



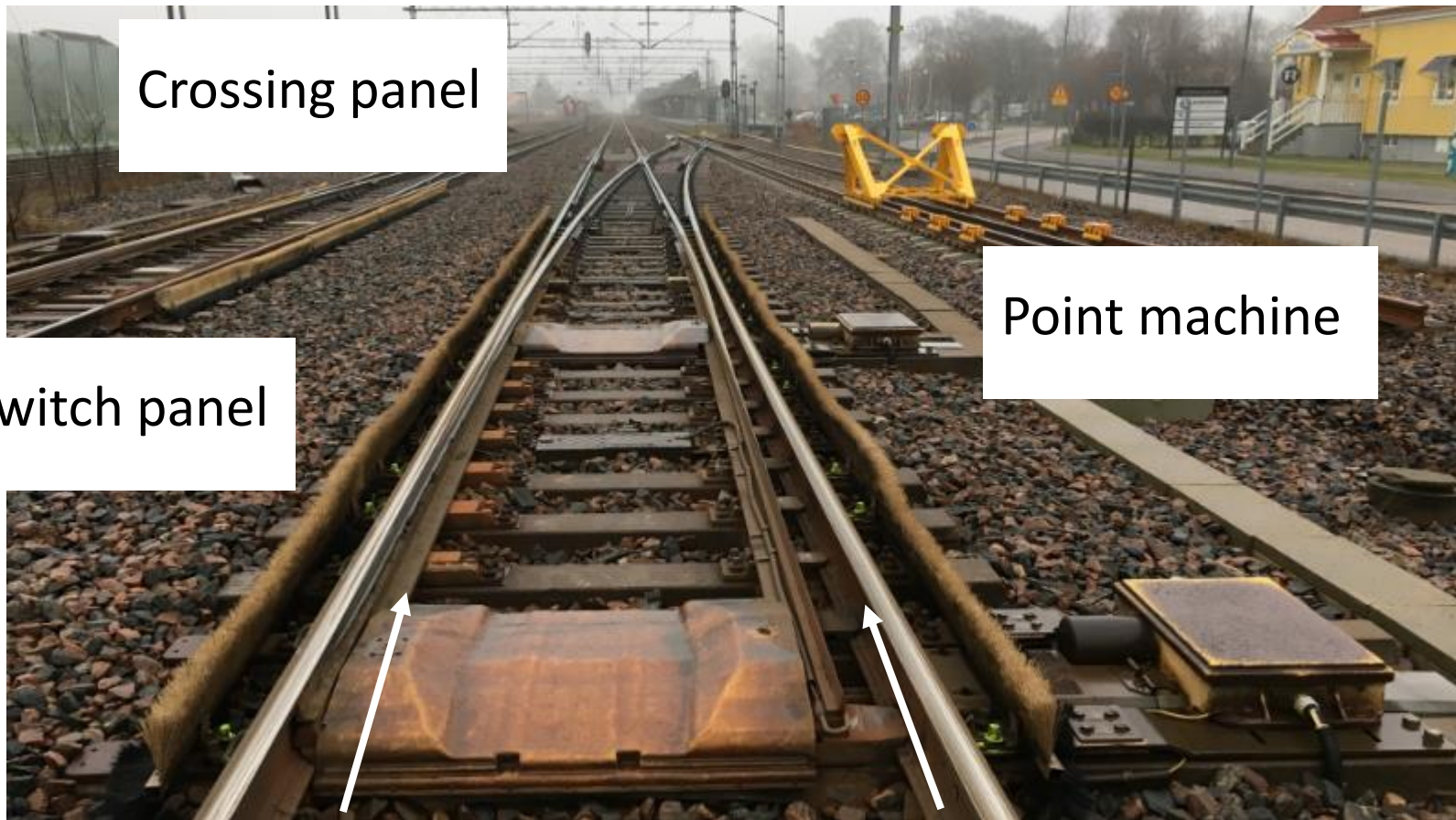
WP 1.3 Innovative concepts and designs for resilient S&Cs

Madrid – 21st – 22nd September 2017

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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
 - Based on failure catalogue
 - Short/Middle/Long-term solutions
- Resilience to extreme weather condition
 - Failure catalogue
- Sensor strategy



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. ..

(Possible) Causes:

- High contact stresses → sub-surface or near surface cracks that merge together to cause localised loss of structural integrity that results in spalling/shelling of the material. (Rolling Contact Fatigue, RCF)



