

# **Rail Milling Advantages for Railway and Light Rail Infrastructures**

**WRI**  
**EU 2015**

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Machines

STRABAG Rail GmbH

**STRABAG**  
TEAMS WORK.

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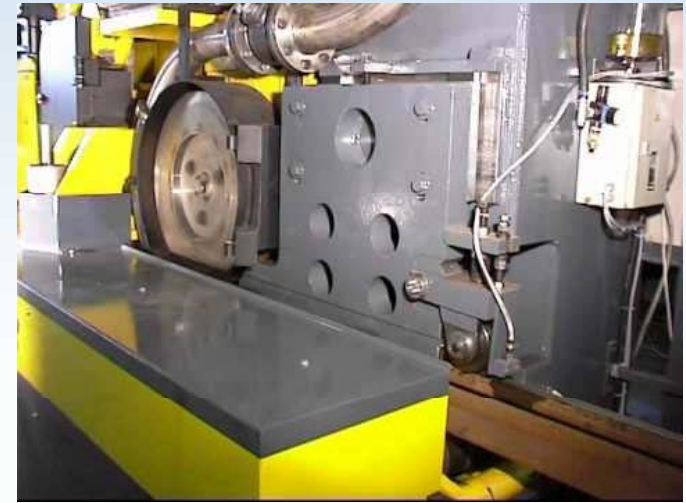
**WRI EU 2015**

# Rail Milling – Agenda

1. Background of the milling technology
2. The technology principals
3. Application and benefits
4. Case Studies
5. Summary

## 1. BACKGROUND

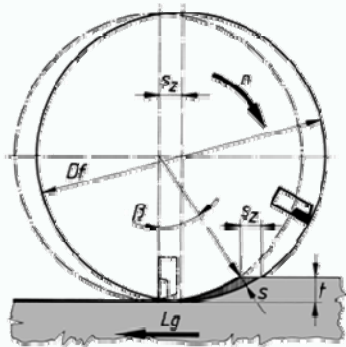
- Rail Grinding established as a preventive approach for rail management → known since decades
- But rail that still had „life“ was scrapped → Rail recovery to milling plant → than plant to track location → expensive
- Now different mobile milling machines on market



**STRABAG**  
TEAMS WORK.

## 2. TECHNOLOGY PRINCIPALS

- Milling with surface grinding



Grinding wheel with capture device

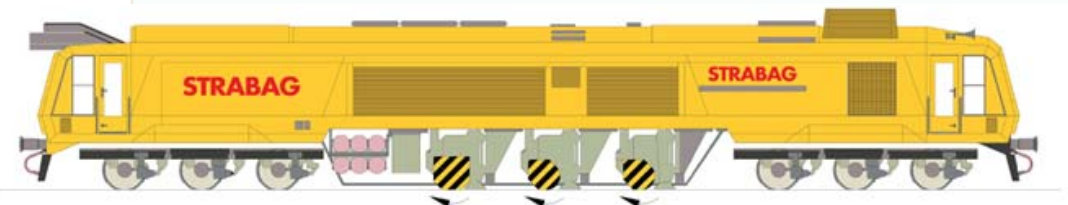




## 2. TECHNOLOGY PRINCIPALS



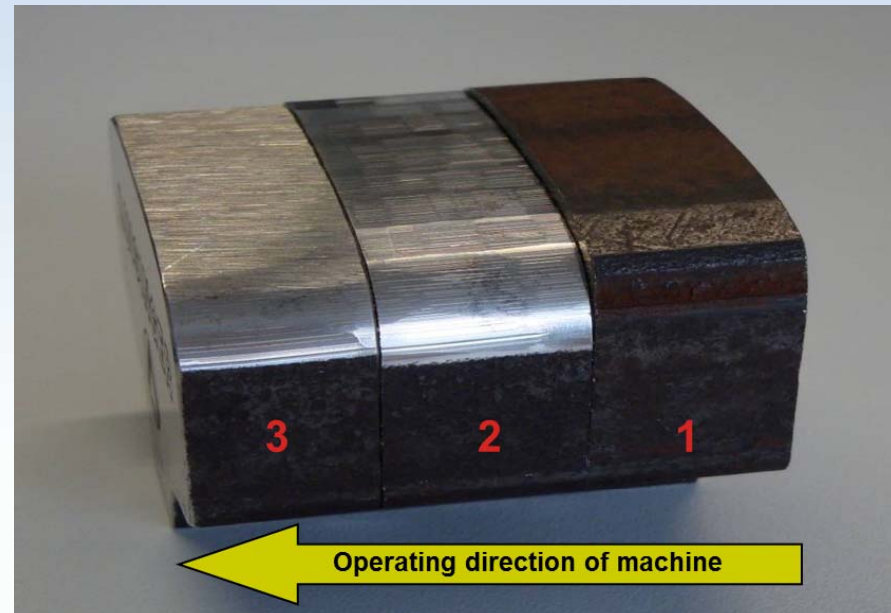
- **Step 1: Milling**
  - SF02 W-FS Truck: 1 unit (on each side)
  - SF03 W-FFS: 2 units (on each side)
- **Step 2: Grinding**
  - SF02 W-FS Truck: 1 unit (on each side)
  - SF03 W-FFS: 1 unit (on each side)



