Rail base breaks:
One of the most concerns for Brazilian Heavy-Haul railways

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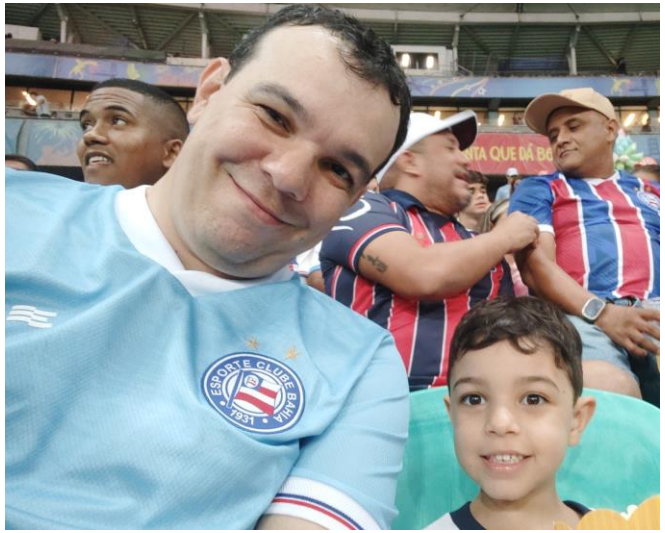

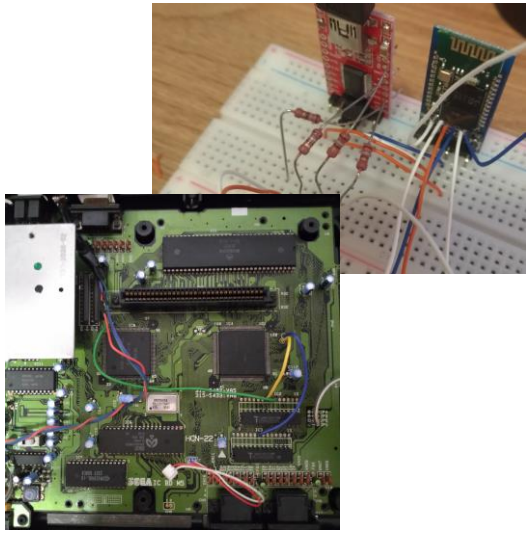

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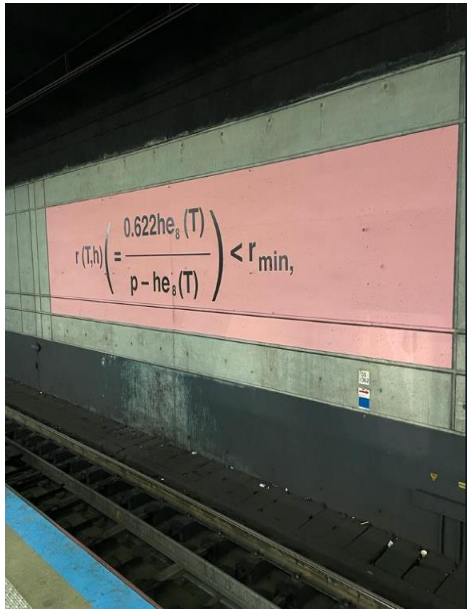


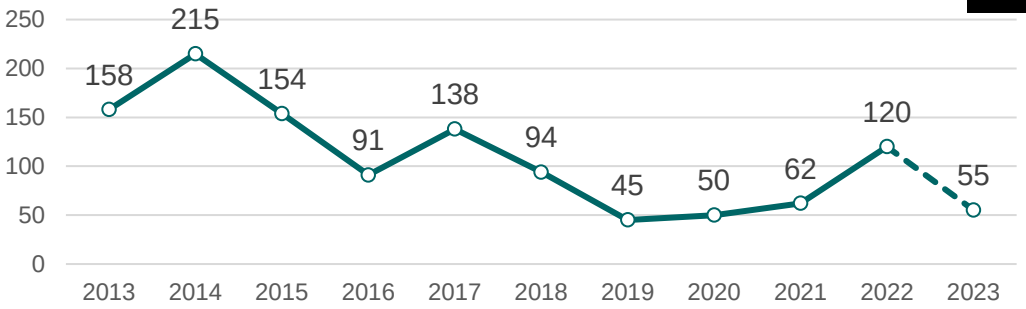
EFC Railway

- 976 km extension
- +20,000 wagons
- +300 Locomotives
- 40 Bridges
- 6 Viaducts
- 4 Tunnels

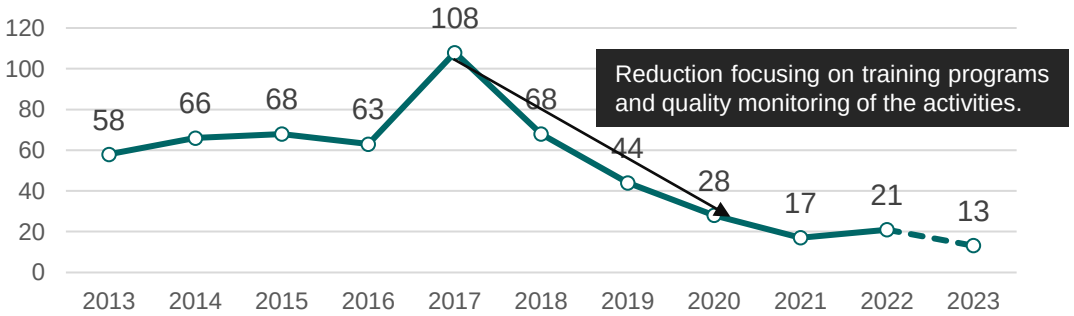
EFVM Railway

- 905 km extension
- +12,000 wagons
- +280 Locomotives
- 138 Bridges
- 51 Viaducts
- 44 Tunnels

