

# Track and Substructure Diagnosis

James Hyslip



Steven Chrismer

**LTK** Engineering Services

*Formerly*

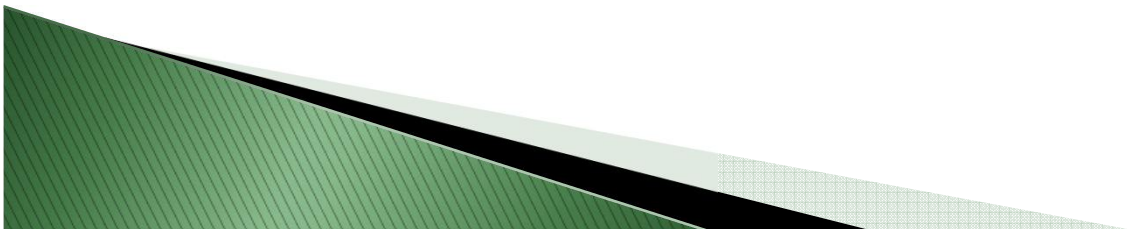


*September 16, 2015*

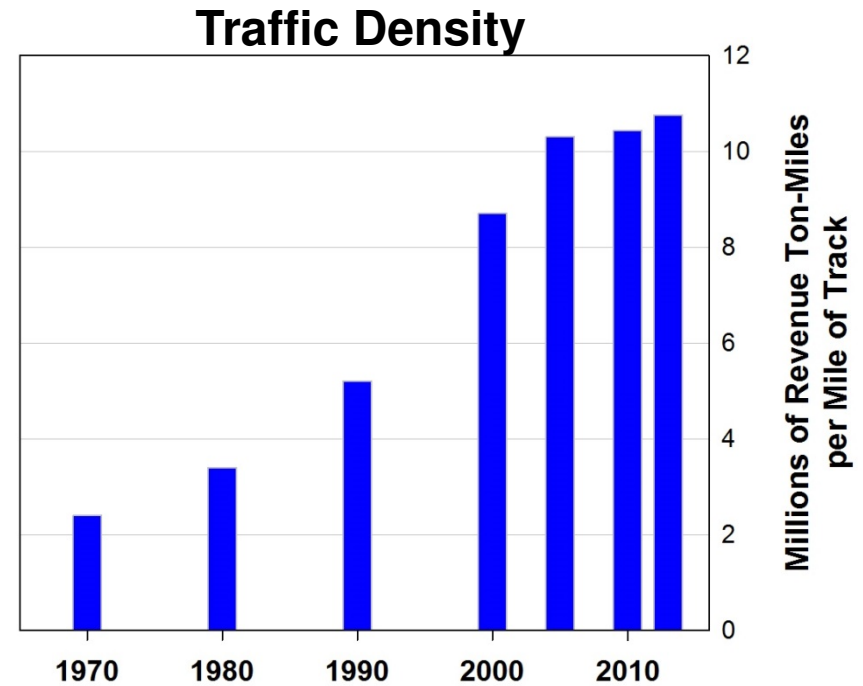
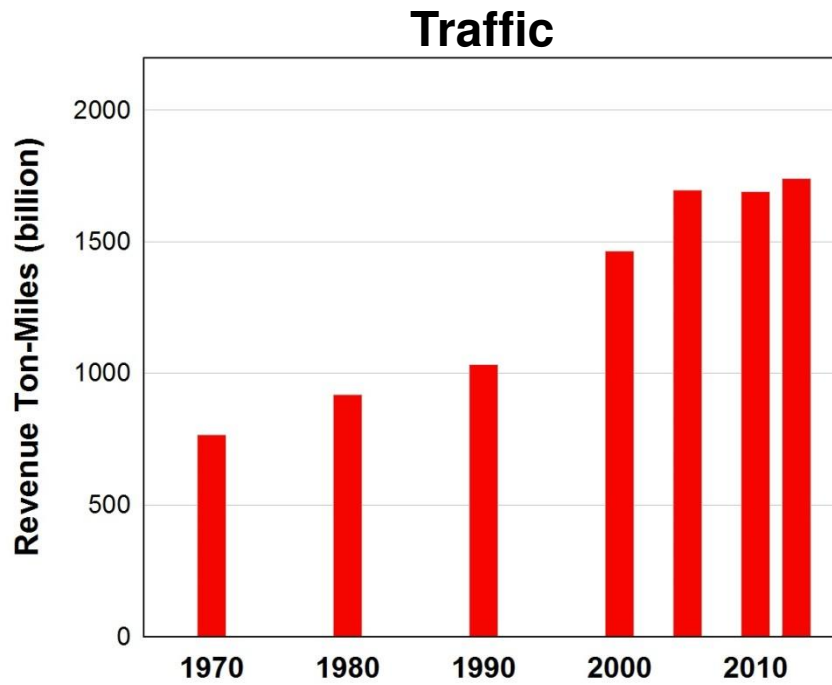
20<sup>th</sup> International Convention of the Working Committee on Railway  
Technology (Infrastructure)  
Salzburg, Austria

# Outline

- ▶ **Background**
  - North American Railroads, Amtrak
- ▶ **Substructure Diagnostics**
- ▶ **Track Geometry Analysis**
- ▶ **Remedies**
  - Design Overlift Tamping, Stoneblowing, Chemical Grouting

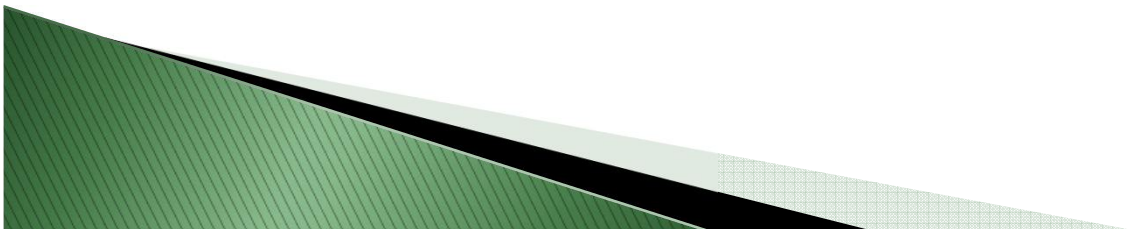


# US Railroad Traffic and Traffic Density

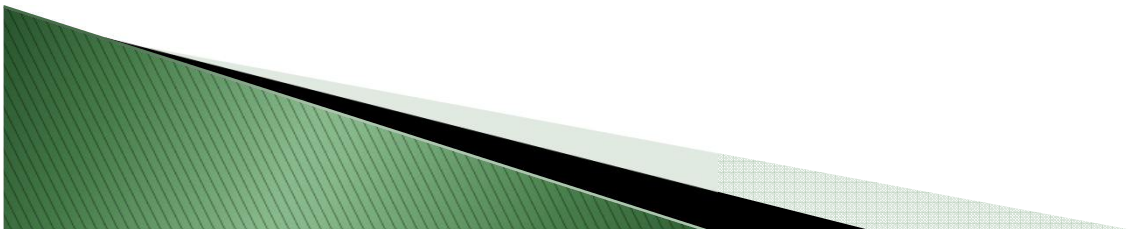
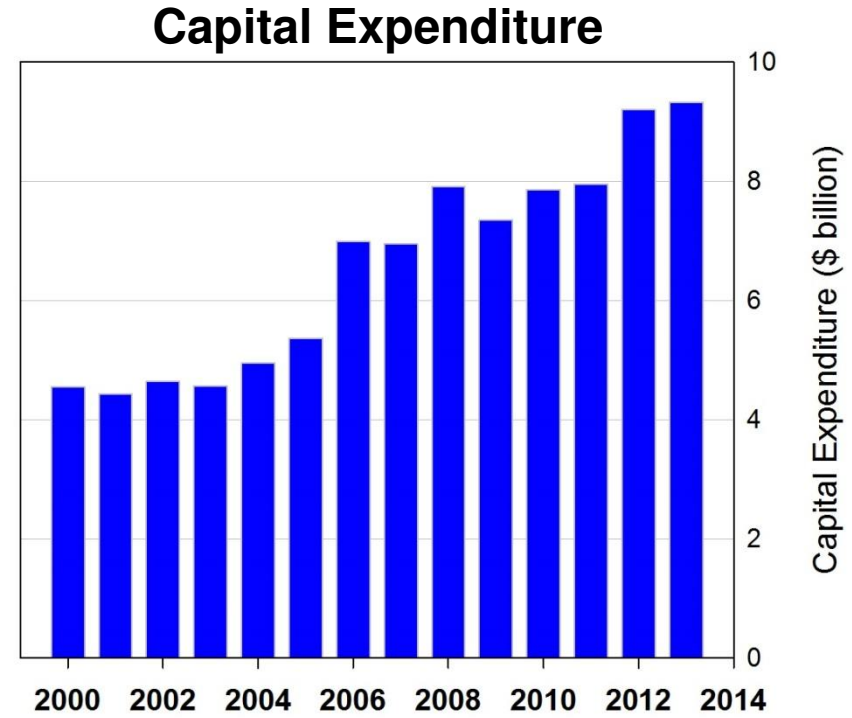
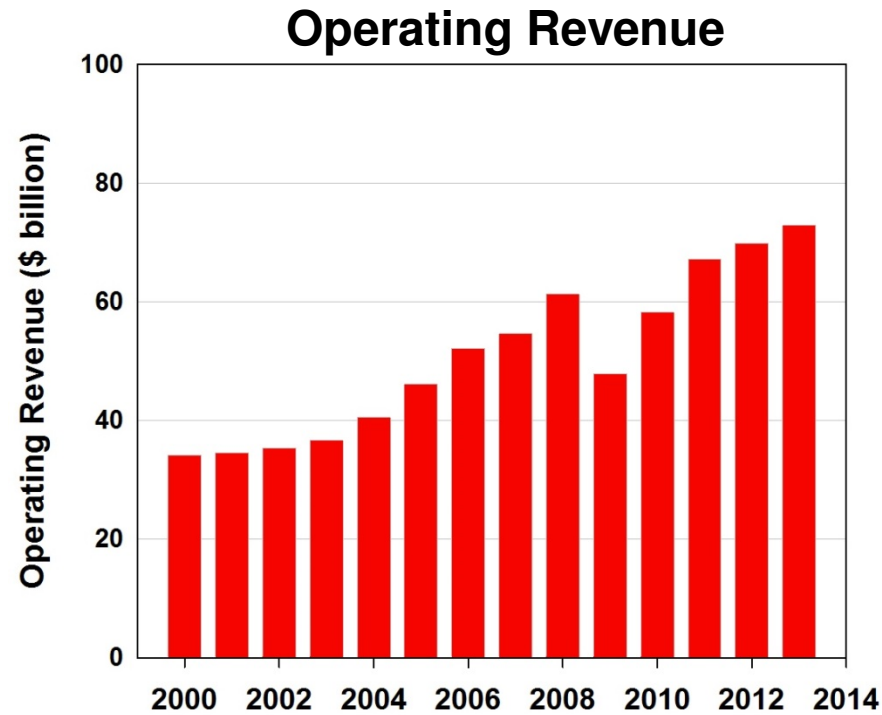


