Assessing Information Obtained from Dynamic Cant Measurement

Dynamic or “loaded” cant measurements provide valuable information about:

- Rail
- Ties
- Differential plate cutting
- Fasteners
- Rail seat abrasion
- Overall track conditions

Holland

Dynamic cant measurements can also be good indicators of abnormal rail wear, which can have an effect on:

- Wheel/rail contact
- Rail profile grinding plans
- Derailment potential — both before and after cant is corrected

How dynamic cant is measured

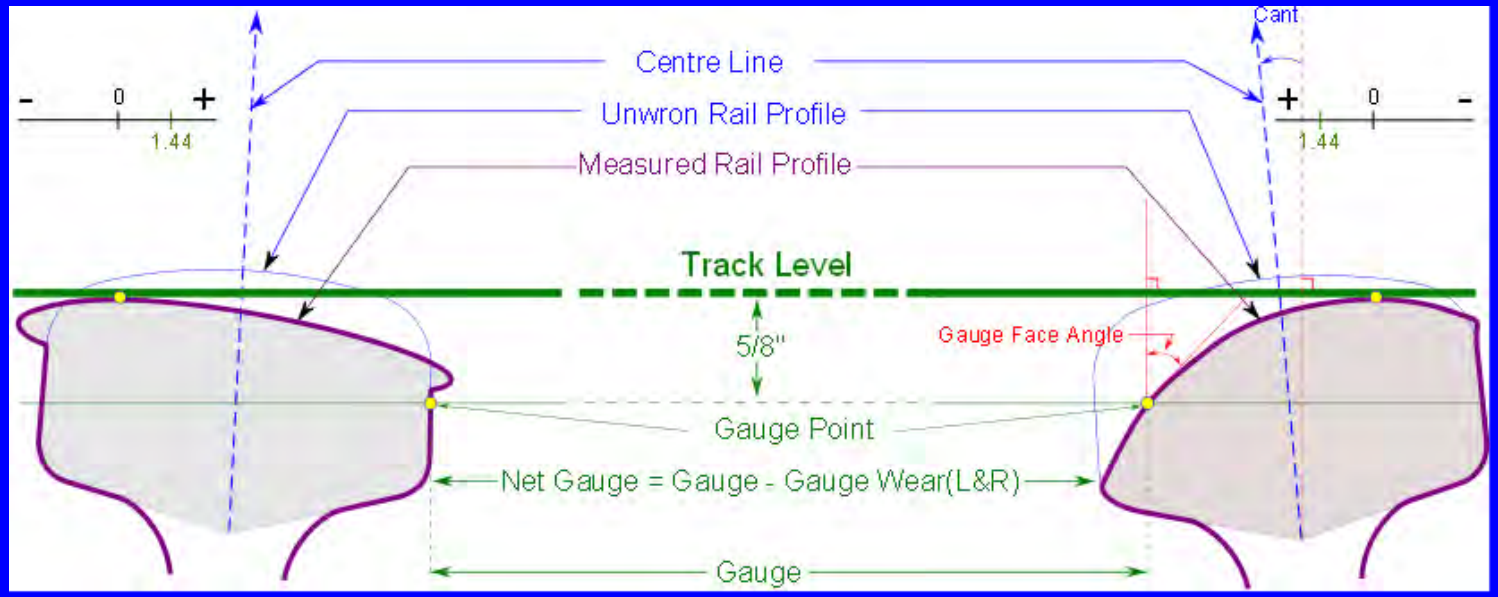
Hi-rail (GRMS) vehicles

Railbound track geometry cars with or without GRMS

Split-axle loaded gauge system (hi-rail)

- 15 kips *vertical* load
- 10 kips *lateral* load
- Measurements at 1- to 15-foot intervals
- Can generate L/V ratios between 0.5 and 1.2, depending on the applied loads (hi-rail)

