



Capacity for Rail

# Innovative concepts and designs for resilient S&Cs

2<sup>nd</sup> Dissemination Event, Brussels – 3<sup>rd</sup> November 2016

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Trafikverket



- C4R WP13 second task: “Resilient S&C” D132
  - Objectives:
    - Collect and organise relevant information on S&C related failure modes, based on the expertise available within the consortium and outside where possible (D131)
    - Propose innovative design to minimize material deterioration and failures
    - Suggest innovative design and operational practices to ensure resilience to extreme weather conditions
    - Survey optimized sensor strategies
- Minimizing S&C loads and deterioration
  - Short-term solutions
  - Middle-term solutions
  - Long-term solutions
- Resilience to extreme weather condition
  - Failure catalogue
- Sensor strategy

# Failure catalogue

## 1.2 Rails

### 1.2.2 SHELLING

#### Component

Rails



Capacity for Rail

**Characteristics:** Running surface: small crack in the outer face of the rail head (few mm below running surface). At a later stage, a piece of the metal may break or peel away. Gauge corner: long dark spots randomly spaced out over the gauge corner of the merger of such cracks leading to localised loss of structural integrity and peeling /shelling of the surface material in the gauge corner which can sometimes be quite extensive

#### (Possible) Causes:

- High contact stresses leading to sub-surface or near surface cracks that merge together to cause localised loss of structural integrity that results in spalling/shelling of the material.
- Cracks due to Rolling Contact Fatigue (RCF), which are not removed before they merge.
- Previous weld repair was executed incorrectly.
- Crossings: High dynamic forces, lack of maintenance (grinding)



**Preventive/corrective measures:**  
Repair by resurfacing or repair welding.  
Replacement of rail

**Detection:**  
Can be detected by ultrasonic testing

# Short term solutions

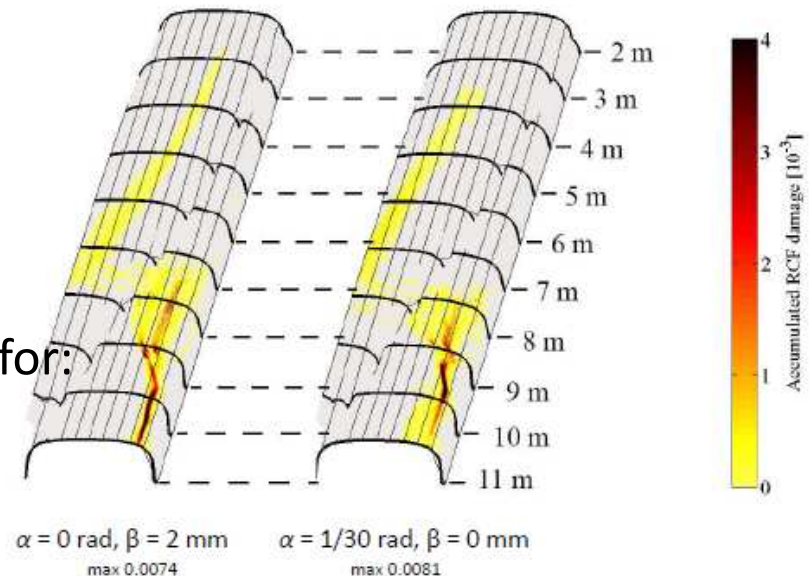
## Modelling – switch panel

- Minimizing the effect of high lateral and longitudinal force
- Predicting the effect of design changes in the switch panels
  - Switch and stock rail design changes (**cutting angles**, nominal and **gauge widening**, rail profiles, **rail inclination...**)

- Improvement of material grades
- Friction management
- Output cumulative contact band

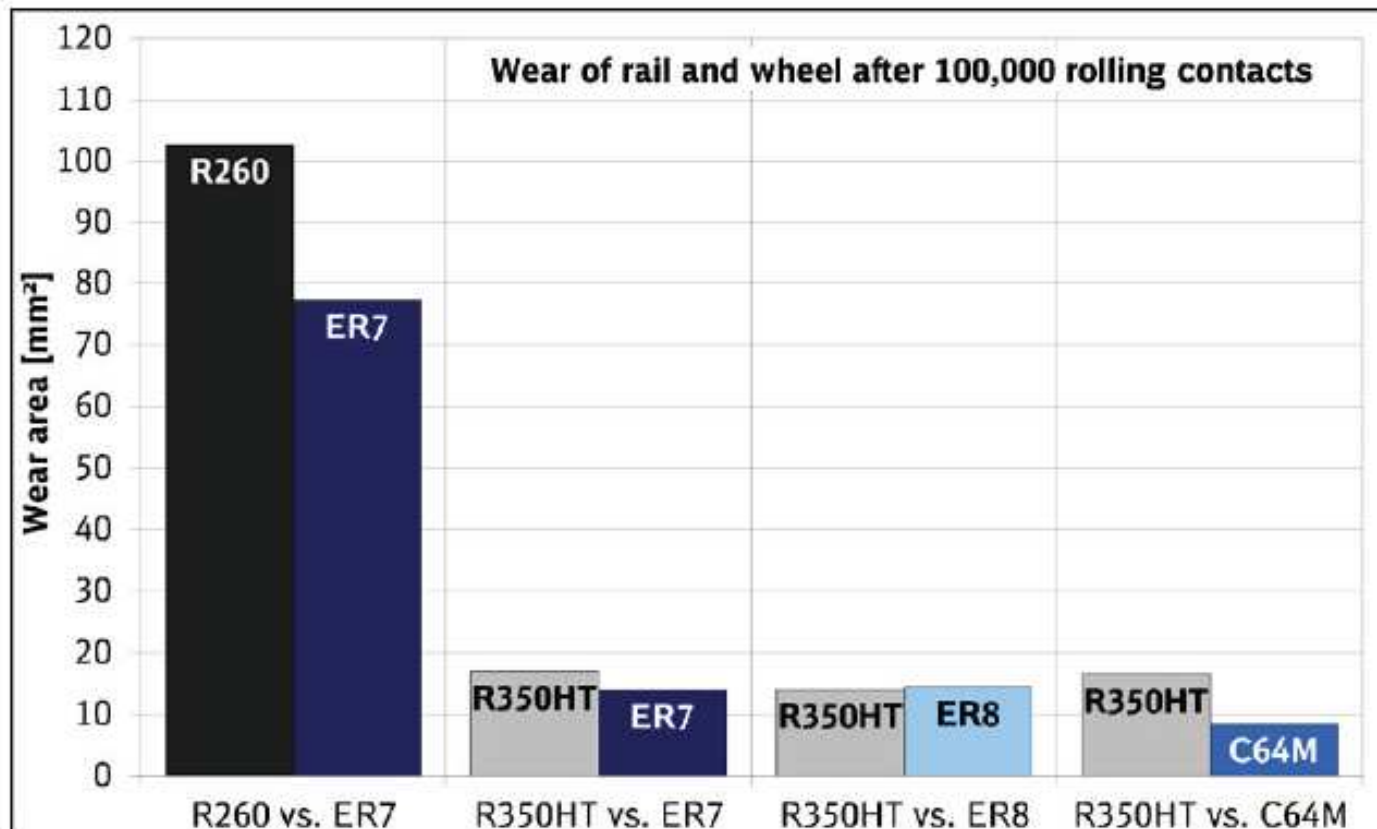
and cumulative damage estimates for:

