14TH JUNE 2022

Vampire on London Underground: A Practical Perspective

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Transport for London

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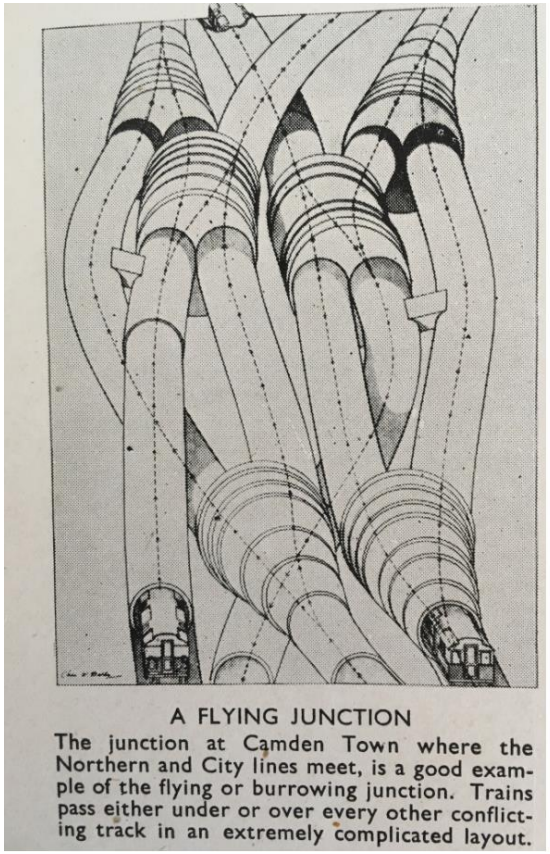
- Brief History of Vampire on London Underground
- Check Rail Rules
- LU56V
- RCF/Corrugation

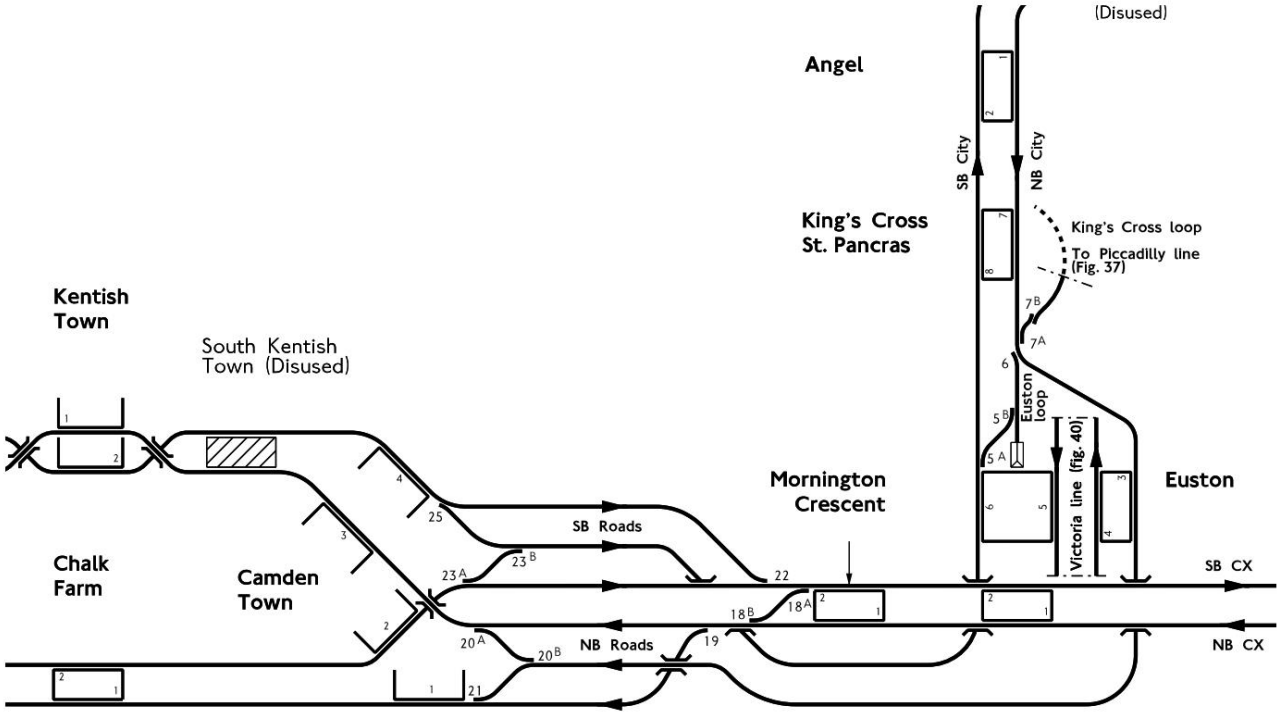
Camden Town Derailment 20B

- 19th October 2003



A FLYING JUNCTION

The junction at Camden Town where the Northern and City lines meet, is a good example of the flying or burrowing junction. Trains pass either under or over every other conflicting track in an extremely complicated layout.



