Track geometry degradation in Swedish heavy haul railroad

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Introduction

Higher axle loads and faster trains

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Faster degradation of assets

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Higher maintenance costs

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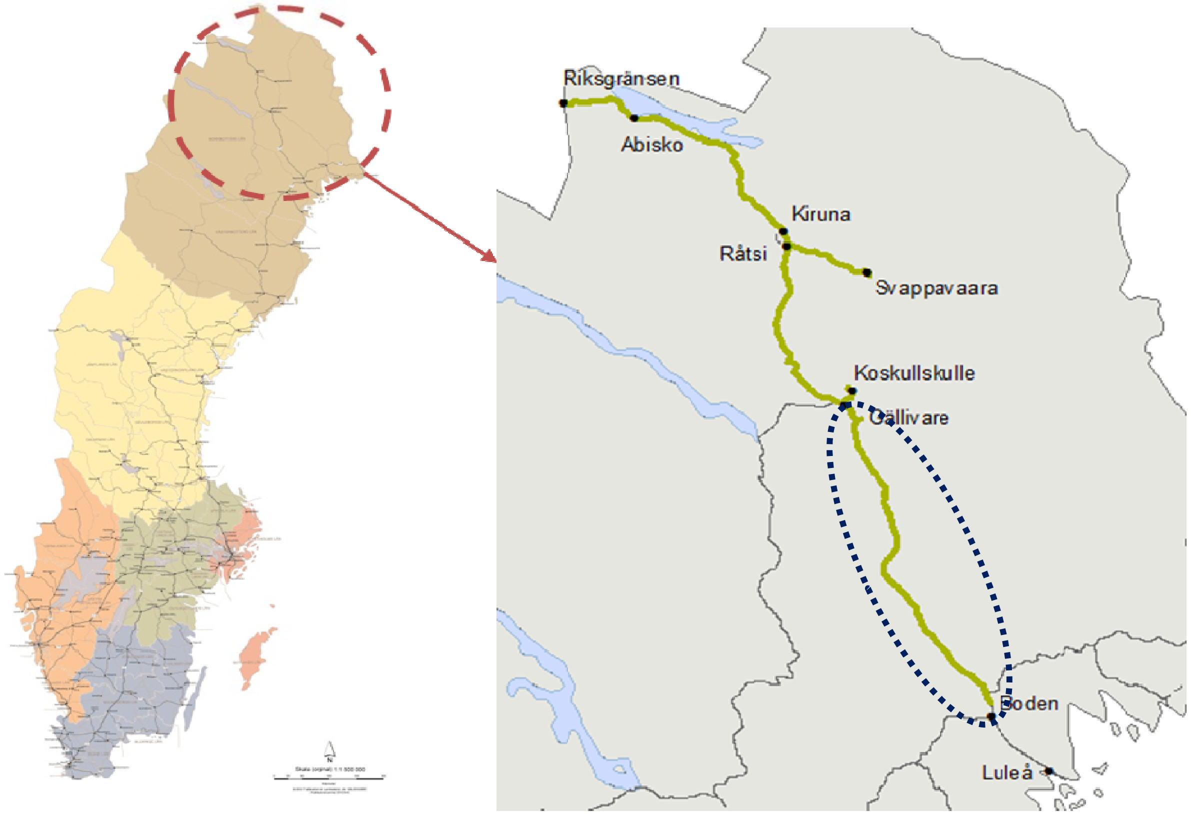
Cost-effective maintenance strategy

Research Purpose

- To develop a methodology to optimize track geometry maintenance by using historical geometry data. The methodology is based on reliability and cost analysis and supports the maintenance decision-making process to identify cost-effective maintenance thresholds.

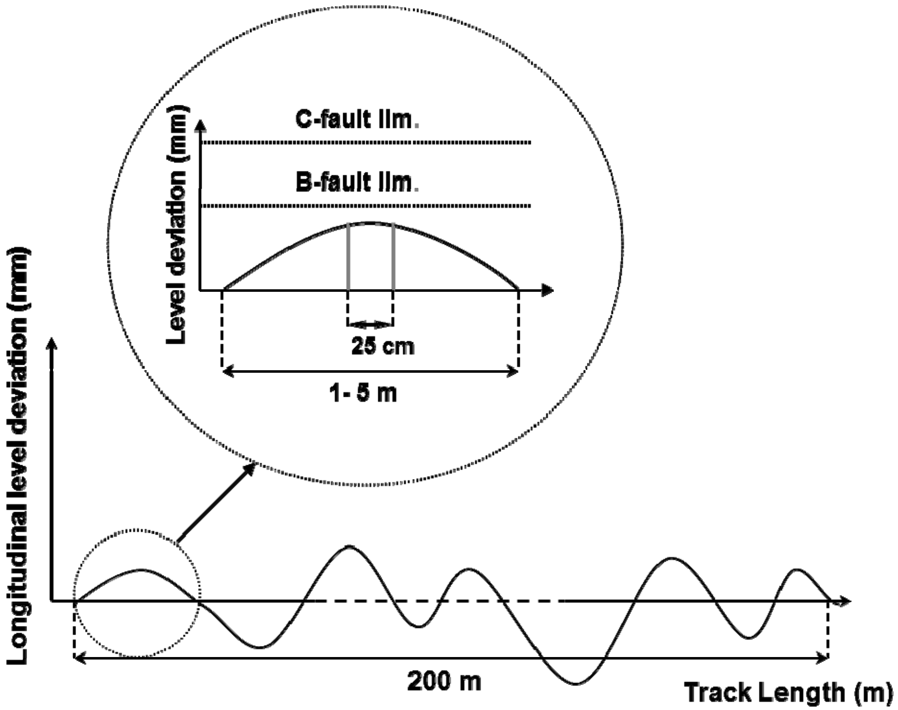
Case Study Background

- Section of iron ore line in north of Sweden
- Harsh climate conditions: snow and extreme temperatures.