- Wear
- RCF



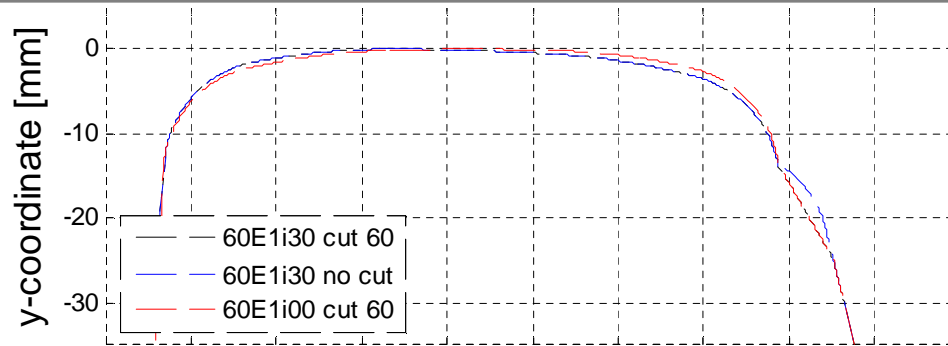
# Material influence

Wear 20-40 % for R350HT compared to R260  
RCF 30-50 % for R350HT compared to R260



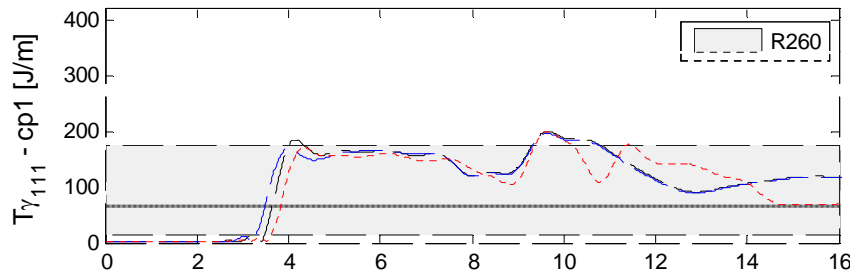
Less wear in laboratory test (INNOTRACK)

# Rail profile optimisation

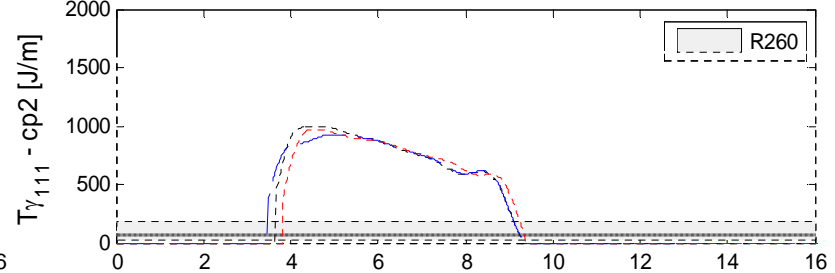


$T\gamma$  – Energy function for RCF initiation

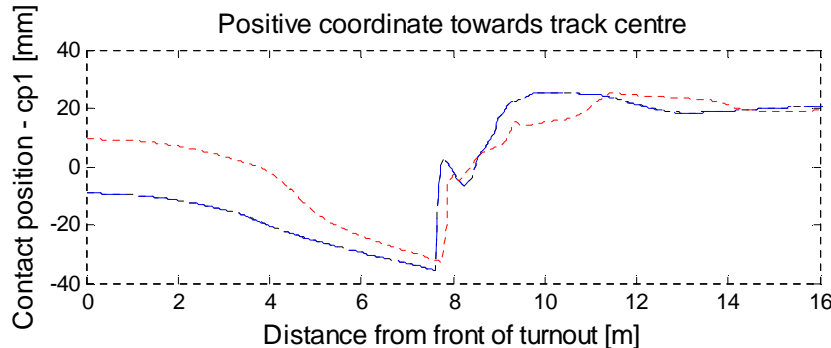
Diverging route, facing move, 70 km/h,  $\mu = 0.3$