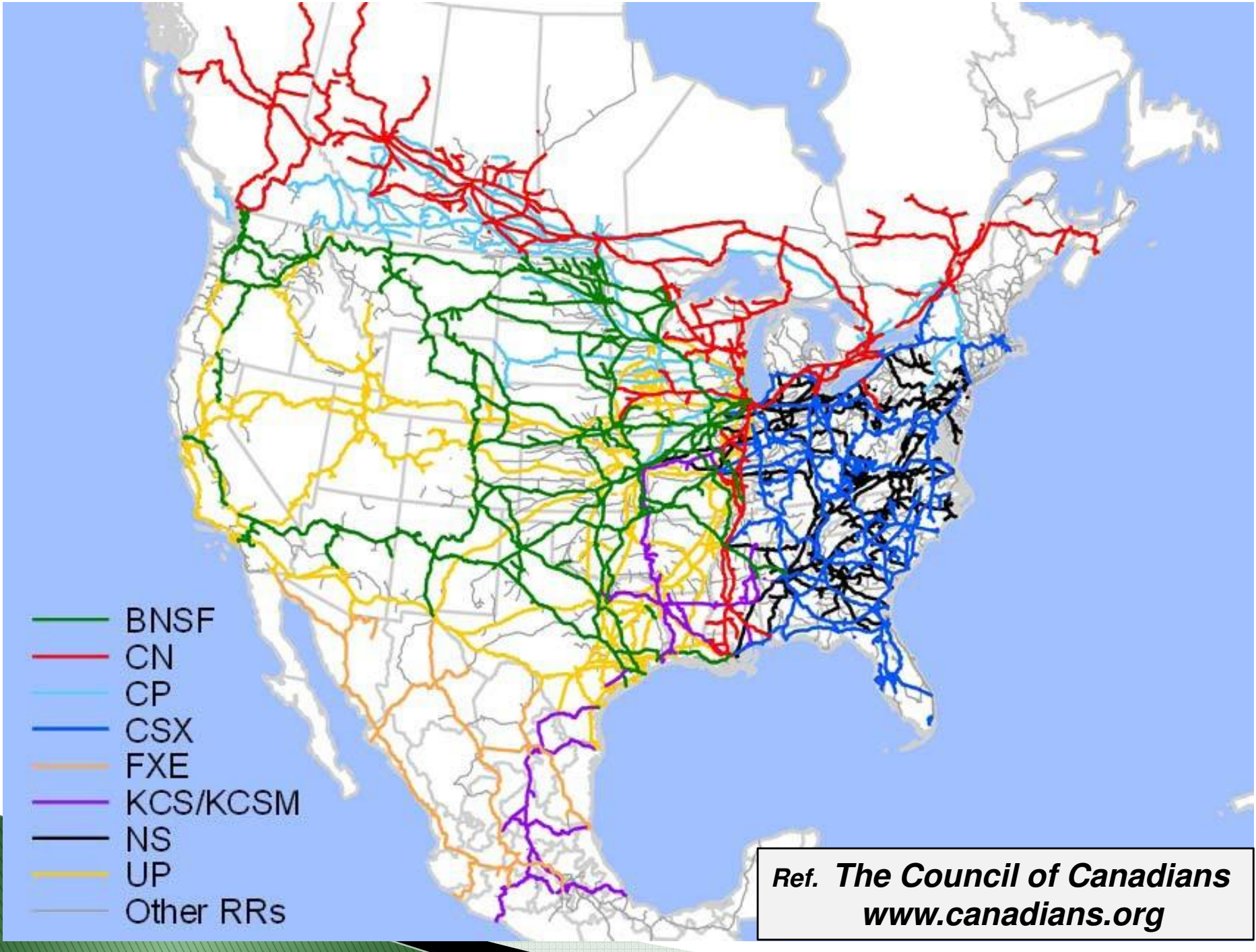
**x 2**

**x 5**



# US Railroad Revenue and Capital Expenditure





- BNSF
- CN
- CP
- CSX
- FXE
- KCS/KCSM
- NS
- UP
- Other RRs

*Ref. The Council of Canadians  
[www.canadians.org](http://www.canadians.org)*

# Amtrak



ation)



**Karst**

**Boston**

**New York**

**Philadelphia**

**Washington**

**Rock**

**Urban**



**Peat / Muskeg**

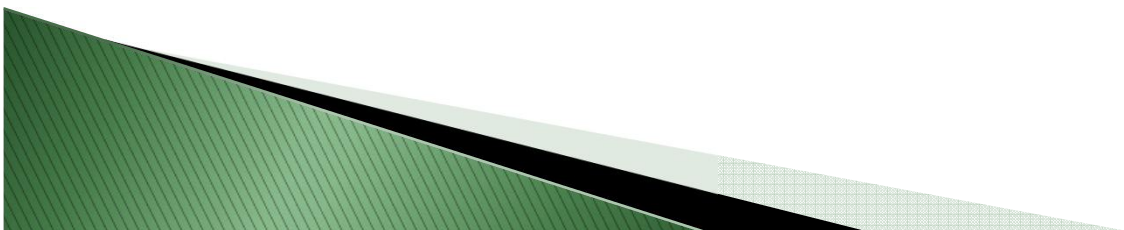


**Coastal Plain**



# Typical Problems

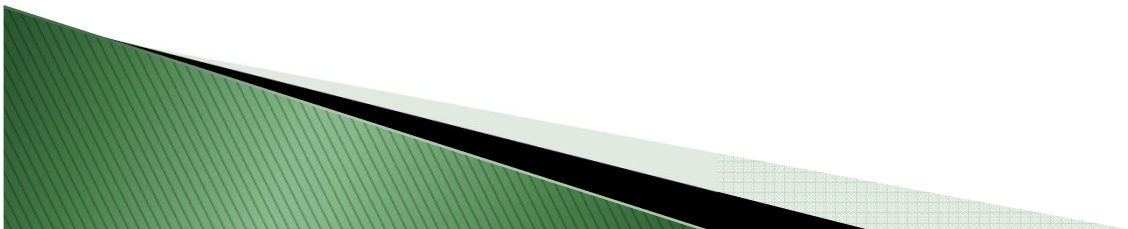
- ▶ Fouled Ballast
- ▶ Mudspots
- ▶ Ties
- ▶ Embankments
- ▶ Drainage
- ▶ Transitions

