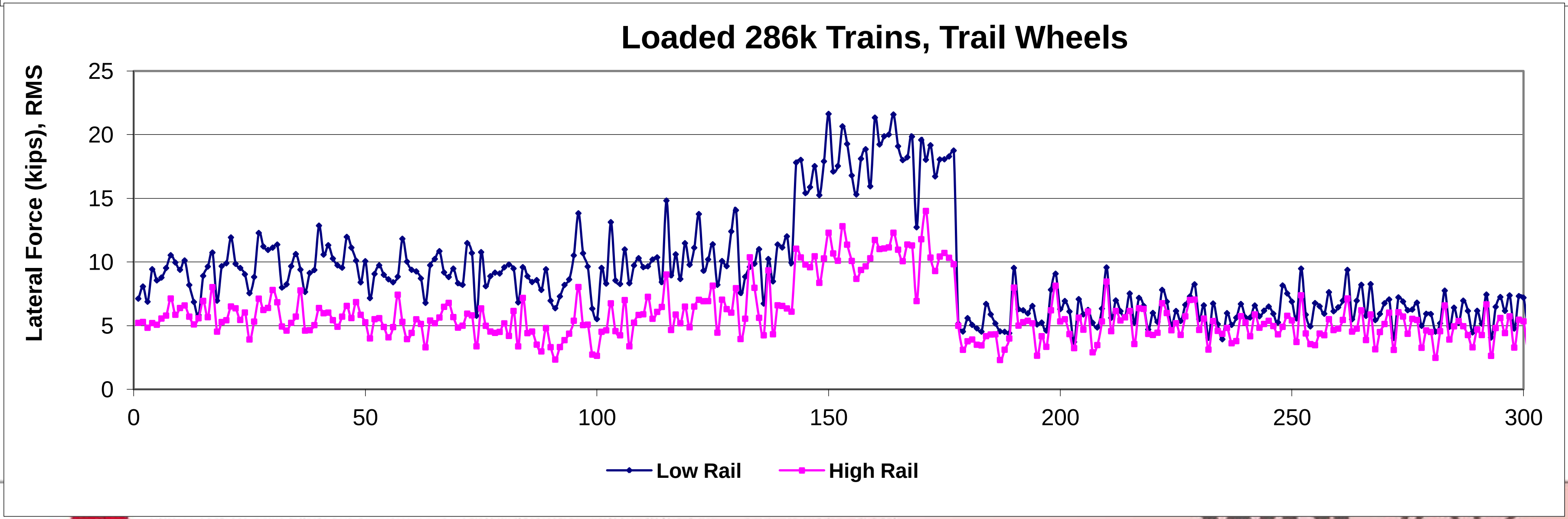
Track conditions after June 21

- Low rail - Victor plates with Pandrols
- Gage opened to 56-3/4”

Wills - video of low rail with Victor plates

Wills 2011 - lateral forces





2012 - 2013 Research Objective

What caused the dramatic force reduction at Wills?

- Gage?
- Elastic fasteners?
- Rail orientation?

Hardy rail cant test site

Established March, 2012

- Hardy, VA
- 5.7°curve, 3-1/2” elevation, 35 mph
- Strain gages for L & V forces

Track Conditions

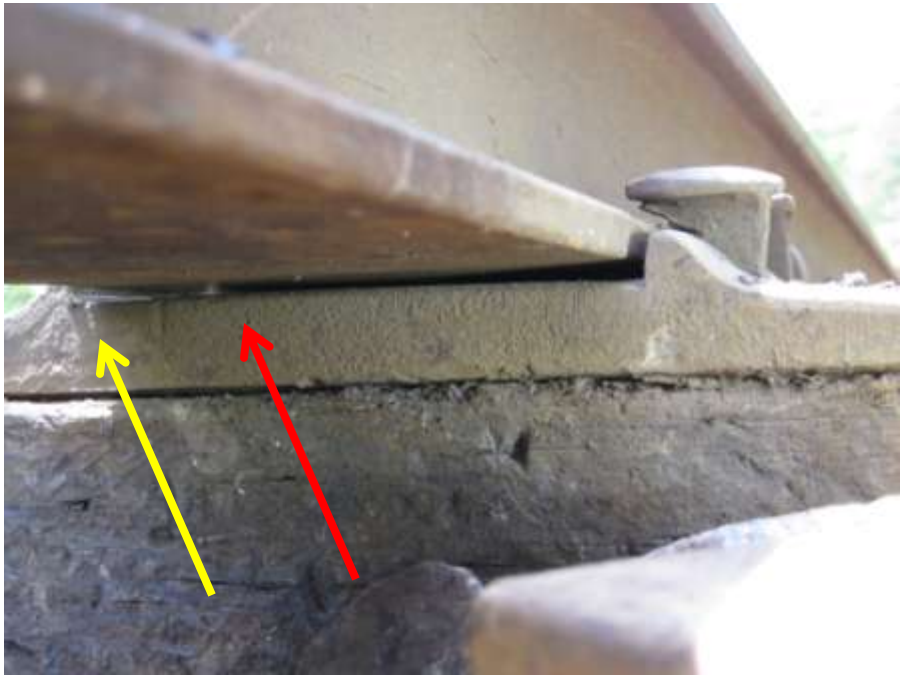
- Cut spikes , 8x18” plates
- Gage 57”
- Cant 2°high rail, 3°low rail
- Gage face lube
- No TOR FM