Diverging route, facing move, 70 km/h,  $\mu = 0.3$

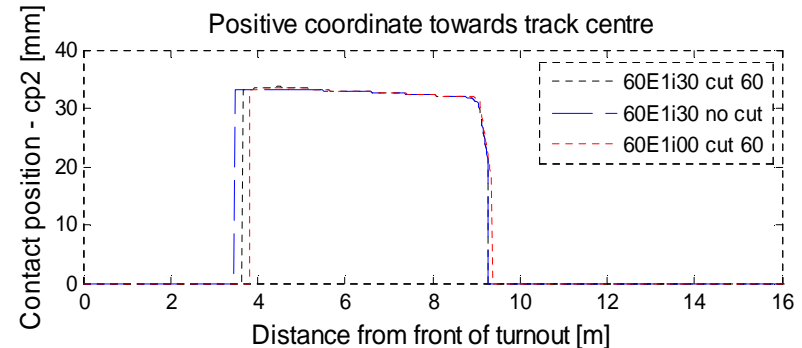


Positive coordinate towards track centre



Contact point top

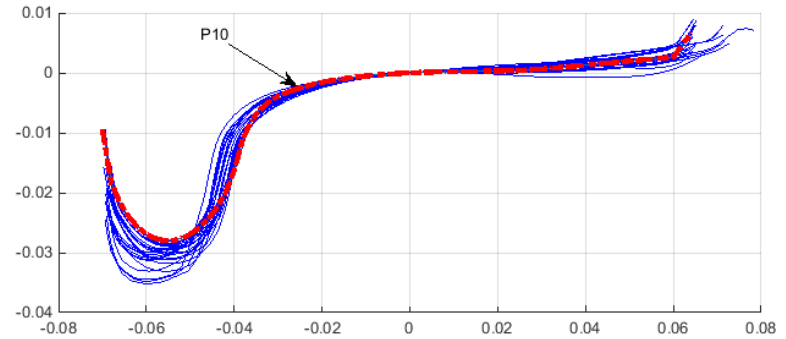
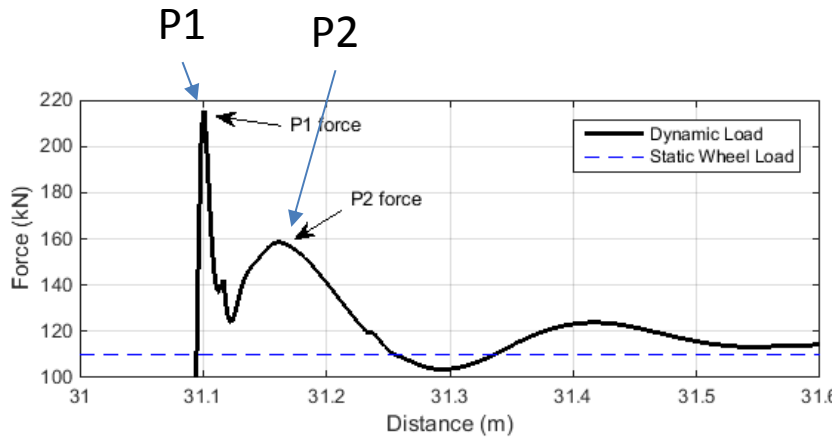
Positive coordinate towards track centre