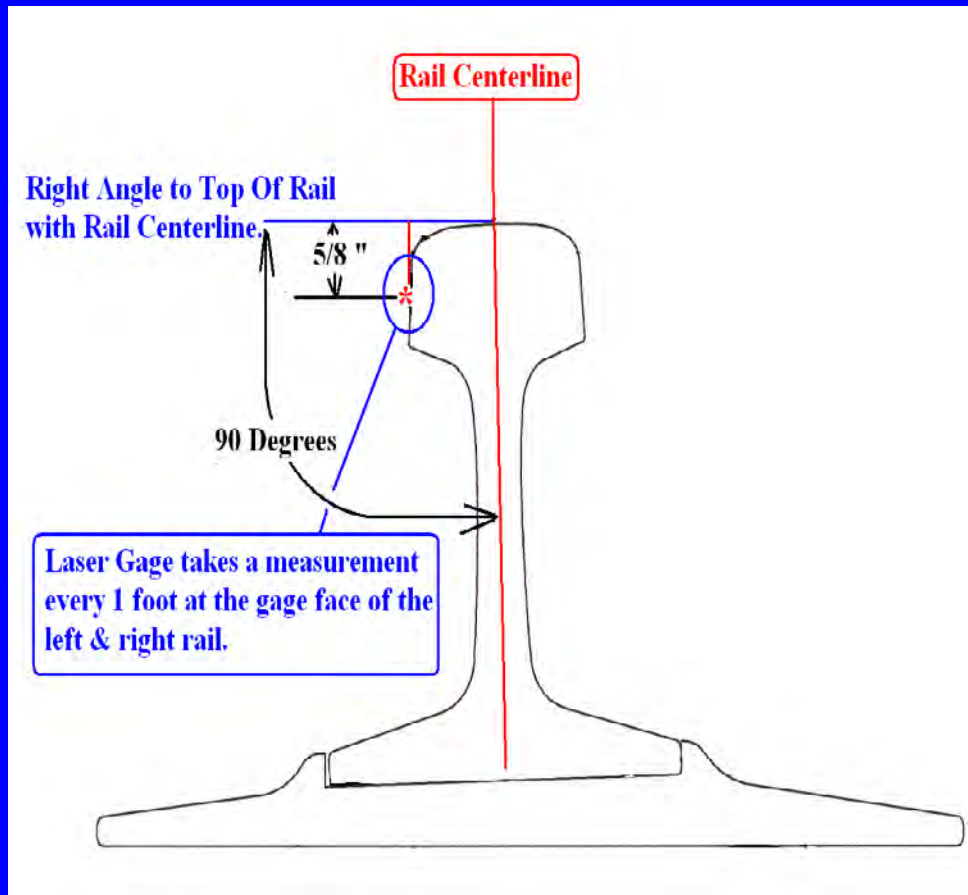
Measured Cant



- Track Level – the level is placed on top of both measured rails.
- Cant Angle – the angle measured from the perpendicular line of track level to the direction of the measured rail center line. Inward direction (gauge side) is measured as positive angle. Outward direction (field side) is measured as negative angle. The standard cant angle is measured as +1.44 degrees.