White City Derailment 2712

- 11th May 2004

Decision Support Tool for CERN Switches

DeltaRail

Controlled Switches Decision Support Tool

Transport for London

Approach Track Cross Level (Canted or Flat)
Canted

Vehicle Stock Type
1995 Worn Wheels

Instructions

1. Click the "Clear All Data" button
2. Select the Stock Type
3. Select the Approach Track Cross Level
4. Select the Approach Curve Start Radius
5. Select the Approach Curve End Radius
6. Select the Turnout Through Route Radius
7. Select the Switch Type
8. Select the Switch Size
9. Select the Switch Handing
10. The colour coded results for the turnout route will appear in the

Approach Radii Start	Approach Radii End	Through Route Radii
Main_Curve_400m	Stock_Front_400m	Through_Route_Radius_200m

Switch Type	Switch Size	Switch Handing
Flat_Bottom_Full_Depth	D	Normal Handing

Clear All Data

Turnout Route Derailment Risk Matrix

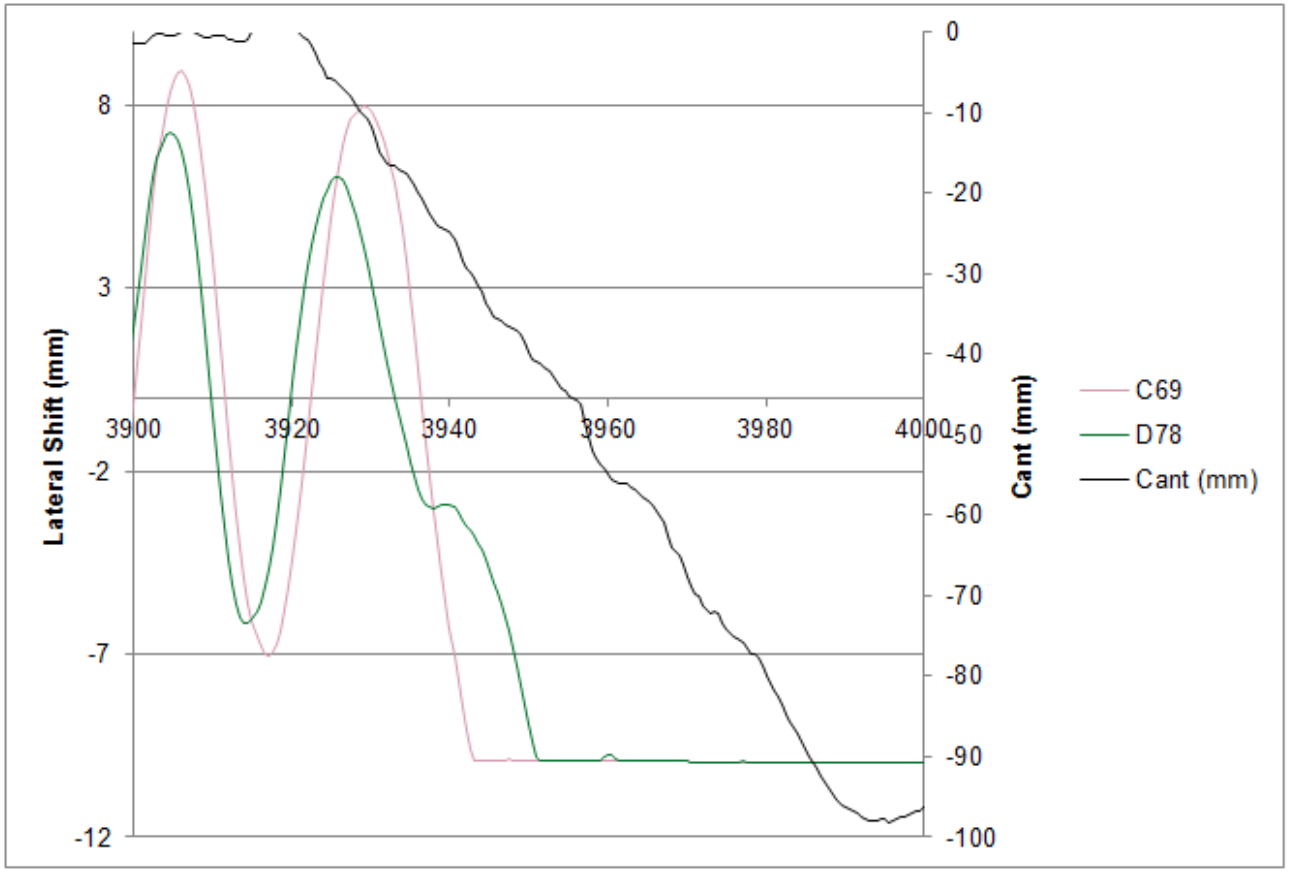
Vehicle Speed / Track Faults	Vehicle Speed 5 mph	10 mph	15 mph	20 mph	25 mph	30 mph
Nominal (as Designed)	Yellow	Yellow	Orange	Orange		
Maintenance Limit	Yellow	Yellow	Yellow	Yellow		
Safety Limit	Yellow	Yellow	Yellow	Yellow		

