Taiwan TTSB
國家運輸安全調查委員會
Transportation Safety Board

Passenger Train Derailment on Pingxi Branch Line

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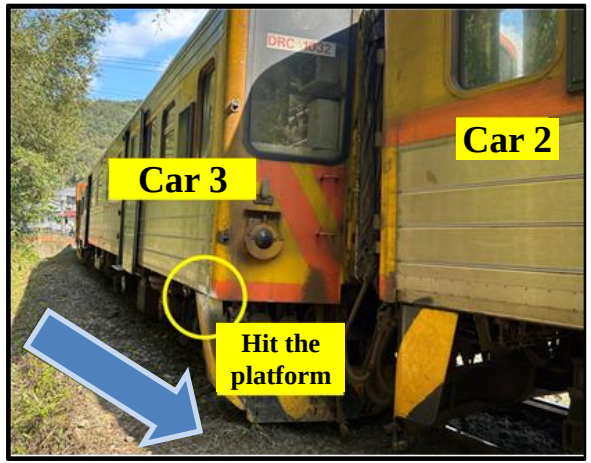
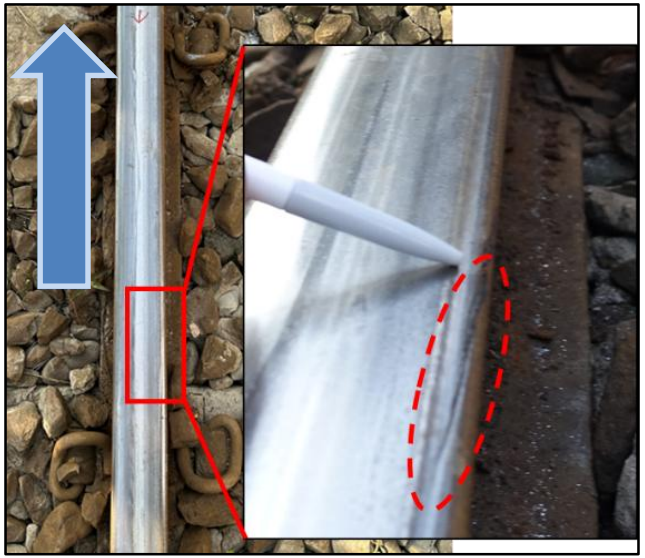
Accident

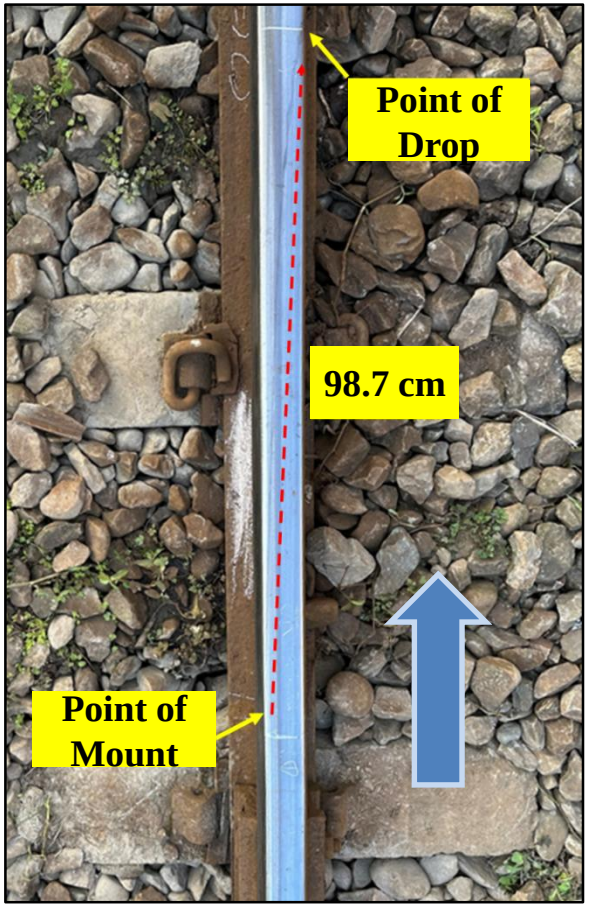
On February 12, 2024, Taiwan Railways Corporation, Ltd. (TRC) local train No. 4816, consisting of four cars, experienced a derailment after departing Lingjiao Station on the Pingxi Branch Line. The first and second axles at the front end of car No. 3 derailed.