Measured Cant

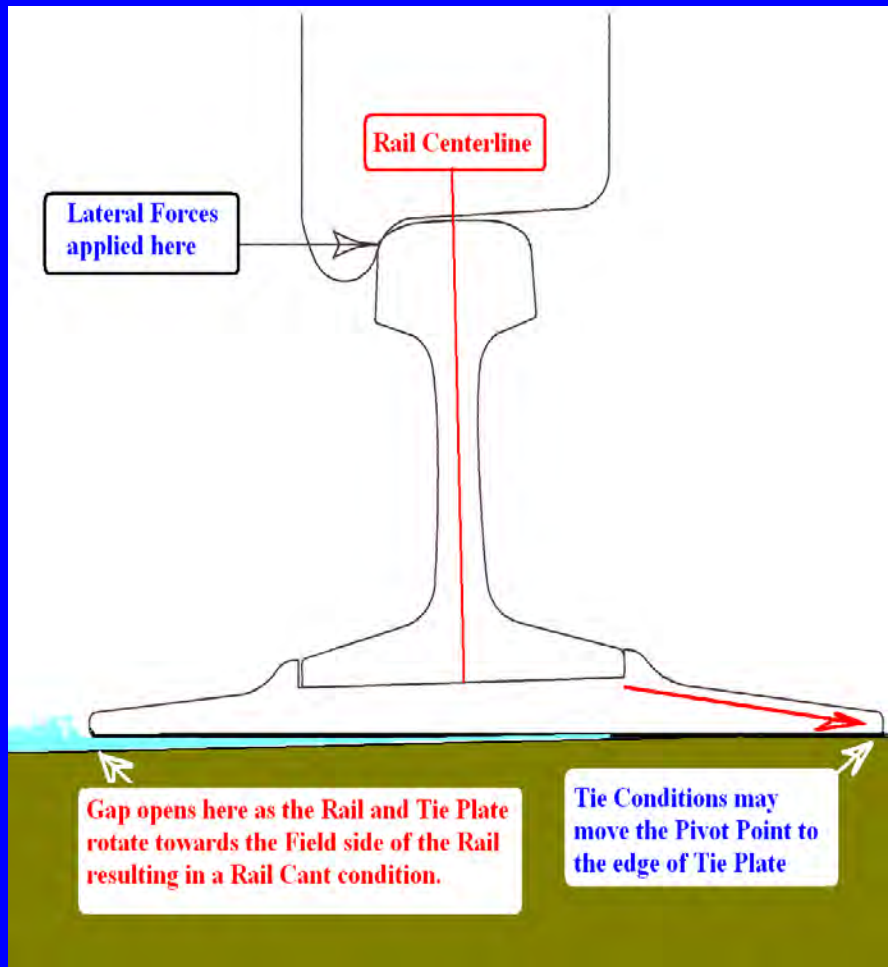
- Rail Cant is measured by a non-contact laser system on the load axle on hi-rail vehicles and railbound vehicles with GRMS or typically at the rear truck on vehicles without it.
- The laser gage system identifies the rail centerline then calculates the degrees of cant difference from a standard 1:40 cant.
- On #132 rail, 1 degree of rail rotation towards the field side = 1/8 inch of gage widening.



Cant Conditions

Outward rail cant may be a result of:

- Poor tie conditions
- Plate-cut timber ties
- Improper adzing *
- Worn insulators or pads on concrete ties
- Rail seat abrasion
- Improper superelevation