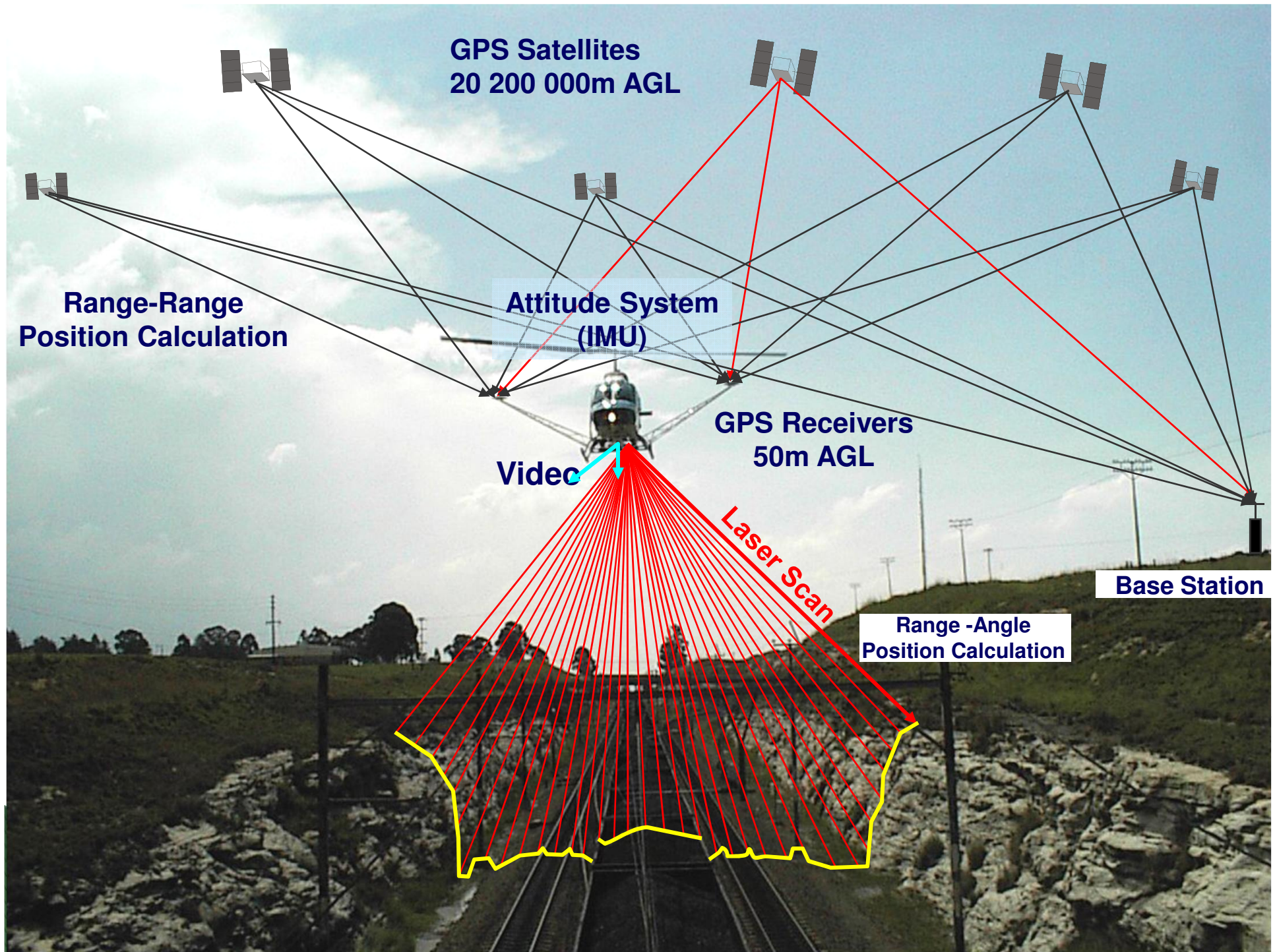




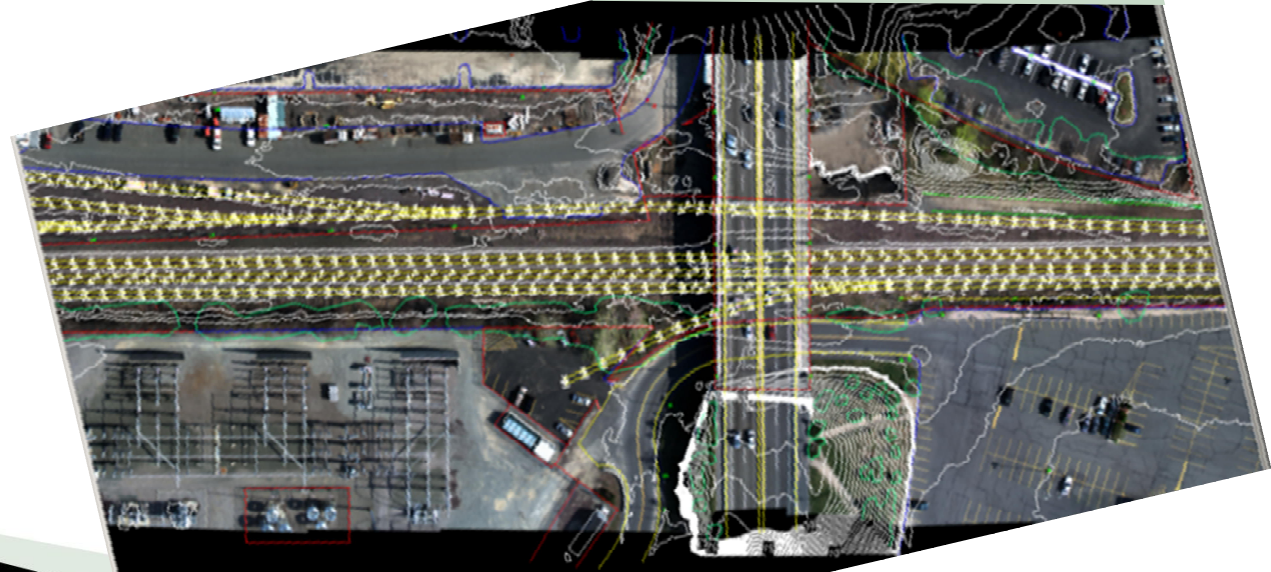
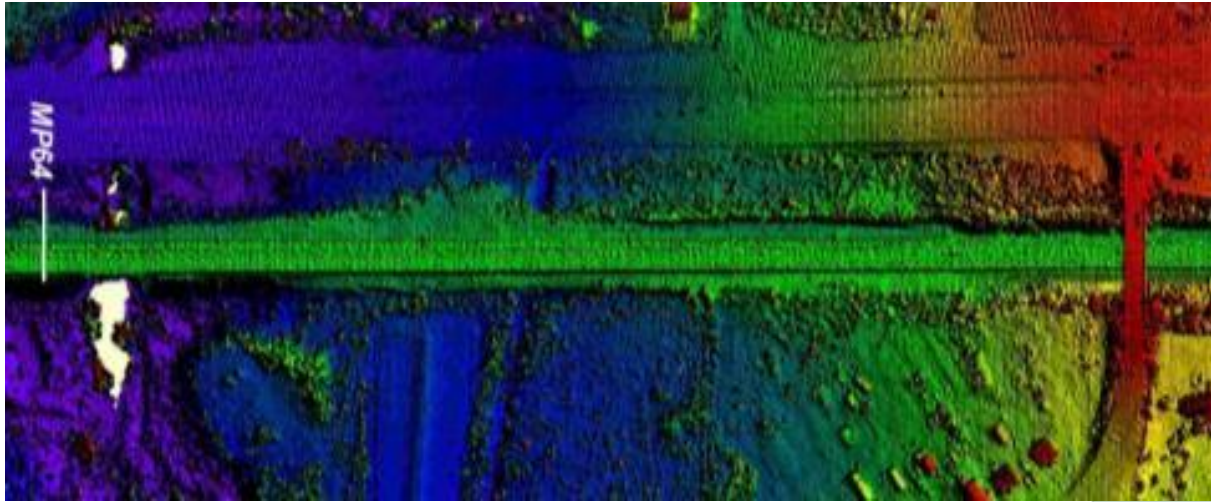
# Substructure Diagnostics

- ▶ Mapping
- ▶ Ground Penetrating Radar
- ▶ Geotechnical Instrumentation
- ▶ Track Geometry
- ▶ Integrated Data & Visualization





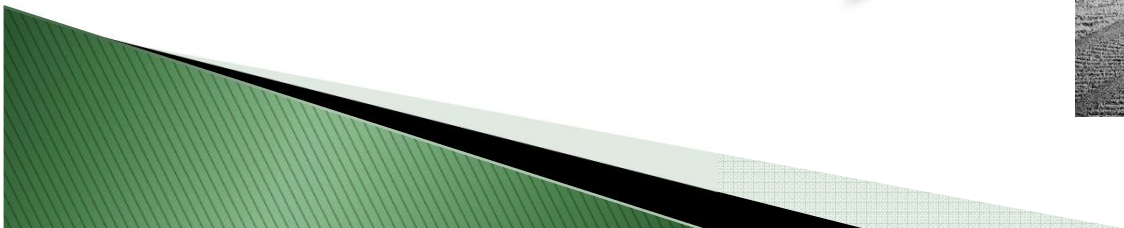
# Aerial Lidar Mapping



# Ground Lidar Mapping



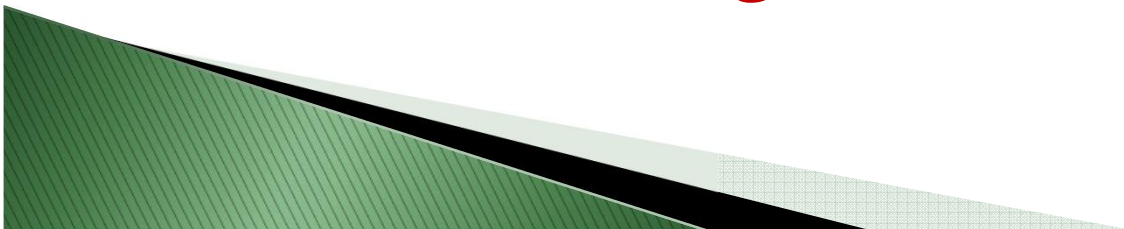
**Terrametrix**<sup>TM</sup>  
terrestrial lidar in motion



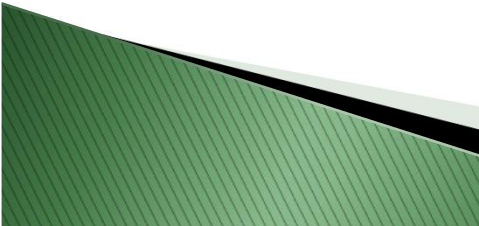
# Ground Penetrating Radar (GPR)



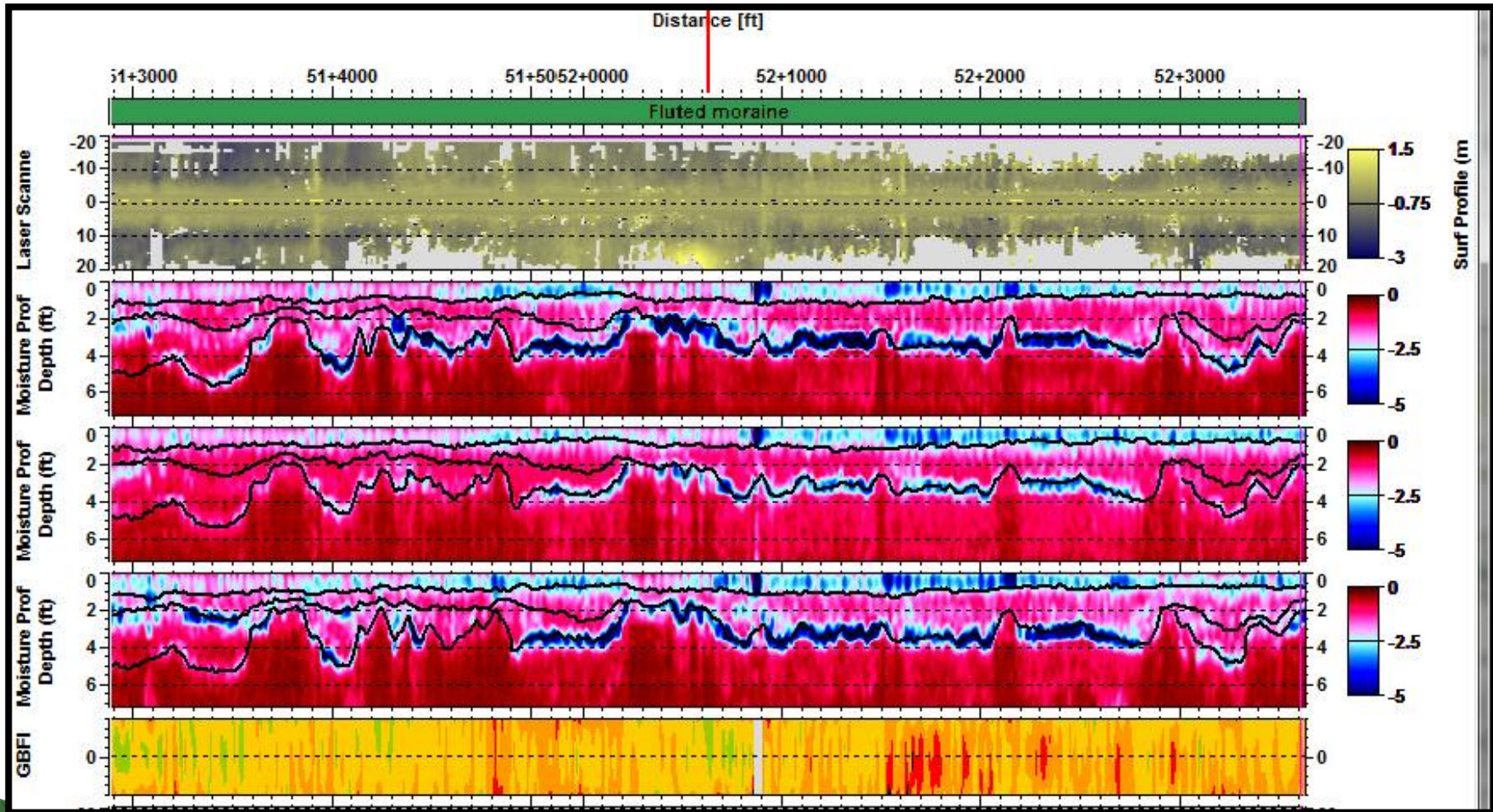
- ***Layers***
- ***Moisture***
- ***Fouling***