Low rail cant – Wills vs. Hardy

At Wills, 3°of cant was spike lift and evidence of rail rotation.

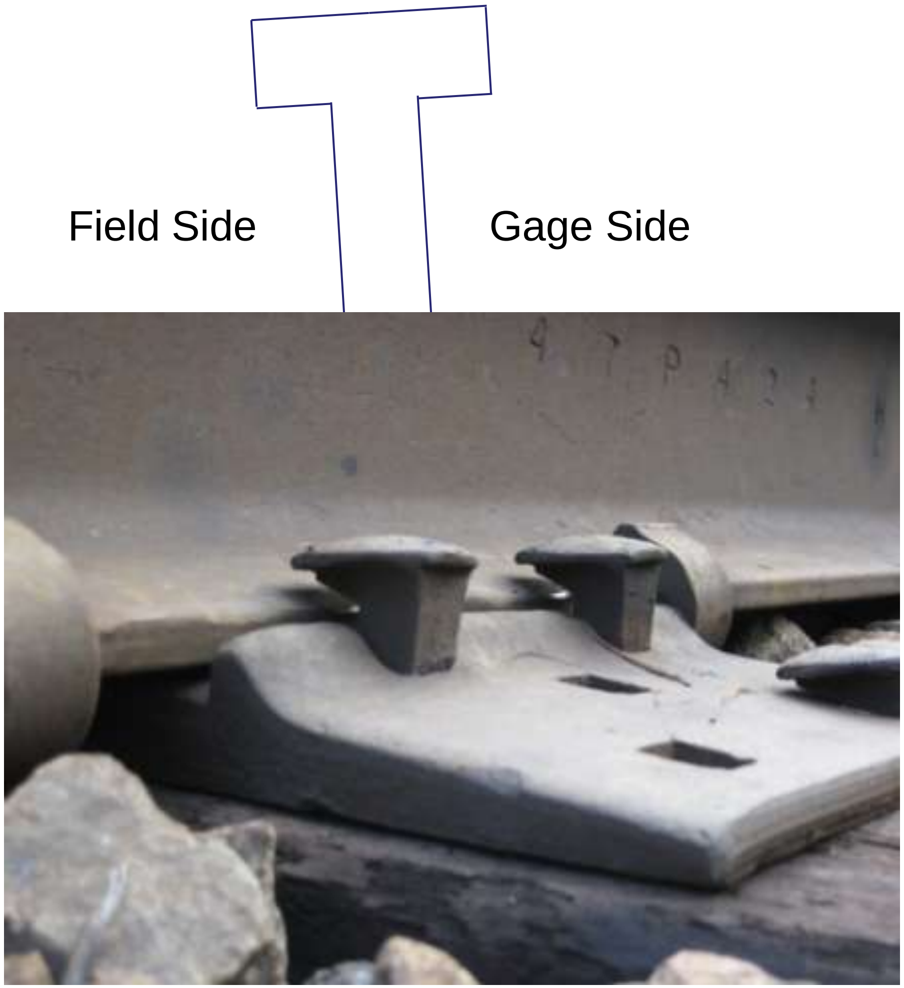
At Hardy, 3°of cant was difficult to explain.