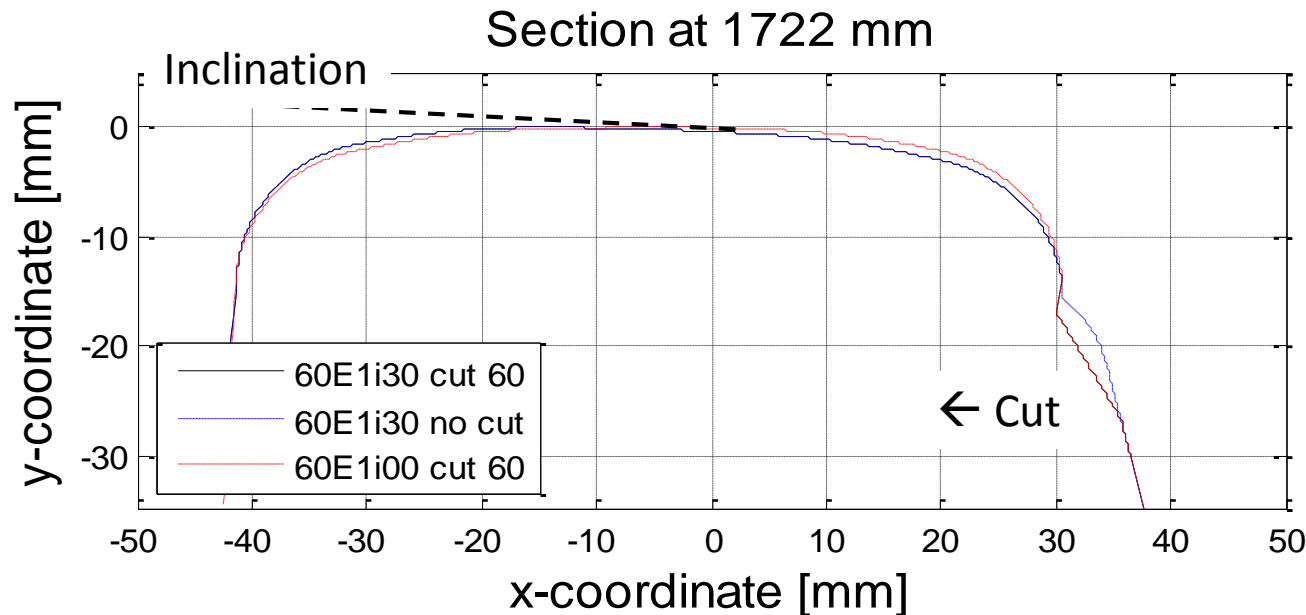
Preventive/corrective measures:

Resurfacing or repair welding.
Replacement of rail

Detection:

By ultrasonic testing/eddy current

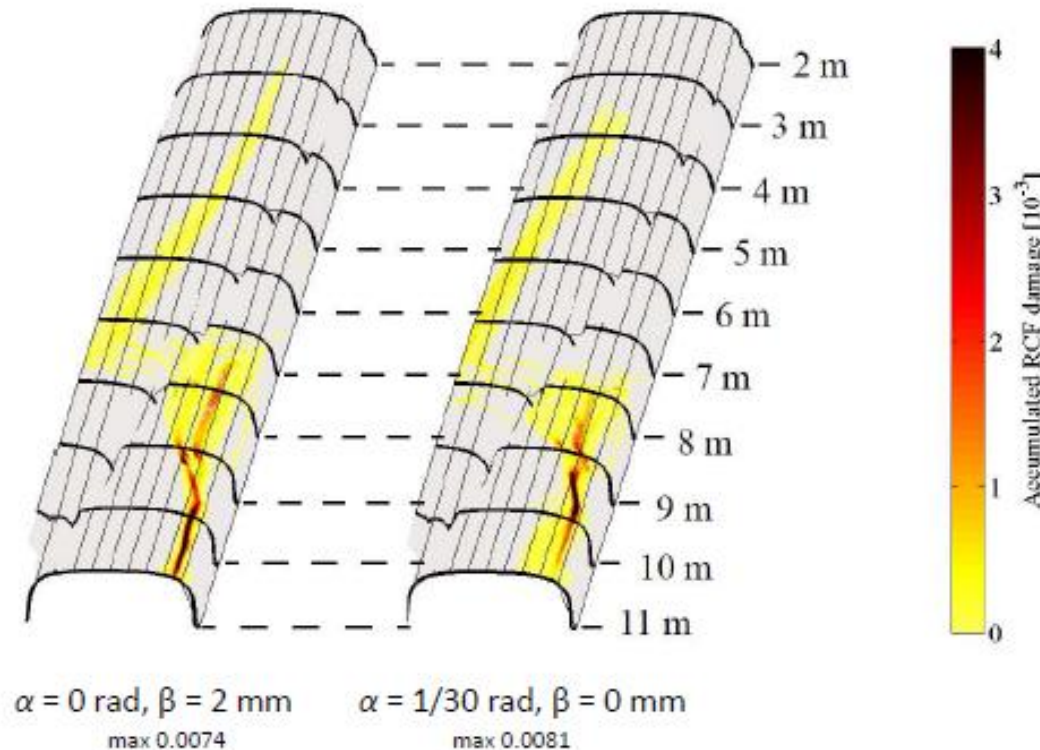
- Minimizing the effect of high lateral and longitudinal force
- Predicting the effect of design changes in the switch panels
 - Switch and stock rail design changes (**cutting angles**, nominal and **gauge widening**, rail profiles, **rail inclination...**)



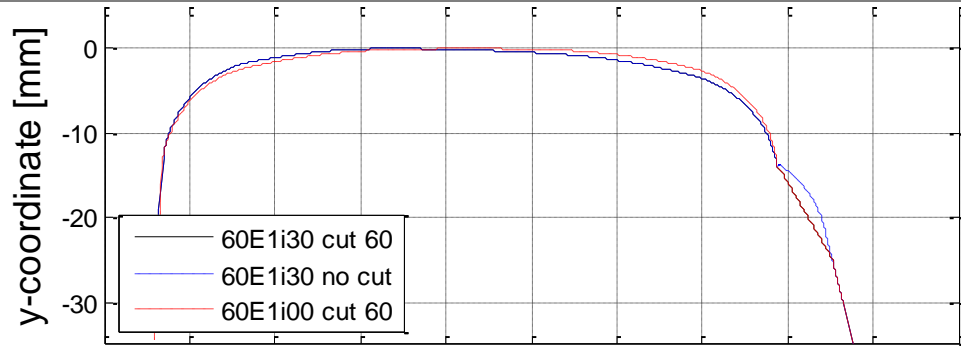
Output

– Cumulative contact band and cumulative damage estimates for:

- Wear
- RCF

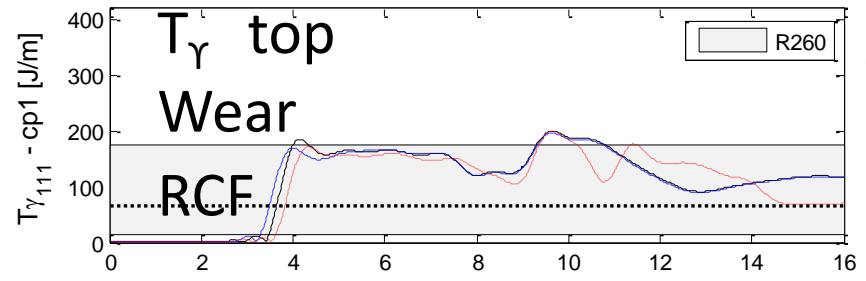


Rail profile optimisation

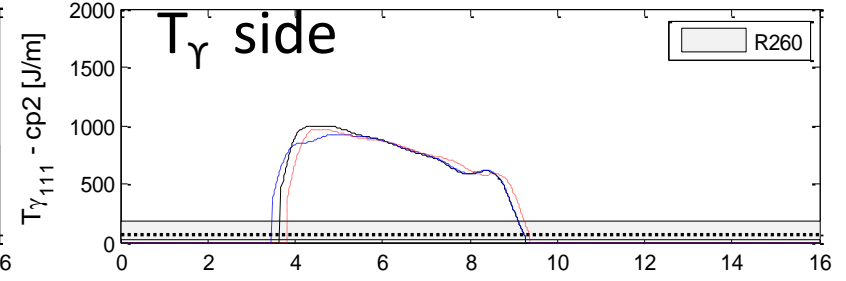


T_γ – Energy function for RCF initiation

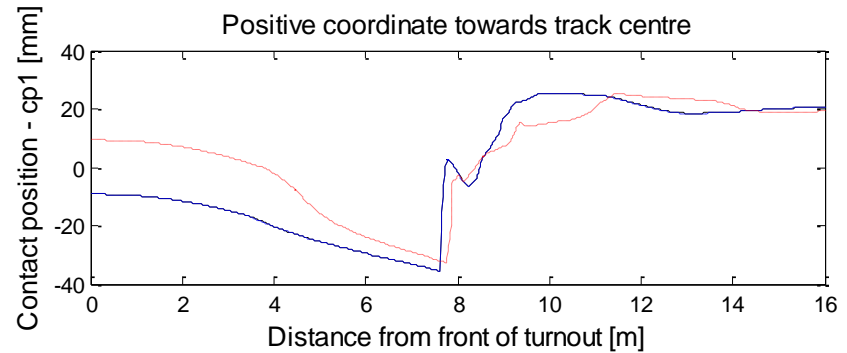
Diverging route, facing move, 70 km/h, $\mu = 0.3$