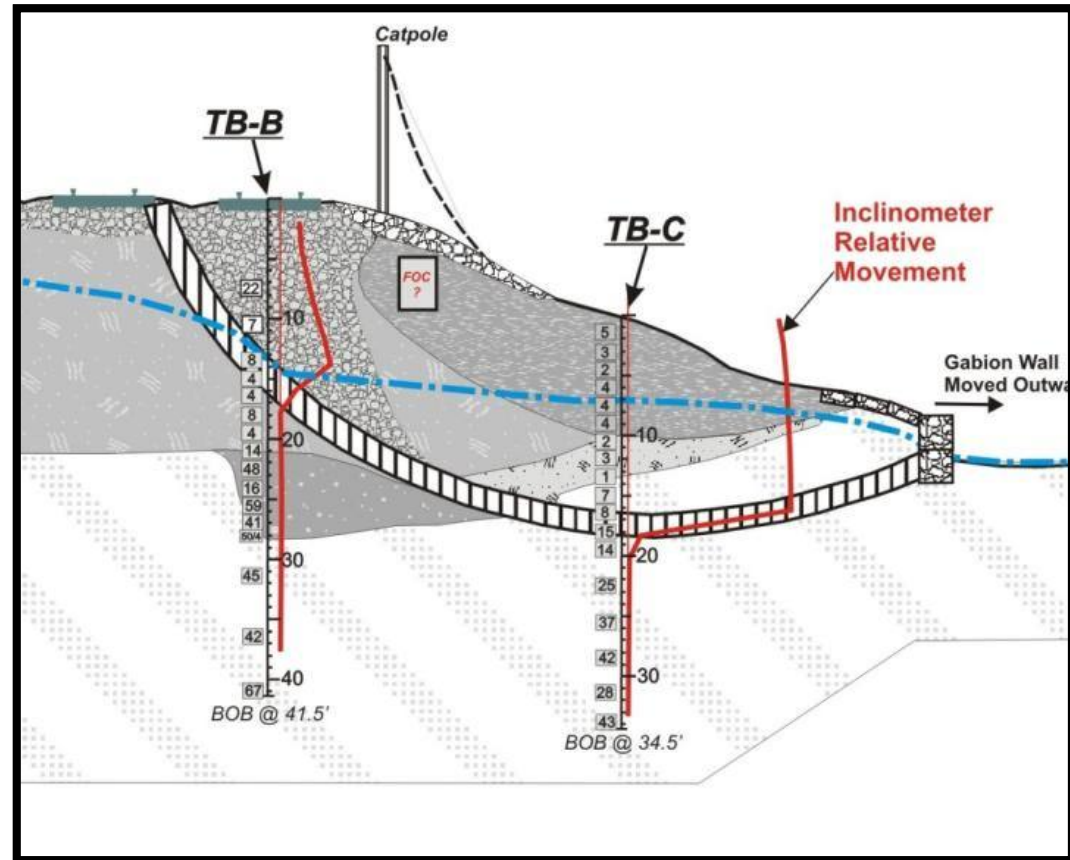
# Different GPR Equipment



# Example GPR Results

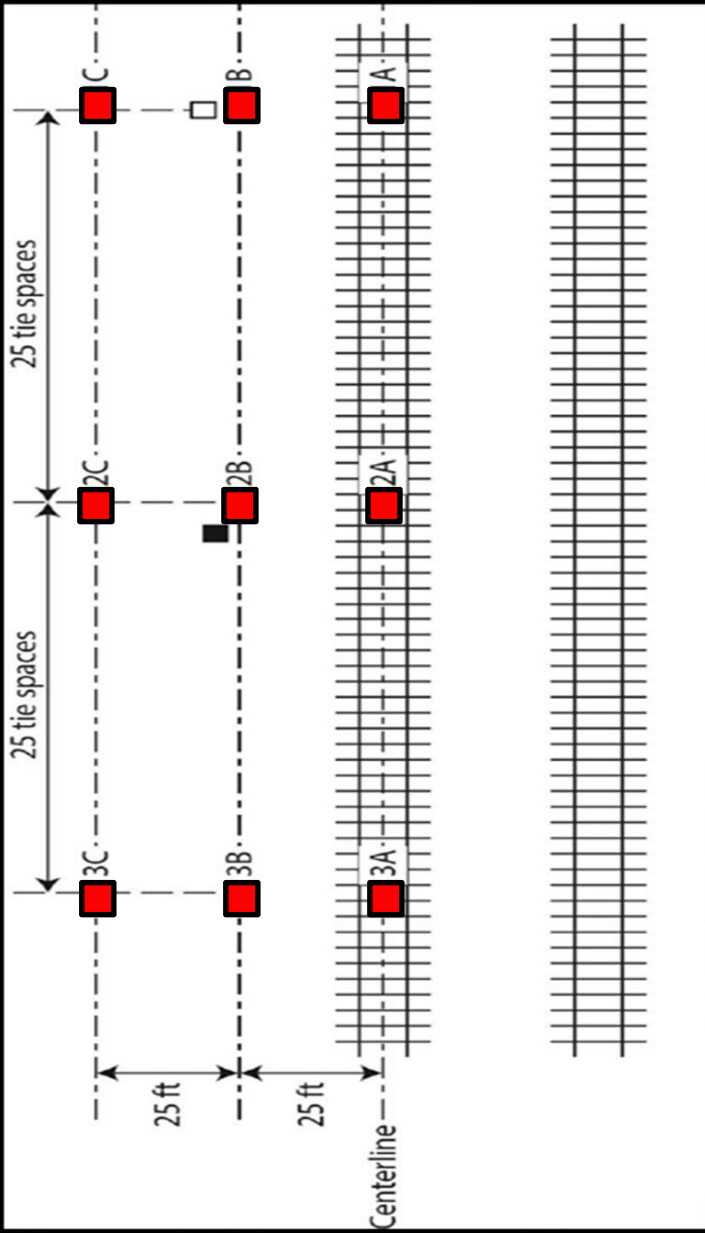


# Geotechnical Instrumentation – Slope Stability

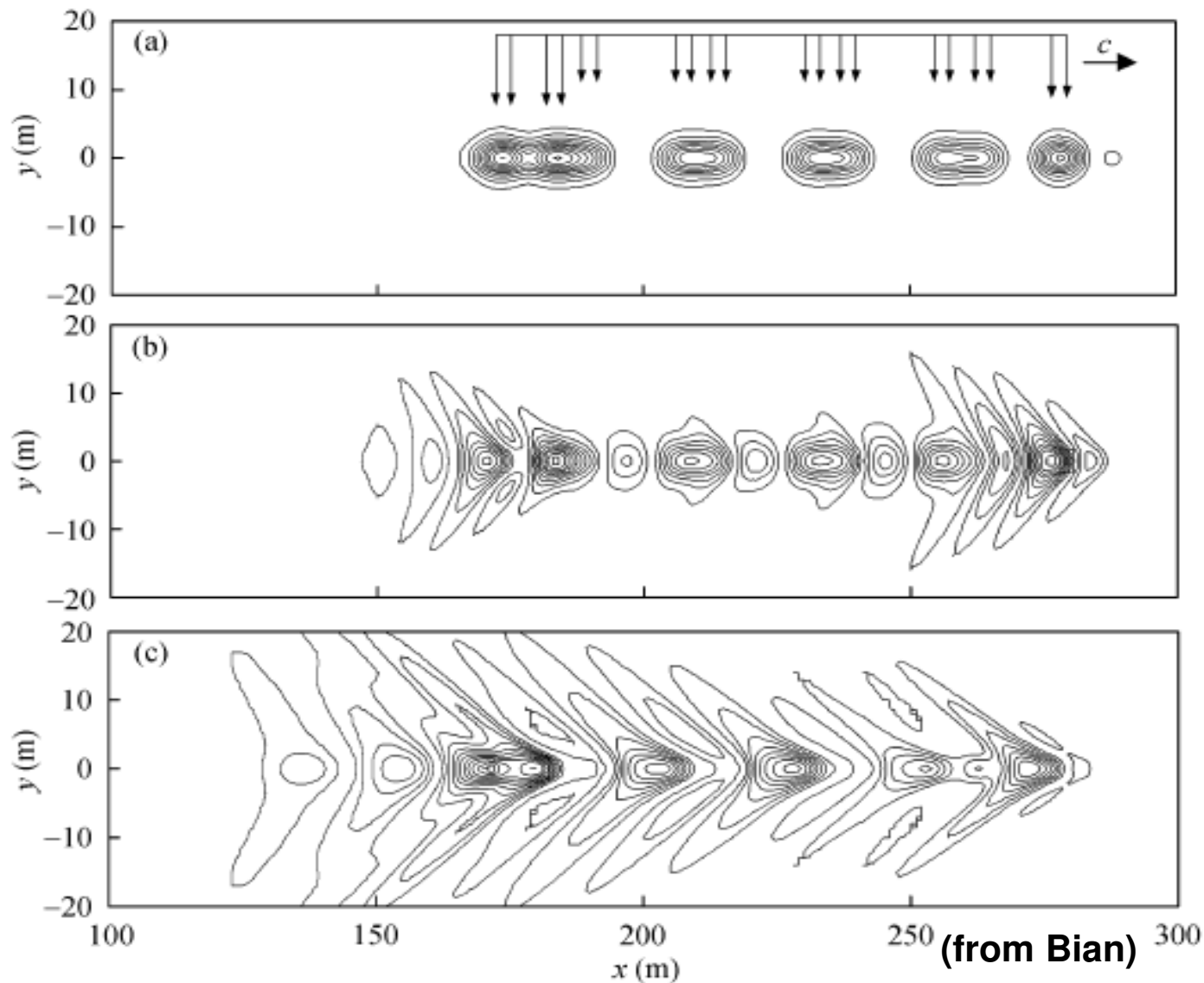




# Geotechnical Instrumentation – Critical Speed



# Critical Speed



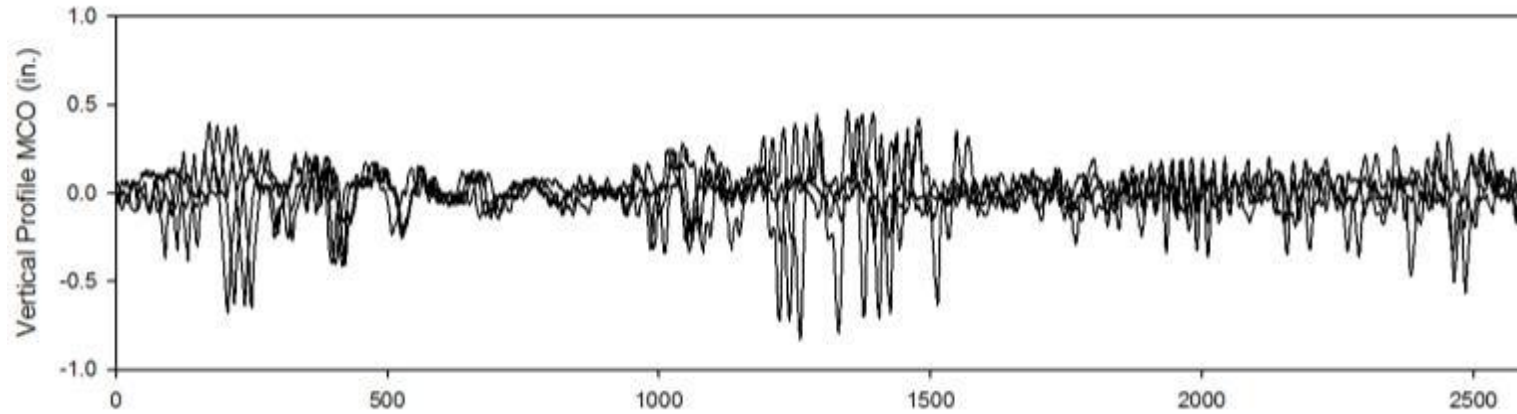
Slow Speed  
Ground Deformation

Approaching  
Critical Speed

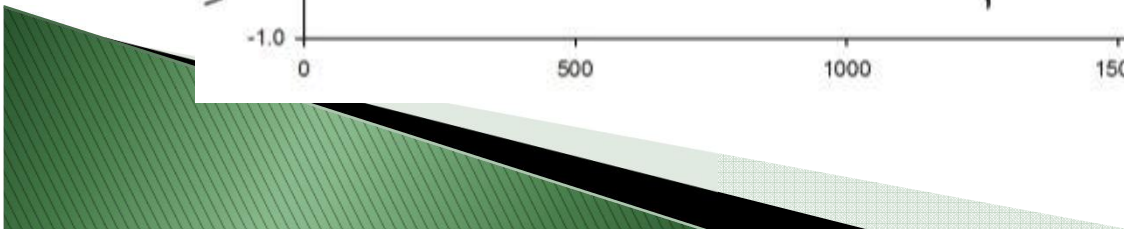
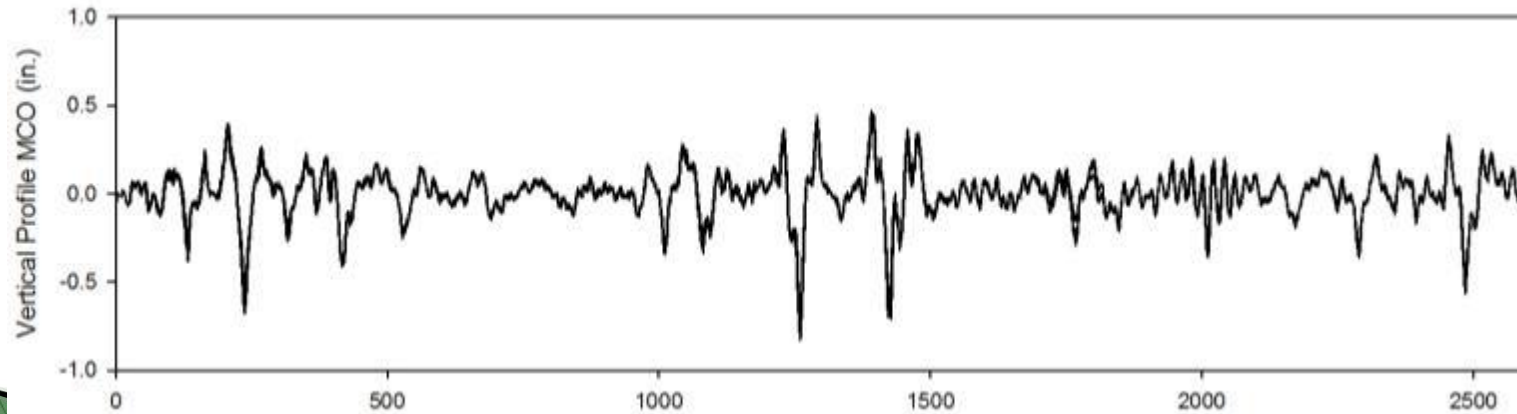
Critical Speed