Trafikverket track geometry assessment

- Two fault limits are defined for isolated points:
  - "B-fault" limit: it identifies the limit for the execution of preventive maintenance.
  - "C-fault" limit: it is a safety-related limit and identifies the maximum allowable deviation from the design position



Track geometry quality

- The most important condition indice is Q-value.
- Q-value: indicates the quality of track geometry.

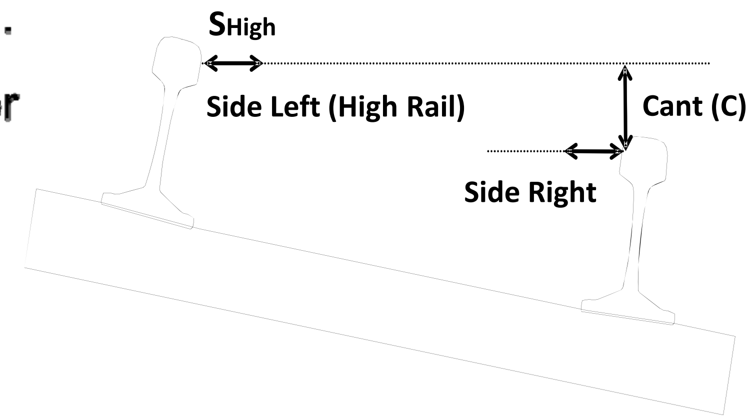
$$Q = 150 - 100\left[\frac{\sigma_H}{\sigma_{H\,lim.}} + 2\frac{\sigma_S}{\sigma_{S\,lim.}}\right]/3$$

σ_S : STDV of the cant error (C) and the average lateral position error of the high rail (S_{High}).

σ_H : STDV of the average vertical error for left and right rails.

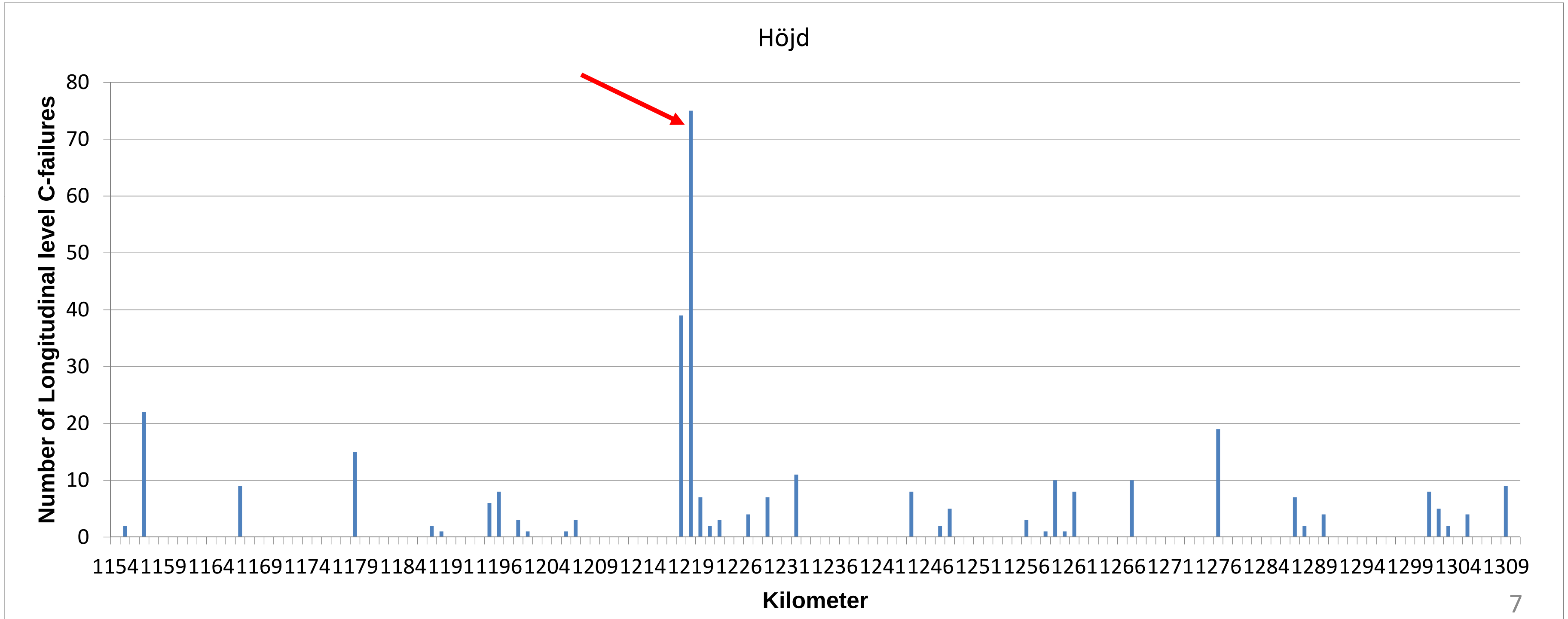
$\sigma_{H\,lim.}$: The comfort limit for the σ_H value.