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

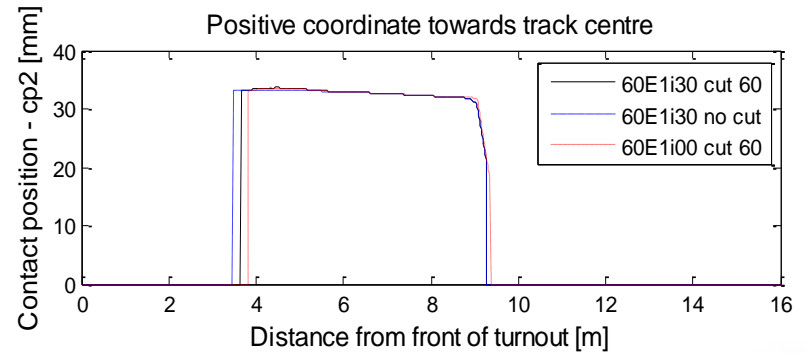


Positive coordinate towards track centre



Contact point top

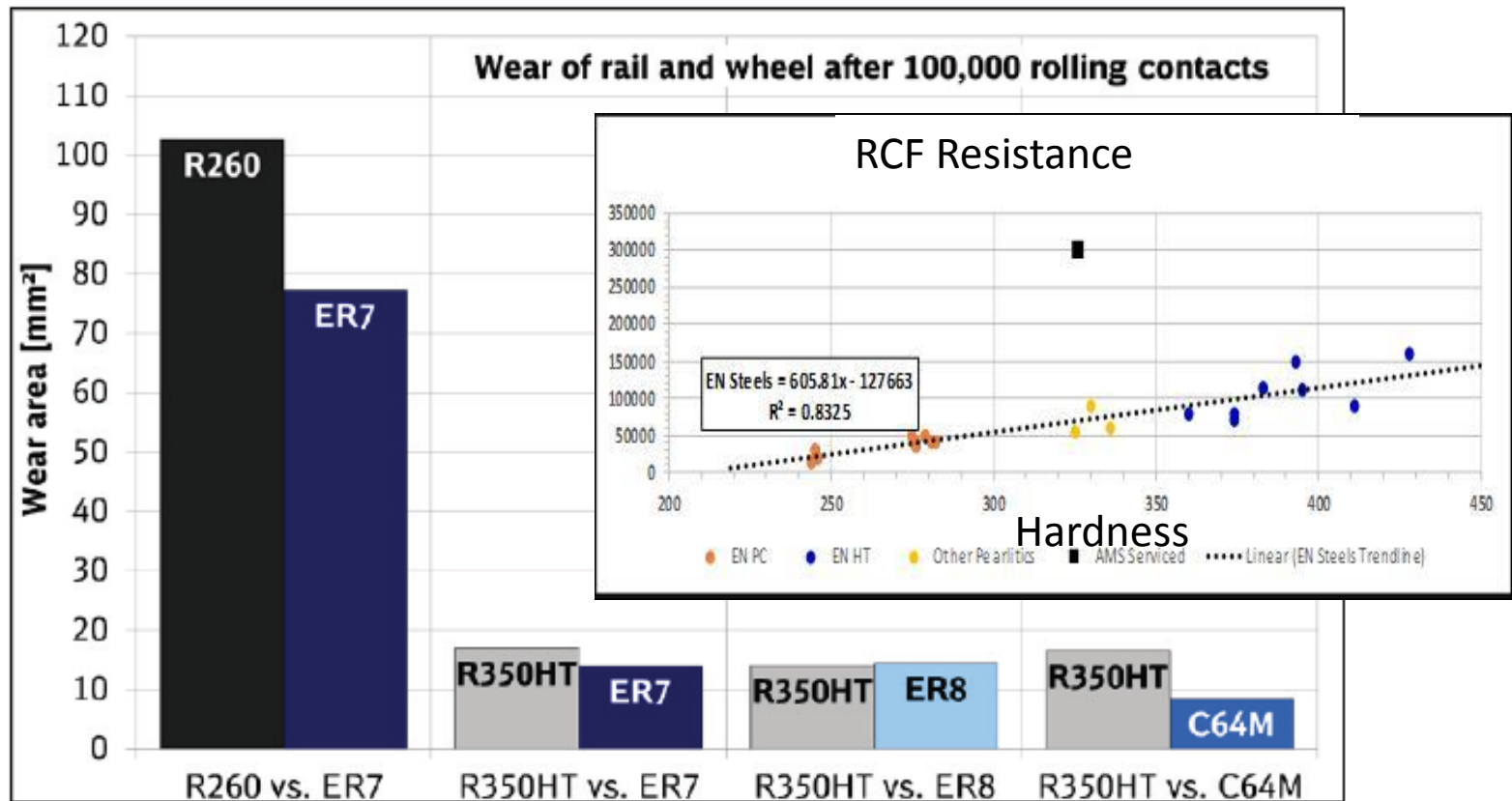
Positive coordinate towards track centre



Contact point side

Material influence

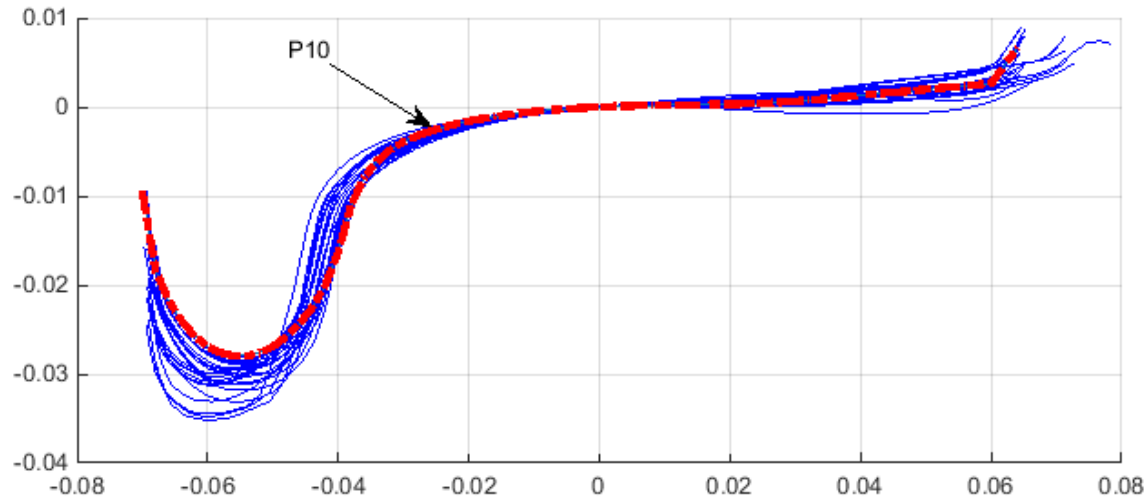
Wear 20-40 % for R350HT compared to R260
 RCF 30-50 % for R350HT compared to R260