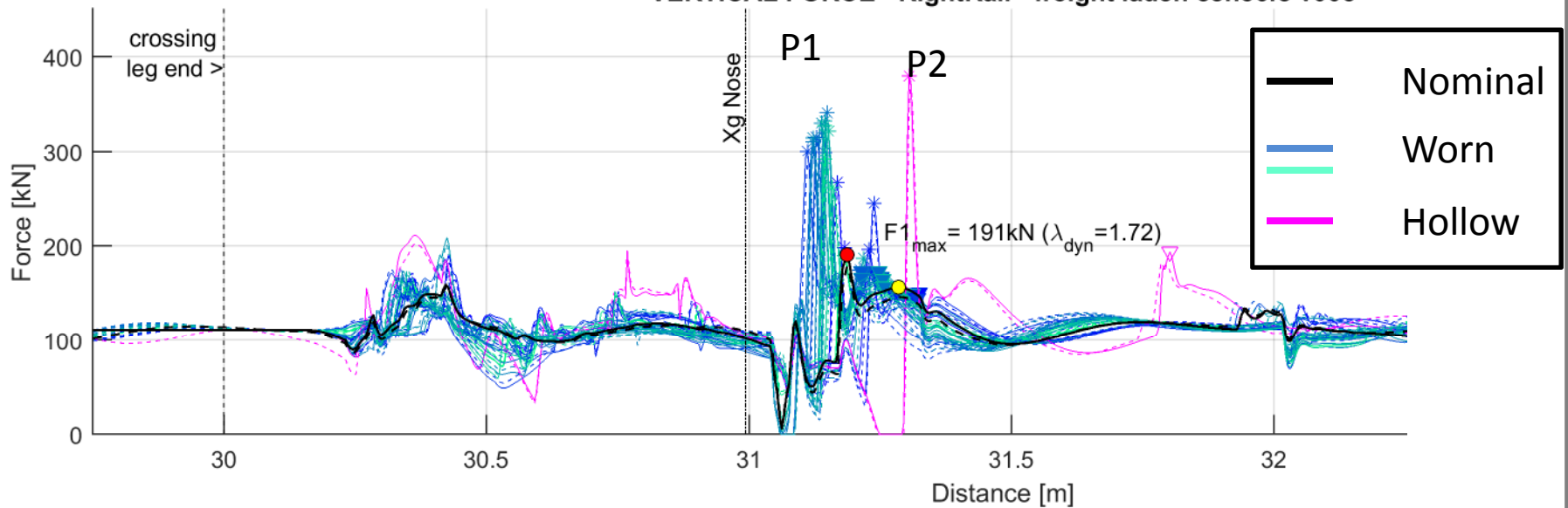
Contact point side

# Medium term solutions

## Crossing panel



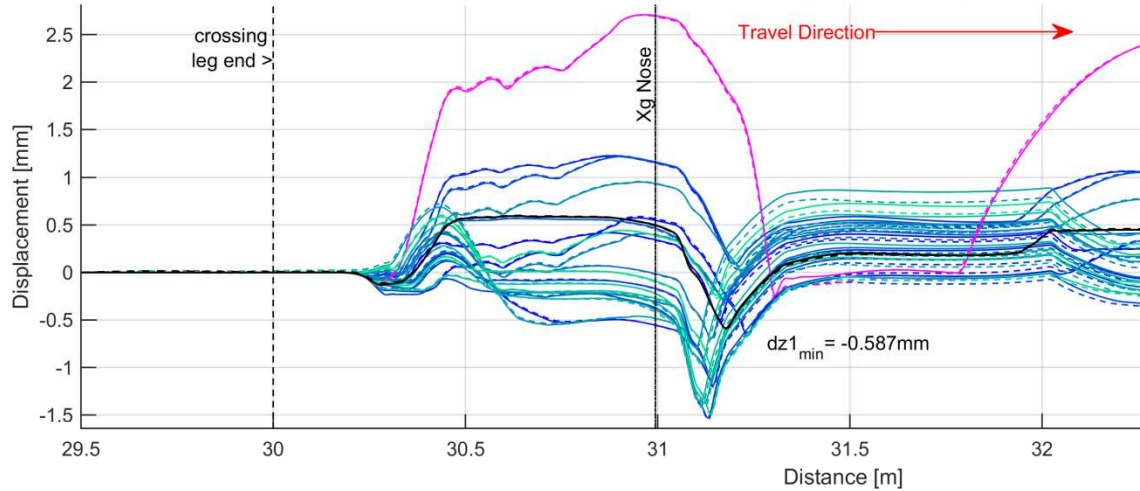
VERTICAL FORCE - RightRail - freight laden cen56fc v005