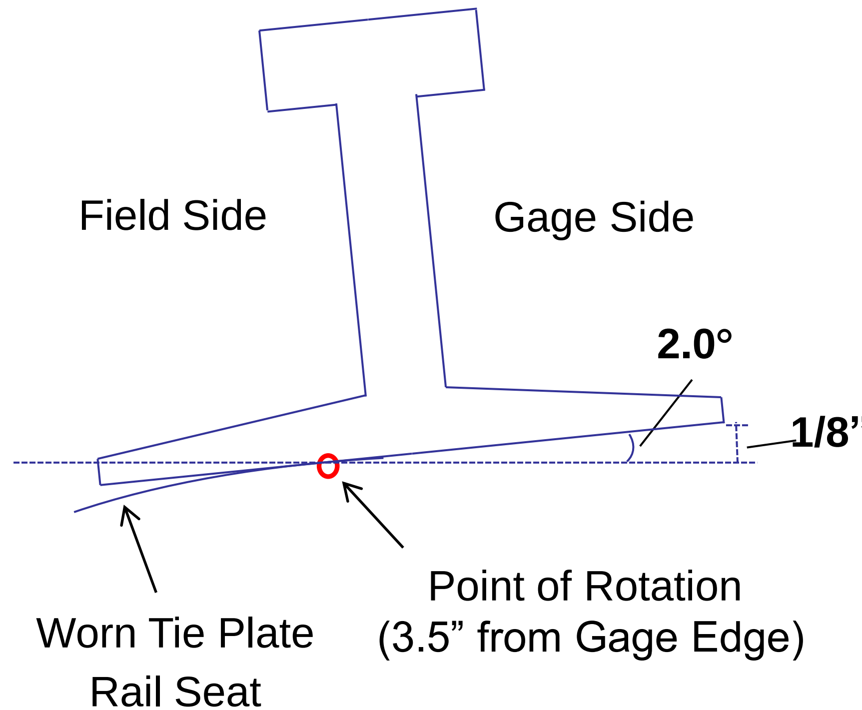
Hardy - condition of plates on low rail



Point of maximum wear on field side > 1/8” (yellow arrow); the shape of the worn rail seat changes the pivot point (red arrow).