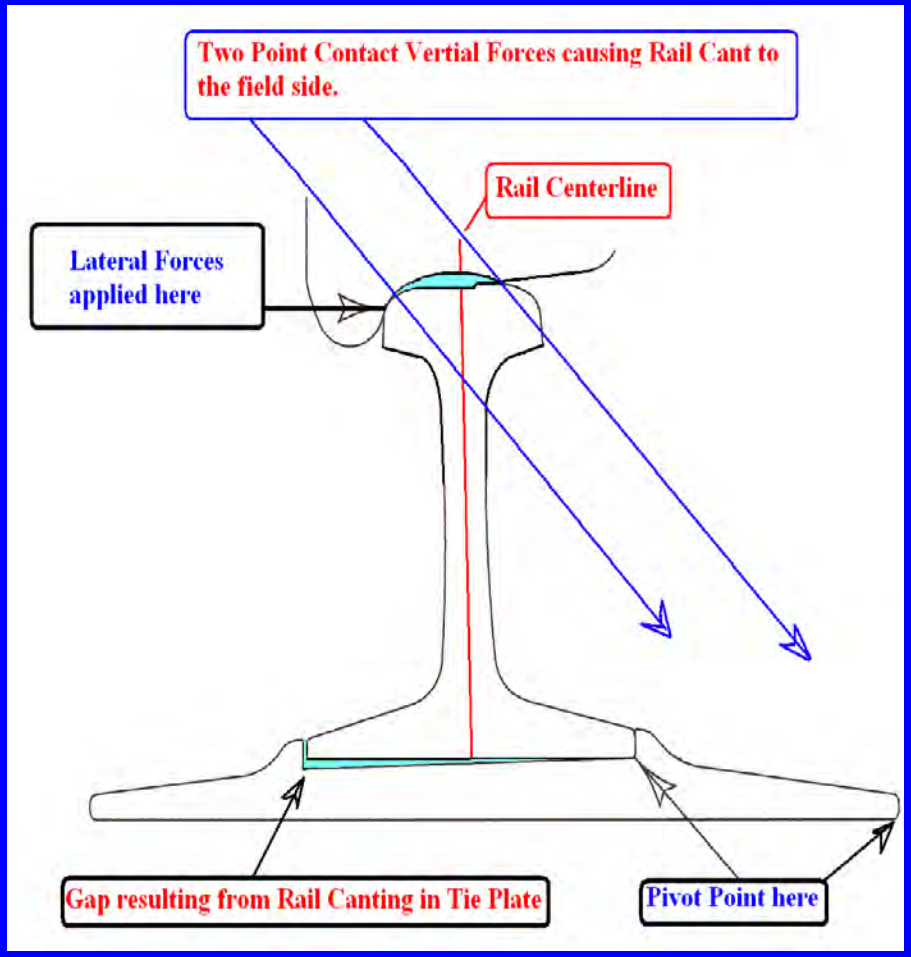


Cant Conditions

Outward cant may be the result of high lateral loads resulting from a strong two-point contact at the wheel/rail interface.

Visible indications of a excessive rail cant include:

- Raised spikes in track with cut spikes.
- Missing or broken clips in track with elastic fasteners



Cant conditions

Evidence of dynamic rail cant on an 8-degree curve

Cant conditions

About 1/2-inch of rail rotation = about 4 degrees of outward cant

Cant measurements: Querying the data

Loaded Cant, Geometry Query Summary

Div: SOUTHERN
Test Date: Jun 15, 2008 - Jun 15, 2009
Safety: (Ld Cant <=-2.6 deg.)