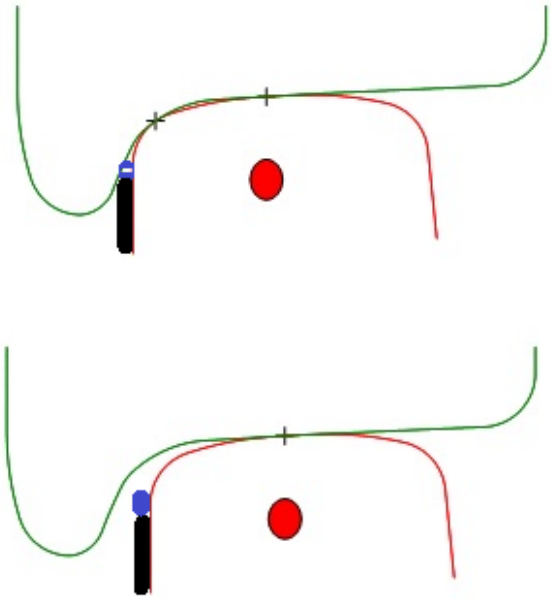
Key to Derailment Risk Matrix Colour Code

Green	Safe (all contact on safe part of wheel)	Orange	High Risk of Derailment (contact outside safe portion of wheel flange and >10mm of wheel climb)
Yellow	Low Risk of Derailment (contact outside of safe portion of wheel flange, but wheel climb <10mm)	Red	Unsafe, derailment is predicted