Accident Scene



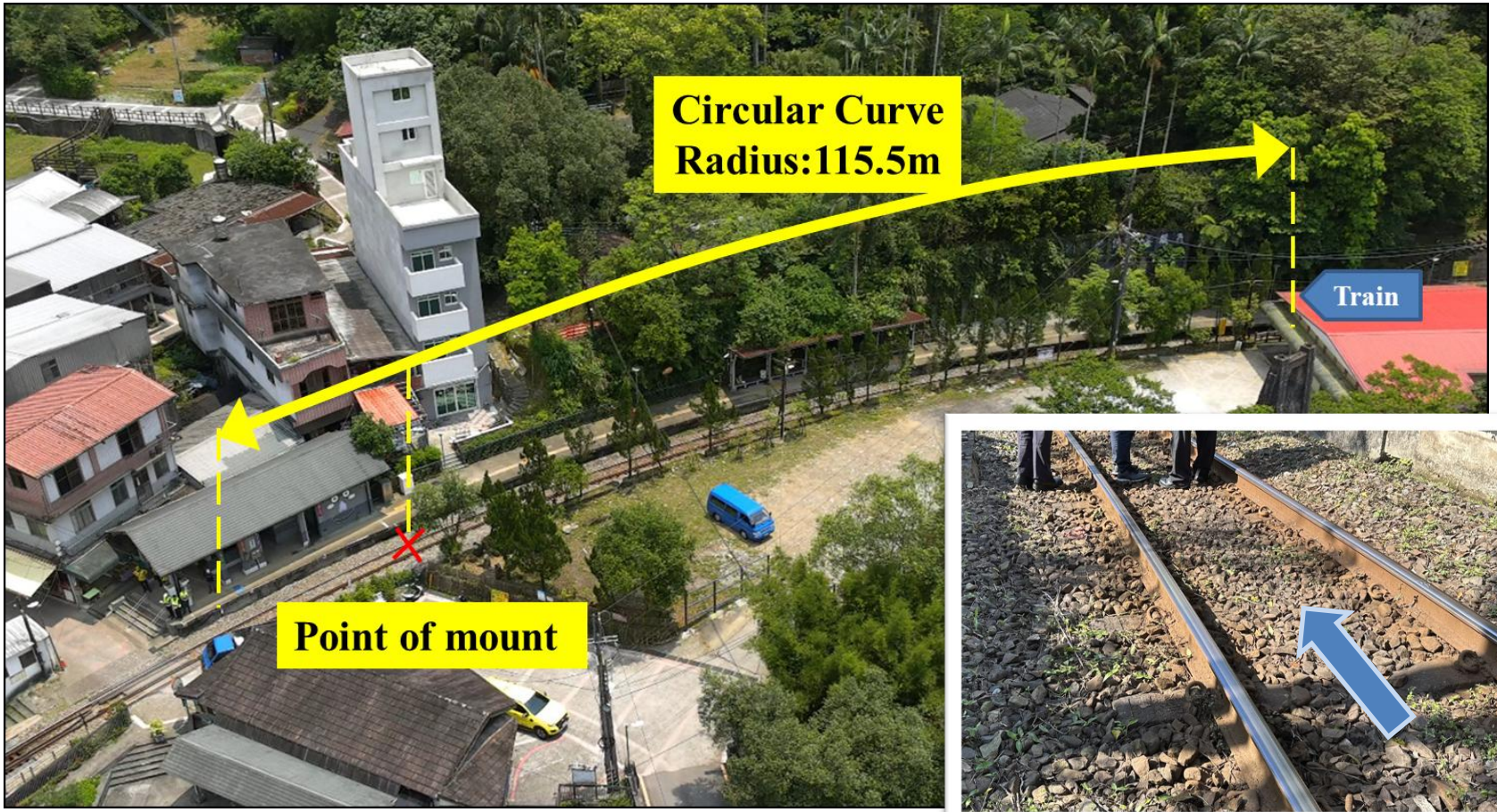


Left

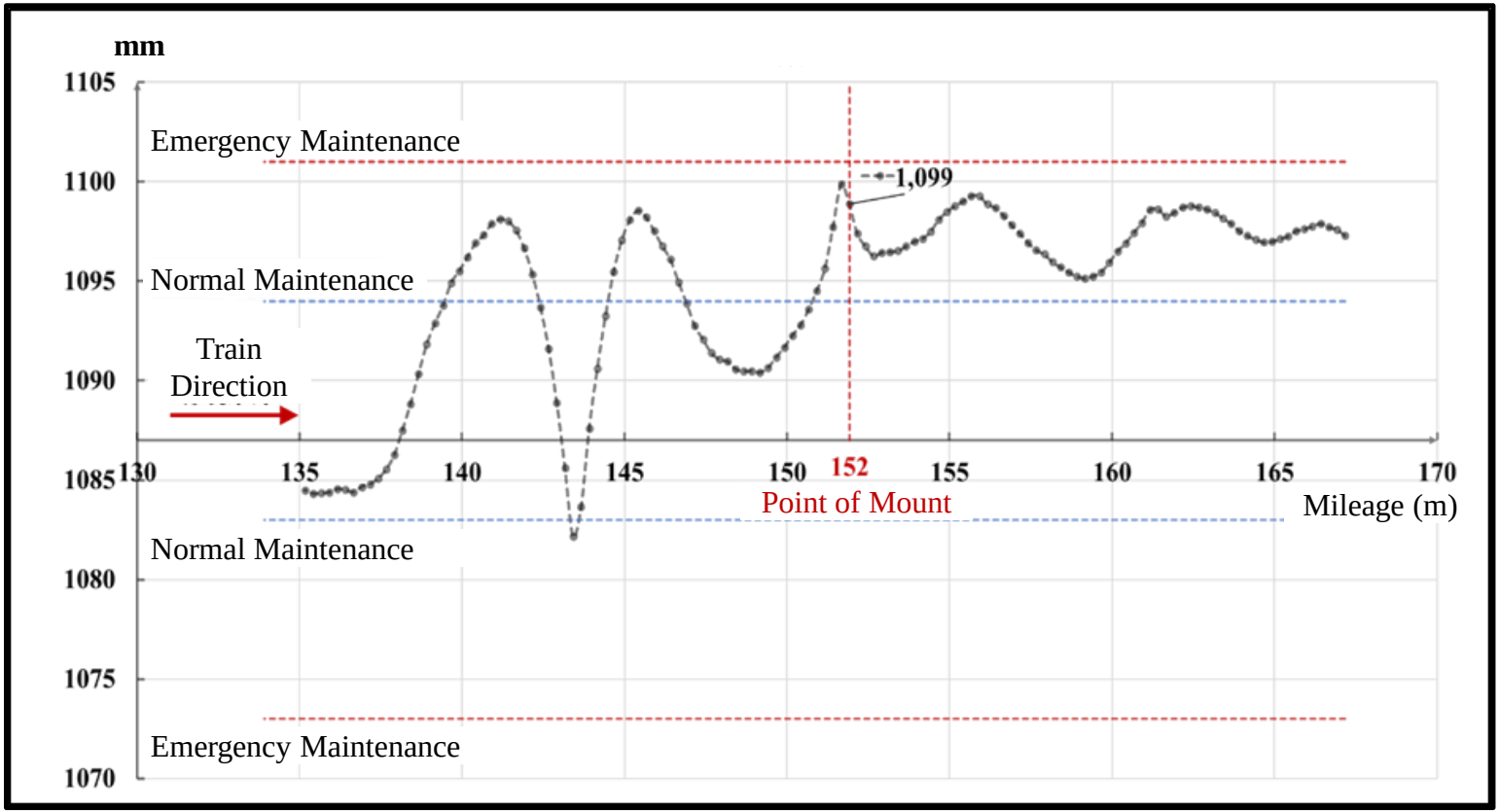