## 2. TECHNOLOGY PRINCIPALS

### TREATMENT RESULT

1. Untreated Rail
2. Milled Rail
3. Milled rail with surface grinding



Complete control from Cab

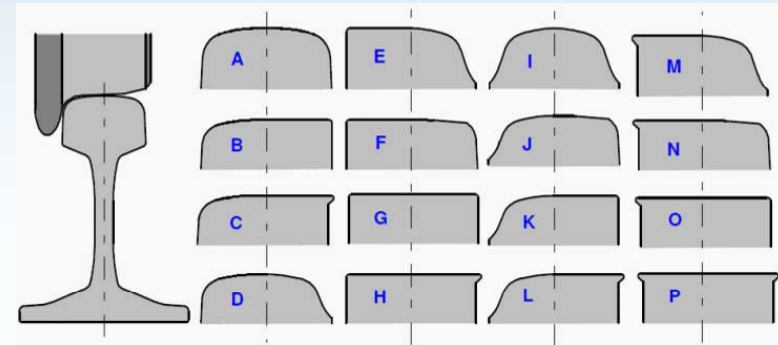
- Left side: milling operation
- Right side: travel

### 3. APPLICATION AND BENEFITS

- New rails- starting with 0.3-0,5mm metal removal  
(not very economical)
- Rail defects

- Treatment of RCF (rolling contact fatigue)

- Gauge widening



- Restoring transverse profile or bringing new profile type on the rails

- Treatment of all profile types



Rail defect: head check



Rail defect: squat



Restoring rail profile



### 3. APPLICATION AND BENEFITS

- Short Spark stream → low fire risk

- Minimal dust
- Low noise <82 dB
- Low visual impact
- Tunnel capability



- No hazard to work groups or passing trains
- Low risk for operating crew



### 3. APPLICATION AND BENEFITS

- Enclosed heads
- All waste gets recovered.
- The swarf separate from the grinding dust
- Operator and machine environment



### 3. APPLICATION AND BENEFITS

- No blueing of the rail →  
all heat goes into the swarf pieces
- No facets in gauge corner



- Too strong grinding pattern
- Blueing



### 3. APPLICATION AND BENEFITS

#### On Tracking with Rail-Road Miller



### 3. APPLICATION AND BENEFITS

On Tracking with Rail-Road Miller – LESMAC mobile level crossing





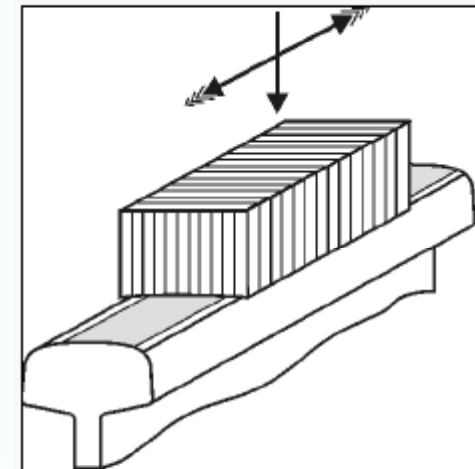
### 3. APPLICATION AND BENEFITS

Possible to mill under different weather conditions



### 3. APPLICATION AND BENEFITS

Milling with GWM (Schweerbau) BÜG in Berlin





### 3. APPLICATION AND BENEFITS

Unloading of swarf → Big Bag System



### 3. APPLICATION AND BENEFITS

Unloading of swarf → Container










### 3. APPLICATION AND BENEFITS



#### Overview of Working Procedures and Their Applications

Operating procedure		New rail treatment	Prevention	Maintenance / defect removal	BÜG	Gauge correction
Oscillating grinding					✓	
Rotating grinding		✓	✓	✓		✓
Milling		(✓) <sup>1</sup>		✓	(✓) <sup>2</sup>	✓
Planing				✓		✓
High-Speed grinding			✓		(✓) <sup>3</sup>	

<sup>1</sup> Only when combined with other work, since the material removal is too great

<sup>2</sup> Only in combination with oscillating grinding

<sup>3</sup> Recognition of EBA in preparation

### 3. APPLICATION AND BENEFITS

#### Milling



- Working speed:  
0.6 – 1.0 km/h
- Material removal per pass:  
 $\leq 1.8$  mm
- Optimum application:  
Maintenance /  
defects removal