$\sigma_{S\,lim.}$: The comfort limit for the σ_S value.

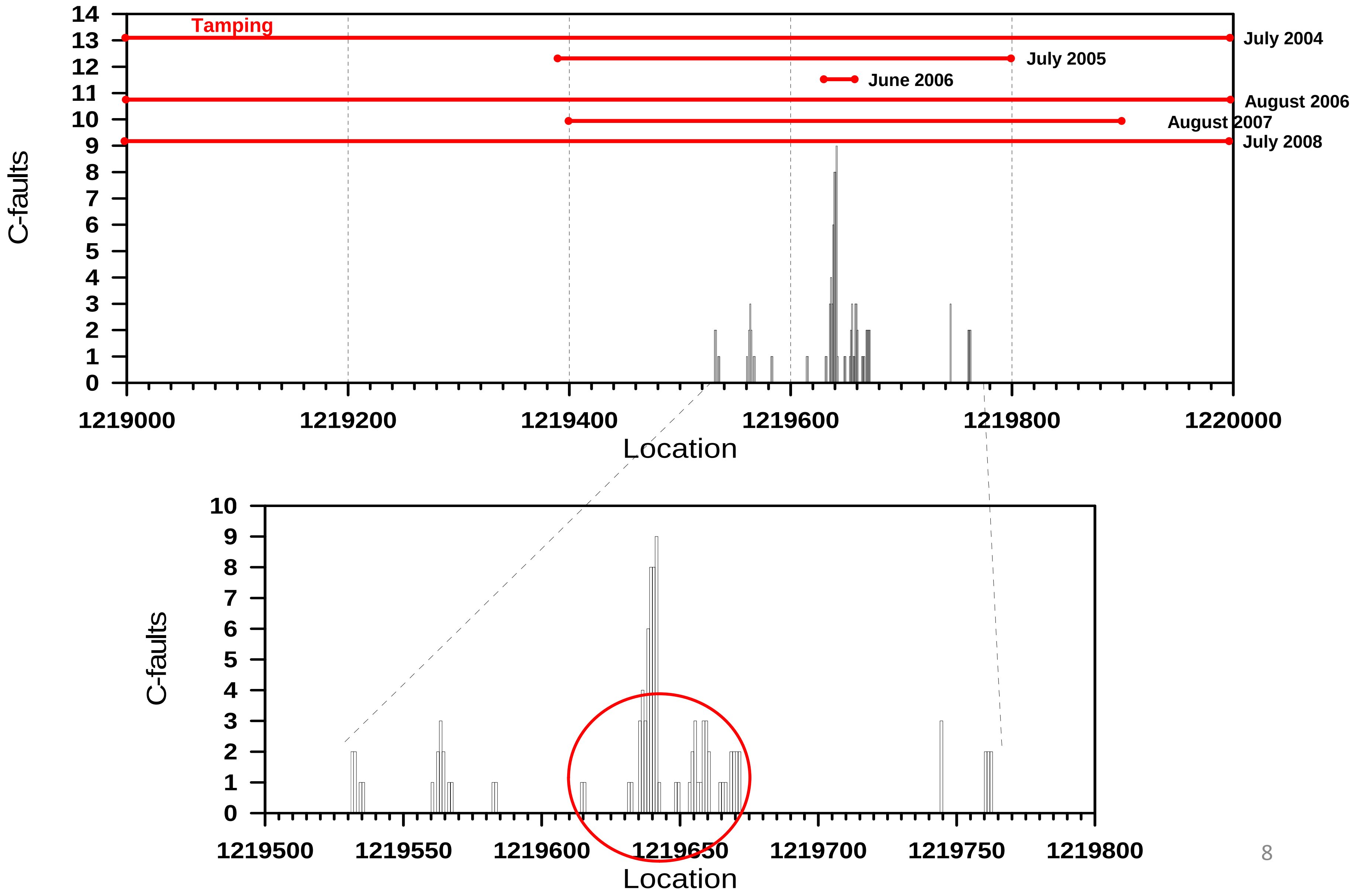


Track geometry degradation analysis

- Total number of detected longitudinal level C-faults on each 1000m track segment between 2004 and 2010
- Collected from inspection database (STRIX)