Rail breaks

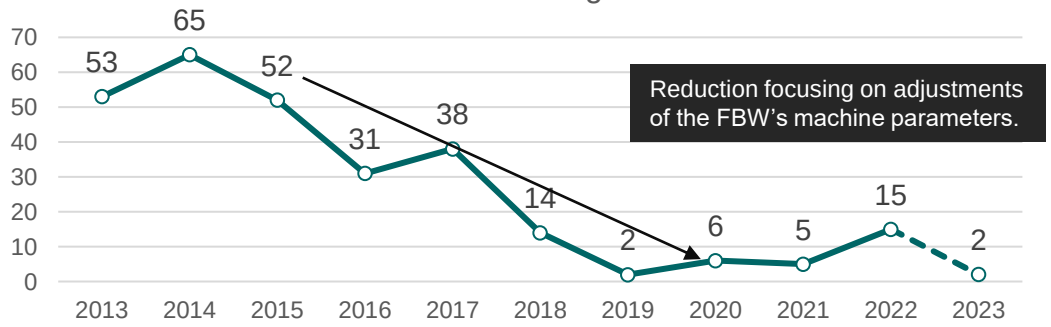


Thermite Welding breaks



Reduction focusing on training programs and quality monitoring of the activities.

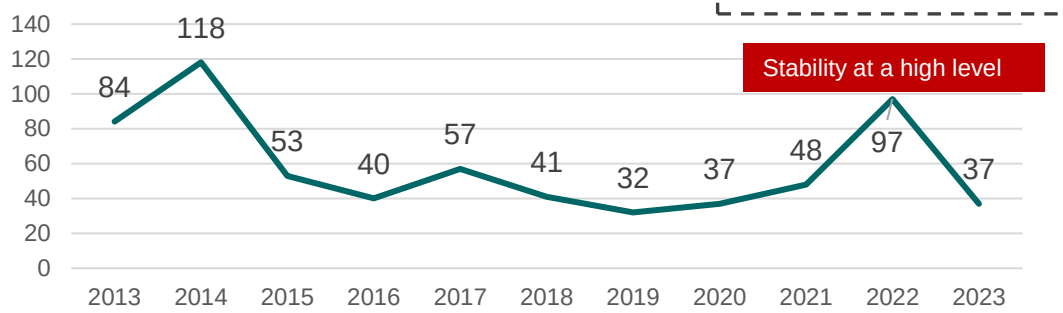
Flash Butt Welding Breaks



Reduction focusing on adjustments of the FBW's machine parameters.

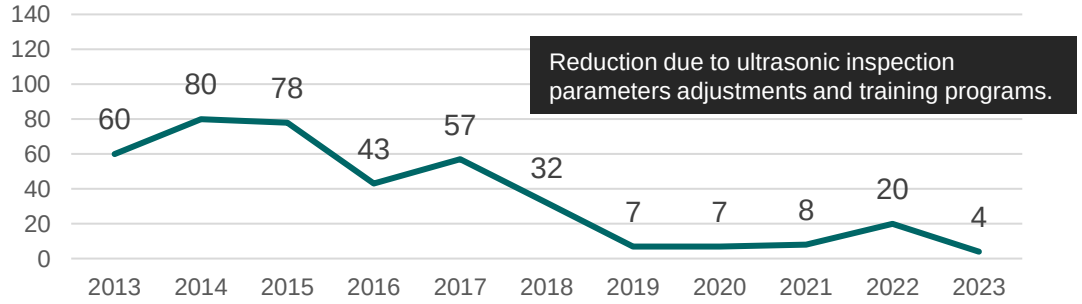
Rail breaks by crack type

TDF – Transversal Detail on Foot



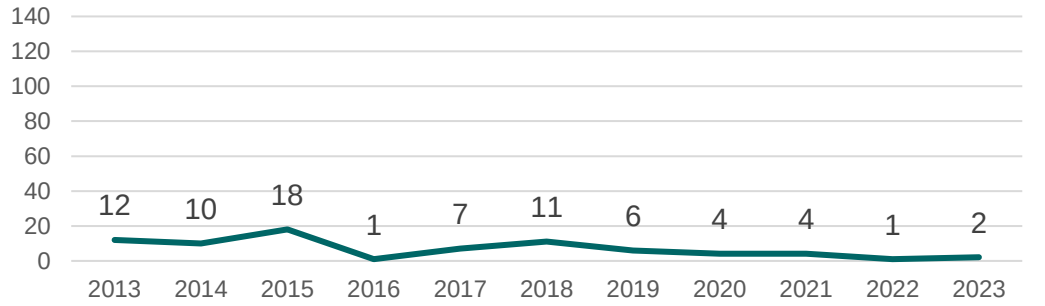
Stability at a high level

TDT – Transversal Detail on Top

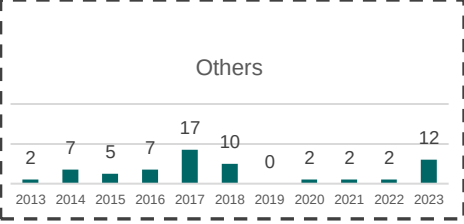


Reduction due to ultrasonic inspection parameters adjustments and training programs.