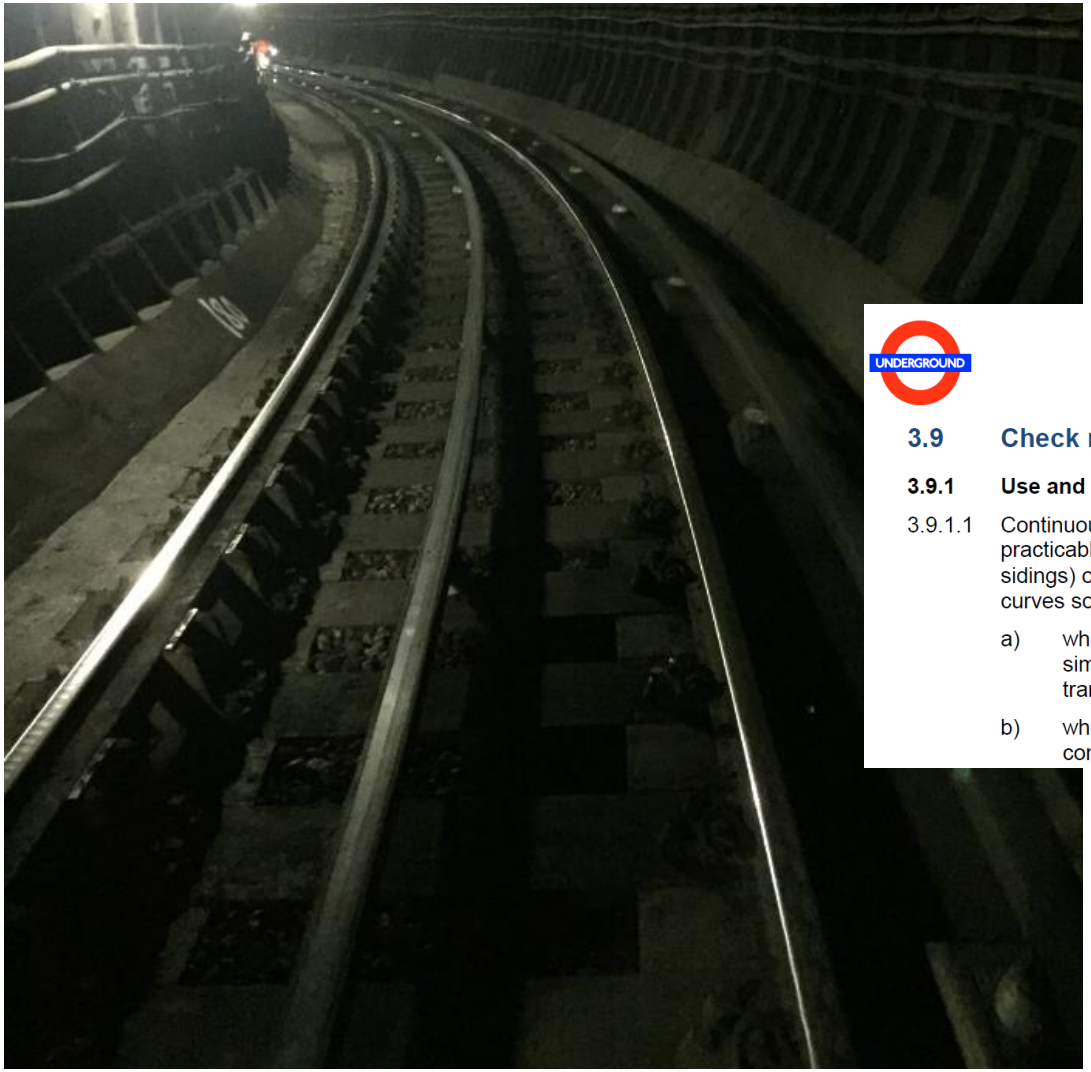
Issue 2, January 2011

Inter Stock Running





Check Rail Application



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3.9 Check rails

3.9.1 Use and configuration

3.9.1.1 Continuous check rails shall be provided in plain line track and, to the extent practicable, in junctionwork where the track radius is 200m (140m in depots and sidings) or less. The check rail shall extend through any transition adjacent to such curves so as to terminate as follows:

a) where the checked curve abuts straight track or an unchecked circular curve of similar hand: at least 5m (exclusive of entry and exit flares) beyond the transition;

b) where the checked curve abuts a curve of opposite hand: at the point of contraflexure, with the flare being beyond that point.