Track geometry degradation analysis



Swampy environment on the south side

Drier environment on the north side

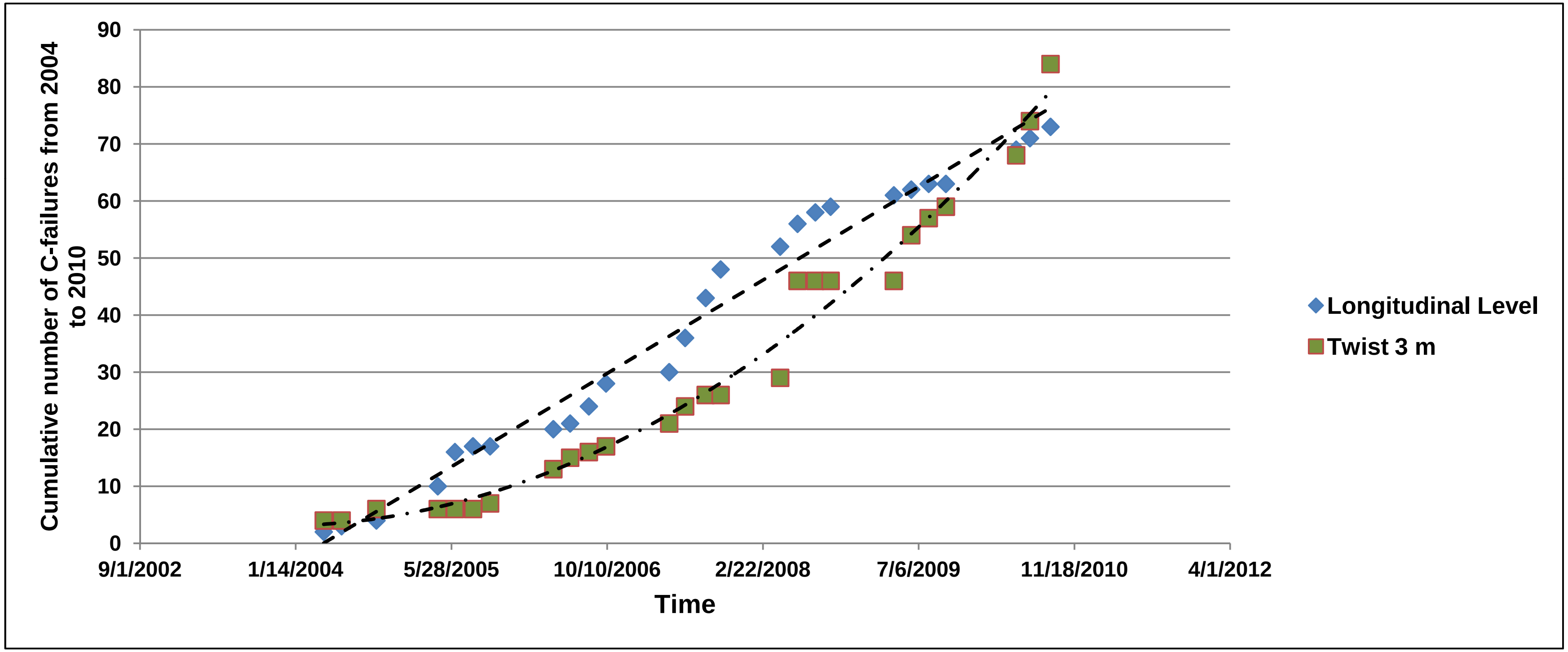
Track geometry degradation analysis

- The effect of poor drainage

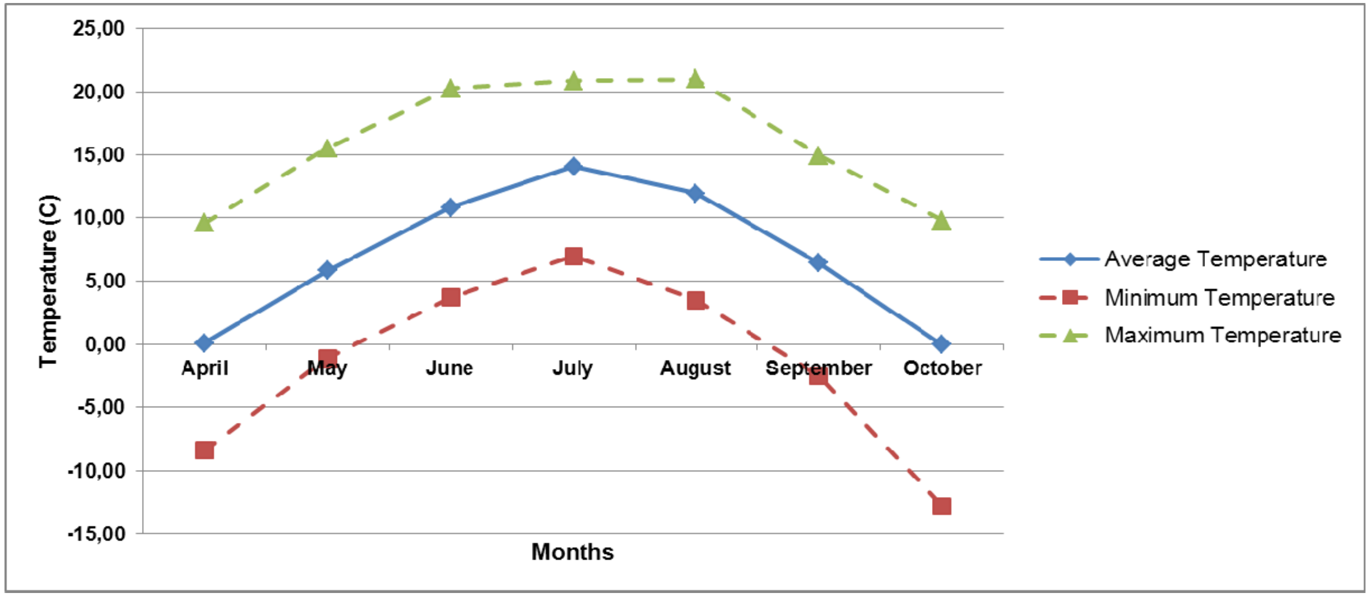


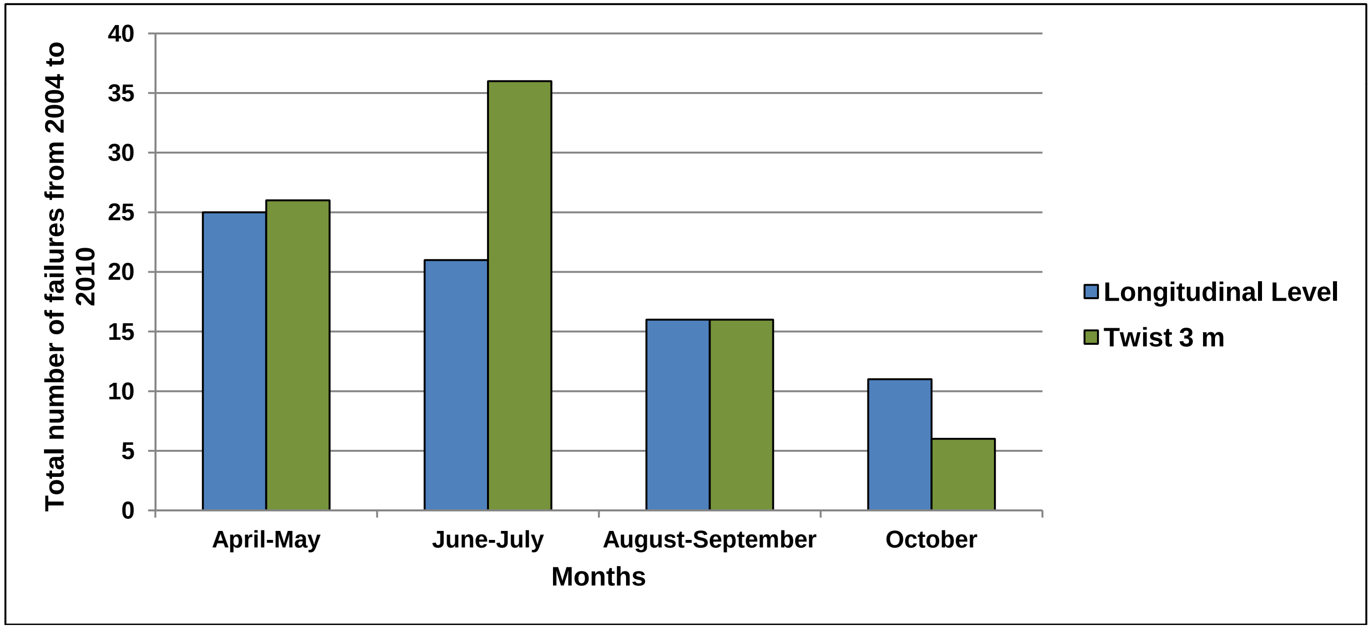
Track geometry degradation analysis