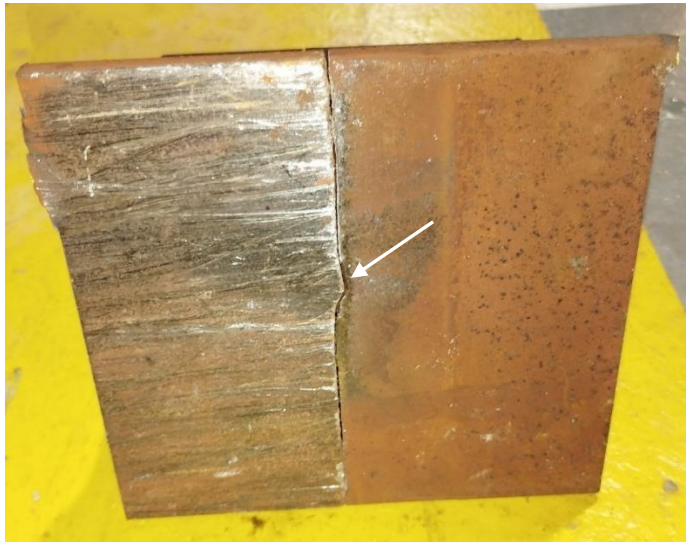
BH – Bolt Hole



Others

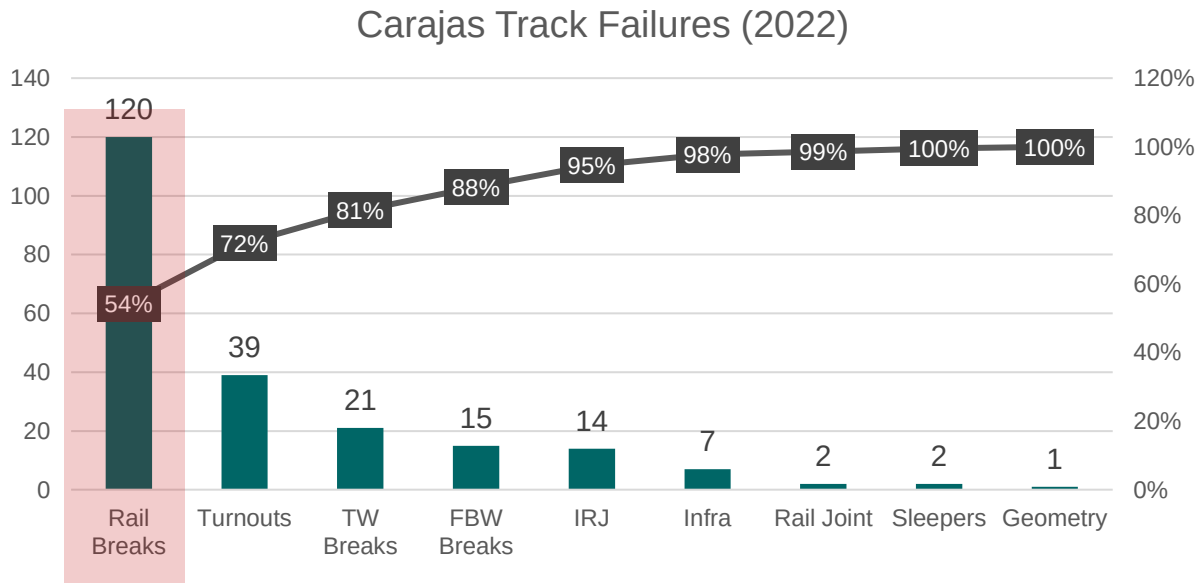


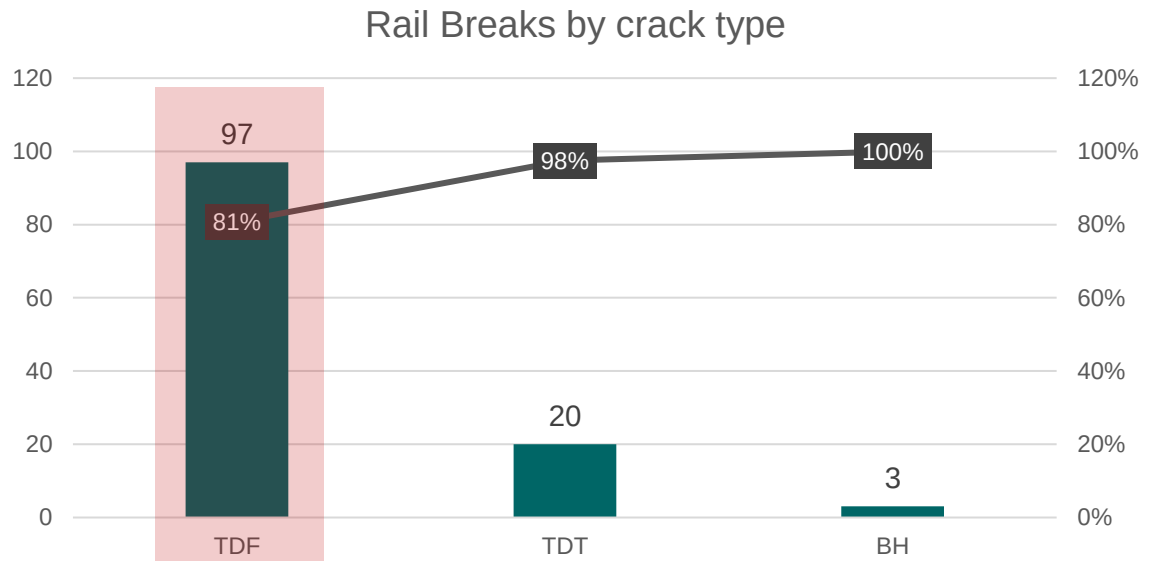