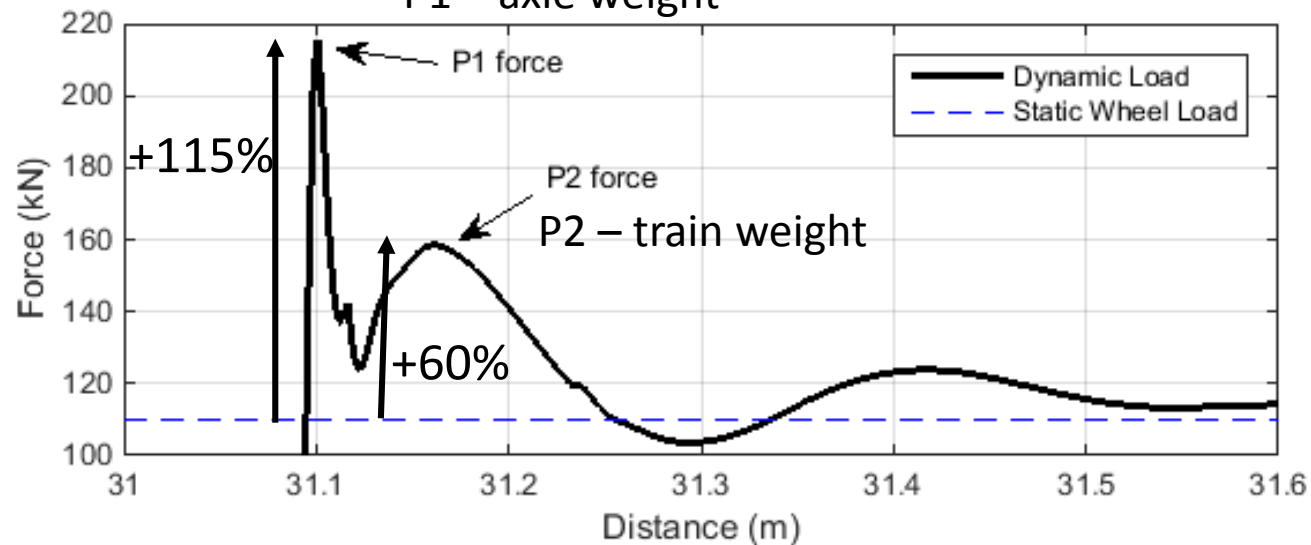
Less wear in laboratory test (INNOTRACK)

Medium term solutions

Crossing panel

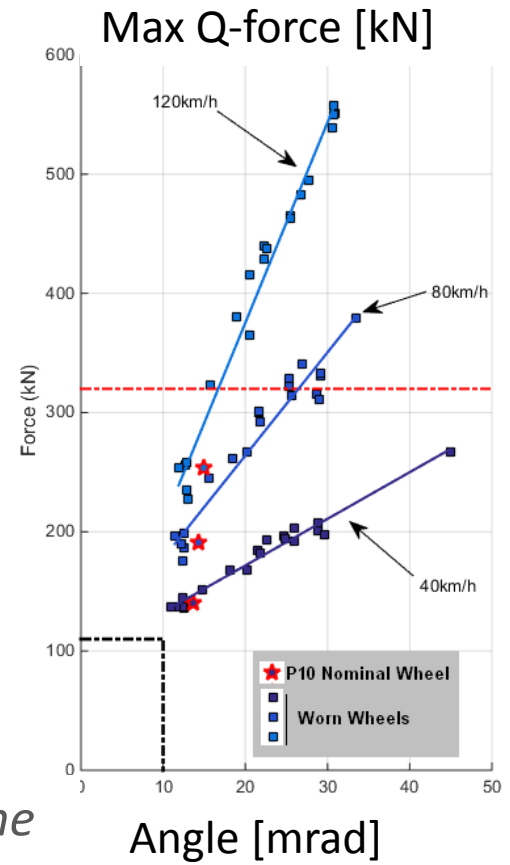
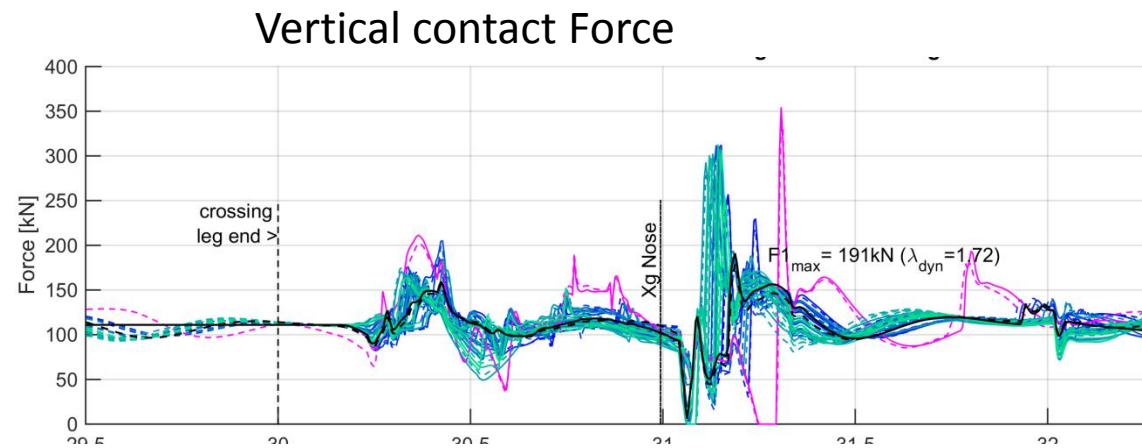
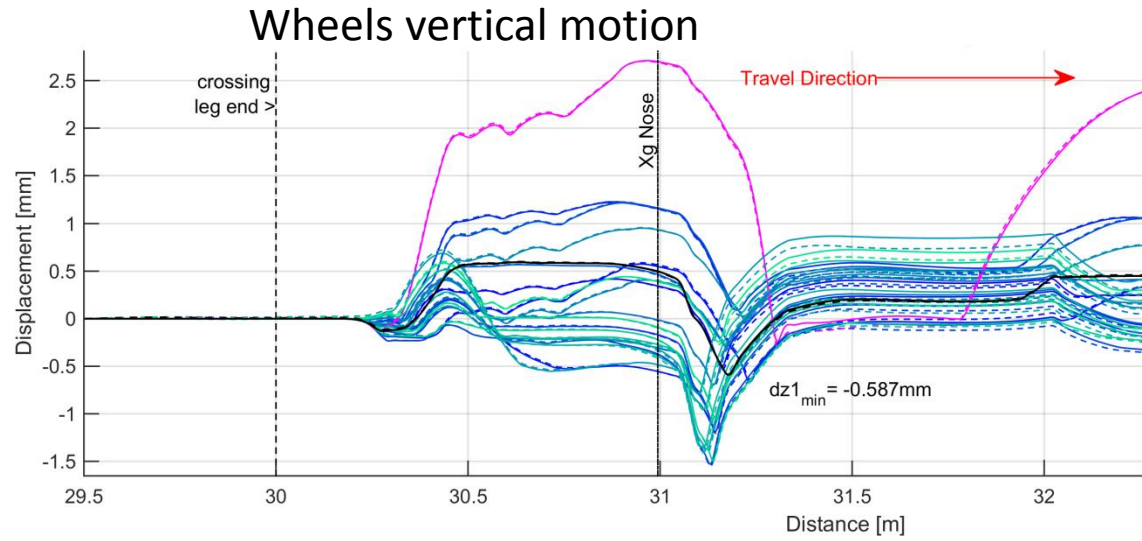