- Accumulated number of C-faults between 2004 and 2010
- Total number of C-faults along the track
- Collected from inspection database (STRIX)



Track geometry degradation analysis





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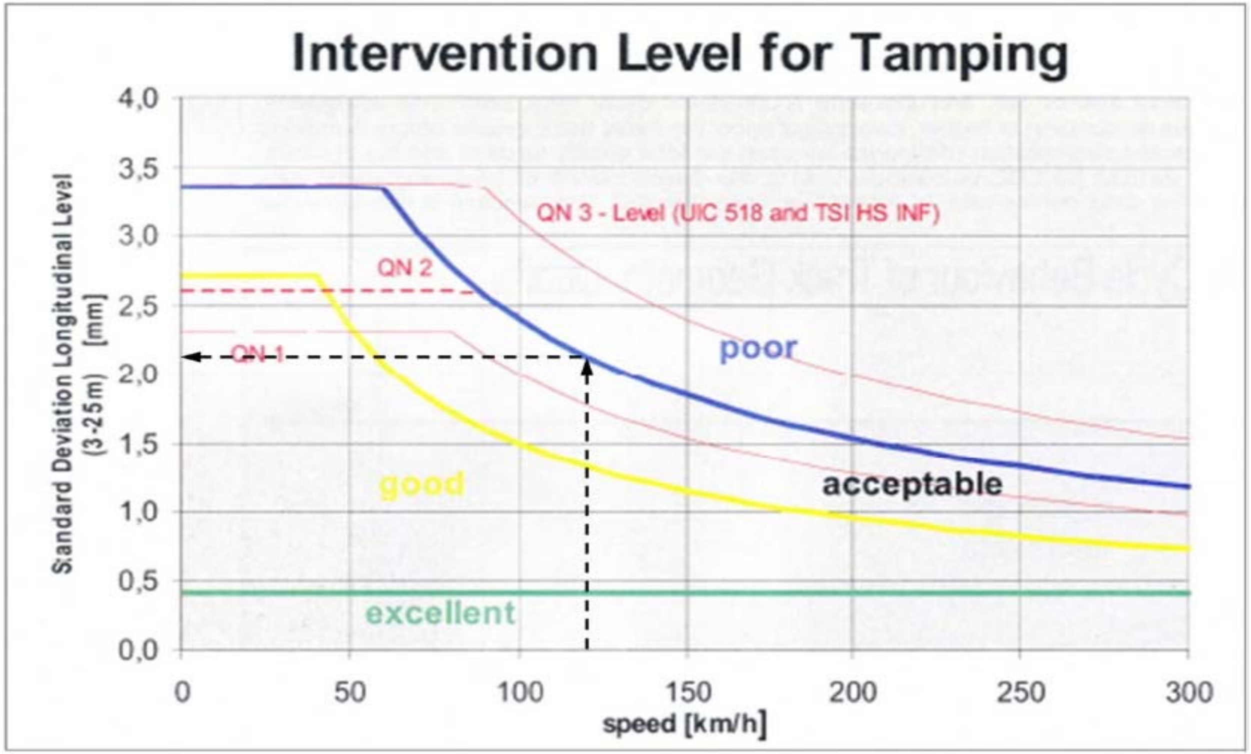
Evaluation track geometry maintenance