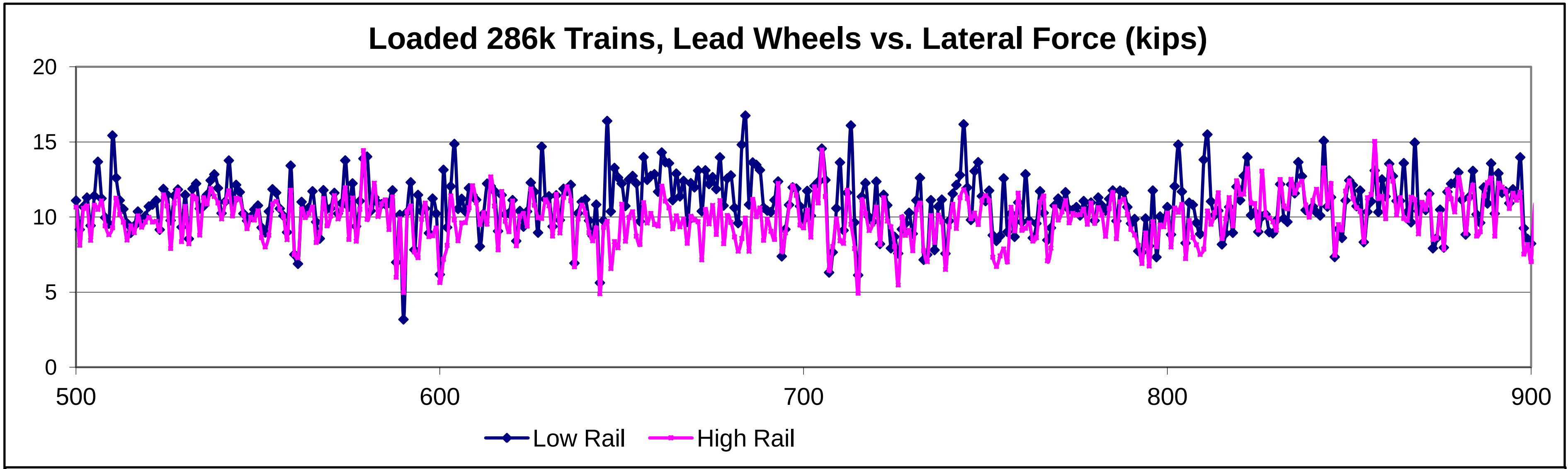
Impact of worn plates on cant

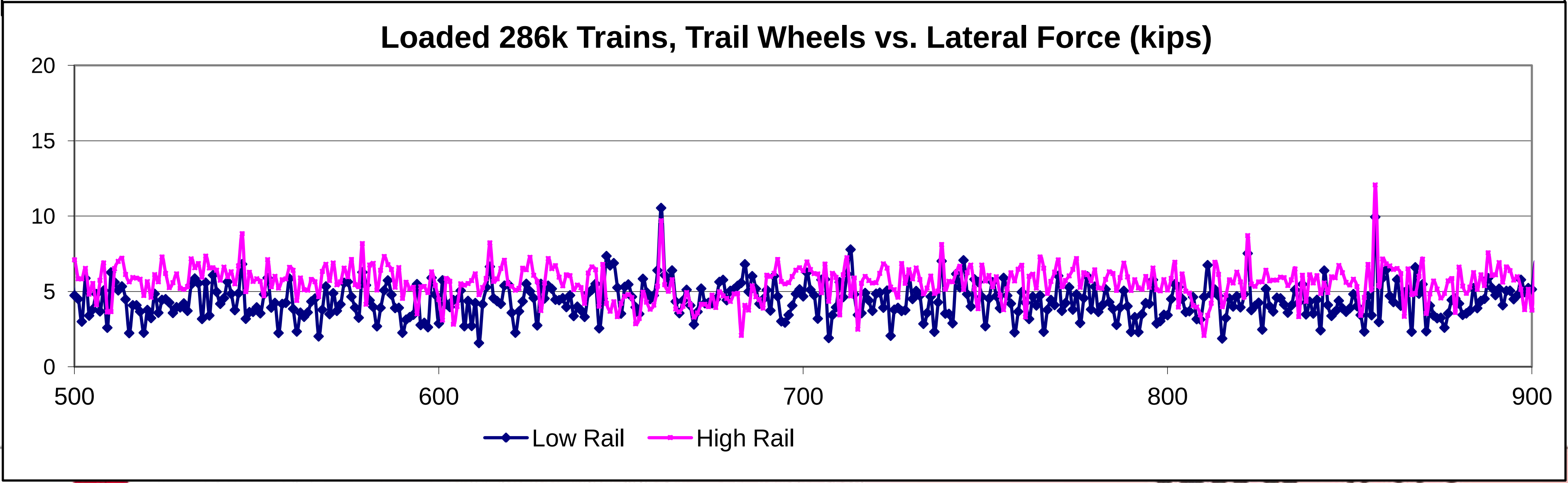




Hardy - video of worn plate on low rail

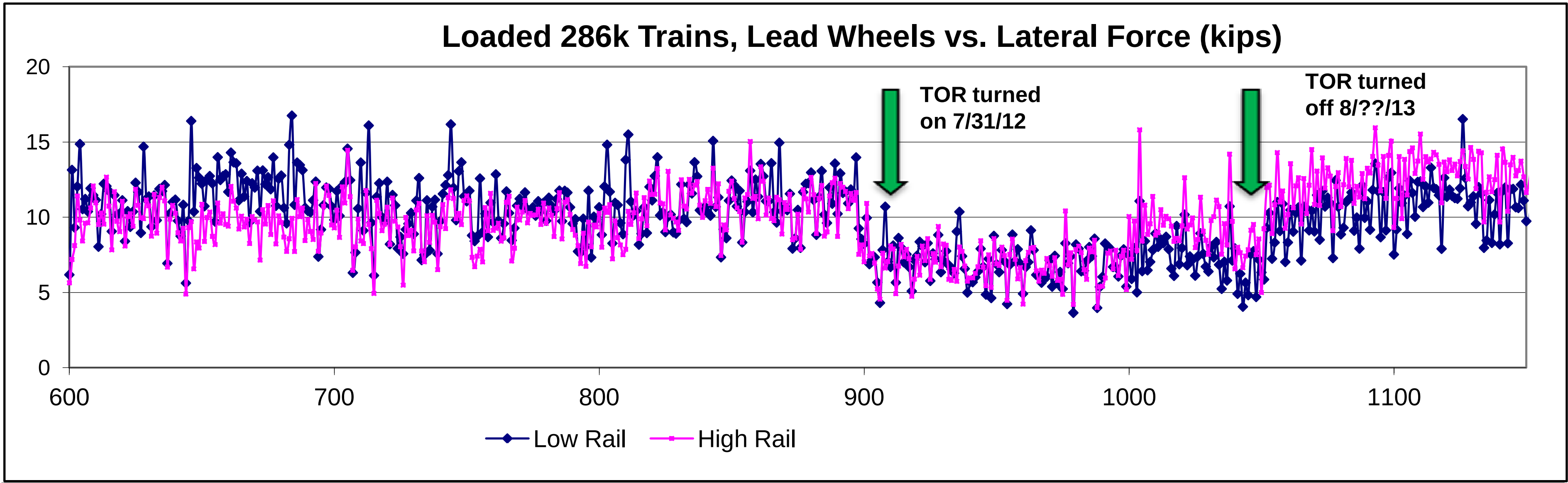
Hardy 2012 – lateral forces at start of test