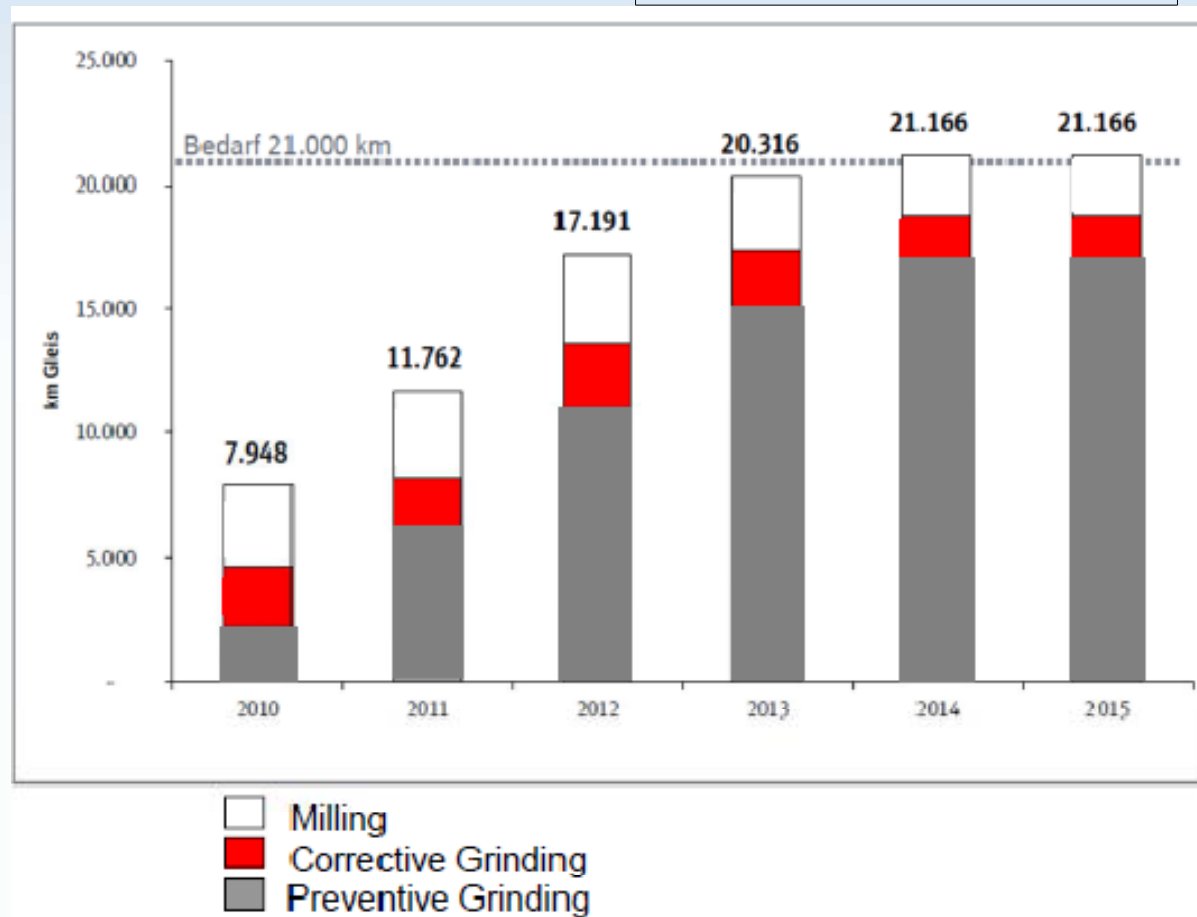
#### Advantages

- Restoration of the longitudinal and transverse profiles in a single pass
- High transverse profile accuracy
- No need to remove obstacles (contacts, sound absorbers, ...)
- No sparks emitted

#### Disadvantages

- Profiling cannot be performed on tight curves where the rail exhibits side wear
- Only one direction of operation
- No changes can be made to the transverse profile geometry

### 3. APPLICATION AND BENEFITS



### 3. APPLICATION AND BENEFITS -- MEASURING TOOLS

Miniprof



DQM



RAILMONITOR



RMF2.3E



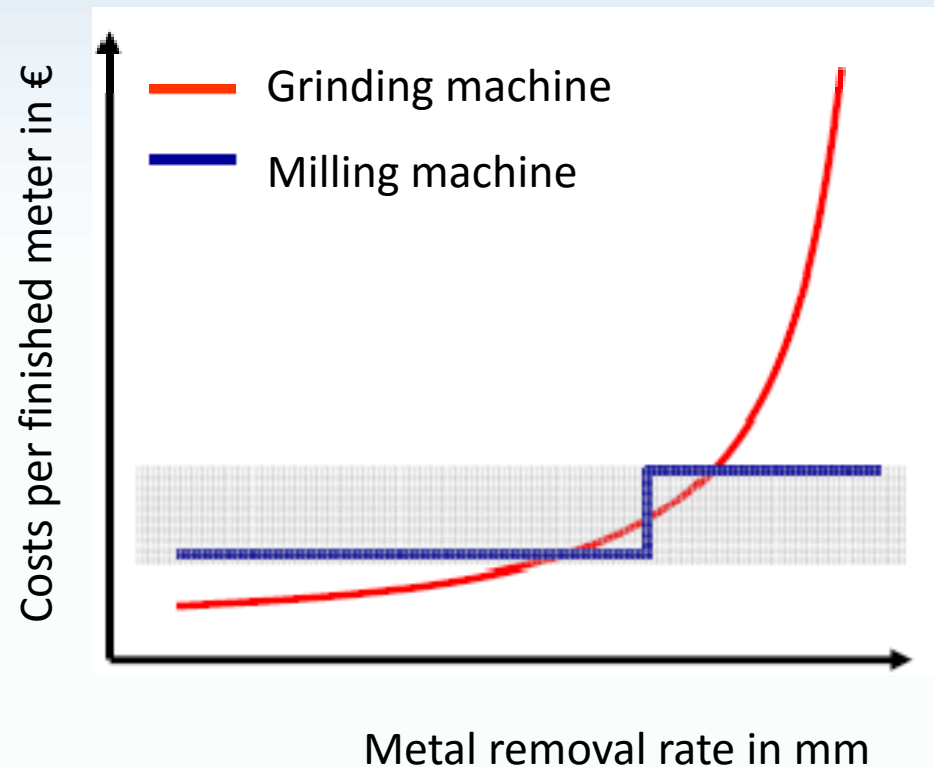
WPG PLR



WILMEC



### 3. APPLICATION AND BENEFITS -- COMPARED WITH GRINDING



Milling becomes more beneficial at a higher metal removal rate

## 4. CASE STUDIES

### LONDON UNDERGROUND

#### RAMS RAIL DEFECT REDUCTION PROJECT PHASE 1+2

- **Client:** Transport for London – London Underground Ltd.
- **Schedule:** 04/2014 – 02/2015
- **Used machine technology:** SF02 W-FS Truck “Einstein”
- **Scope of works:**
  - Working in open sections (LG 3) throughout LUL network on District, Metropolitan, Hammersmith & City and Central Line
  - Rail head reprofiling with milling and simultaneous grinding
  - Prevention and removal of rail defects (e.g. head checks)
  - Overall completed lineage of ca. 85 km of track
  - Single or two pass (0.8-1.8 mm material removal)
- **Special remarks:**
  - STRABAG has established milling as an alternative technology next to grinding