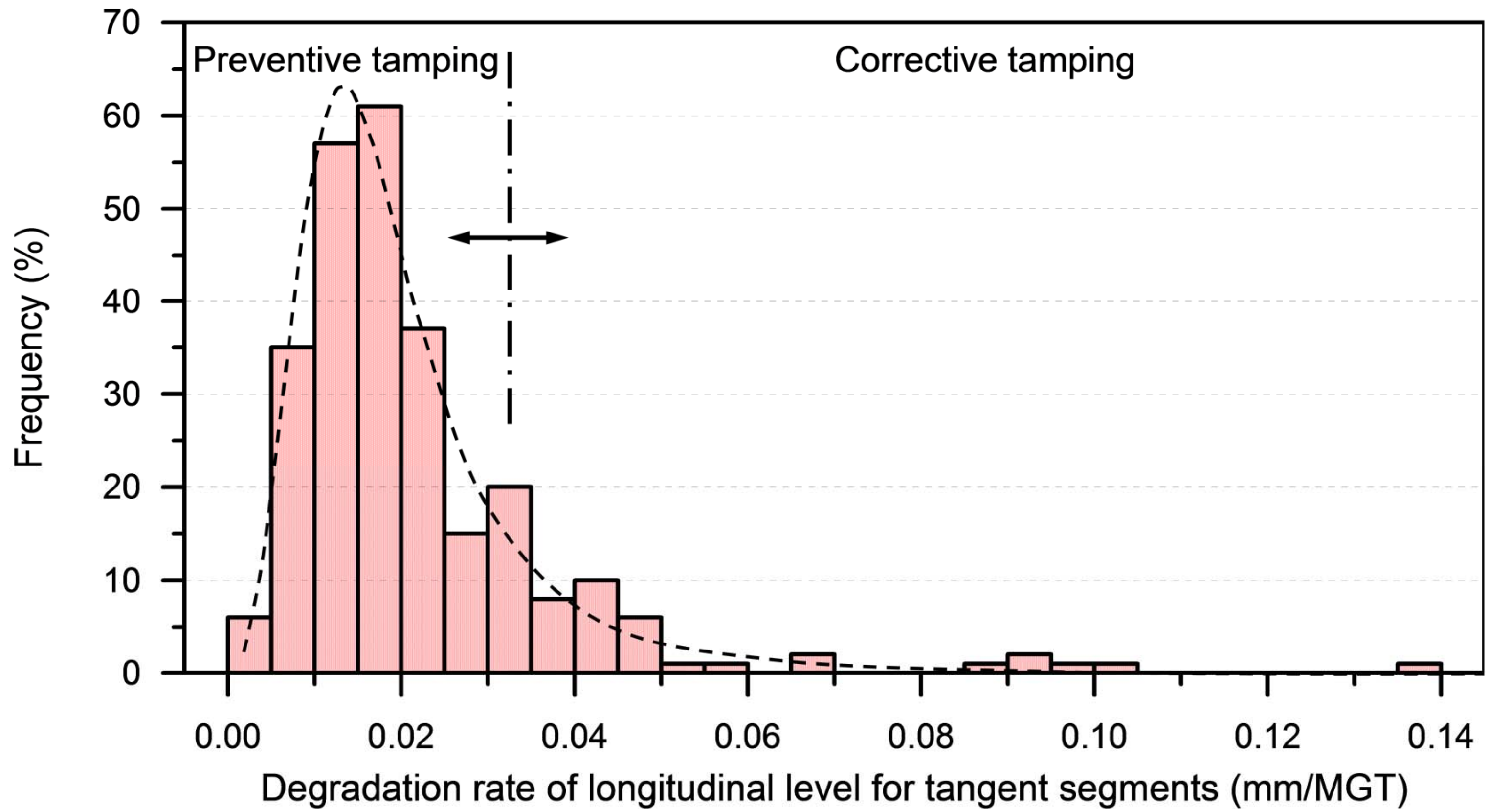
- Probability density function of tamping execution
- Between 2007 and 2009
- 200 m tangent segments