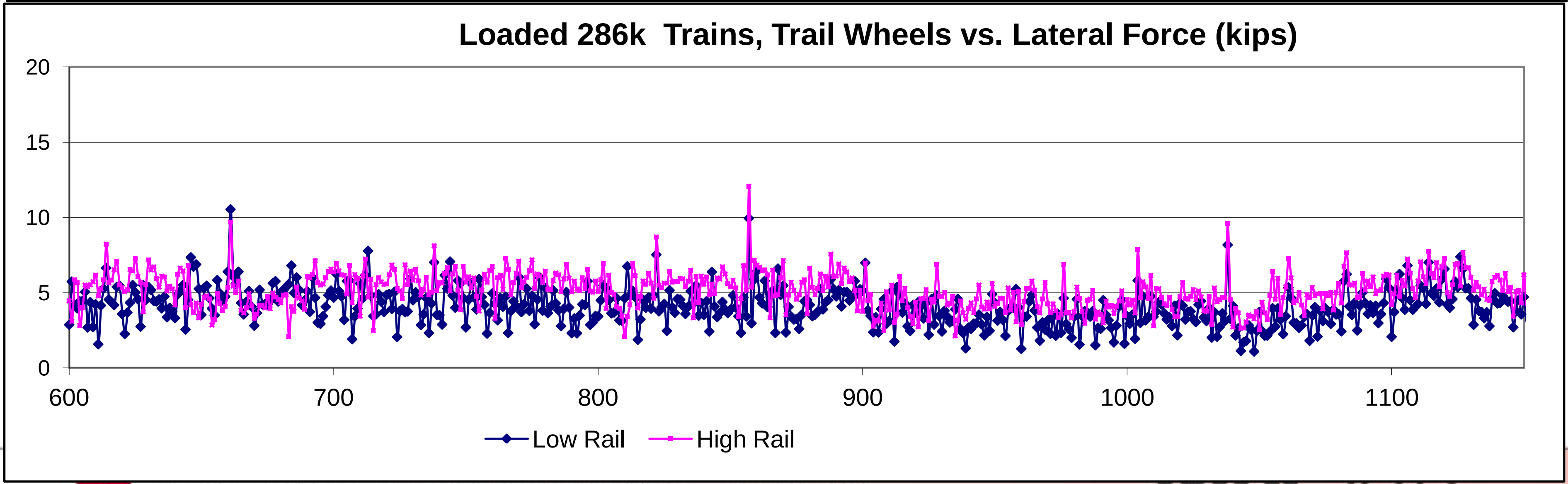




Hardy 2012 – TOR as test variable

Hardy 2012 - lateral forces with TOR On / Off





2012 - 2013 Research Objective

What caused the dramatic force reduction at Wills?

- Gage?
- Elastic fasteners?
- Rail orientation?

Test plan:

- Replace the worn plates on low rail with new 8x18” plates
- Keep rail profile, gage & friction constant

Hardy - low side plate renewal

Hardy – rail / tie plate contact

Old plate from tangent – rail base is contacting most of rail seat

Old plate from body of curve – rail base is contacting only field side of rail seat