# Track Geometry

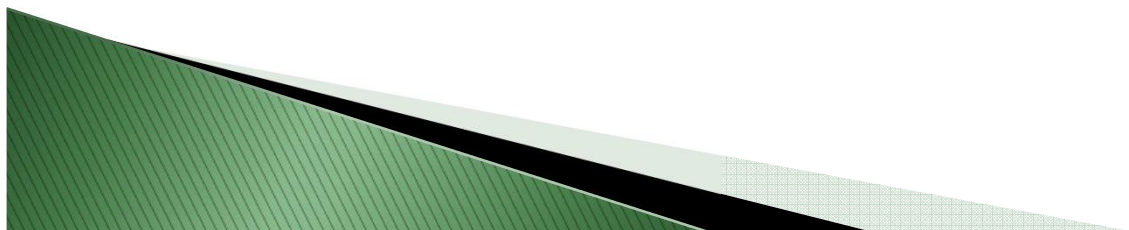
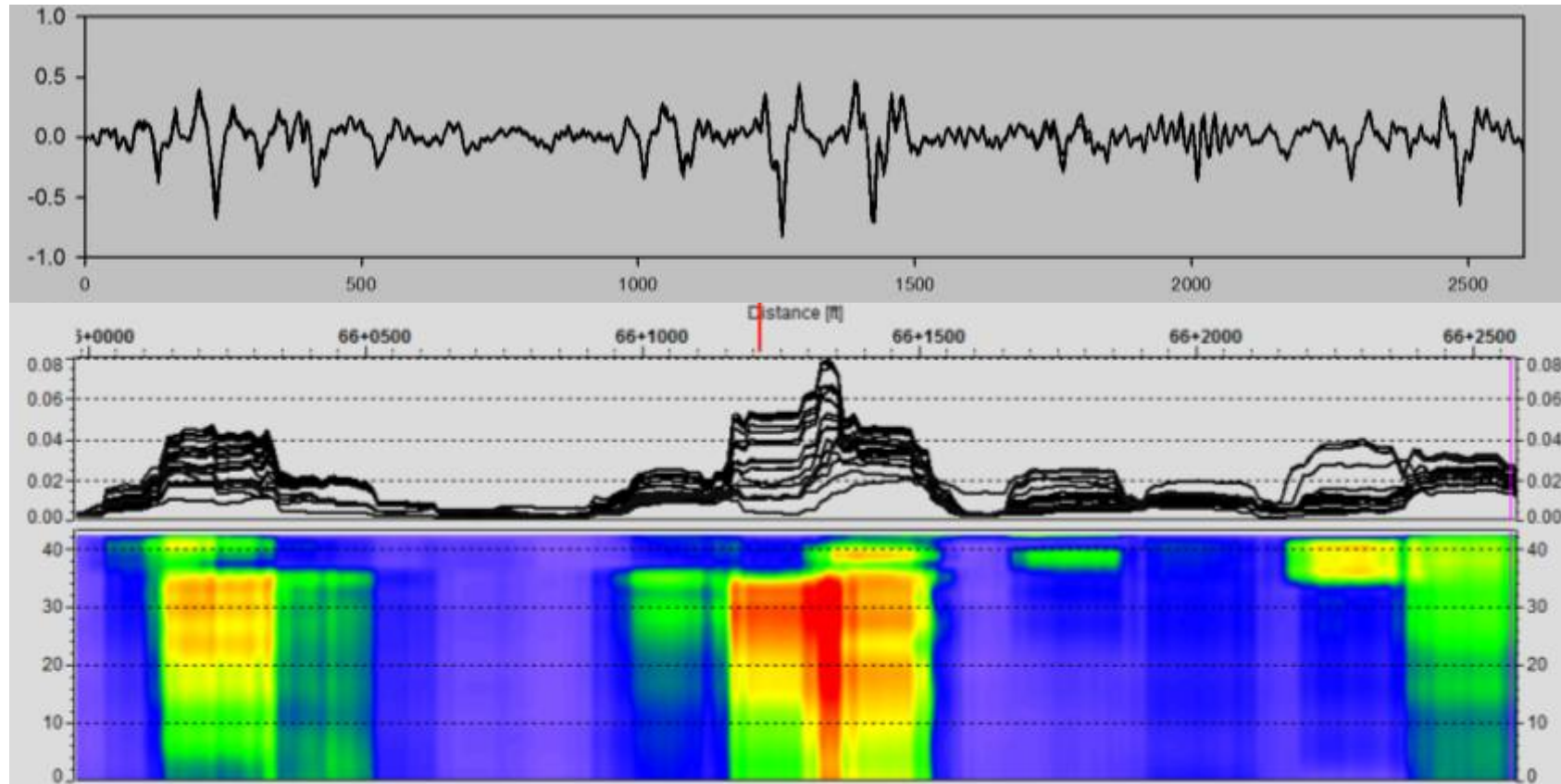
## Measured