Sub: 1 - MIDDLE
Km: 226.738 - 327.108

Track: SM

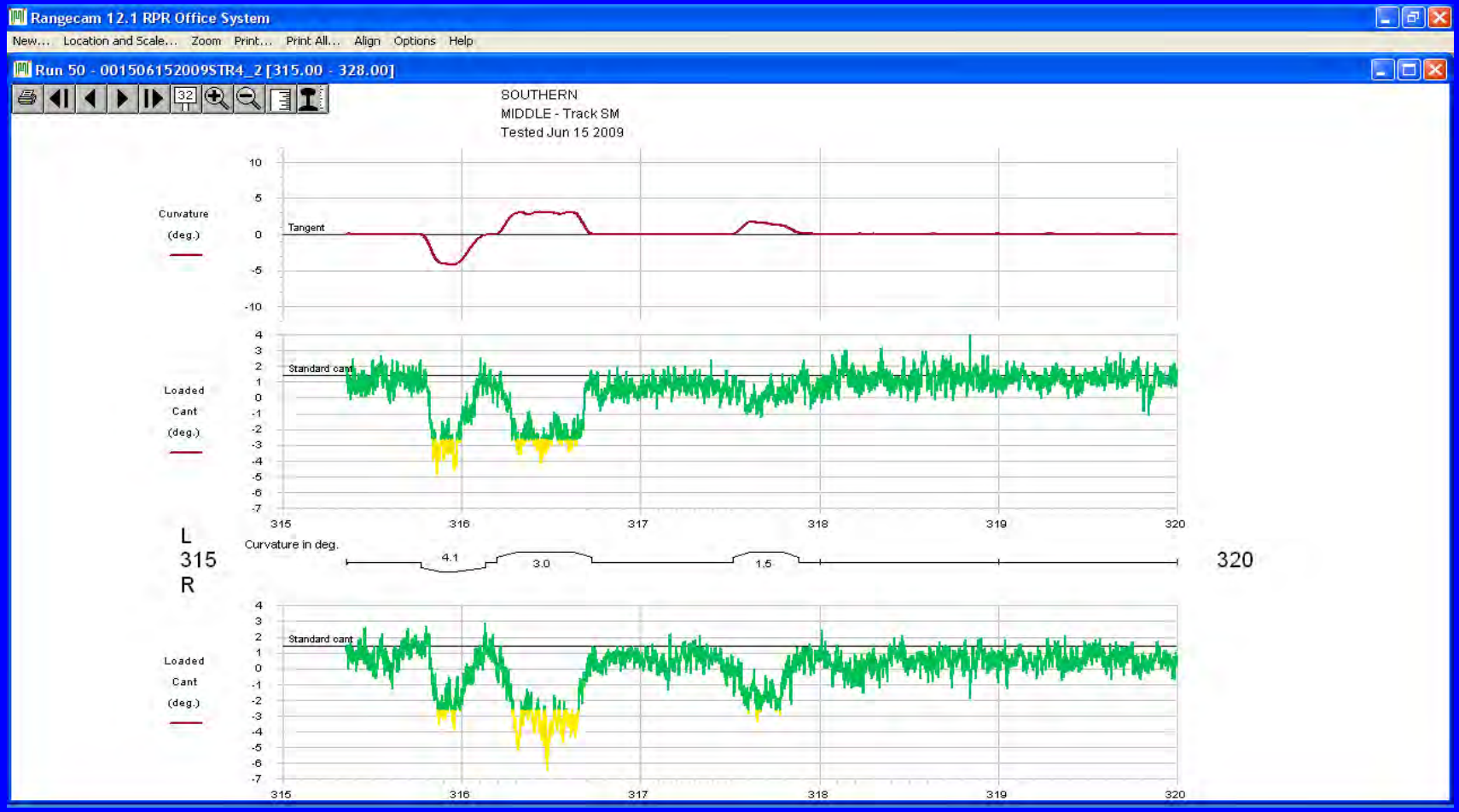
Curve	Side	From	To	Len_m	Safety	TestDate
2.0 deg. R	R	265.019	265.027	8	Y	Jun 15, 2009
2.0 deg. R	R	265.028	265.034	6	Y	Jun 15, 2009
2.0 deg. R	R	265.045	265.047	2	Y	Jun 15, 2009
2.0 deg. R	R	265.048	265.053	6	Y	Jun 15, 2009
2.0 deg. R	R	265.098	265.102	4	Y	Jun 15, 2009
2.0 deg. R	R	265.107	265.110	3	Y	Jun 15, 2009
2.0 deg. R	R	265.127	265.128	1	Y	Jun 15, 2009
Tangent	R	265.459	265.460	1	Y	Jun 15, 2009
2.9 deg. L	L	266.936	266.937	1	Y	Jun 15, 2009
2.9 deg. L	L	266.951	266.955	4	Y	Jun 15, 2009
2.9 deg. L	L	266.959	266.966	6	Y	Jun 15, 2009
2.9 deg. L	L	266.967	266.979	11	Y	Jun 15, 2009
2.9 deg. L	R	266.971	266.971	1	Y	Jun 15, 2009
2.9 deg. L	L	266.979	266.982	2	Y	Jun 15, 2009
2.9 deg. L	L	266.993	267.003	9	Y	Jun 15, 2009
2.9 deg. L	L	267.006	267.025	19	Y	Jun 15, 2009