Hardy – rail / tie plate contact

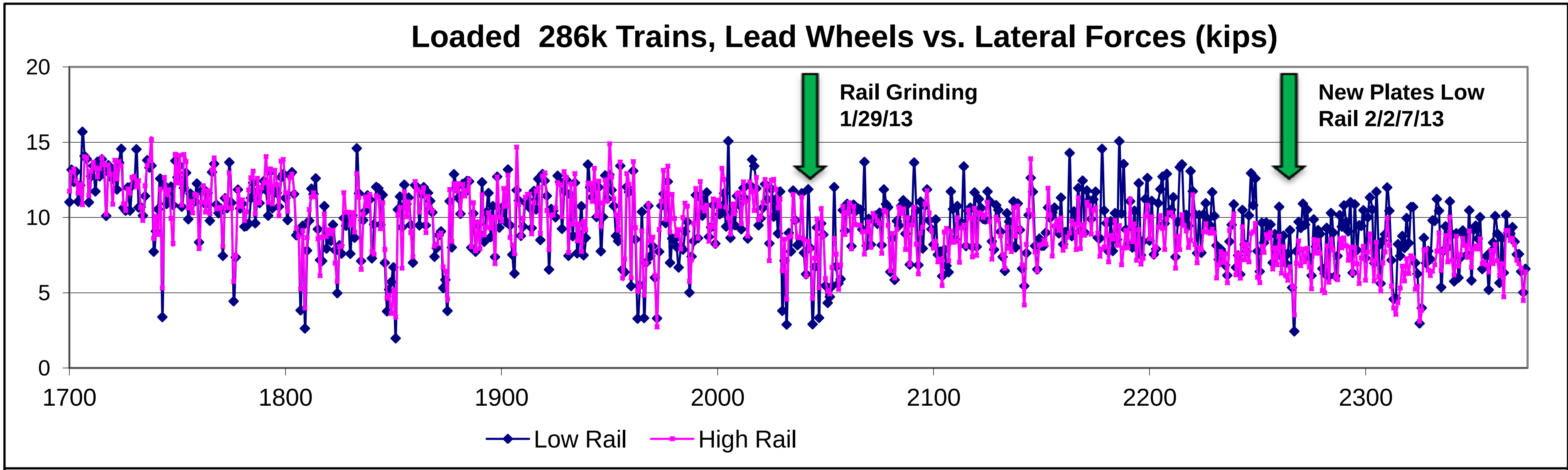
Hardy - comparison of new & worn plates

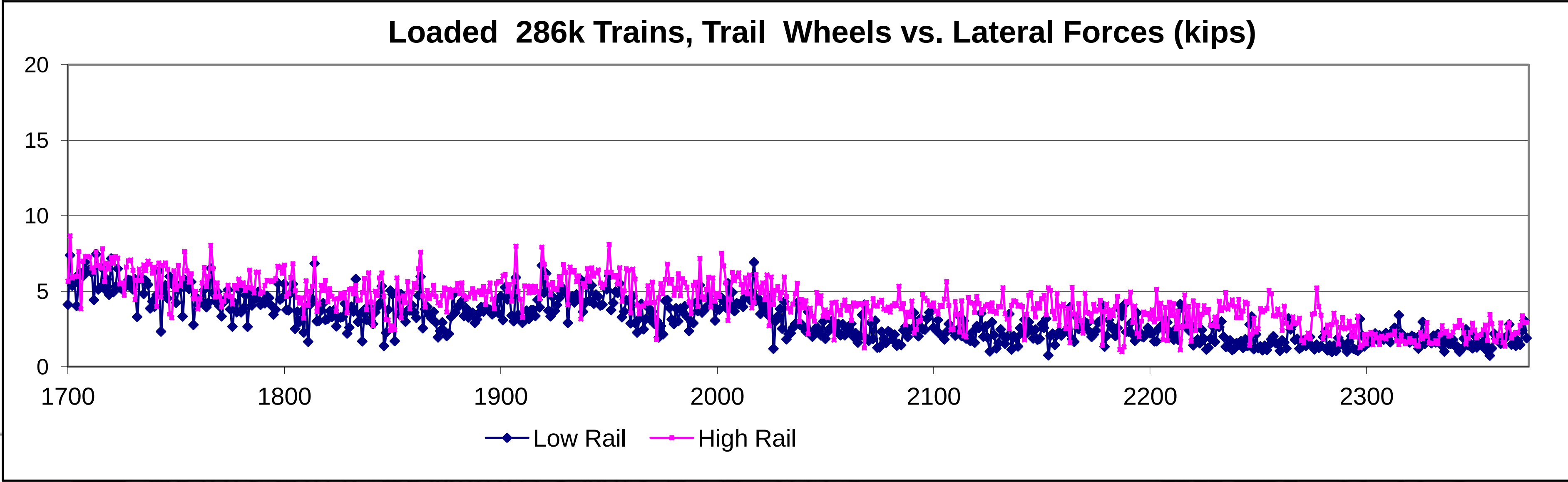
New plate 1-1/8”

Worn plate < 1”

Hardy - video of new plate under low rail

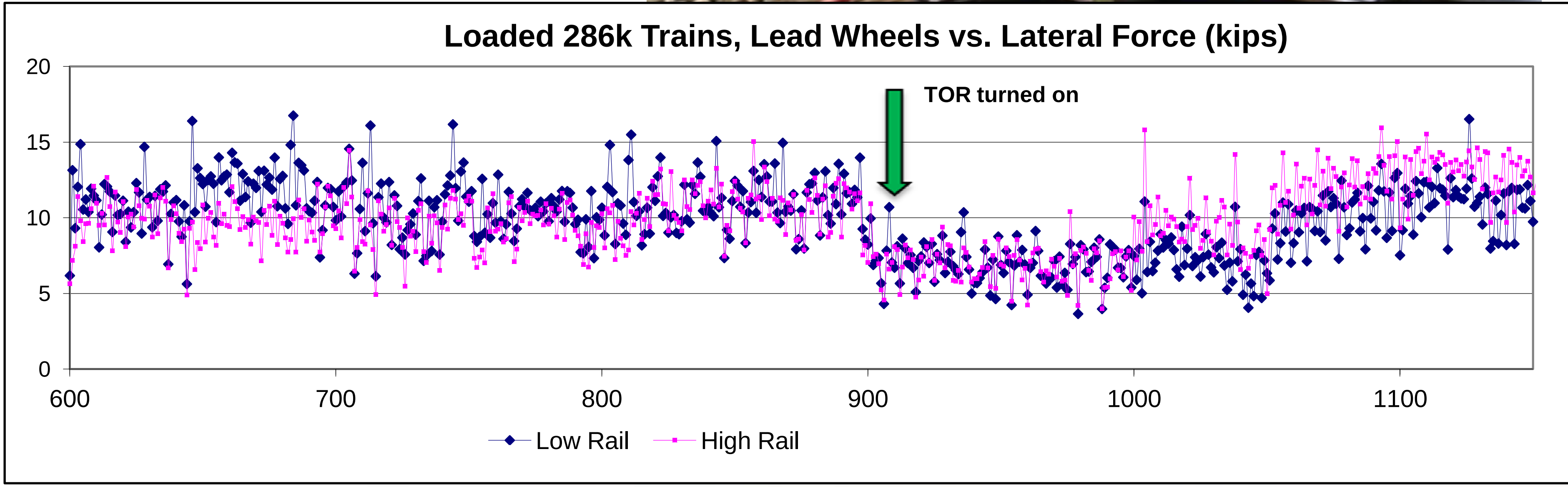
Hardy 2012 - lateral forces with new plates