## 4. CASE STUDIES

### LONDON UNDERGROUND

#### RAMS RAIL DEFECT REDUCTION PROJECT PHASE 1+2

- Normally only limited spark time available through shifts in RAMS 1 due to infrastructure limitations but during 76hr-possession in May 2014 the full possible performance of the machine was shown
- Largest single weekend milling and grinding scope ever delivered on TFL LUL infrastructure (with 3 suppliers overall 37 km of track have been reprofiled)
- STRABAG worked in 12h blocks with each 8h milling time, 2 teams
- Rail head reprofiling, defects removal (pitting) and corrugations
- Total finished tracks of 13.5 km by STRABAG on Central Line:
  - West Ruislip / Northolt 10.5 km track finished as planned by client
  - Additional 3 km to Perivale treated as original planned programme was outbalanced by STRABAG's machine performance



## 4. CASE STUDIES

### BVB BASEL SWITZERLAND

#### PROJECT BASEL 2012-2014

- **Client:** Basler Verkehrs-Betriebe
- **Schedule:** 08/2012 – 10/2014
- **Used machine technology:** SF02 W-FS Truck “Big Ben”
- **Scope of works:**
  - Rail milling and grinding of 42.3 km track, mainly grooved rail (gauge of the track: 1,000 mm)
  - Refurbishment of head of the rail (double and wide groove)
  - Very hard welding material (up to 2,200 N/mm<sup>2</sup>)
  - Metal removal 5-8 mm from top edge of the rail
- **Special remarks:**
  - Modification of SF02 W-FS Truck by machine manufacturer before the project in order to treat grooved rail
  - Use of new developed milling wheels
  - Only grinding technique of competitors is not successful here





## 4. CASE STUDIES

### BVB BASEL SWITZERLAND

#### PROJECT BASEL 2012-2014



## 4. CASE STUDIES

### BVB BASEL SWITZERLAND

PROJECT BASEL 2012-2014



BEFORE



2 milling passes



FINISHED



## 4. CASE STUDIES

### BVB BASEL SWITZERLAND

#### PROJECT BASEL 2012-2014

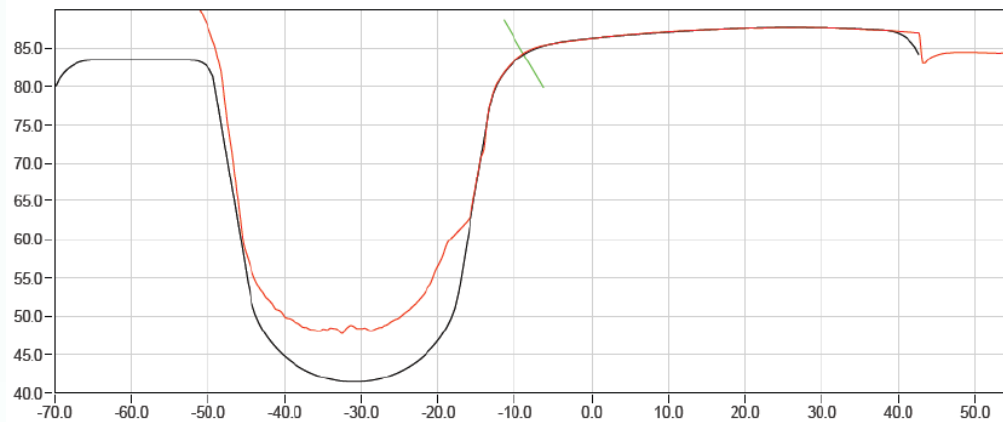
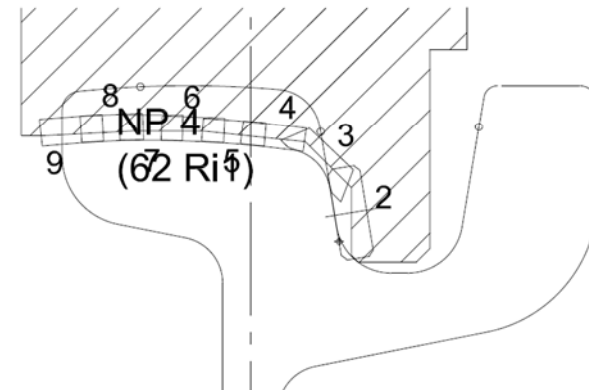