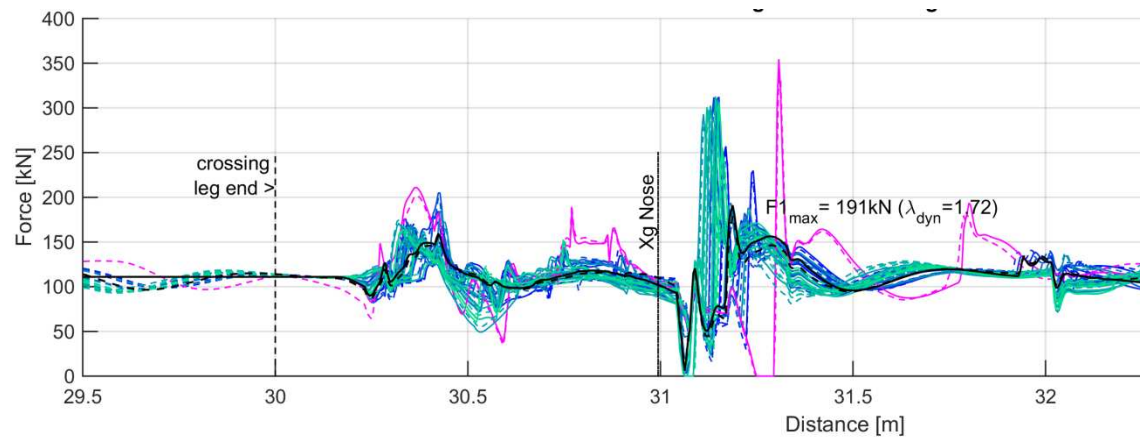
# Medium term solutions

## Crossing panel

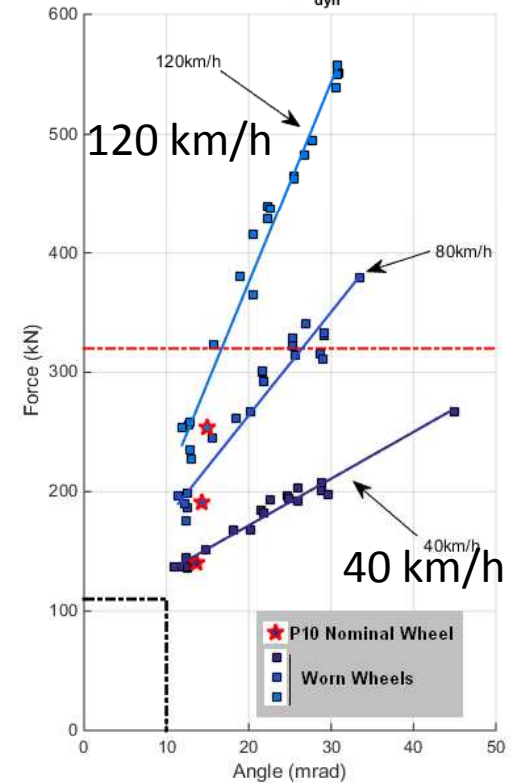
### Wheels vertical motion



### Vertical contact Force



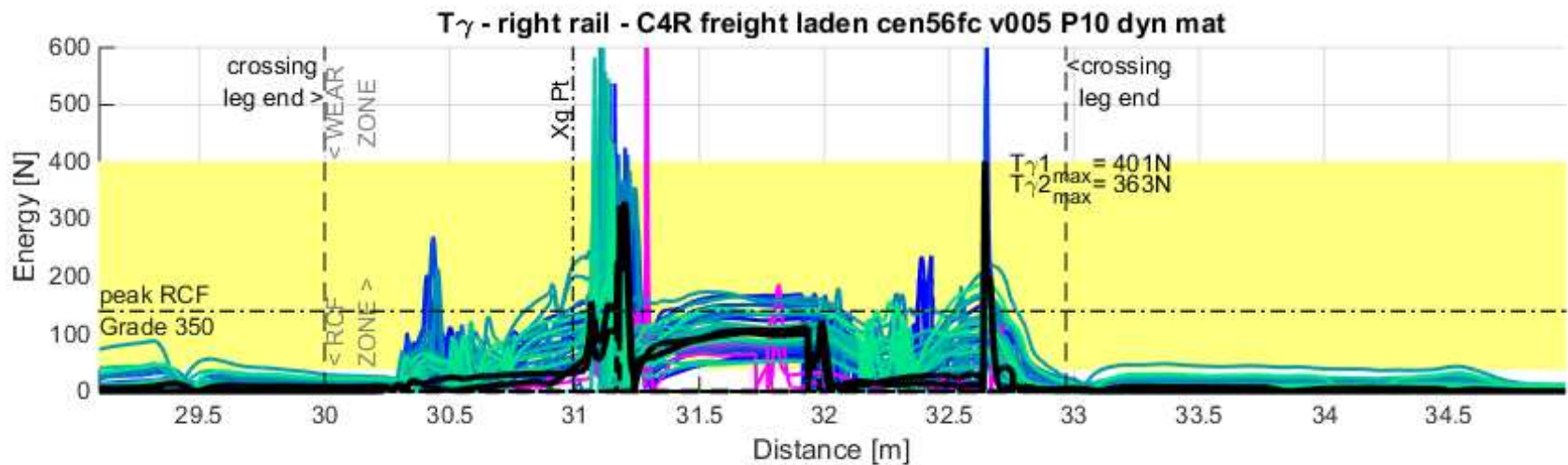
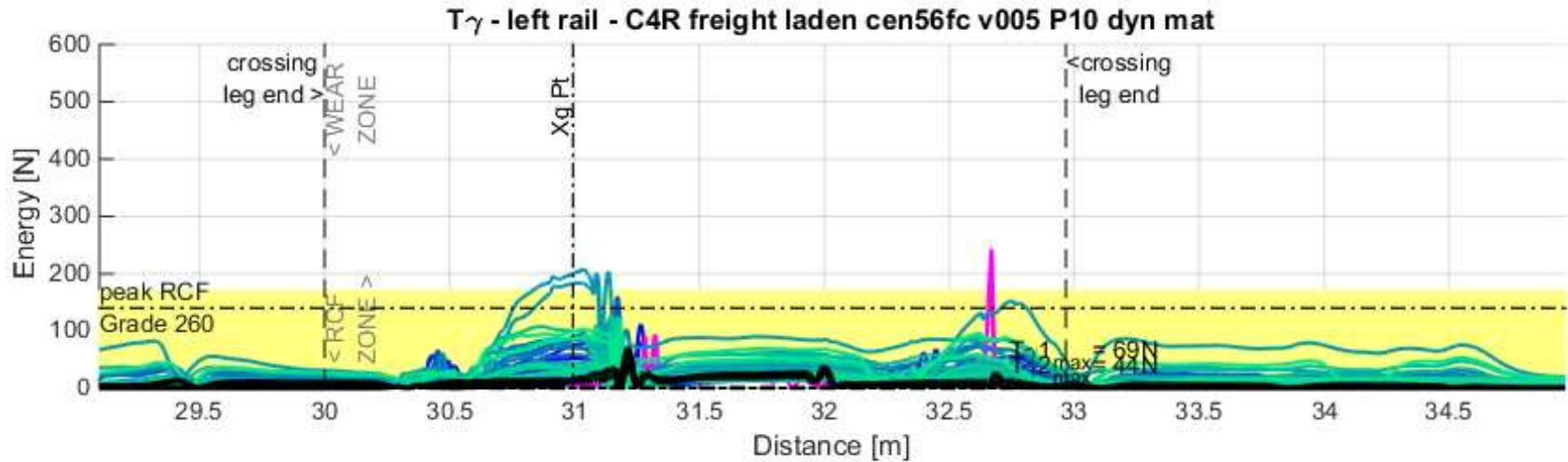
### Unfiltered Max(Q<sub>dyn</sub>) - facing