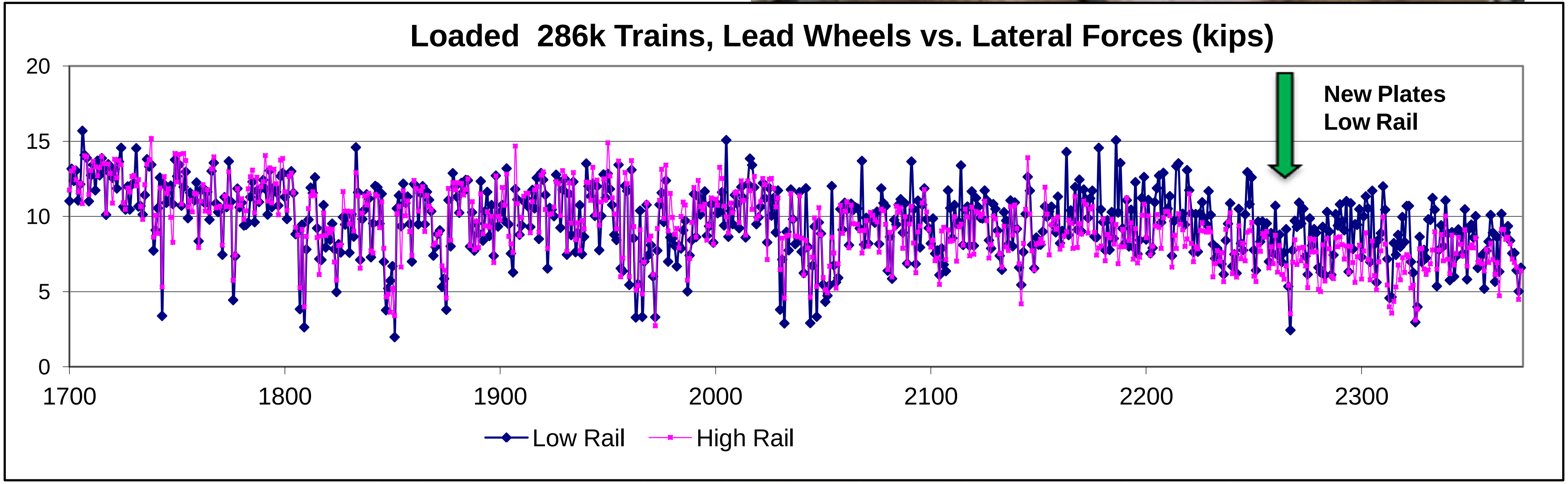


Results with Victor plates

Results with TORFM



Results with 8 x 18 plates, cut spikes



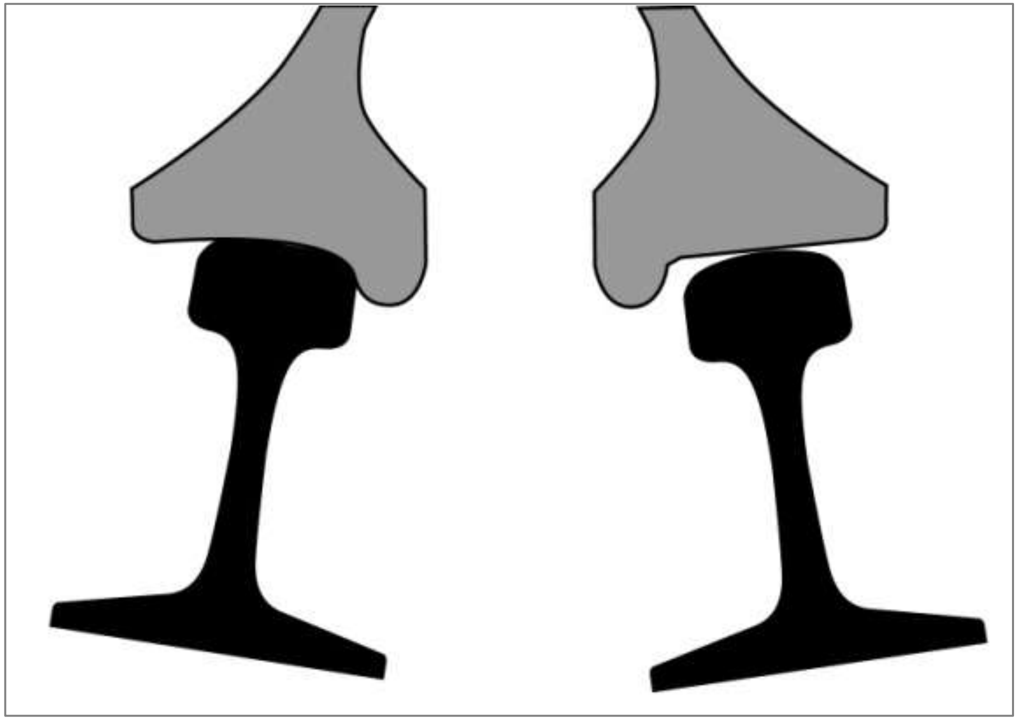
2012 - 2013 Research Objective

What caused the dramatic force reduction at Wills?

- Gage?
- Elastic fasteners?
- Rail orientation?

Conclusions from work at Hardy & Wills

1. Rail orientation is important: lateral forces are greater on canted rail
2. Worn tie plates can be a hidden cause of improper rail orientation, and can be a significant contributor to rail cant defects