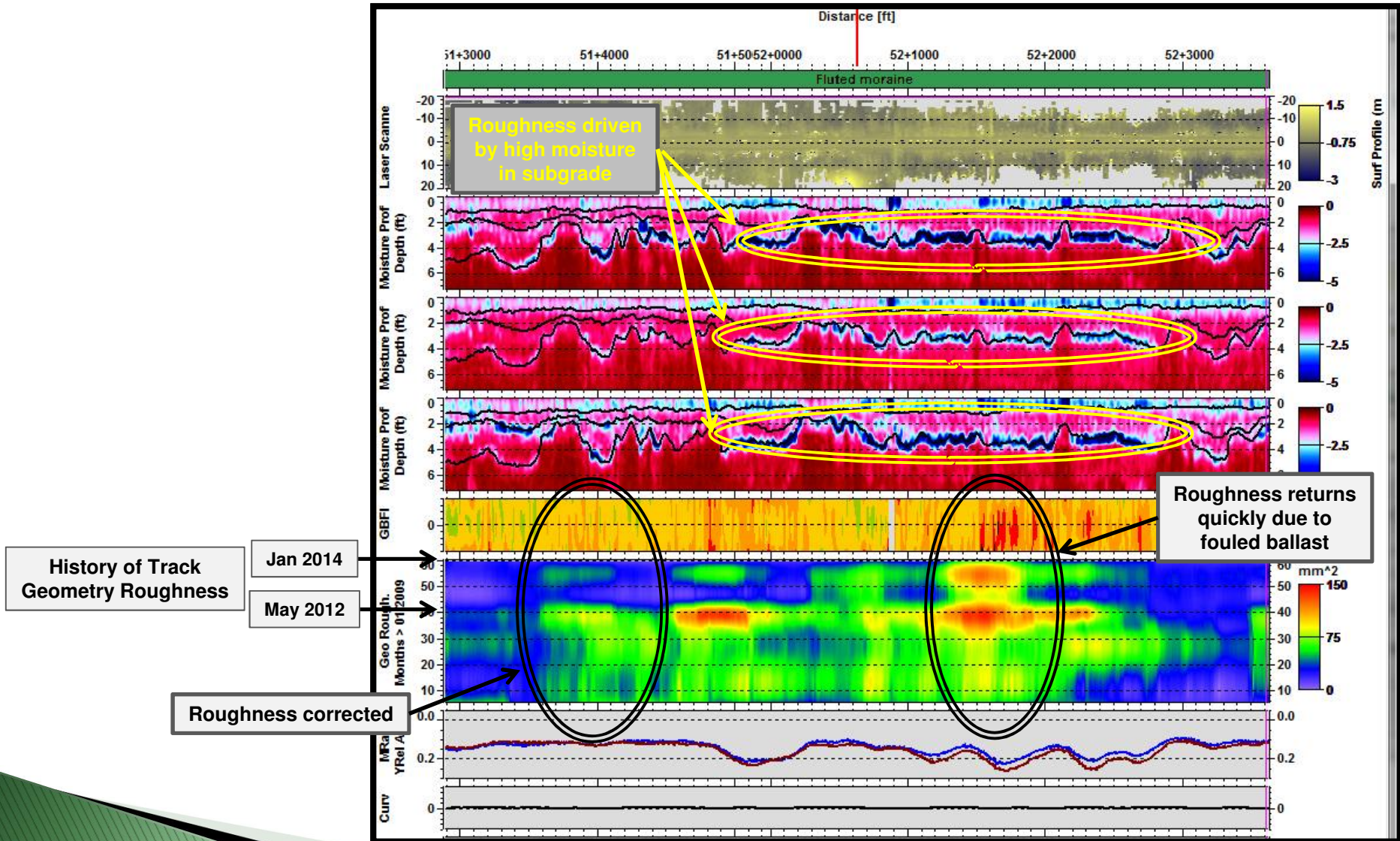
## Aligned



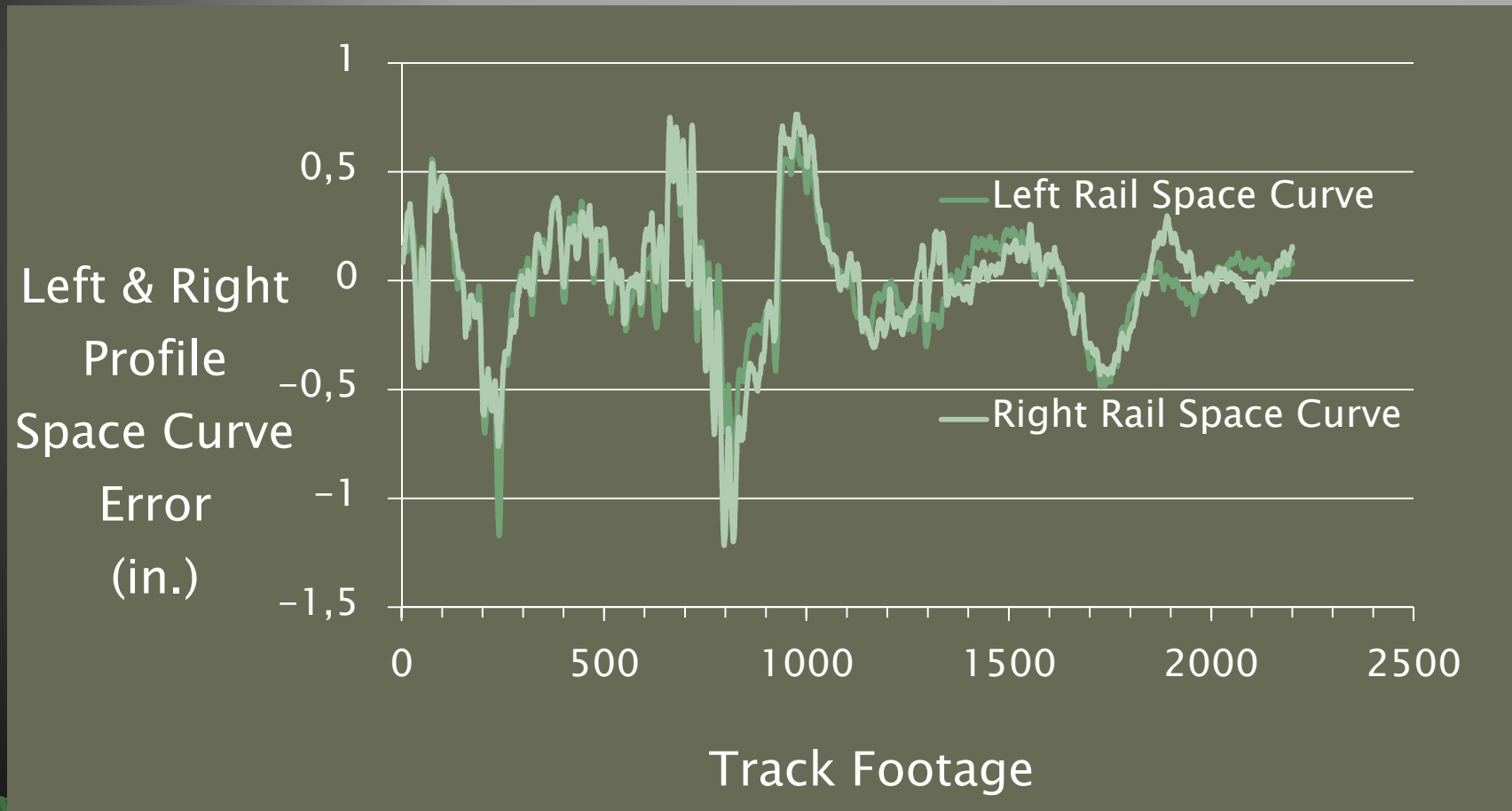
# Track Geometry



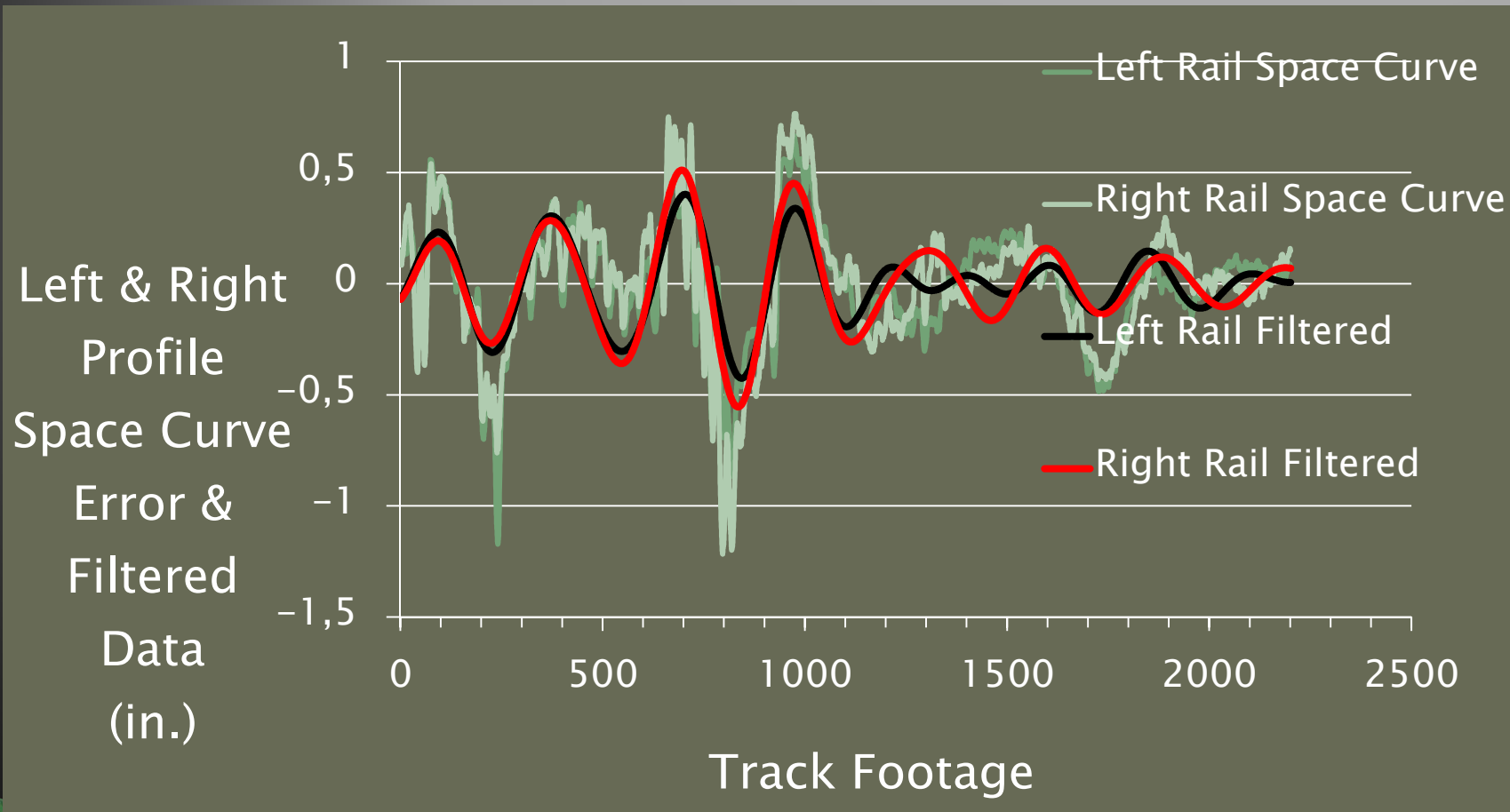
# Example GPR Results with Geometry History



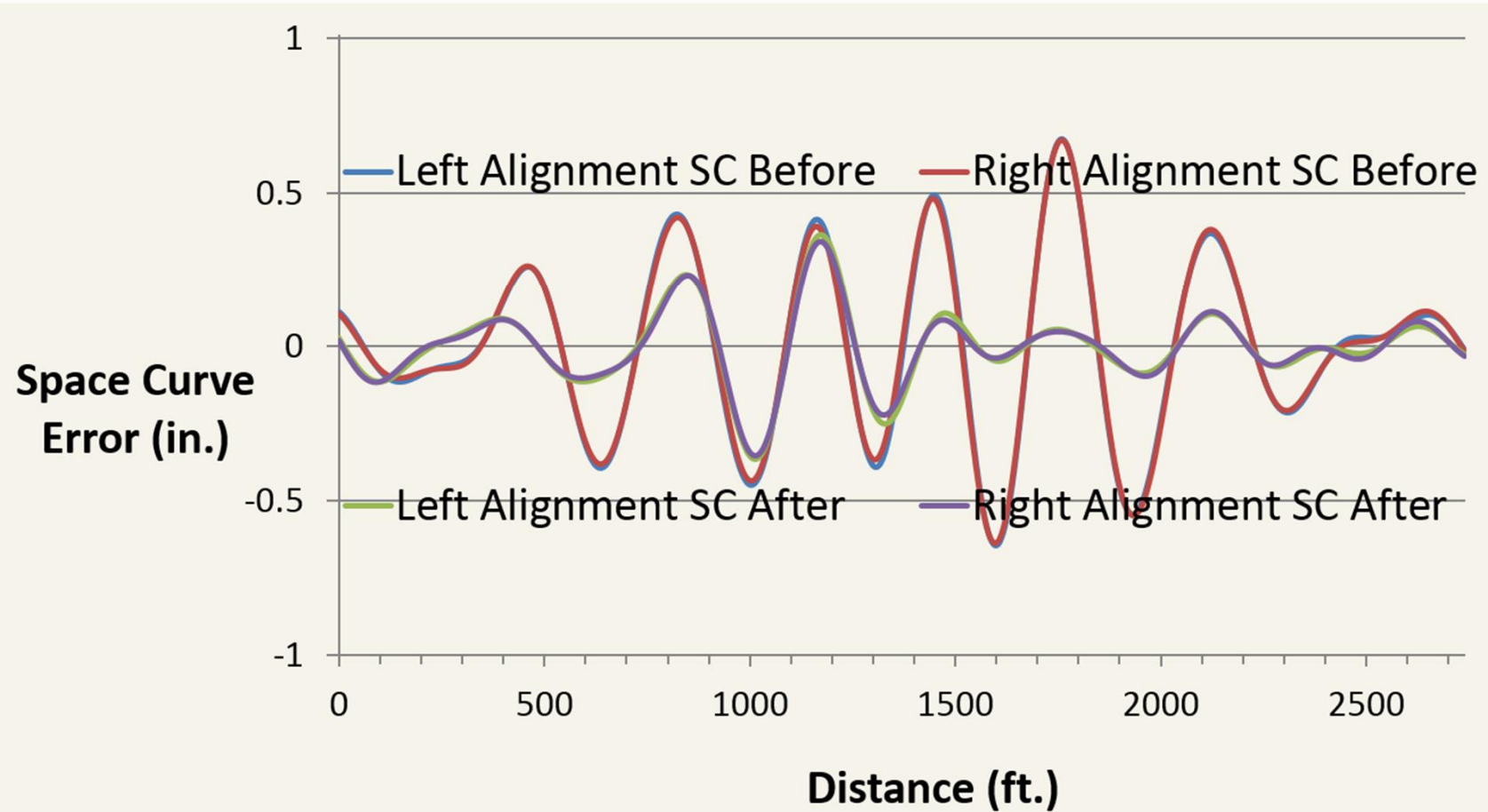
# Identifying Cyclic Error in Track Geometry Data (Vertical Profile)