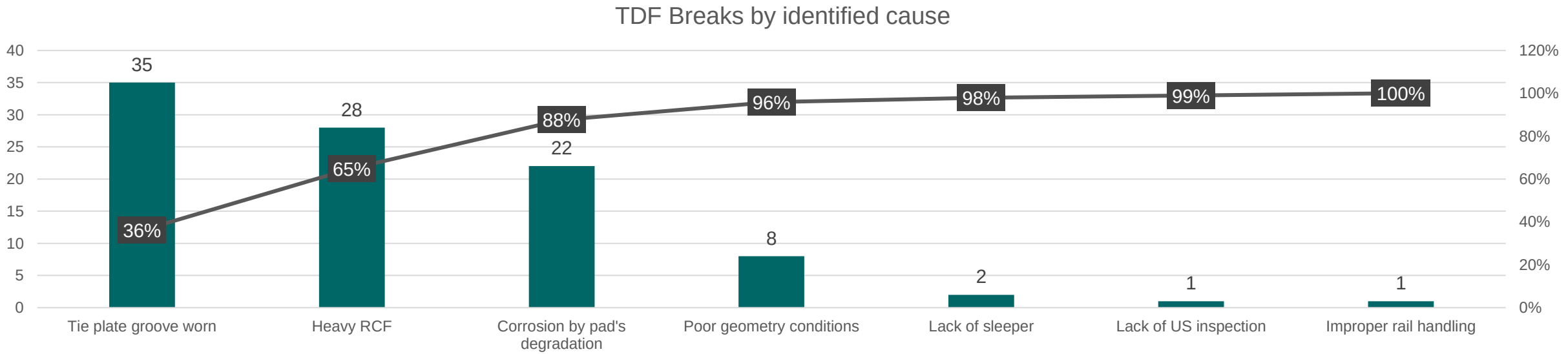




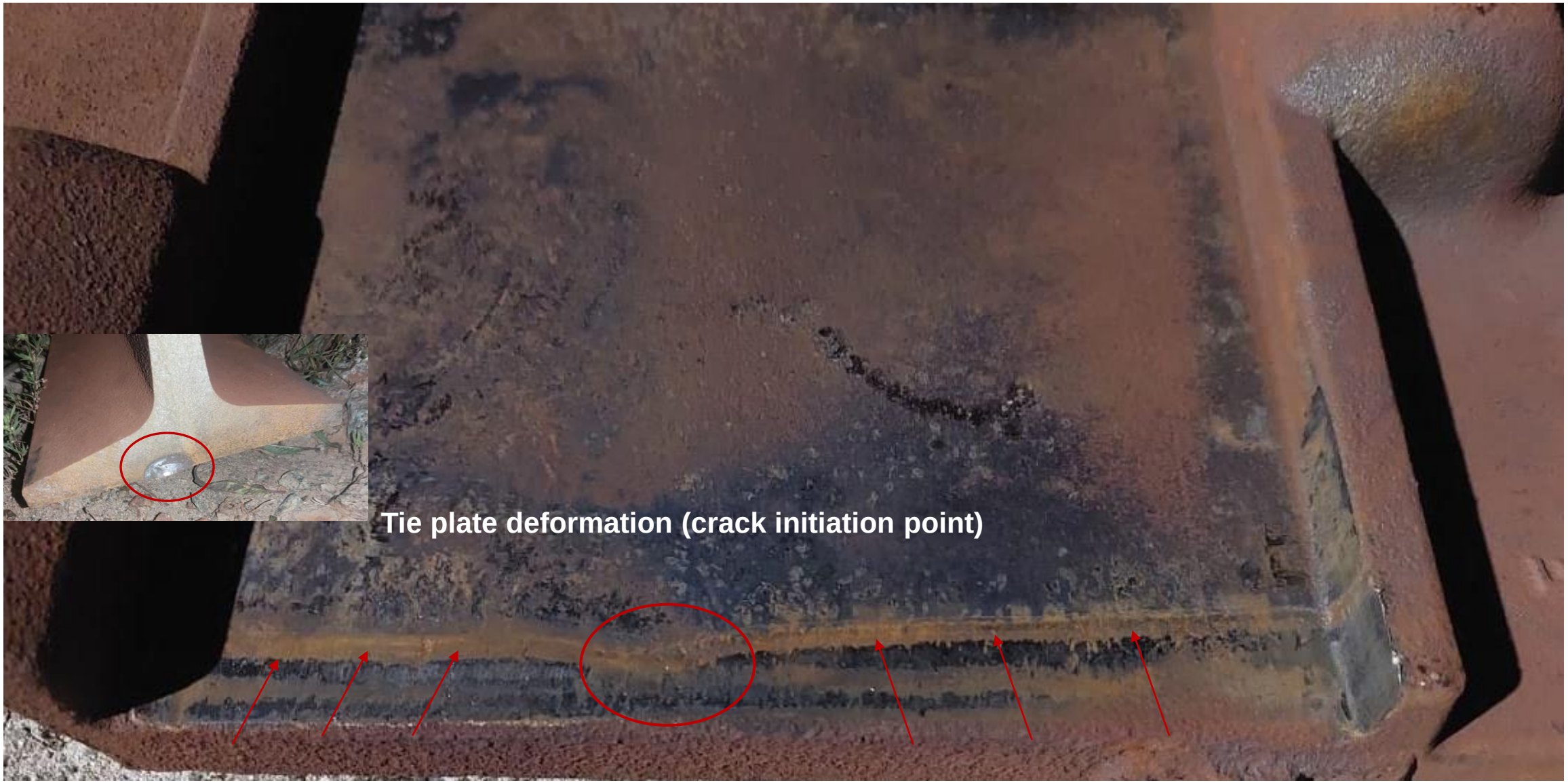


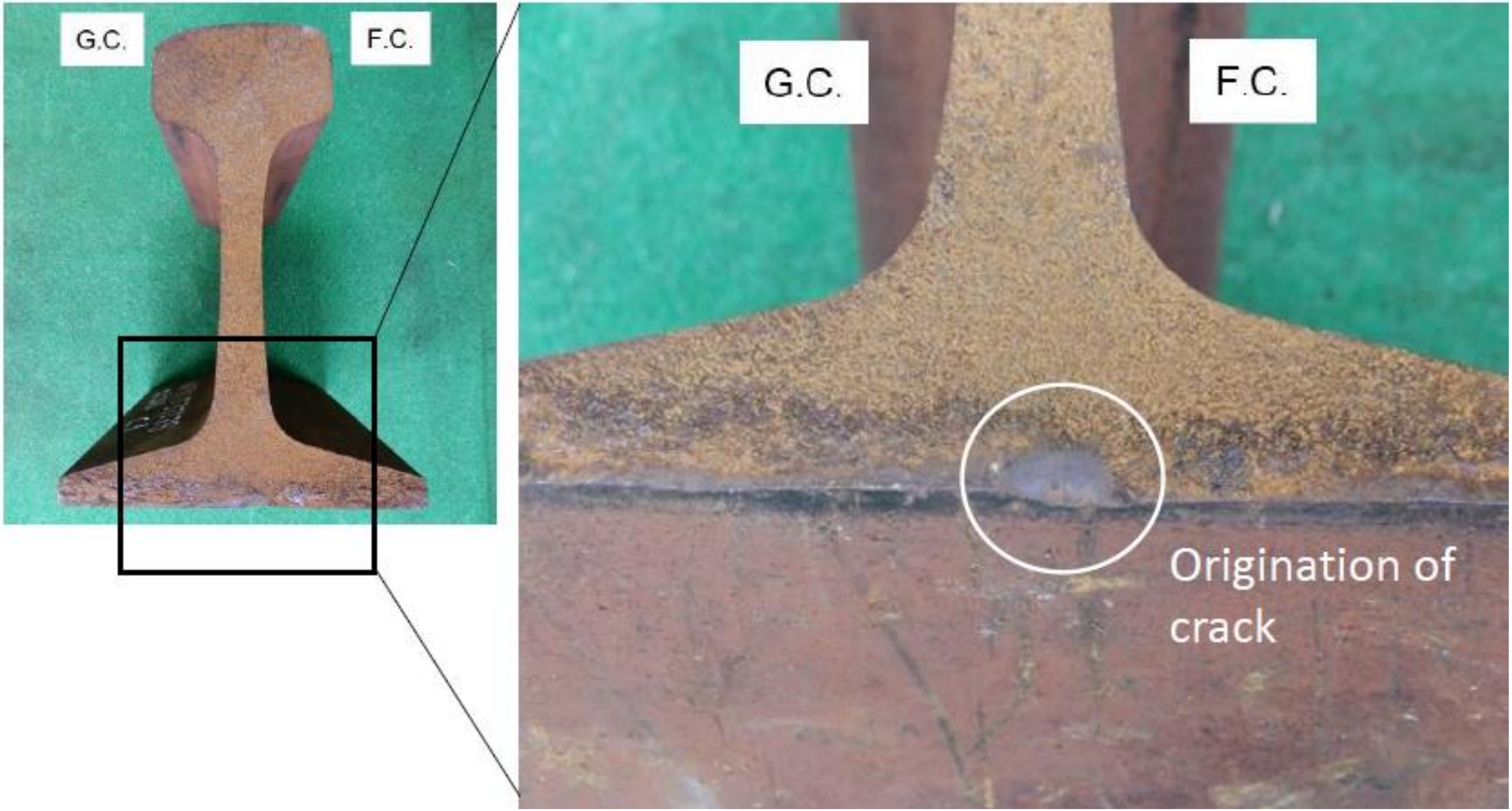

Carajas Track Failures (2022)
140
120
100
80
60
40
20
0
120%
100%
80%
60%
40%
20%
0%
120
39
21
15
14
7
2
2
1
54%
72%
81%
88%
95%
98%
99%
100%
100%
Rail Breaks
Turnouts
TW Breaks
FBW Breaks
IRJ
Infra
Rail Joint
Sleepers
Geometry