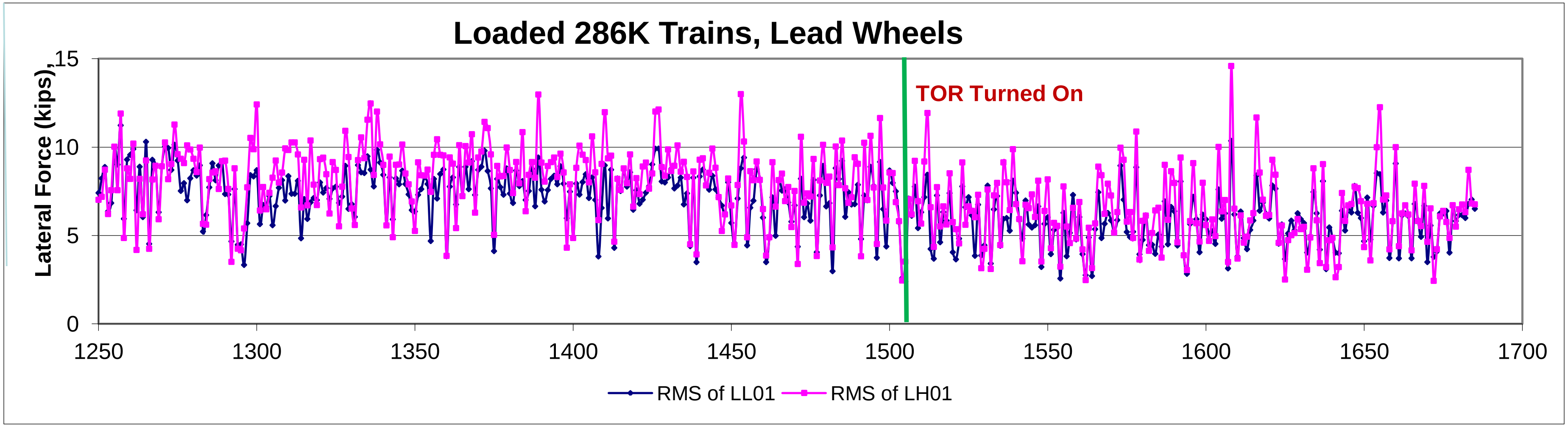
Conclusions from work at Hardy & Wills

3. By controlling gage, rail profile, rail orientation and friction, it is possible to reduce lateral forces significantly.

At both Wills and Hardy, we were able to reduce lateral forces from 10 - 15 kips to 5 – 10 kips by managing the wheel/rail interface.

Questions or Comments?

How low can we go?



Wills test site, Fall, 2012

- TOR unit installed at beginning of test curve
- Lead wheel average forces dropped to 3 – 9 kips, the lowest forces measured in the test