# Identifying Cyclic Error in Track Geometry Data (Vertical Profile)

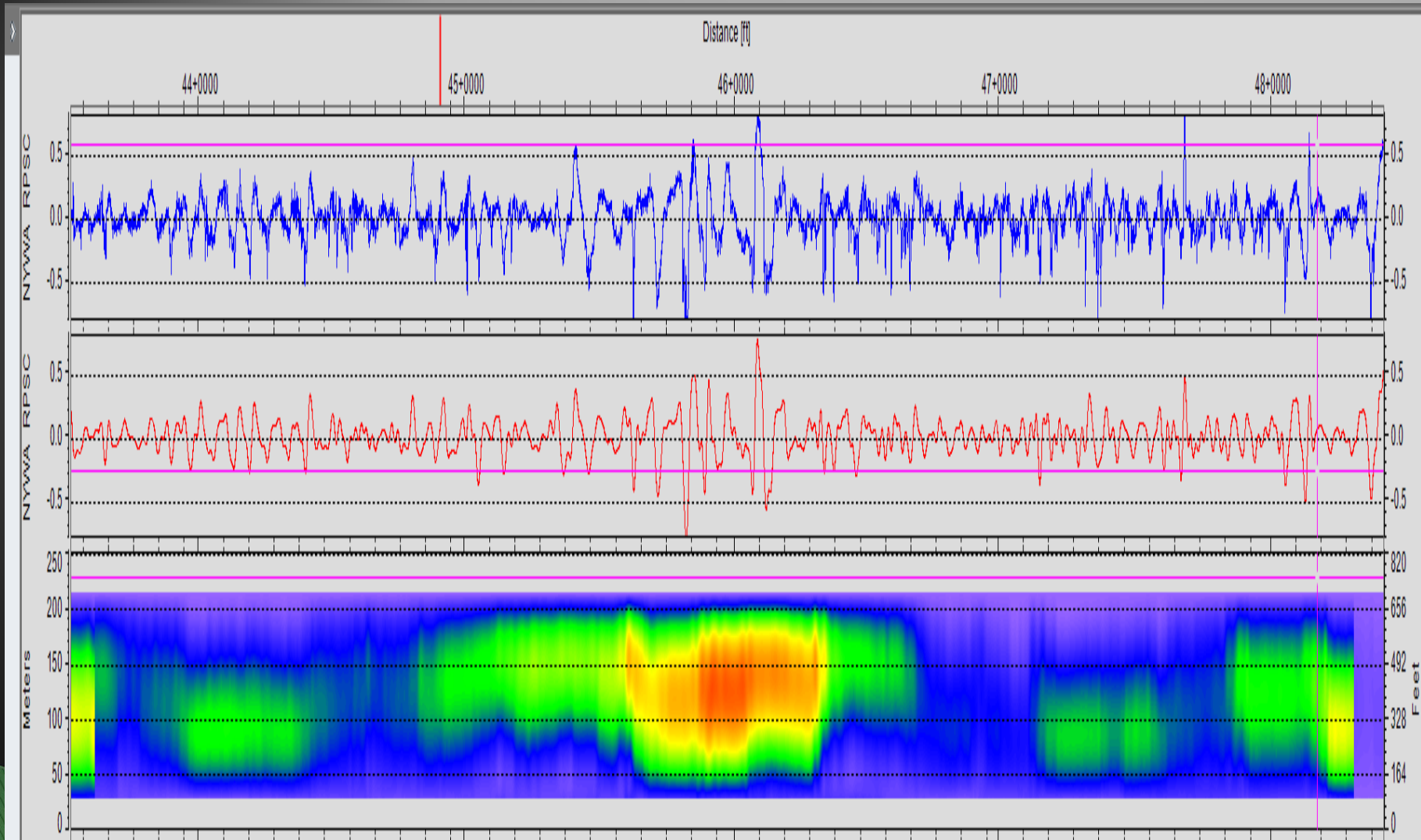


# Correcting Long Wavelength (~100 m) Lateral Alignment Error

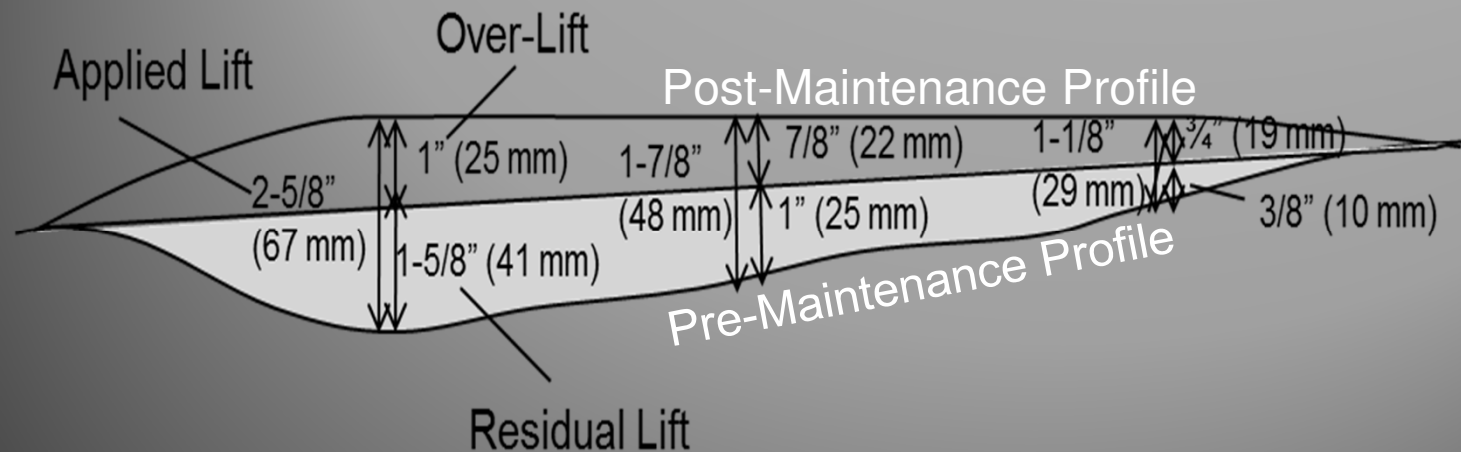




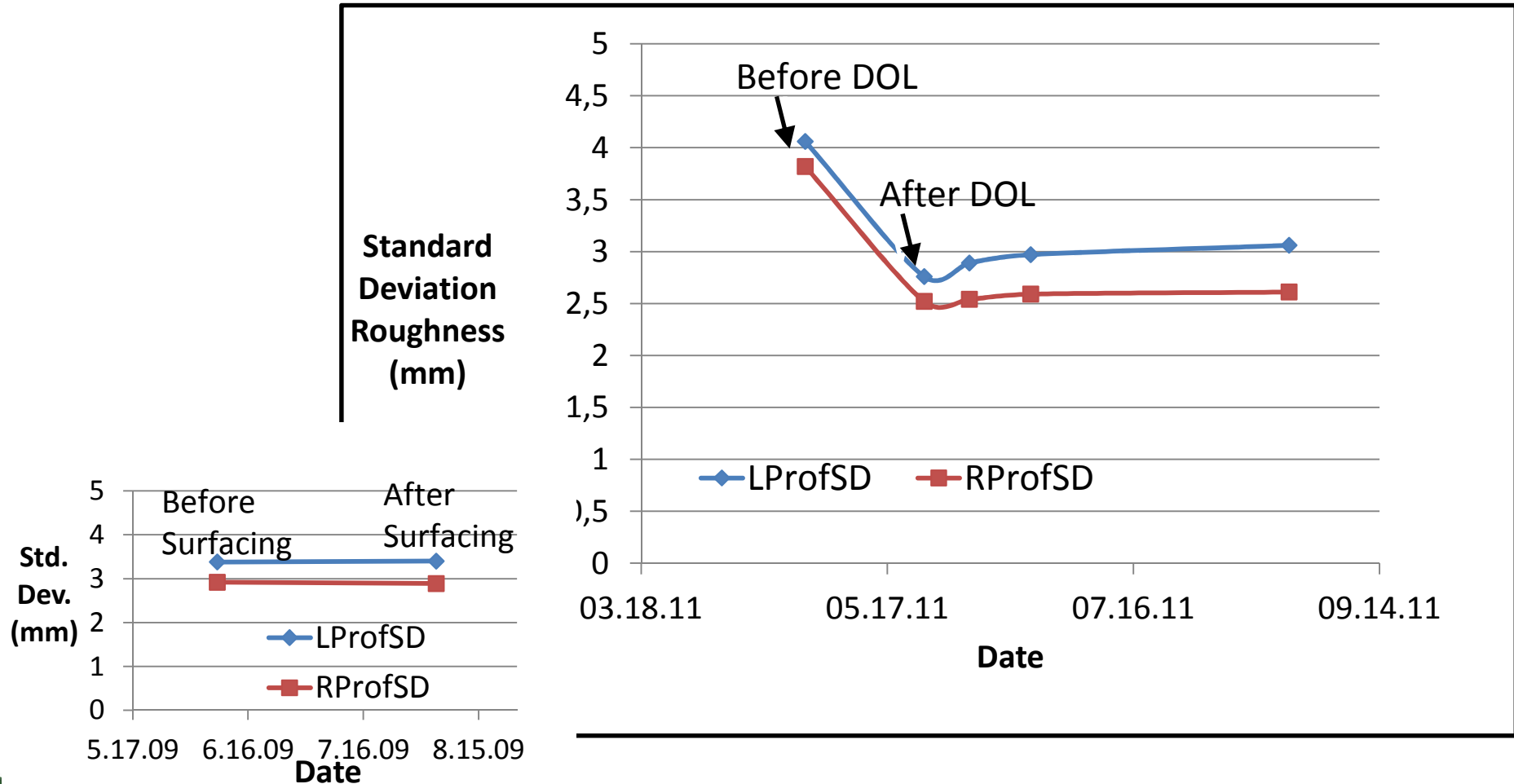
# Waveform Analysis



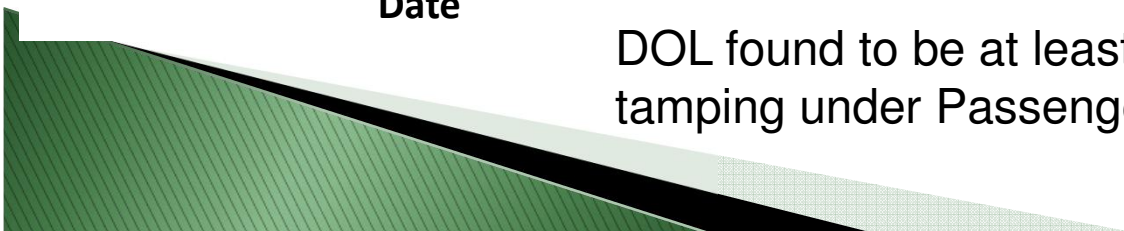
# Design Over Lift (DOL) Tamping



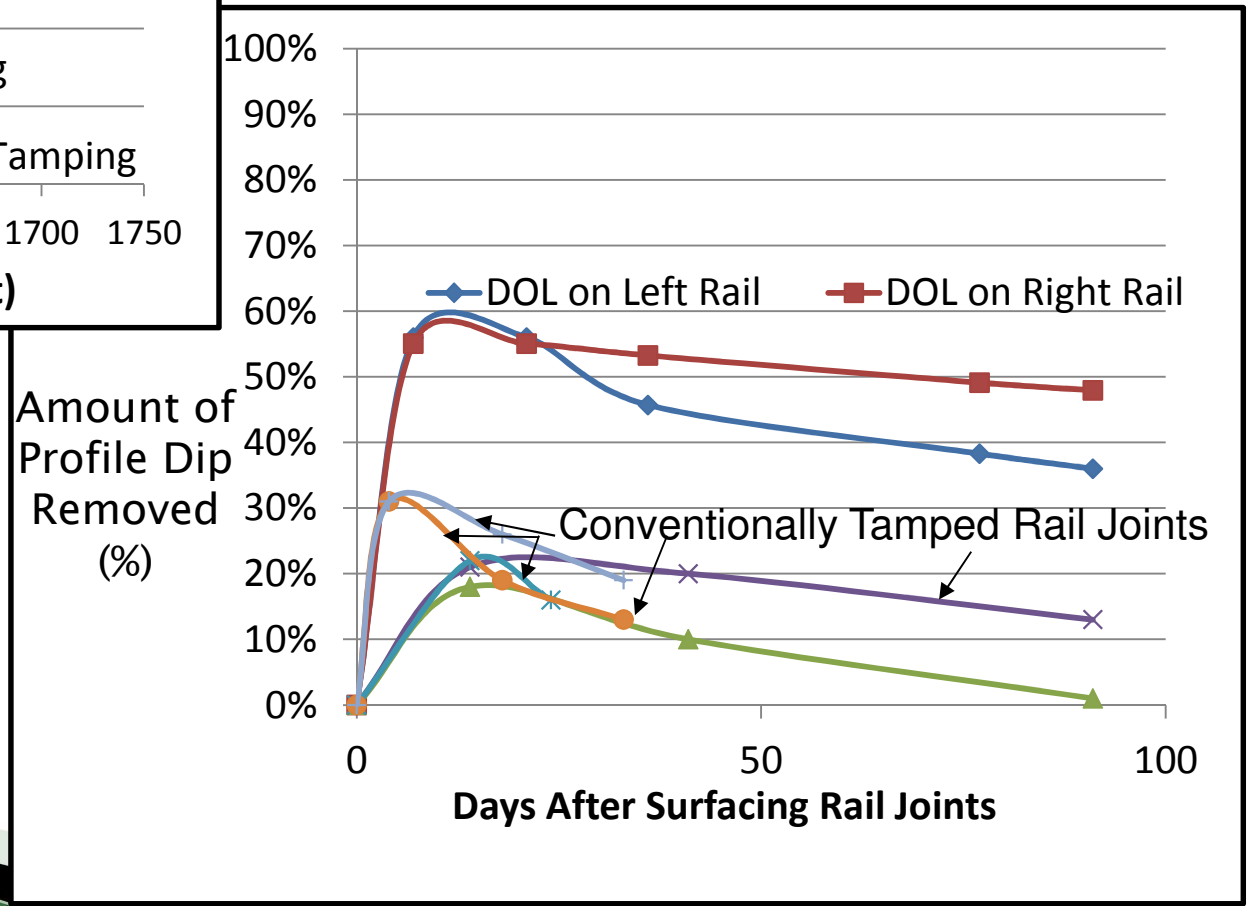
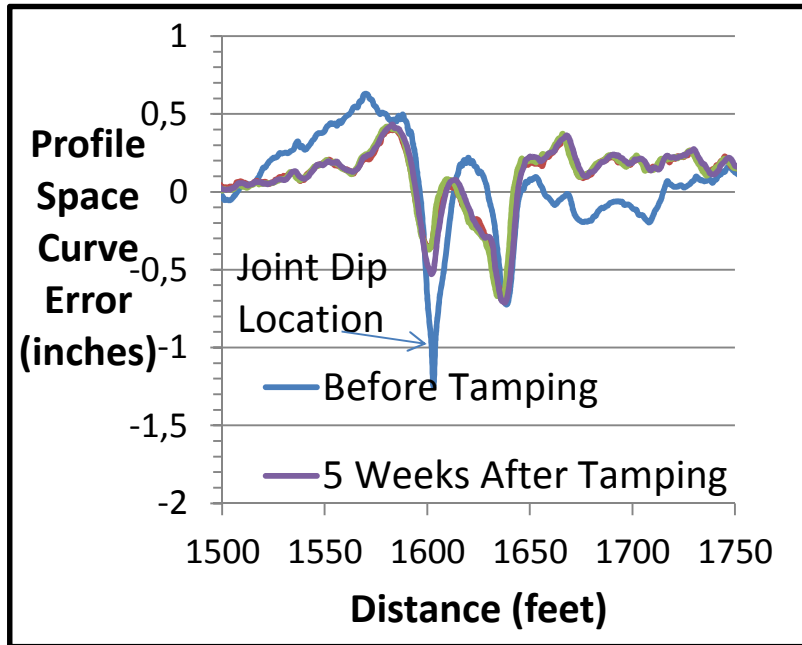
# Design Over Lift (DOL) Tamping



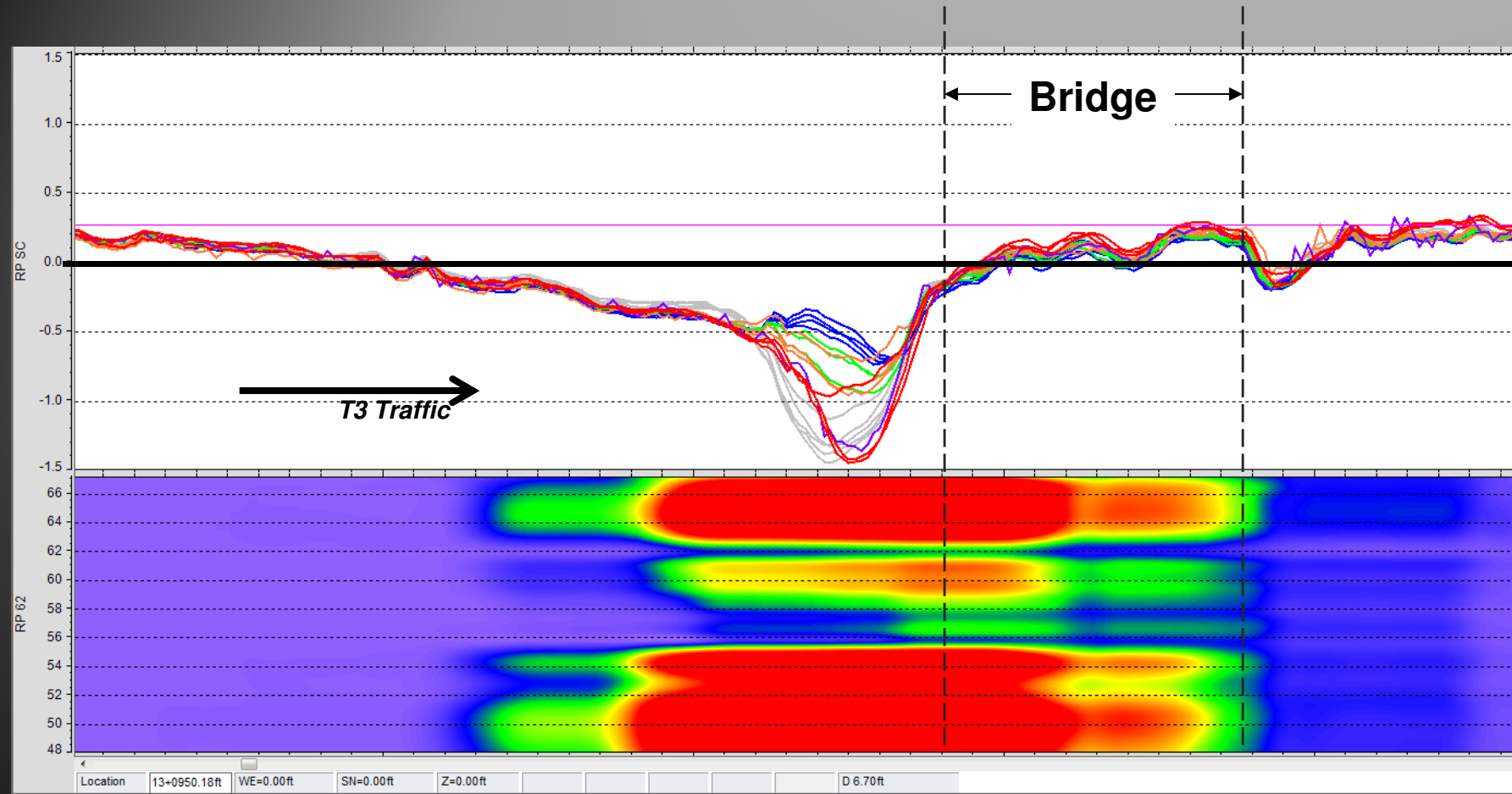