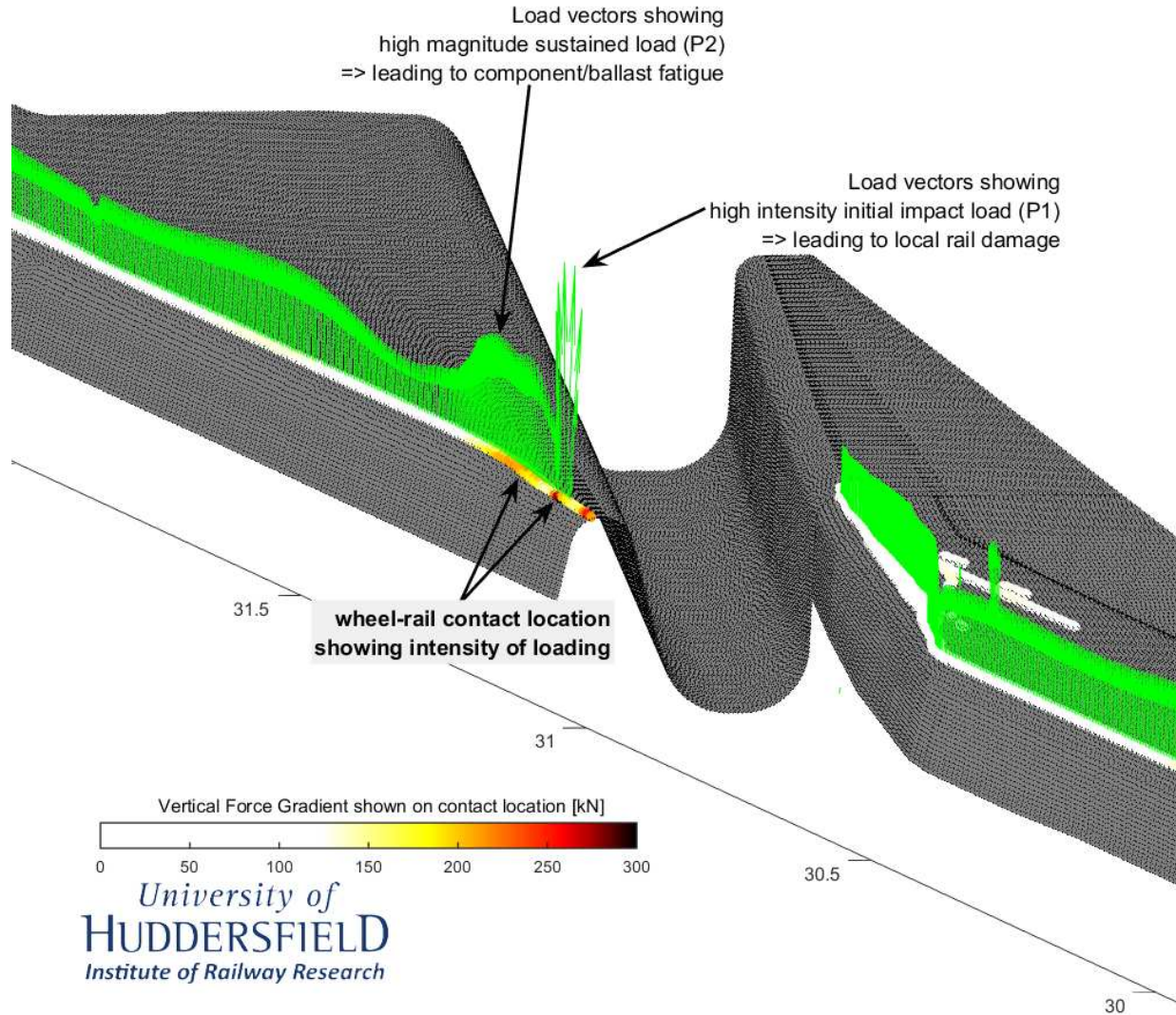
# Medium term solutions

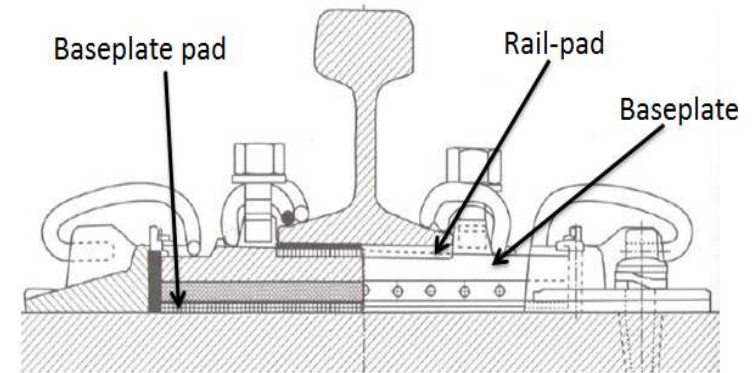
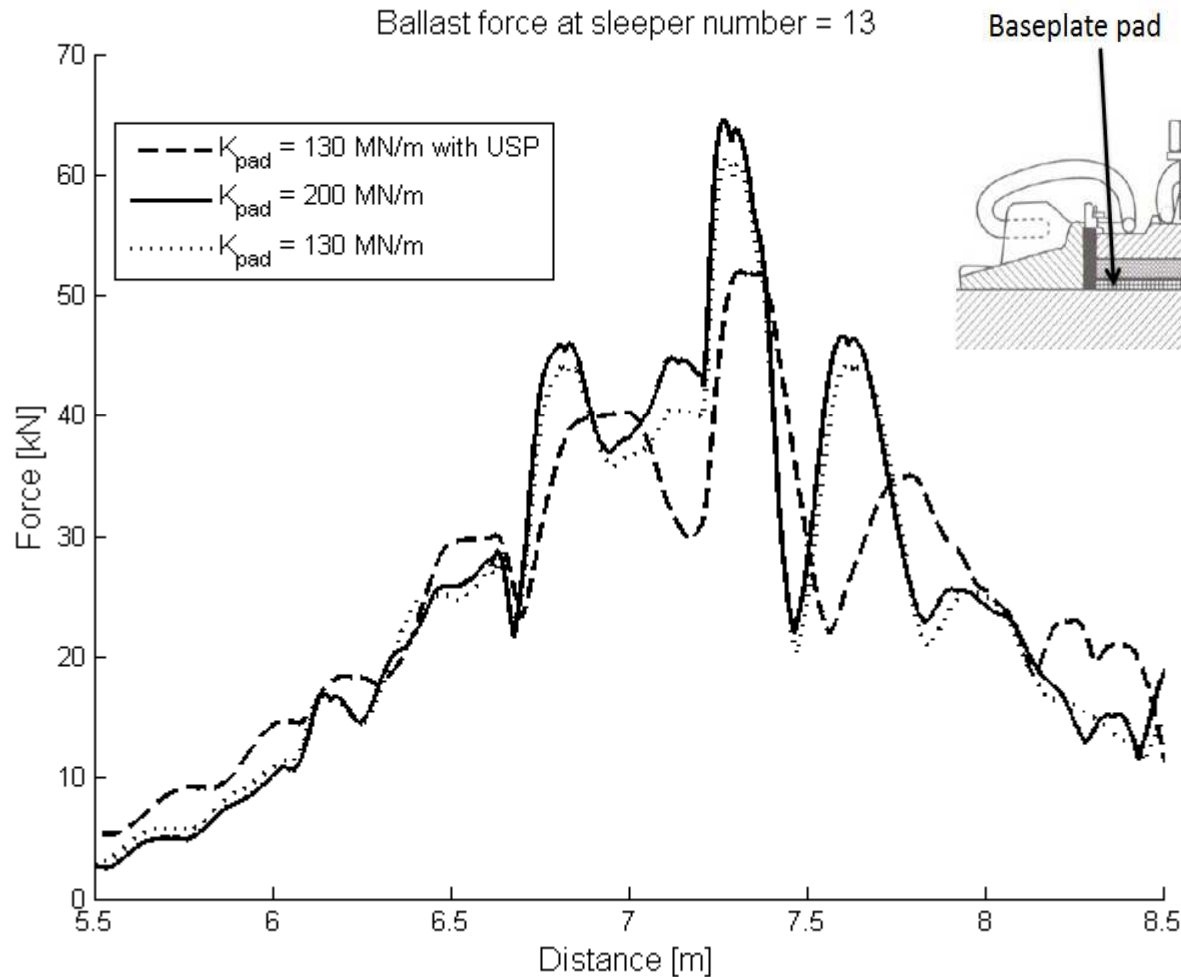
## Crossing panel