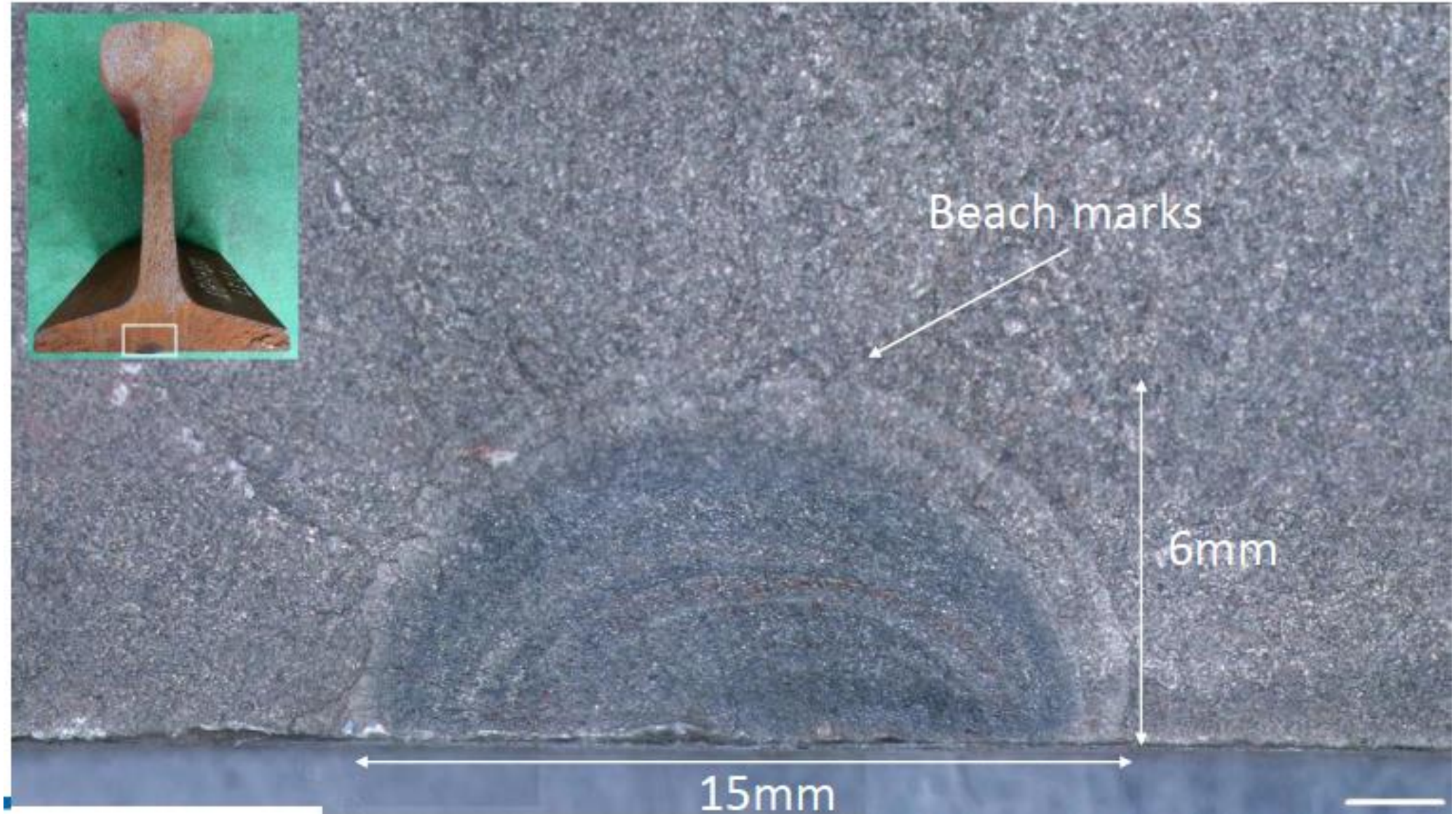

Rail Breaks by crack type
120
100
80
60
40
20
0
120%
100%
80%
60%
40%
20%
0%
97
20
3
81%
98%
100%
TDF
TDT
BH


TDF Breaks by identified cause
40
35
30
25
20
15
10
5
0
120%
100%
80%
60%
40%
20%
0%
35
28
22
8
2
1
1
36%
65%
88%
96%
98%
99%
100%
Tie plate groove worn
Heavy RCF
Corrosion by pad's degradation
Poor geometry conditions
Lack of sleeper
Lack of US inspection
Improper rail handling