UIC: Best Practice Guide for Optimum Track Geometry Durability



Evaluation track geometry maintenance

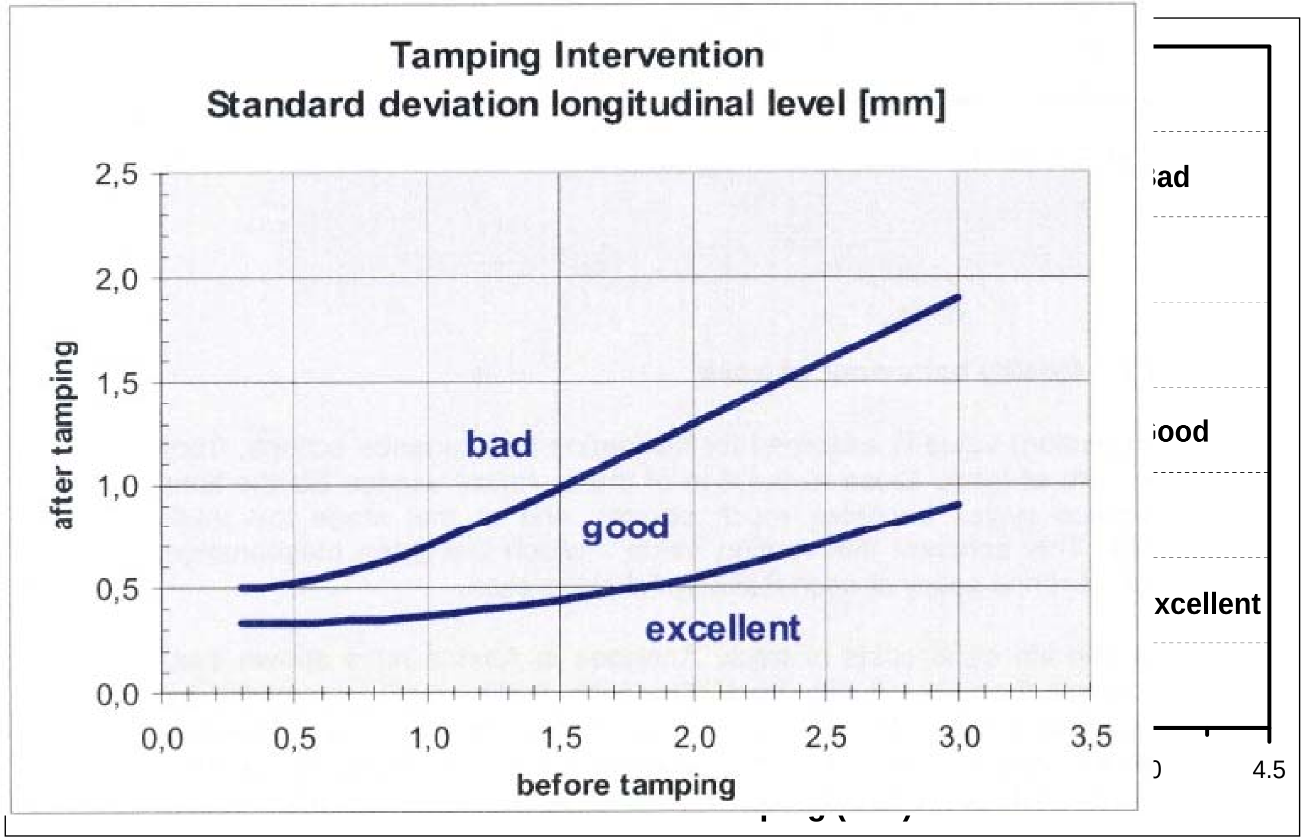
- Degradation rates of longitudinal level for 200m tangent segments (mm/MGT)
- Between 2007 and 2009



Evaluation track geometry maintenance

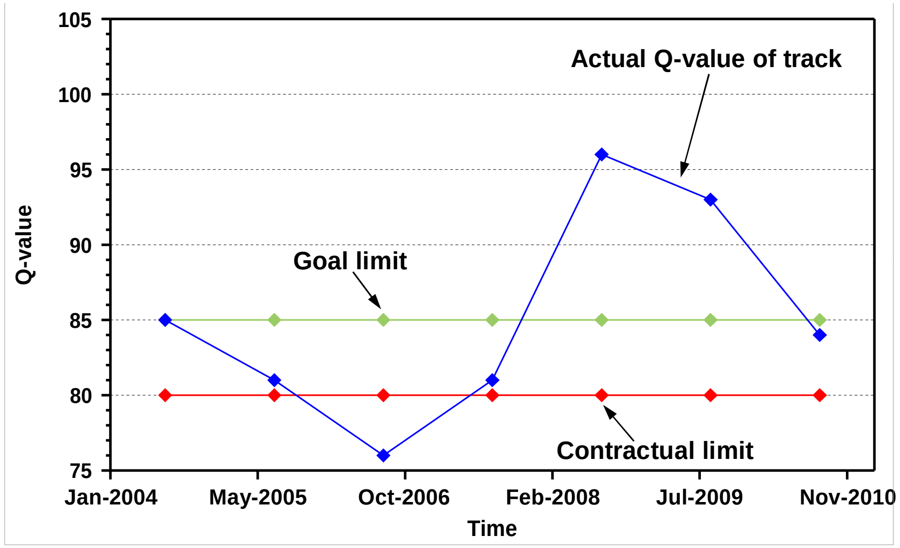
- Tamping efficiency on 200m tangent segments
- Between 2007 and 2009