## 4. CASE STUDIES

### BVB BASEL SWITZERLAND

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## 4. CASE STUDIES

### BVB BASEL SWITZERLAND

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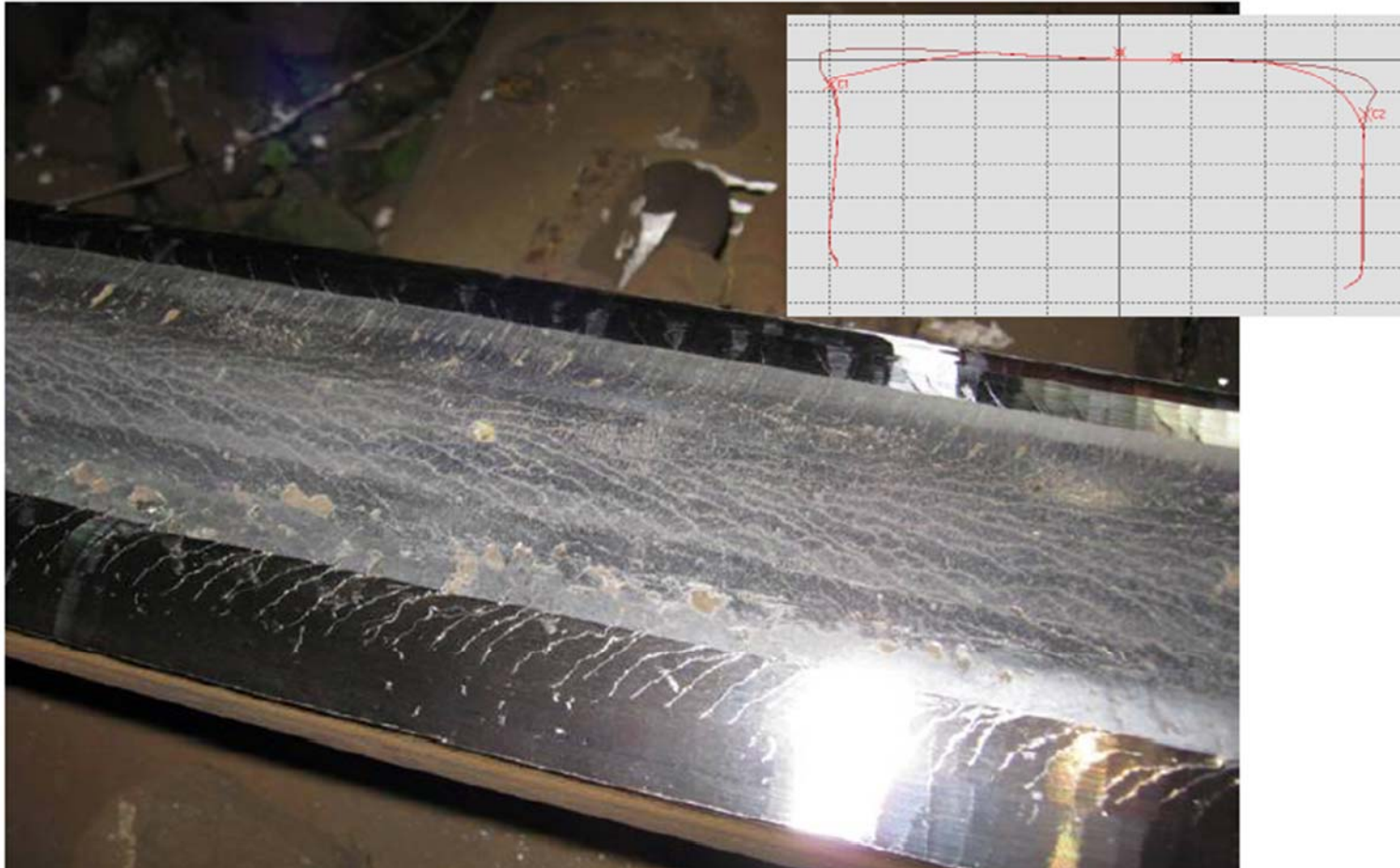
- vignol rail also
- still cheaper as renewal of rail
- Milling work during night time –  
no closure of track during daytime
- Positive support from operator