2.9 deg. L	L	267.025	267.026	1	Y	Jun 15, 2009
2.9 deg. L	L	267.027	267.027	1	Y	Jun 15, 2009
2.9 deg. L	L	267.029	267.042	13	Y	Jun 15, 2009
2.9 deg. L	L	267.062	267.068	6	Y	Jun 15, 2009
2.9 deg. L	L	267.069	267.071	2	Y	Jun 15, 2009
2.9 deg. L	L	267.072	267.131	59	Y	Jun 15, 2009
2.9 deg. L	L	267.132	267.213	81	Y	Jun 15, 2009
2.9 deg. L	R	267.175	267.175	1	Y	Jun 15, 2009
2.9 deg. L	R	267.203	267.204	1	Y	Jun 15, 2009
2.9 deg. L	L	267.215	267.216	1	Y	Jun 15, 2009
2.9 deg. L	L	267.224	267.225	1	Y	Jun 15, 2009
2.9 deg. L	L	267.229	267.313	83	Y	Jun 15, 2009
2.9 deg. L	R	267.273	267.274	2	Y	Jun 15, 2009
2.9 deg. L	R	267.297	267.297	1	Y	Jun 15, 2009
2.9 deg. L	L	267.314	267.314	1	Y	Jun 15, 2009
2.9 deg. L	L	267.316	267.372	56	Y	Jun 15, 2009
2.9 deg. L	L	267.373	267.375	2	Y	Jun 15, 2009
2.9 deg. L	L	267.375	267.377	1	Y	Jun 15, 2009