P1 – axle weight



Medium term solutions

Crossing panel



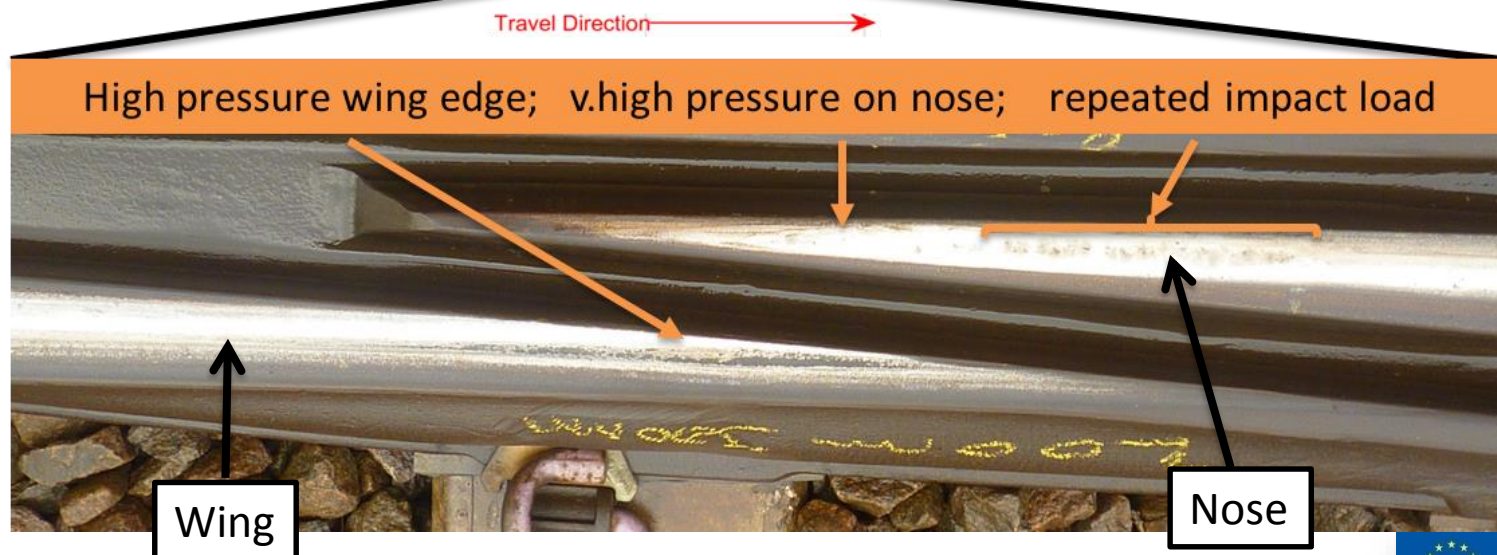
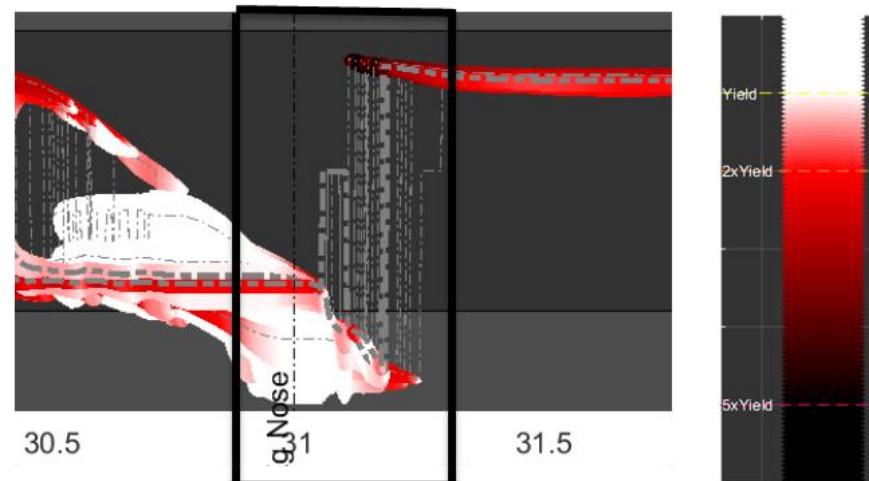
Conclusion Crossing needs to be maintained carefully The degradation goes fast with wrong geometry