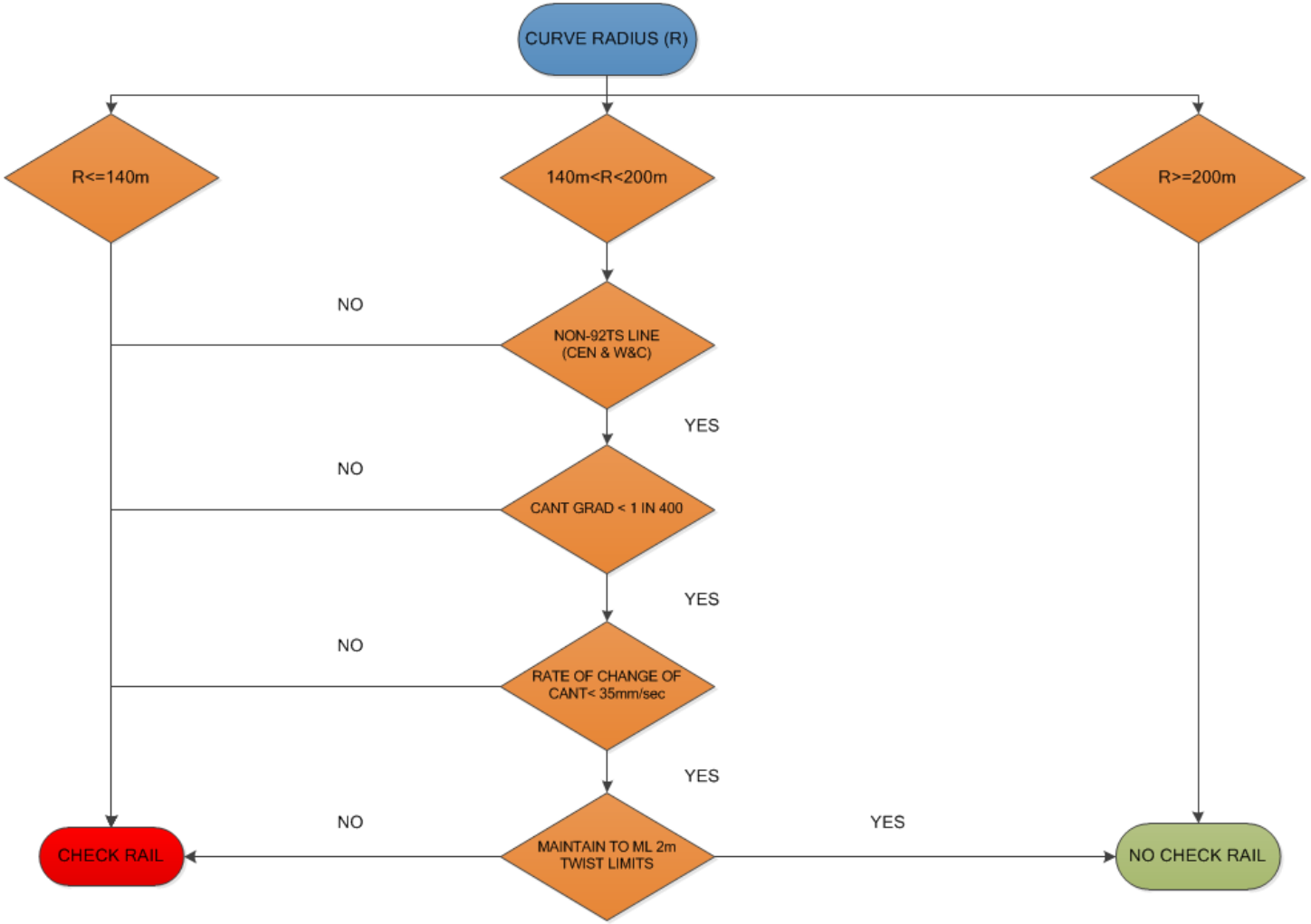
Check Rail Application

- Analysed a range of parameters affecting the risk of derailment using Vampire simulations:
  - Nadal's Ratio (Y/Q)
  - Wheel Unload (ΔQ/Q)
  - Wheel Climb
- Consisted of 64000 simulations in 2 stages covering:
  - Vehicle types (including Engineering Fleet)
  - Curve Radius
  - Worn and new wheels and rails
  - Rate of change of cant & cant deficiency
  - Friction
  - Allowable Twist Faults

Check Rail Application

- Sub 130m radius low rail flanging occurs so two possible ‘climbing’ wheels
- 92TS particularly prone to derailment
- Desirable rate of change of cant required especially crucial in exit transitions
- Maintained to Maintenance Target 2m twist limits rather than Safety Standard especially in exit transitions
- Lower cant and higher cant deficiencies reduces derailment risk
- Negligible change in risk between 200m and 140m

Check Rail Standard

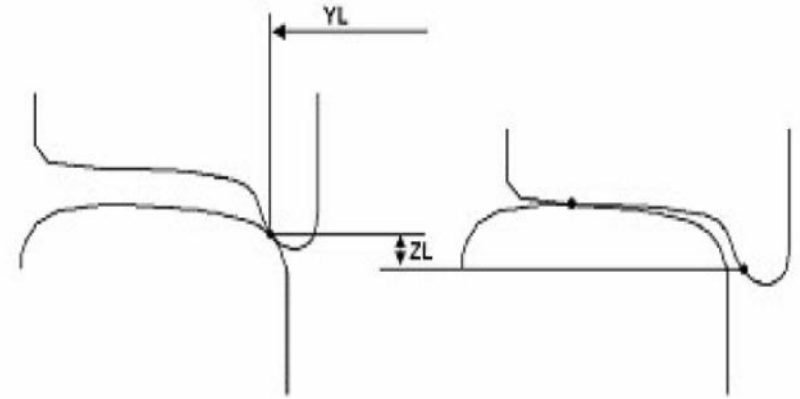


LU56V

- Numerous unique geometries especially in and around depots
- LU56V developed as a method of installing flatbottom on same bullhead footprint
- First site installed in Upminster depot without Vampire simulations.....