Right

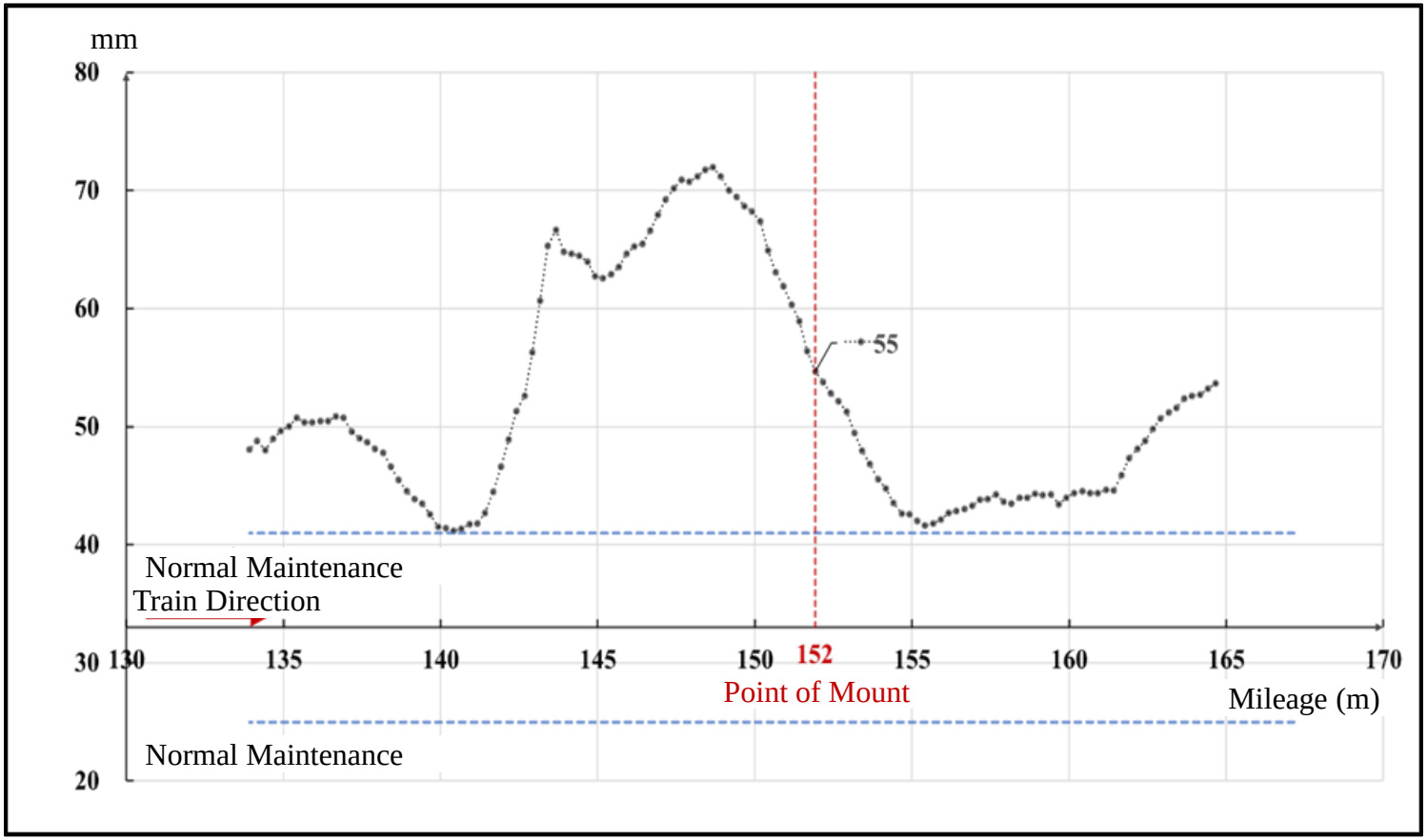
Track



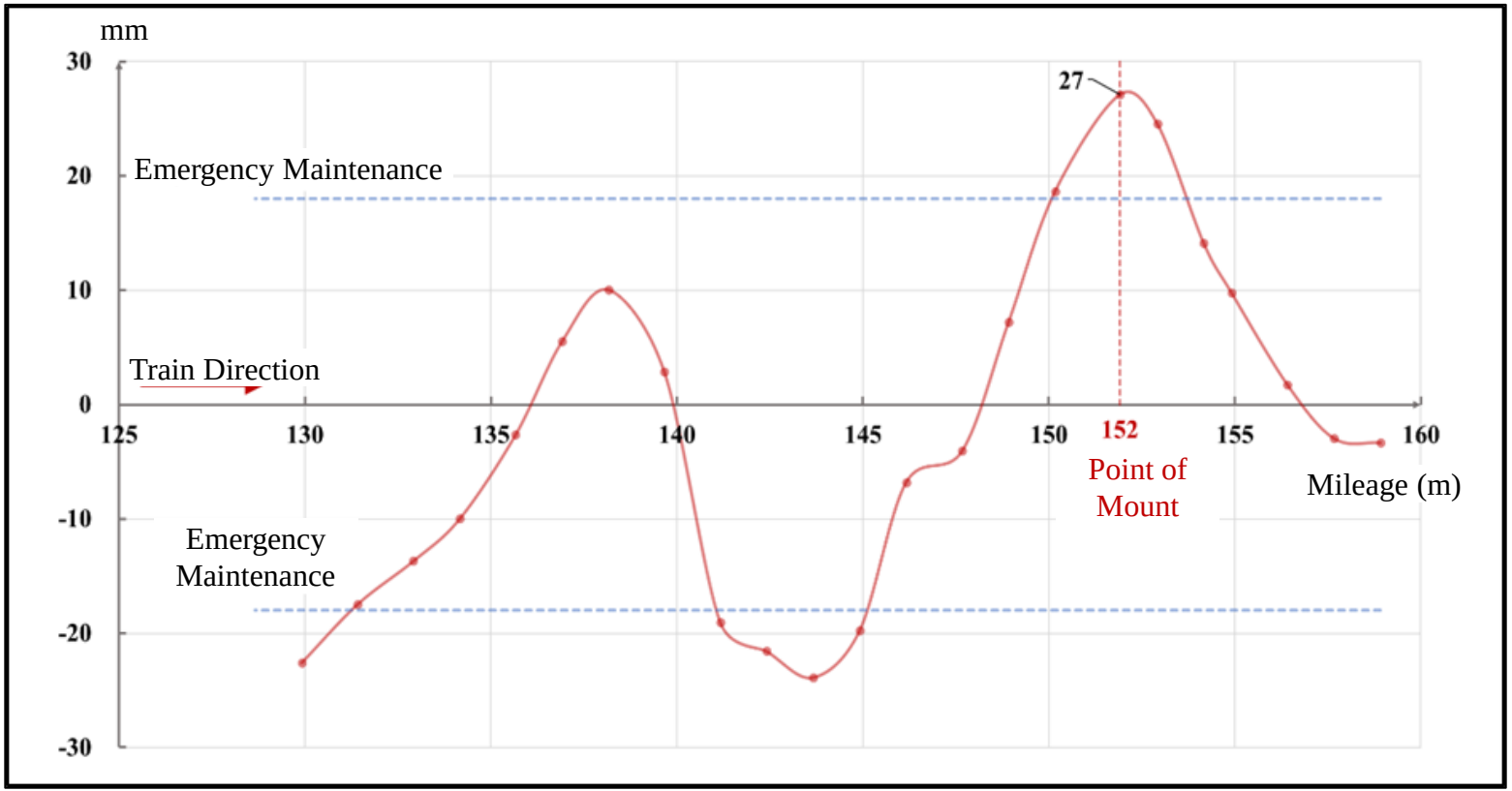
