Welkom

Rolling Contact Fatigue problems at railway turnouts – experience of ProRail

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Outline

• Introduction about ProRail
• Introduction: “What is RCF?”
• Rolling Contact Fatigue problems at railway turnouts
ProRail network

- Population: 16.7 M
- Local residents: 4 M
- Passengers per day: 1,083,000
- 9 passenger operators

- 3,300,000 trains per year
- 115,000 tonnes of freight per day
- 19 freight carriers

Passenger transport per year: 139 M km.
Freight transport per year: 10 M km.

Source: jaarverslag ProRail 2012
What we do

Managing stations

Maintaining existing rail network

Construction
laying new track, building new stations

Informing operators

Controlling all rail traffic

Allocating the space on the track
Our Professionals

4,129 employees

26% female employees

28% parttime

1 head office

4 regional offices

13 traffic control centers and various project offices

source: jaarverslag ProRail 2012
Infrastructure

- 11,683 signals
- 7,033 km of track
- 404 stations
- 56 bridges
- 17 tunnels
- 7,195 switches
- 2,731 railroad crossings
- Network length: 3,063 km

Source: jaarverslag ProRail 2012
Systems

Cutting across
Bridges, tunnels, crossings, fencing, vegetation

Supply
Energy Supply

Transfer
Stations

Communication

Safety
Train safety

Conduction
Track and switches

Foundation
Substructure and buildings

Control
Traffic Control
Our Ambition

Safe rail
Zero avoidable accidents

Reliable rail
Zero avoidable disruptions - 30%

Punctual rail
Further increase in punctuality

Sustainable rail
- Less energy consumption
- Highest rung on the CO₂ performance ladder
ProRail build a new track
Or has already a railway junction
New rail. Top condition!
First defects. Sure to be safe.
Defects are bigger. Yes, still safe.
Defects are yet bigger. Safe? Or should we do something?
Defects are very big! Is it still safe!?? Or should we call to ProRail?
Introduction: “What is RCF?”

• Rolling Contact Fatigue is a general name of rail defects which caused by material fatigue under repeated rolling loading
• RCF at ProRail track manifest in two serious defects at rail head:

  Head Checks

  Squats

• These defects eventually lead to rail fracture (safety problem)
Defects in the turnouts

- Wear
- Head Checks
- Squats
- Shelling
Drivers of RCF project

• Two drivers which have highest priority within ProRail:
  • Safe railway - controlling the safety, no breaches
  • Sustainable railway - maintenance budget for RCF defects must be reduced

• The other two goals of ProRail are also included simultaneous:
  • Reliable railway - less disruptions and less urgent actions
  • Punctual railway - more space for the trains and fewer delays
Railway research

• ProRail has a stable continue research program (since 2002) to predict and understand RCF (Head Checks and Squat). Institutes which are doing research for ProRail RCF project group:
  • Lloyd’s Register Rail Europe (wheel research)
  • DeltaRail (rail research)
  • TU Delft Railway Engineering group

• ProRail invests 1 million euro of budget per year in research

• Newest research programs are Explorail (5 projects of STW / ProRail) and Sustainable Switches (M2I / ProRail)
Turnout

- Turnout is important and vulnerable element
- Increased damage of crossings due to transfer from wooden to concrete sleepers
- Urgent replacements are critical:
  - 2 crossings per week (!)
  - Annually approx. 100 crossings
  - Lifetime of some crossings 2-3 years (!)
- Complex approach to the problem is needed
Crossing damage (examples)
Factors affecting lifetime of turnout
based on previous research, field observations and maintenance experience

• Turnout mechanical properties (elasticity and damping)
• Wheel/rail interaction and turnout geometry (geometry of the crossing in particular)
• Rail material properties (hardness and toughness)
• Maintenance regime (grinding, welding, tamping etc.)
Materials of the crossing

- Casted crossings
  - Manganese steel (Hadfield steel)
- Constructed crossings
  - R260
  - Heat-treated R260 => R350HT
  - MHH
  - S1100
New materials at railway application

• Bainitic steel potentially resistant to cracking (at higher wear)
• ProRail is doing first tests with Bainitic rails in a curve (curves are HeadChecks sensitive)
• Crossings to be tested next
  • Bainite 1400
  • Cr Bainite
Challenge of Bainitic steel:

• How to weld Bainitic rails together?
• How to do repair welding of Bainitic rails and Bainitic crossings?
Thank you for your attention!