## 4. CASE STUDIES

### NETWORK RAIL LIVERPOOL STREET STATION

Result after 1 milling pass

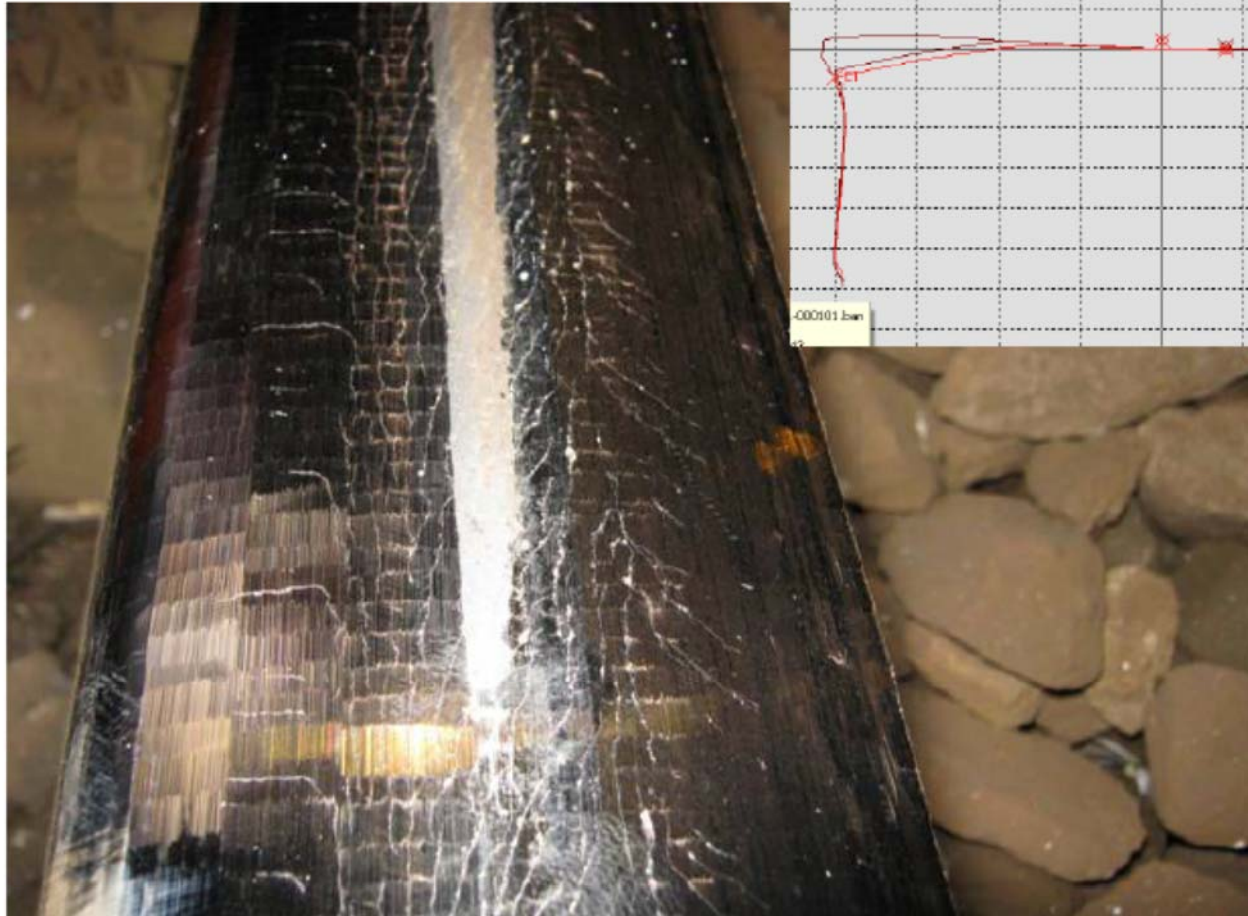




## 4. CASE STUDIES

### NETWORK RAIL LIVERPOOL STREET STATION

Result after 2 milling passes



## 4. CASE STUDIES

### NETWORK RAIL LIVERPOOL STREET STATION

Finish after 5 milling passes and simultaneous surface grinding pass

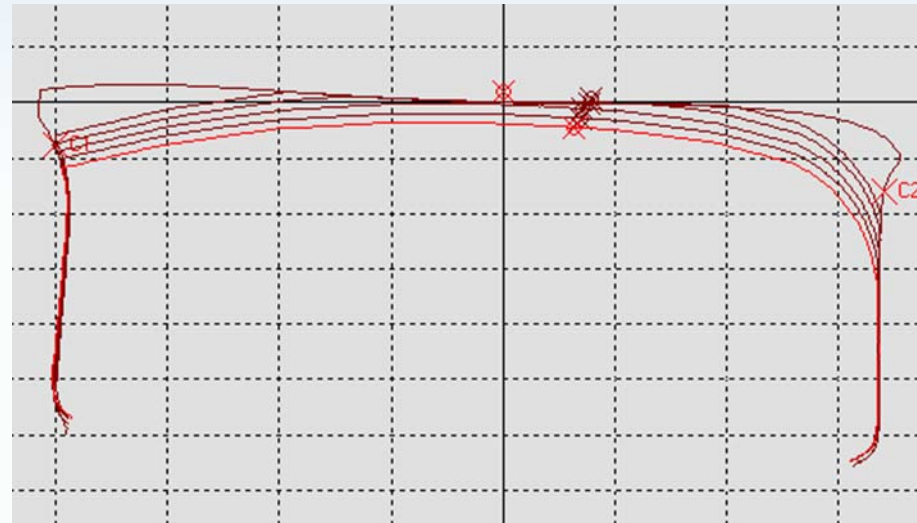


Diagram showing metal removal layers

## 4. CASE STUDIES

### NETWORK RAIL LIVERPOOL STREET STATION

High metal removal rate to restore complete rail profile is possible

	60m Location		120m Location		180m Location	
	Gauge / Field Corner	Centreline	Gauge / Field Corner	Centreline	Gauge / Field Corner	Centreline
Pass 1	4mm	0mm	3.3mm	0mm	1.7mm	0mm
Pass 2	0.8mm	0mm	1.3mm	0mm	0.8mm	0.2mm
Pass 3	0.8mm	0.3mm	0.9mm	1.0mm	0.9mm	0.9mm
Pass 4	0.9mm	0.9mm	0.8mm	0.9mm	0.9mm	0.9mm
Pass 5	0.8mm	0.8mm	0.9mm	1.0mm	1.0mm	1.0mm
<b>TOTAL</b>	<b>7.3mm</b>	<b>2.0mm</b>	<b>7.2mm</b>	<b>2.9mm</b>	<b>5.3mm</b>	<b>3.0mm</b>
Remaining rail depth		4.1mm		5.6mm		9.0mm



## 4. CASE STUDIES

### NETWORK RAIL WARRINGTON

- **Client:** Network Rail Infrastructure Ltd.
- **Schedule:** 07/2015 – 07/2015
- **Used machine technology:** SF02 W-FS Truck “Einstein”
- **Scope of works:**
  - Site: Warrington (UK), Arpley Junction to Monk Sidings
  - Rail head reprofiling with milling and simultaneous grinding
  - Removal of rolling contact fatigue (RCF) at 5-6 mm depth
  - 4 shifts, overall completed lineage of 1.5 km
  - 2-6 passes required depending on track condition
- **Special remarks:**
  - Establishment of milling as an alternative technology next to grinding as first company on Network Rail managed infrastructure
  - Requirement for full RIS-1530-PLT Issue 5 certification