UIC: Best Practice Guide for Optimum Track Geometry Durability

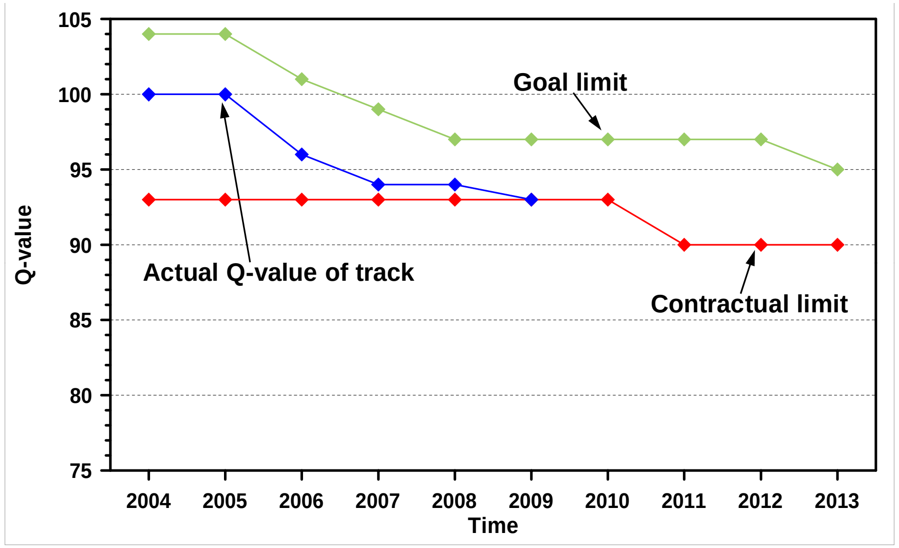


Evaluation track geometry maintenance

- The contractor’s performance between 2004 and 2010
- Q-value of entire track



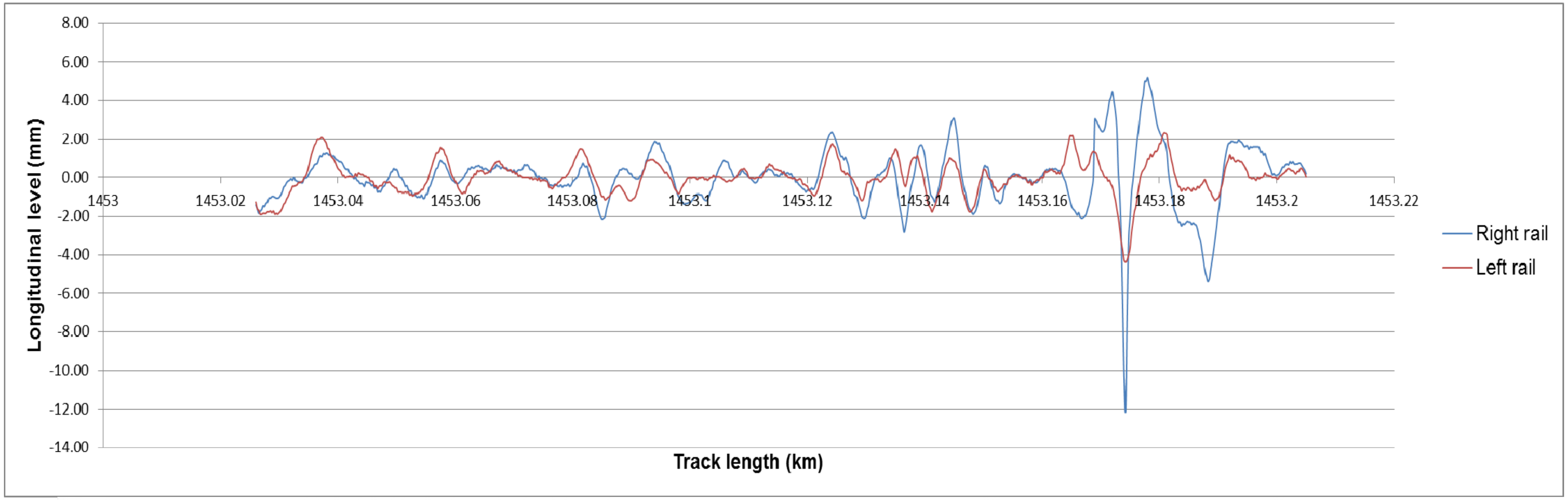
a) The contractor’s performance on the “case study line”.

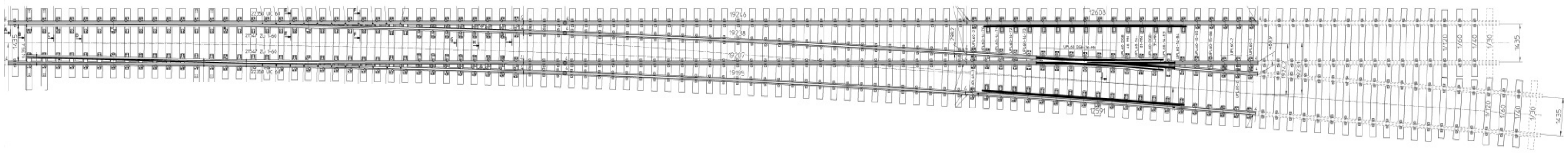


b) The contractor’s performance on a reference line in central Sweden.

On-going research

- Geometrical degradation of turnouts





Thank you!