Derailment Risk Criteria

Risk Rating		Contact Angle	Wheel Climb
1	Safe	< 65°	< 10 mm
2	Low Risk	< 65°	> 10 mm & < 20 mm
		> 65°	< 10 mm
3	High Risk	< 65°	> 20 mm
		> 65°	> 10 mm
4	Unsafe	Vampire predicts derailment	

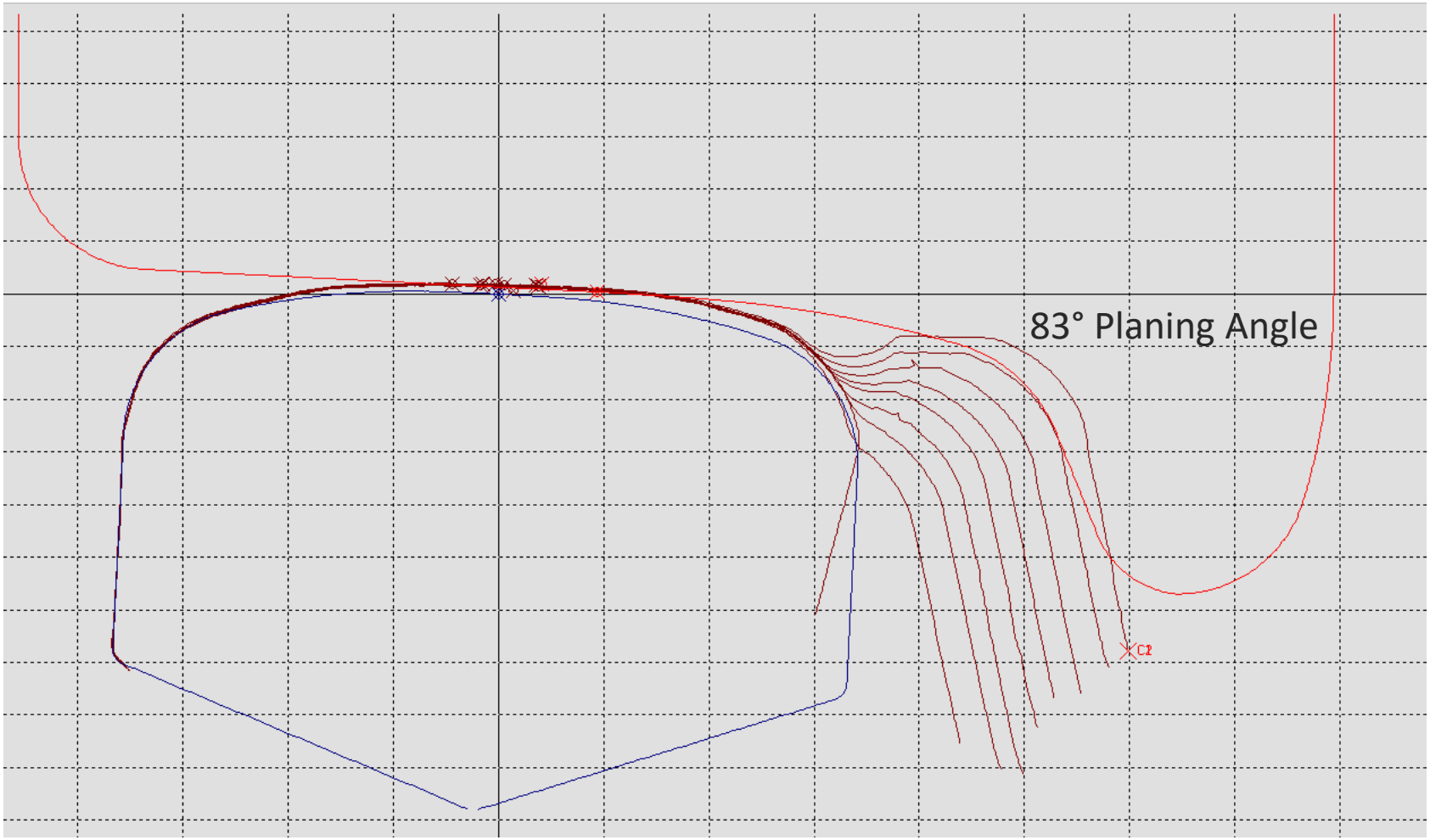


Left Wheel Contact Point at YL
Due to Wheelset Lateral Shift