Report Date: April 29, 2011

Rangecam

Loaded cant query for 4 degrees of outward rail rotation (- cant)

Measured cant

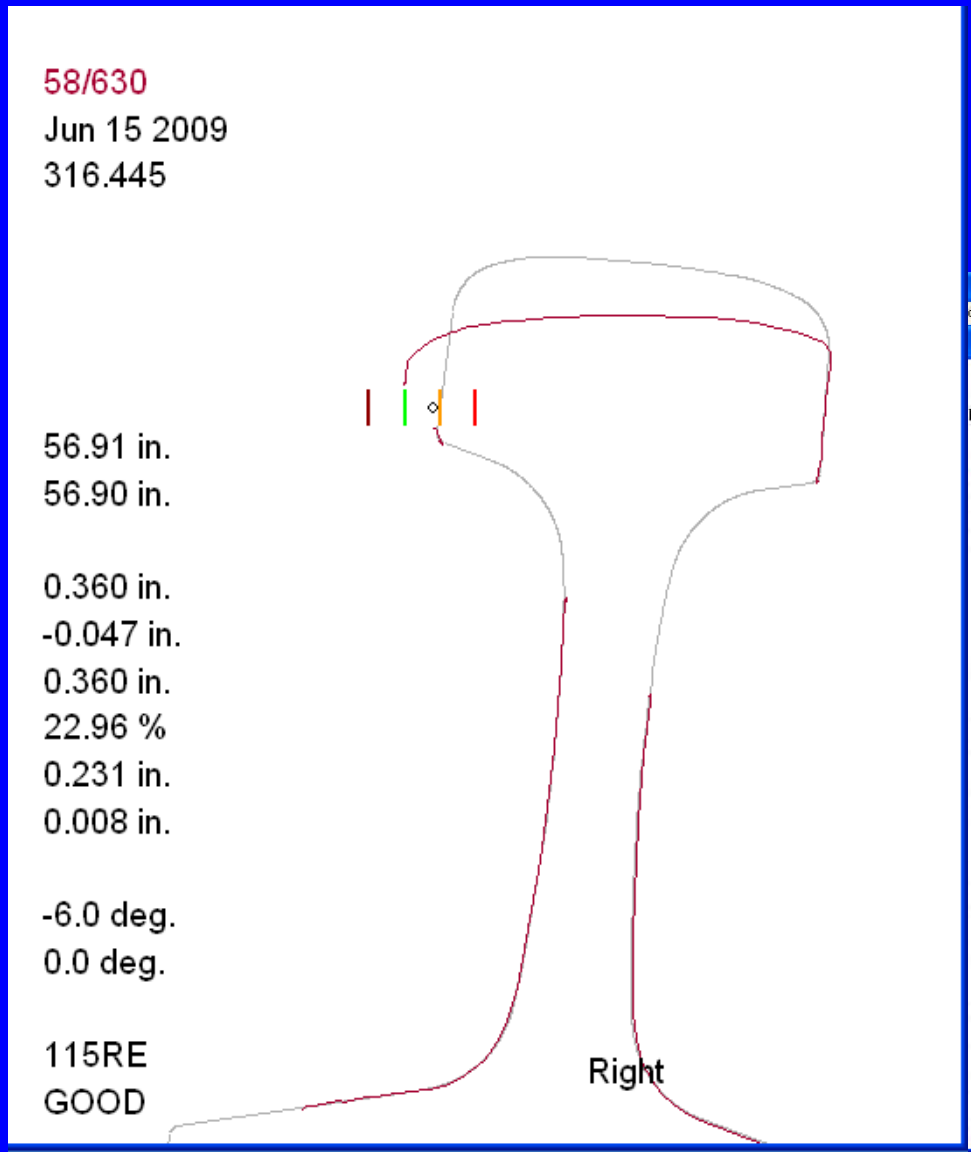


Threshold level at +/- 4 degrees of rail rotation

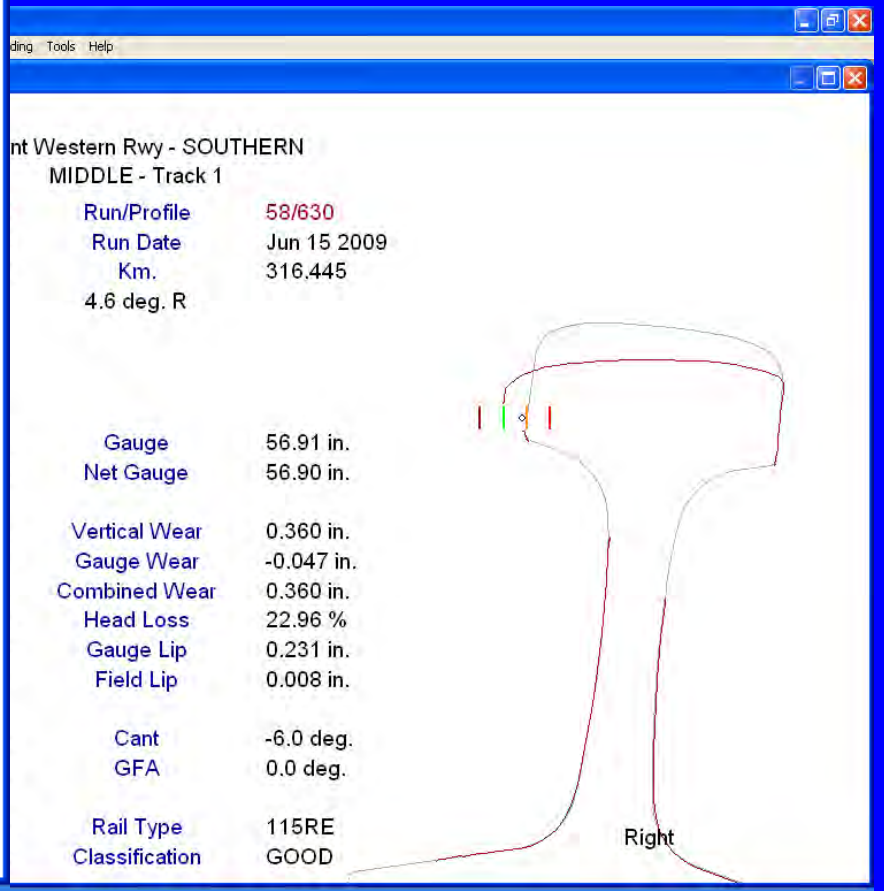
Measured cant

- -6 degrees absolute cant = -7.44 degrees of rail rotation

Measured cant



- -6 degrees cant (absolute) =
- -7.44 degrees of rail rotation



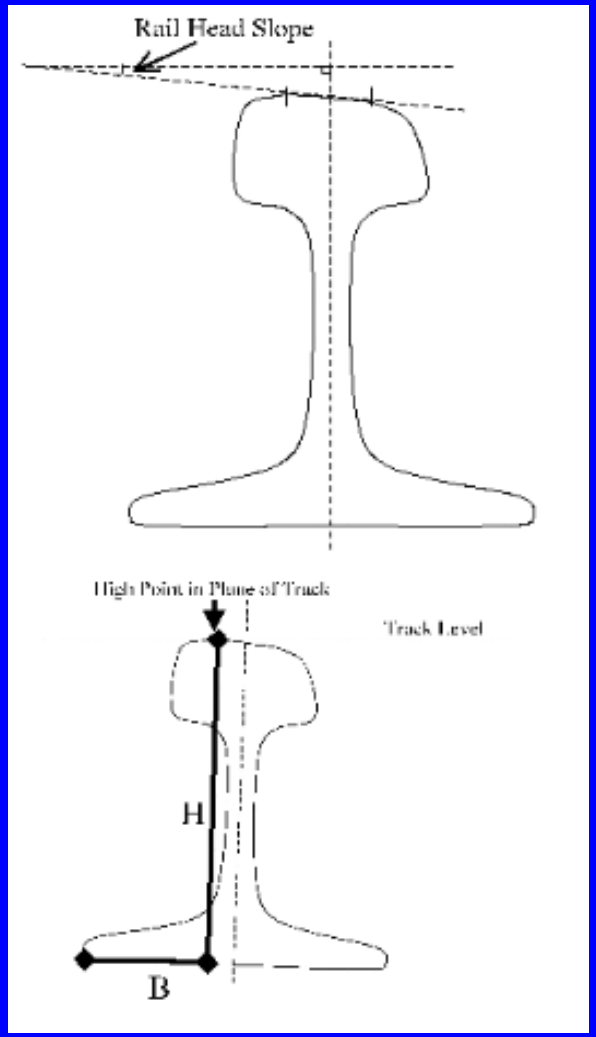
Outward cant

Negative (outward) cant is a causative factor in rail rollover and gauge widening derailments

Cant and railhead slope

Rail head slope and the base-to-height ratio can be used to identify potential rail rollover conditions.

Height is measured from the high point of the worn rail head in the plane of track to a point *bx* on the bottom surface of the rail base, along a line parallel to the rail centerline. Base is measured from the point *bx* to the field-side edge of the rail base, along the underside of the rail base.



Cant and railhead slope

As-found or corrected cant can affect railhead slope conditions, which can affect wheel/rail contact conditions. This should be considered when planning:

- Tie replacement programs
- Adzing
- Changes to superelevation
- Rail grinding

Cant thresholds

- FRA requirements: None
  - FRA allows 40% plate cutting on a tie
  - New FRA rule relating to rail seat abrasion allows, but does not require, railroads to use cant measurements
- Railway thresholds (examples):
  - R/L cant: 3 - 4 degrees (measured over 50 feet, for example)
  - Combined cant 5 – 6 degrees (measured over 50 feet, for example)
  - R/L cant: 3 degrees, with B/H ratio of 0.33 and 5-degree rail head slope.

Notes from the Principles Course

"The track may look fine from an inspection train or a hi-rail truck, but appearances can be deceiving. Scrutinize the track geometry car records"

"Implement proactive strategies that will retard the development of reverse rail cant."

— Bob Blank, NS

Acknowledgements

- AREMA, Committee 2
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