DOL found to be at least 3X more durable than conventional tamping under Passenger and HAL Freight traffic



# Design Over Lift (DOL) Tamping at Rail Joints

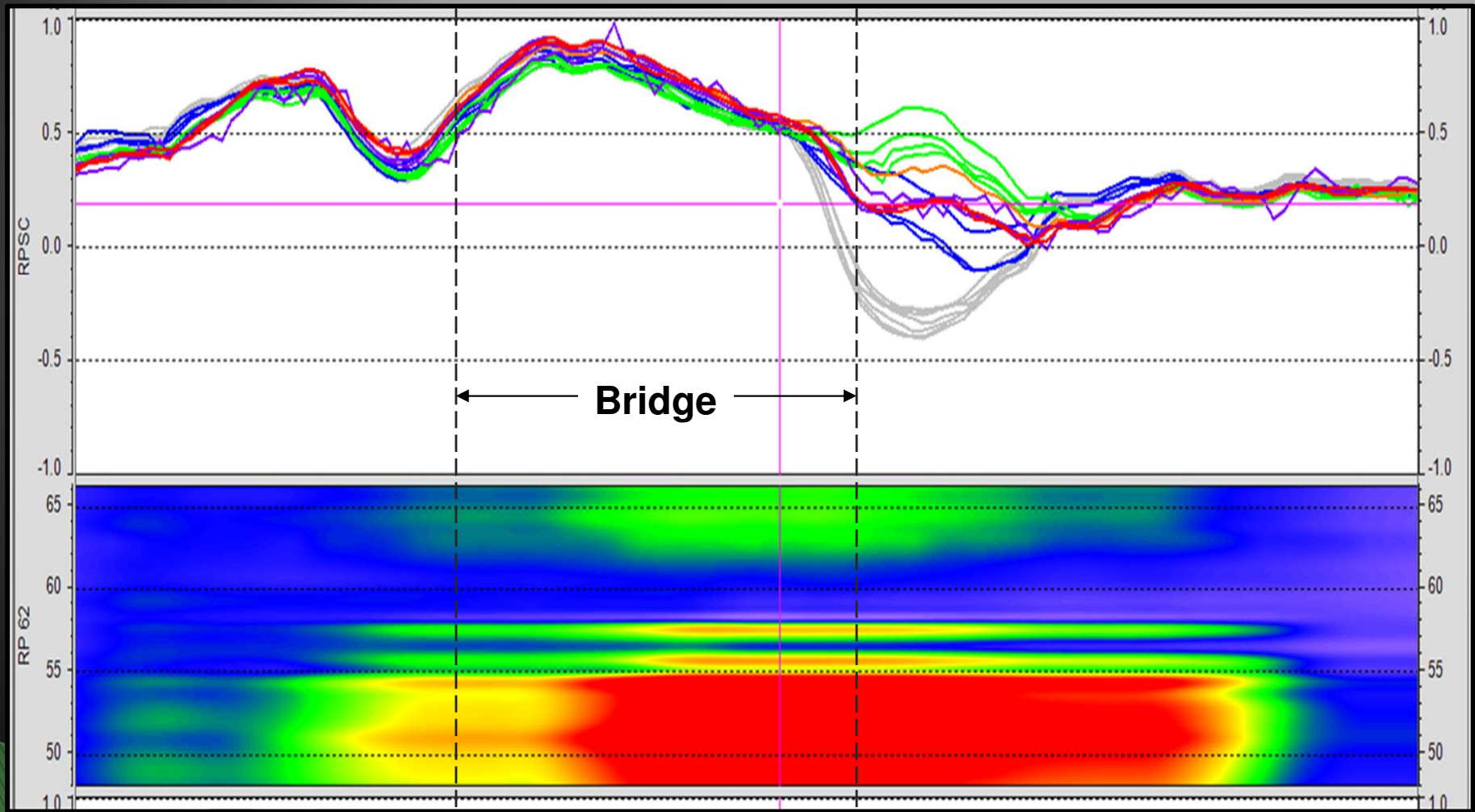


# Transition Improvement - Chemical Grouting



Chemical Grouting  
performed on 7/18/14

# Transition Improvement – Stoneblowing



# Acknowledgments

Mike Trosino



Mika Silvast



Hai Huang

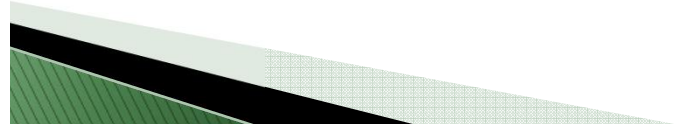




*Thank you for your attention!*



**HYGROUND**



**LTK**