Tie plate groove worn – Wooden sleepers




G.C.
F.C.
G.C.
F.C.
Origination of crack


Beach marks
6mm
15mm

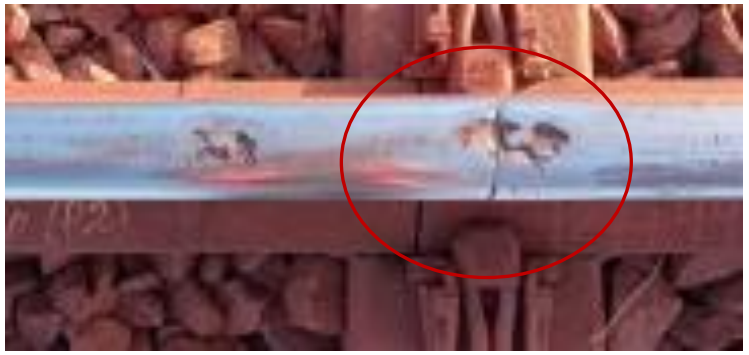

Corrosion pittings on pad’s degradation spots


PORTO
MIMI

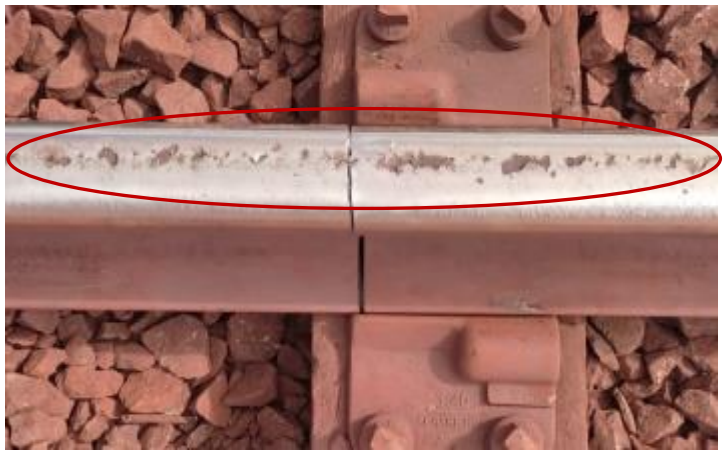

TOP
TOP

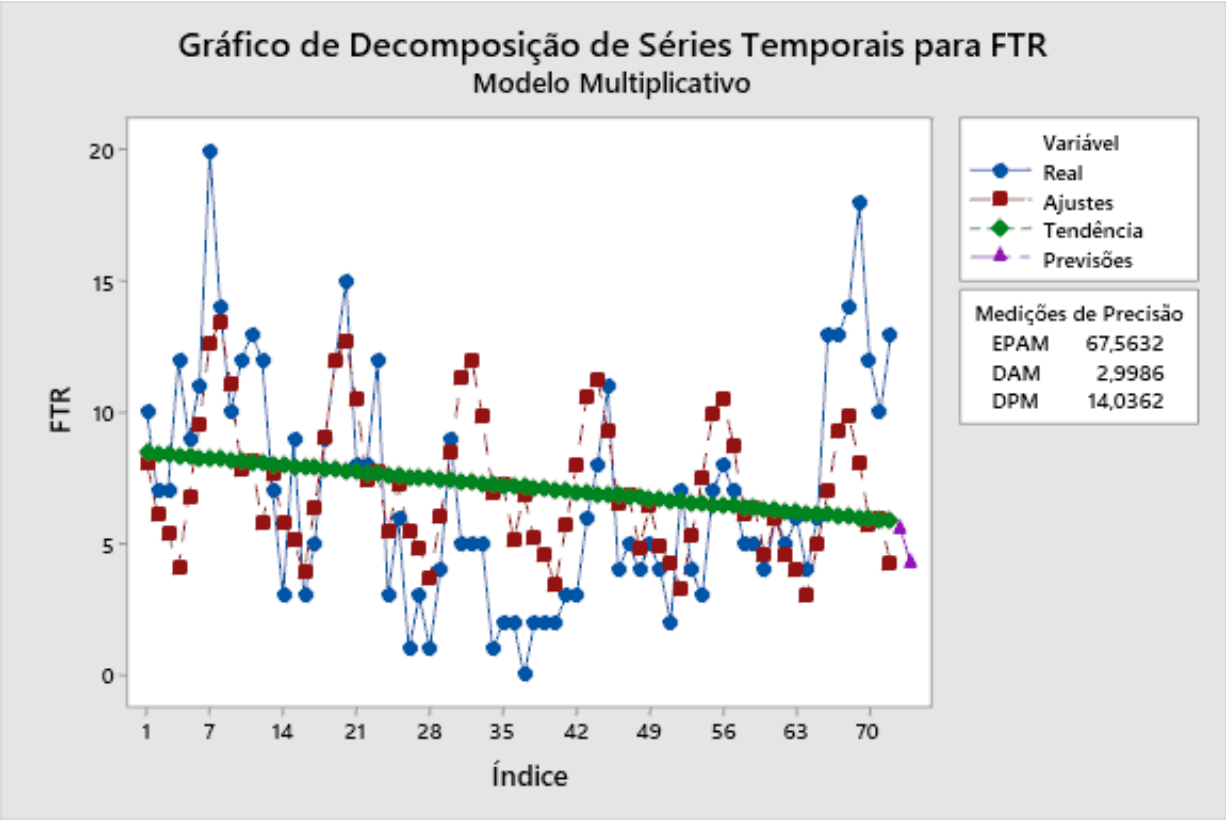

PORTO

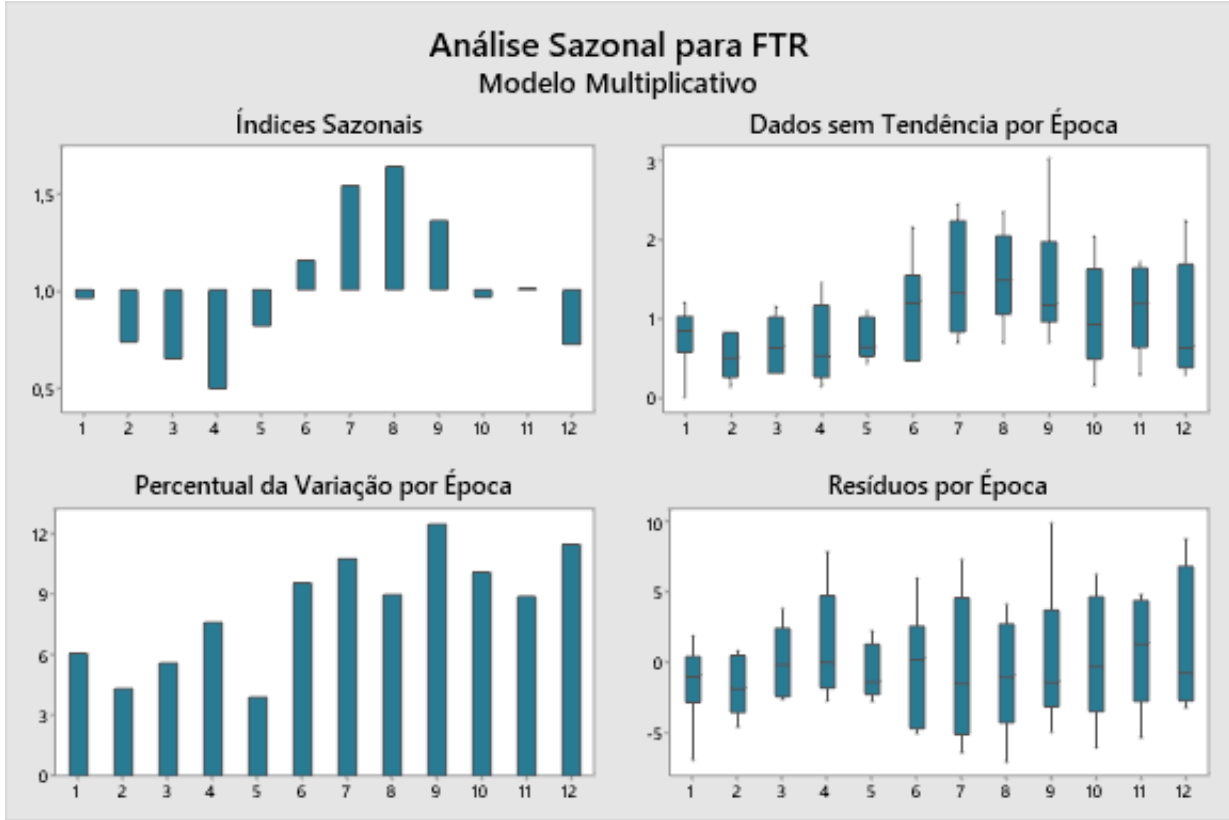
Severe RCF – Wooden and concrete sleepers