Left-hand side:  
RCF before treatment



Right-hand side:  
RCF removed

## 4. CASE STUDIES

### NETWORK RAIL WARRINGTON



(1) After 1 pass



(2) After 2 passes



(3) Finish after 4 passes



(4) Defects before treatment



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## 4. CASE STUDIES

### ÖBB National Railroad Austria

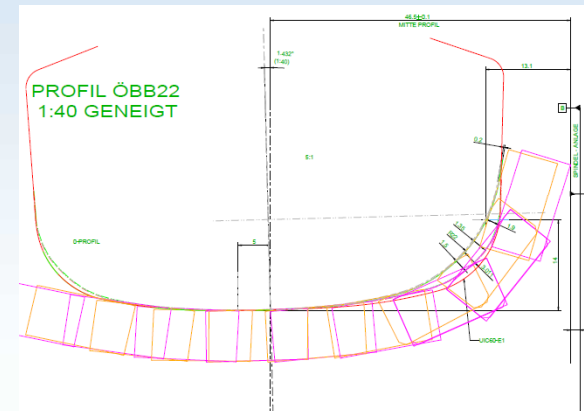
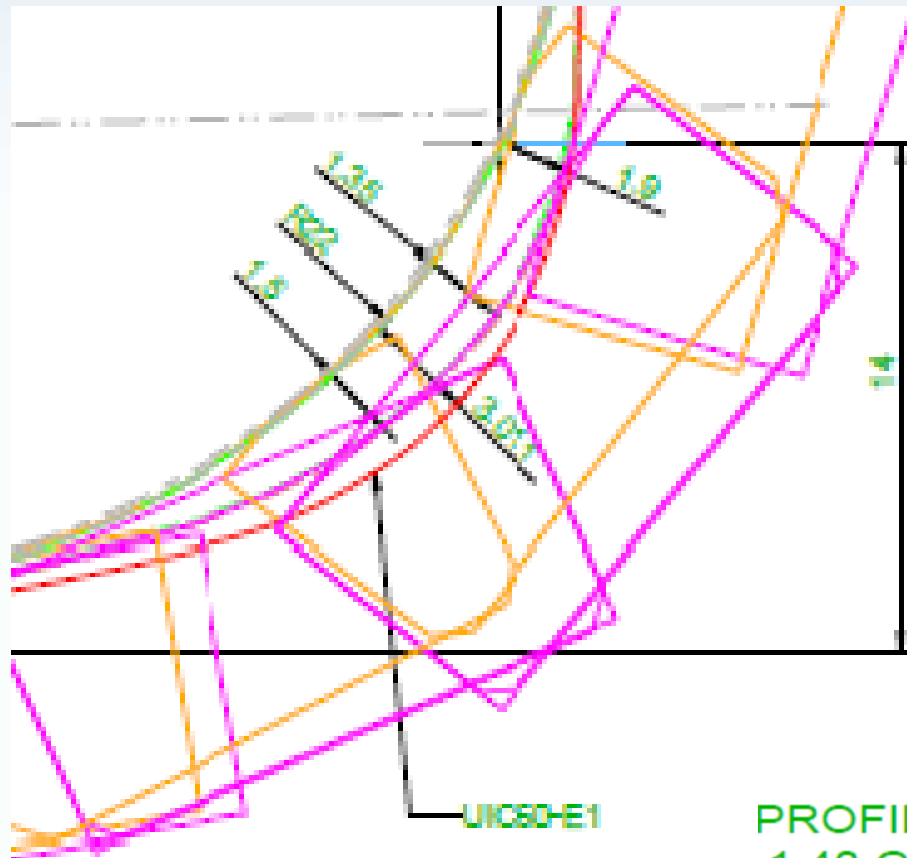
- 44 hours long possession from 26-27 september 2015
- Terfener Tunnel area Innsbruck
- No milling before → HeadChecks > 3mm
- Total 16.000 meters
- New ÖBB22 Profile
- Unloading swarf with skip on closed track