# Medium term solutions

## Crossing panel





*New design*

*Improved material*

*Enhanced control and monitoring*

*Better maintainability*

A concept based on continuous support for turnouts is proposed by Vossloh Cogifer.

This concept is based on two principles :

Modular design

Continuous support

Winter  
Summer

Rain  
Desert condition

## Buckling within S&C

Caused by:

- Extreme positive temperature gradients - rail expansion
- Insufficient lateral resistance

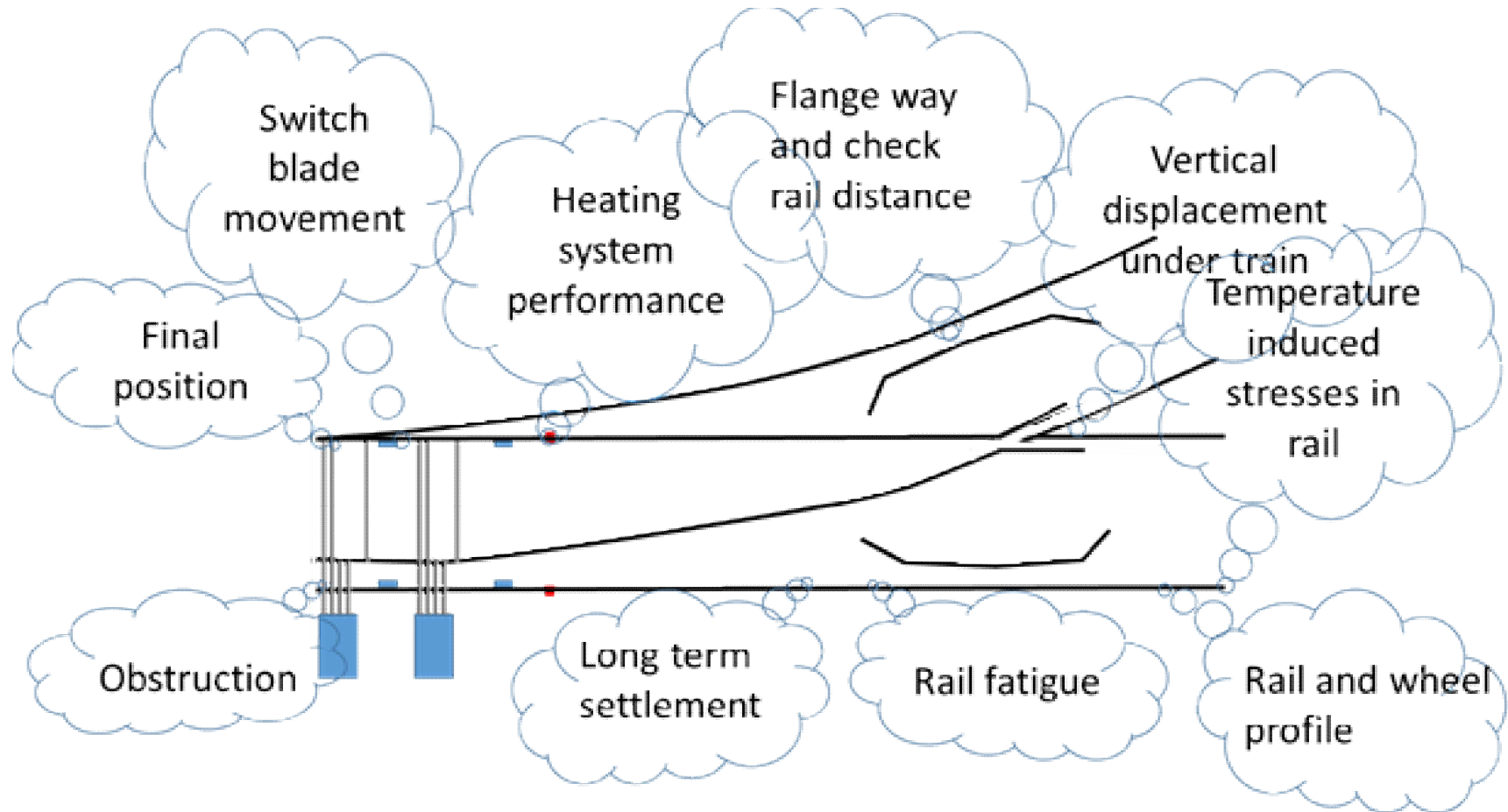
Preventative measure:

- Proper stress compensation done at assembly and welding.
- Stress redistribution after the S&C is set in operation (according to the real temperature range in the rail)

Longitudinal stresses give increased probability of buckling and will also affect the longitudinal position of the switch blade

Inside the S&C some forces also comes from diverging track







**TRAFIKVERKET**

**voestalpine**

**vossloh**



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*Thank you for your kind attention*