Medium term solutions

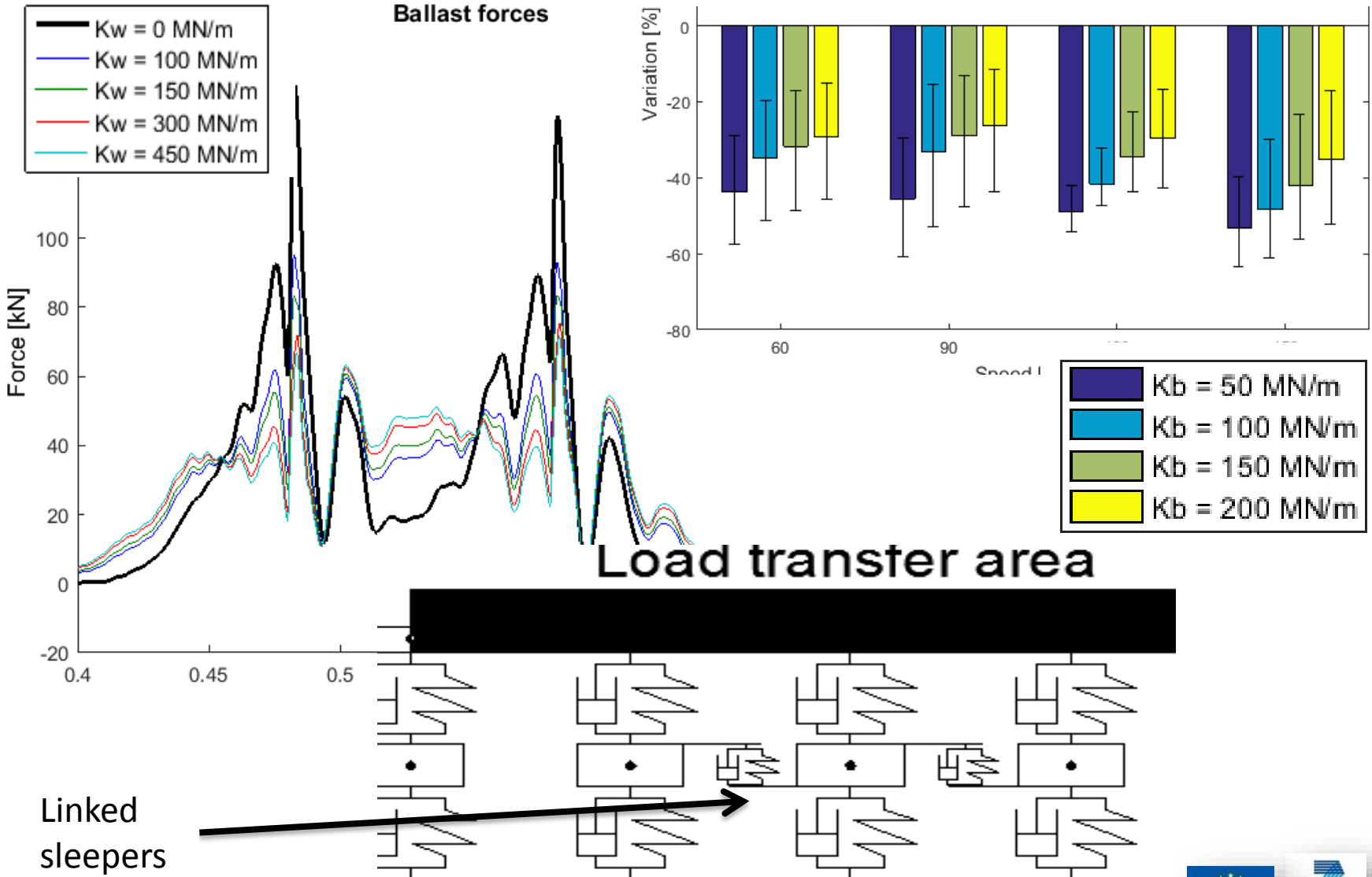
Crossing panel

Cumulative contact band viewed from the top – crossing rails



Medium term solutions

Crossing panel



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



Strategy for condition monitoring of S&C

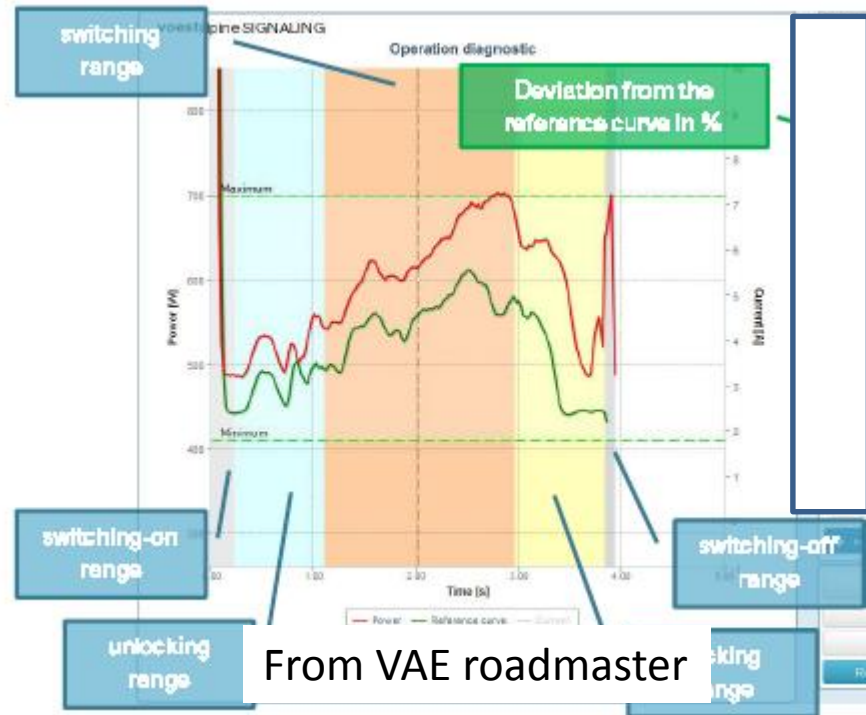
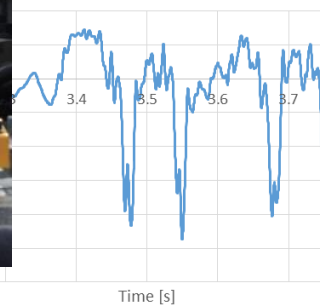
Fixed installations