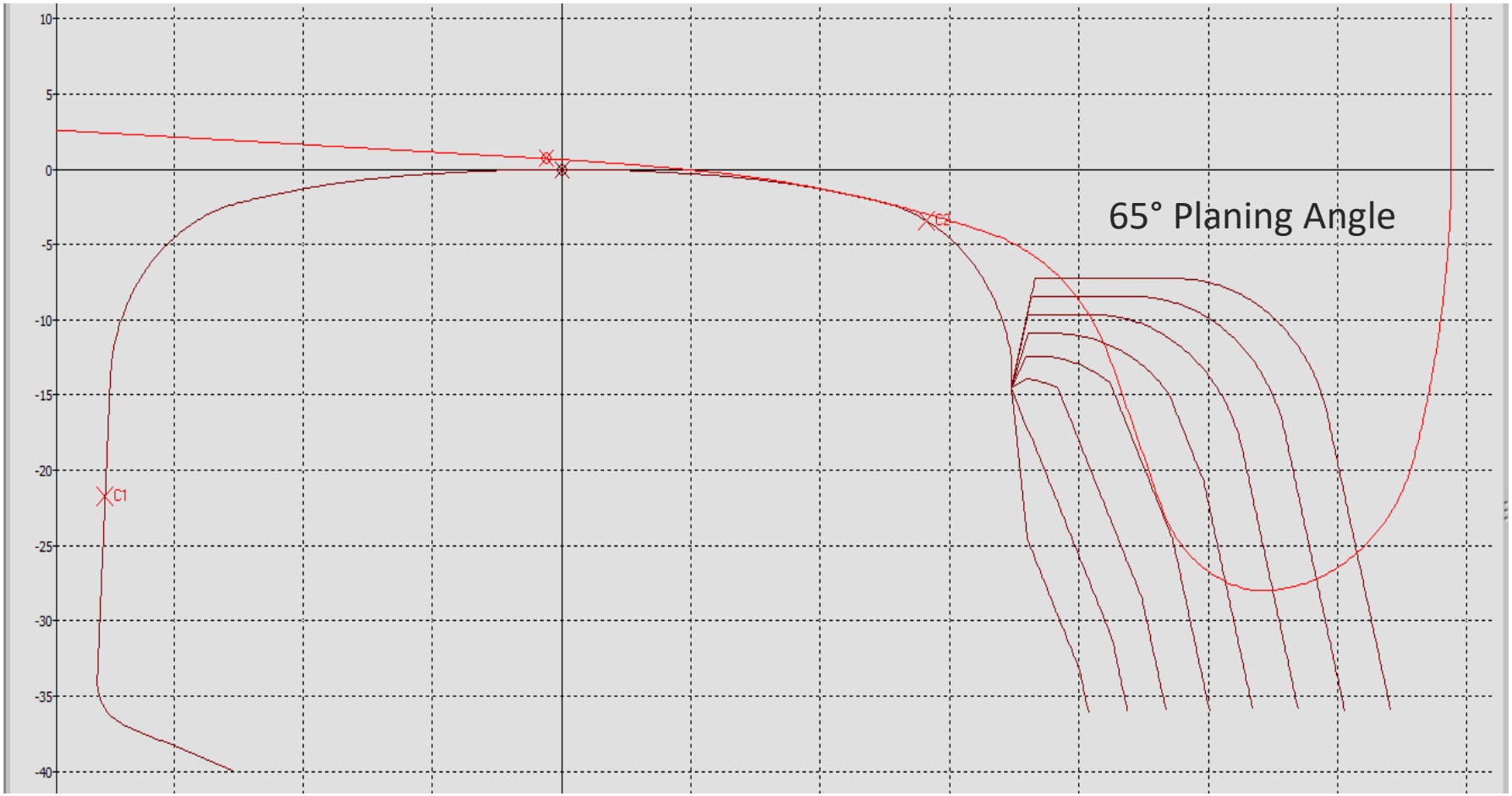
Left Wheel at Zero Lateral Shift

- Sustained for 2m:
  - Y/Q > 0.8 in P&C
  - Y/Q > 1.2 in Plain Line

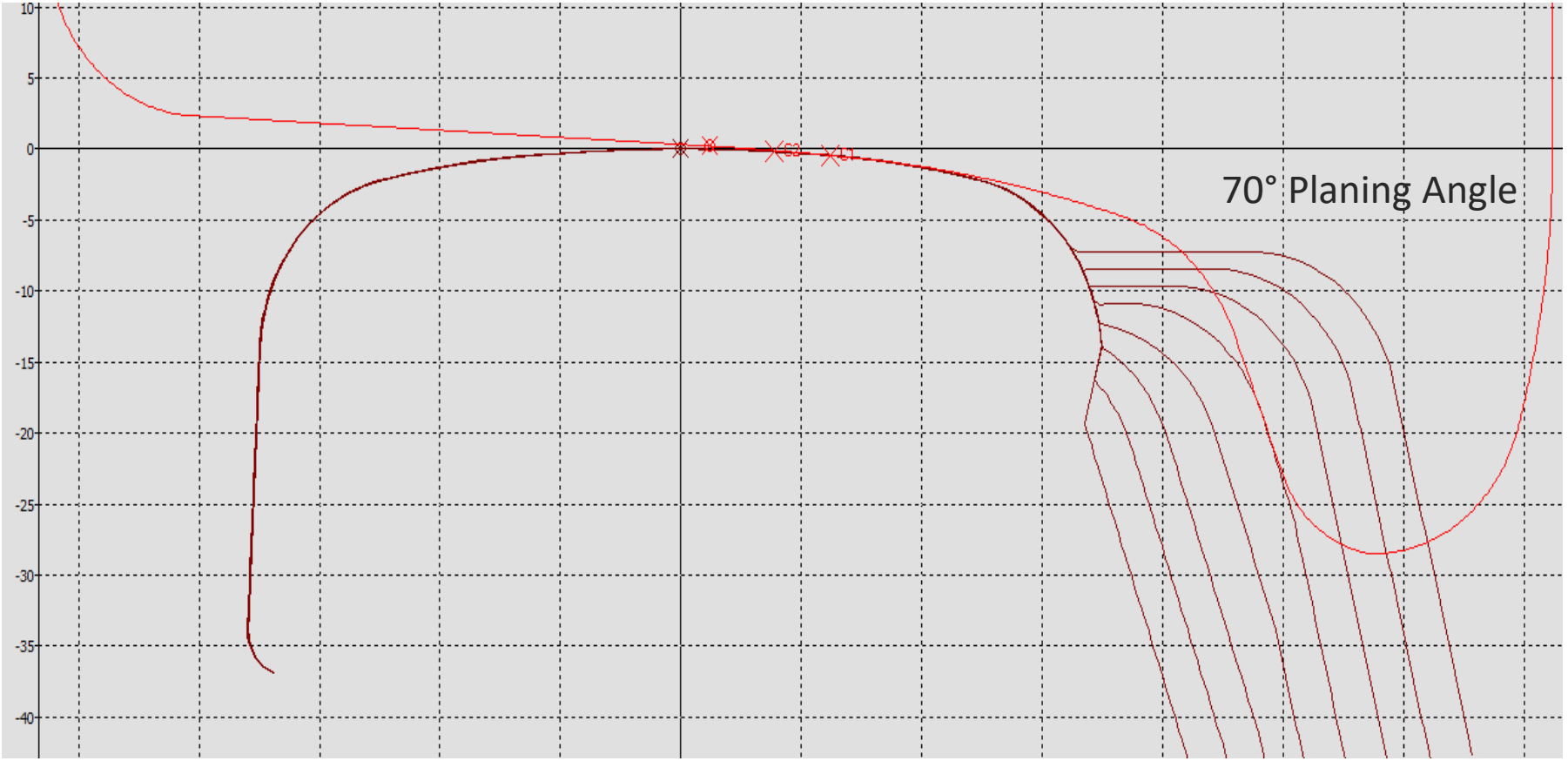
Bullhead UC



LU56V First Iteration



LU56V Second Iteration



RCF/Corrugation

Conclusions

- Vampire assessment is now standard part of track design/renewals process:
  - Asset Performance in Plain Line
  - Asset Safety in Points & Crossings
- Research and Development in corrugation and rolling contact fatigue
- Probably at limits of standard creep laws in a number of areas....
- Identifying risks for introduction of 24TS