## 4. CASE STUDIES

### ÖBB National Railroad Austria



## 4. CASE STUDIES

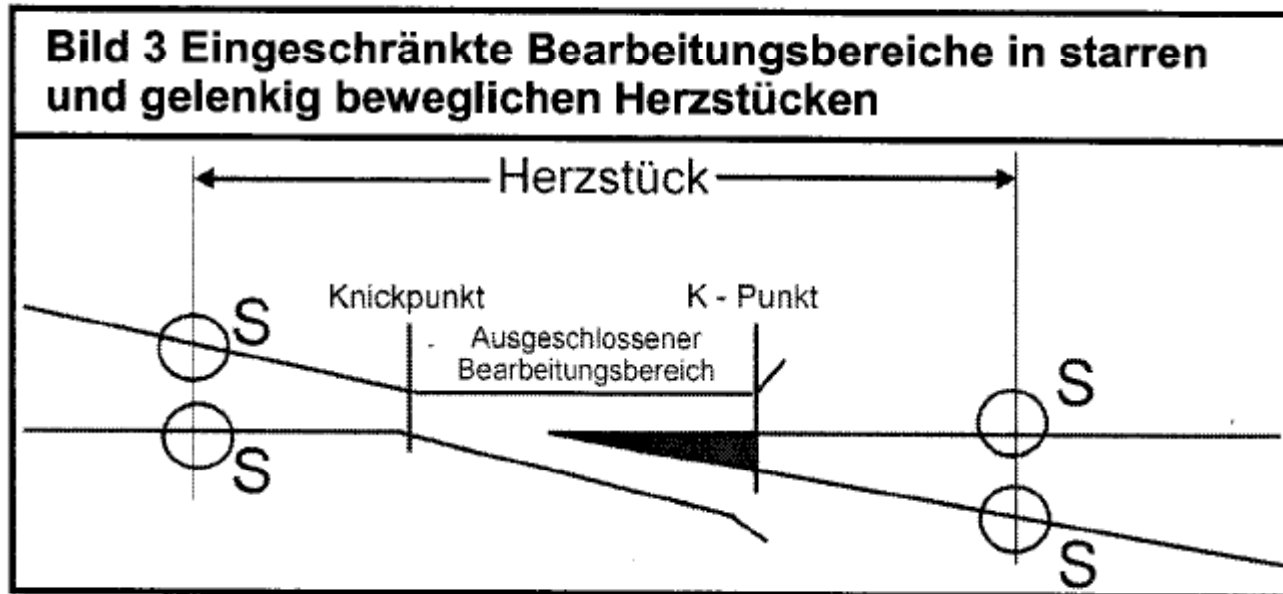
### OTHER

A lot of defects are clearly shown after first milling pass.



## 4. CASE STUDIES

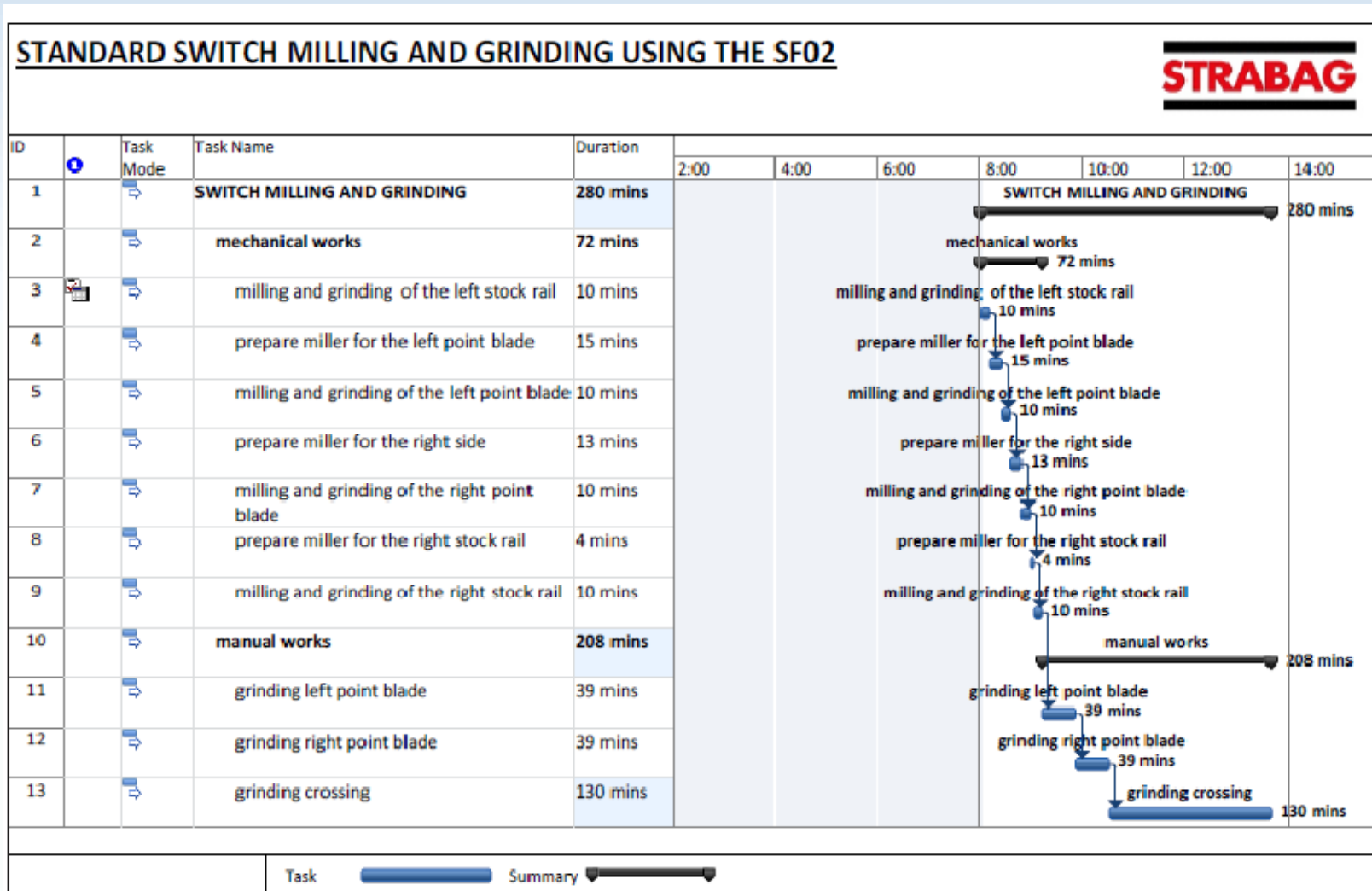
### MILLING OF SWITCHES





## 4. CASE STUDIES

## MILLING OF SWITCHES



## 5. SUMMARY

### MILLING

- Corrective rail profiling technique
- Potential to remove RCF cracks
- Potential for 5mm+ metal removal per pass (gauge corner)
- Perfect finish- no facets in small radius
- All defects will be taken out completely
- Finish in one pass – depends on track condition
- All profiles can be done
- Environmental friendly





*Thank you for your attention!!*

**WRI**  
**EU 2015**

**STRABAG**  
TEAMS WORK.