Severe RCF – Wooden and concrete sleepers



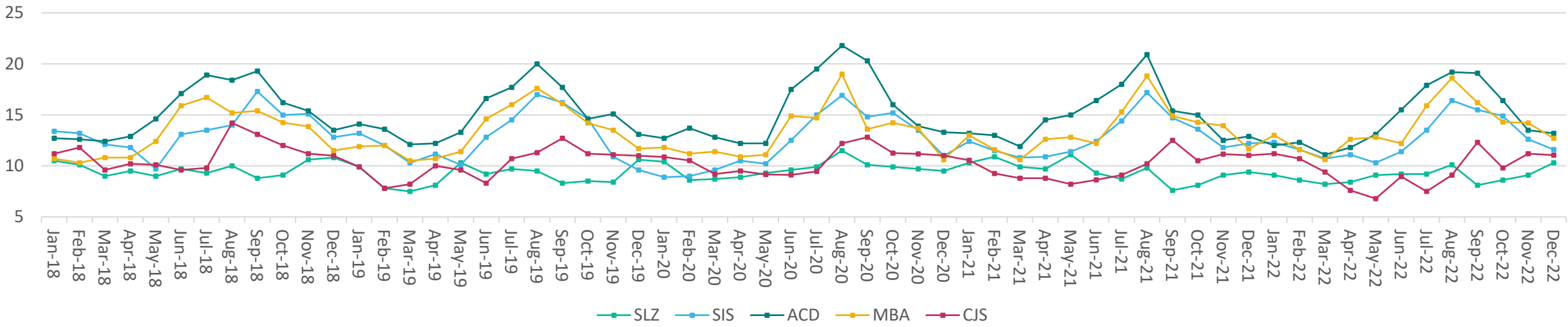




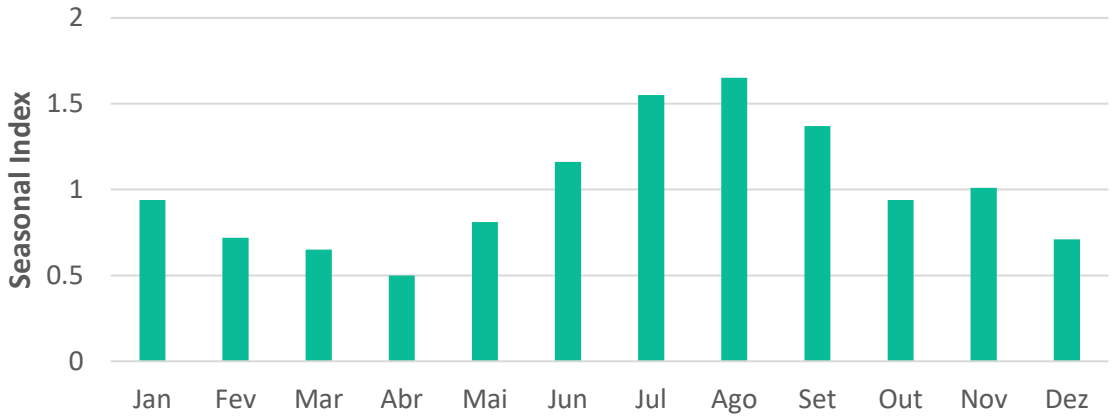
Statistical analysis of seasonality was carried to prove the existence of the phenomenon.

A sample space of 6 years was adopted to evaluate the behavior.

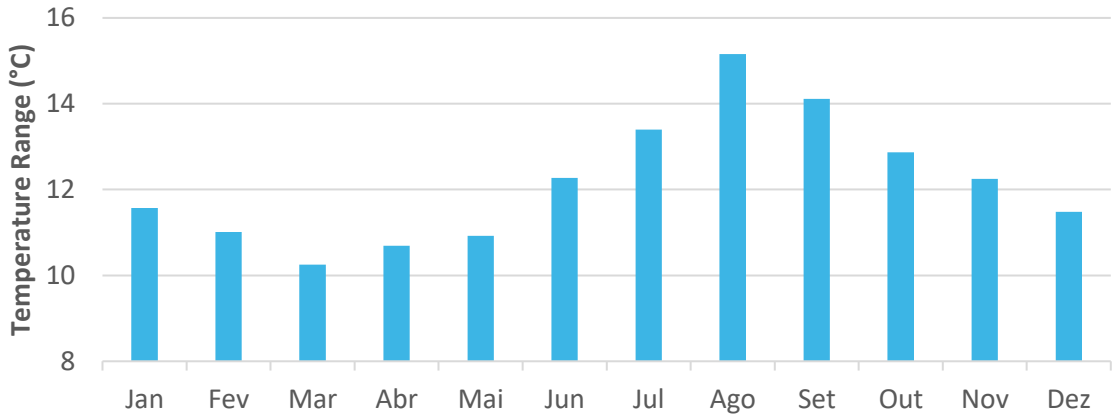
Ambient Temperature Range



Rail fracture seasonal variation



Average ambient temperature range



Sample correlation coefficient: 0,924

- There are two different conditions of rail base breaks on EFC Railway:
  - Concrete sleepers with rigid rail pad at the end of its life cycle;
  - Wooden sleepers with early deterioration, contaminated ballast and poor geometry.

- Months with the greatest temperature range are strongly correlated with the months with the greatest rail fracture quantity.

- Although the cracks appear in the center of the rail base, few are identified previously by ultrasonic inspection.

- There are rail models on the market with lower residual stress on the base, but this option has not yet been tested in EFC railway.

Thank You!