Switch blade movement

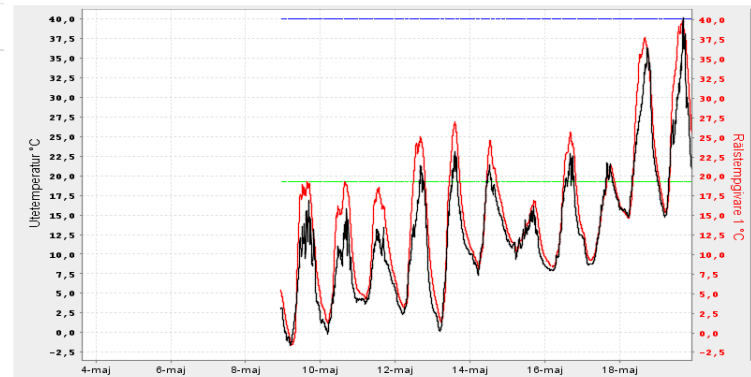
Dynamic forces



ection (Crossing sleeper)



Switch heating

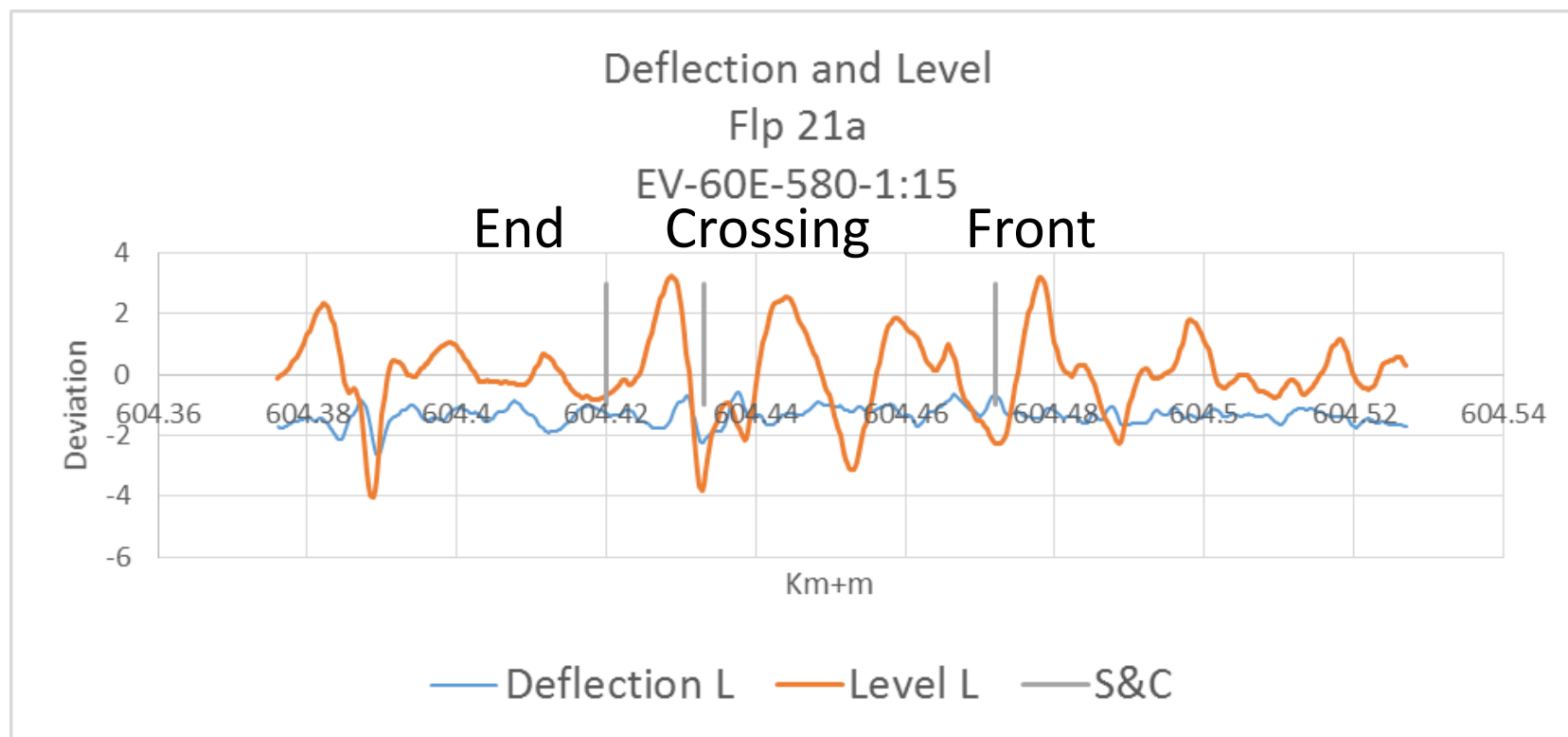


Track geometry

Stiffness

Acceleration (Indirectly force)

Image analysis





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Thank you for your kind attention

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