**Arne Nissen**

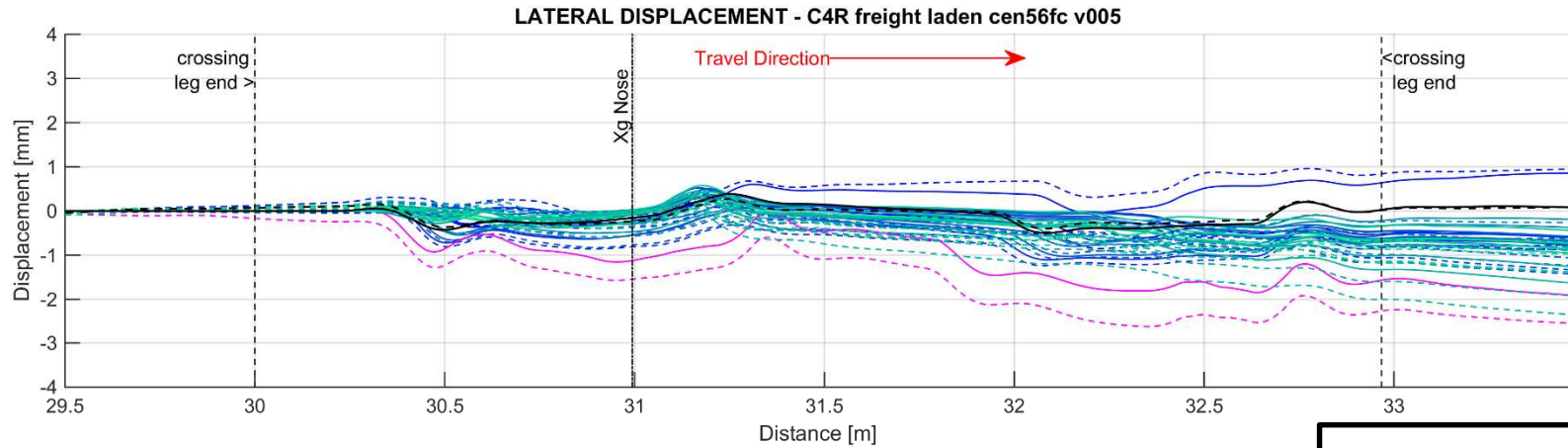
*Track engineer*

*Department of track condition*

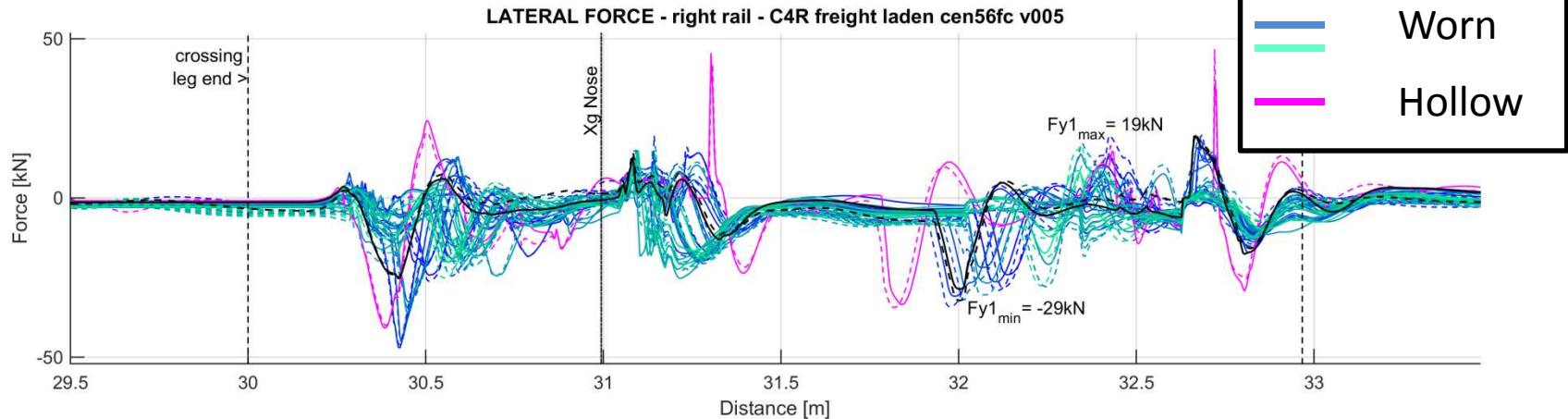
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### Wheelset lateral motion

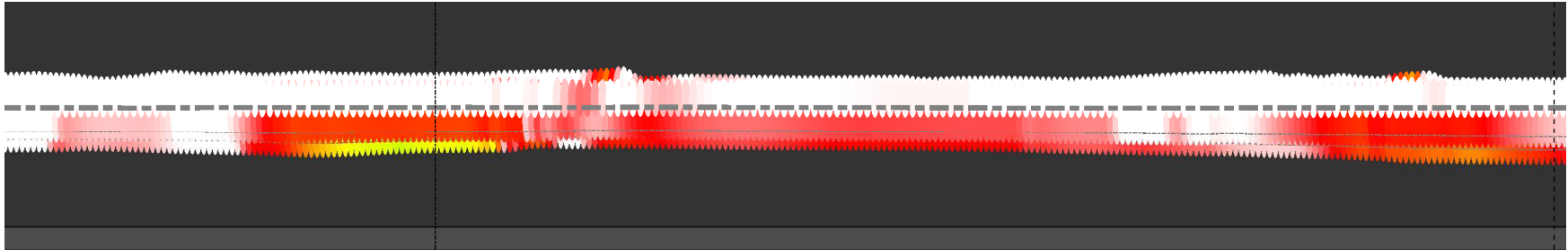


### Lateral contact Force





Cumulative contact band viewed from the top – opposite rail



Cumulative contact band viewed from the top – crossing rails