Gauge


mm
1105
1100
1095
1090
1085
1080
1075
1070
Emergency Maintenance
Normal Maintenance
Train Direction
Normal Maintenance
Emergency Maintenance
1,099
130
135
140
145
150
152
155
160
165
170
Point of Mount
Mileage (m)

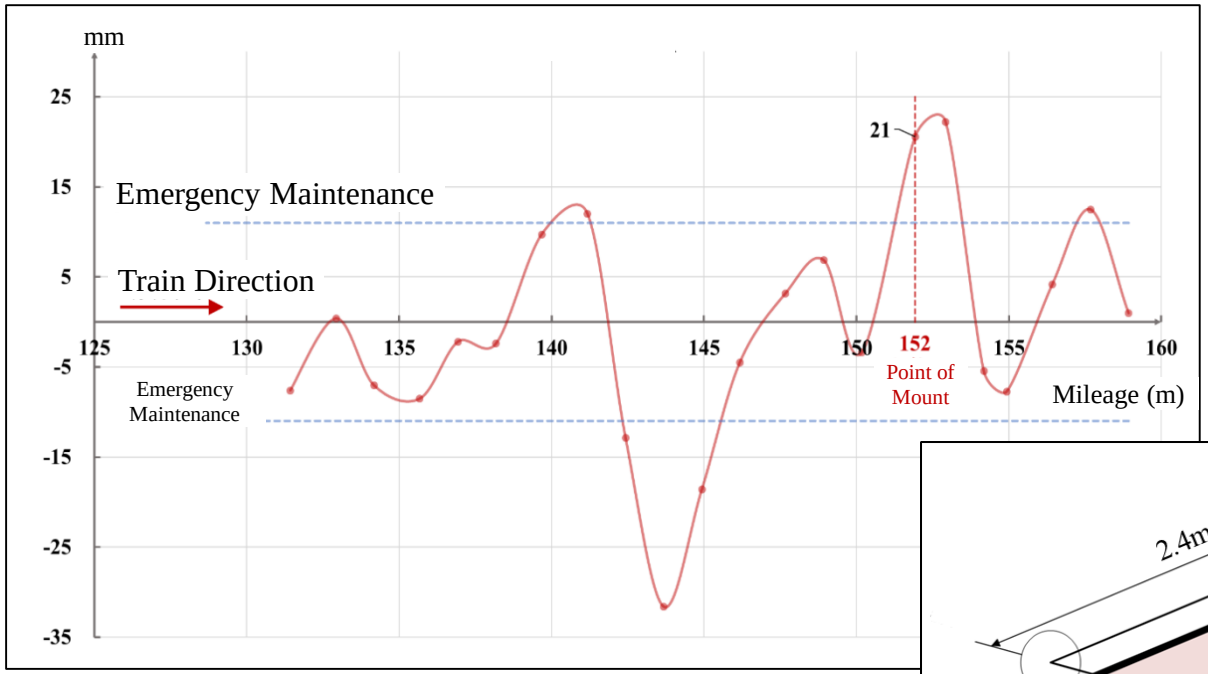
Cant

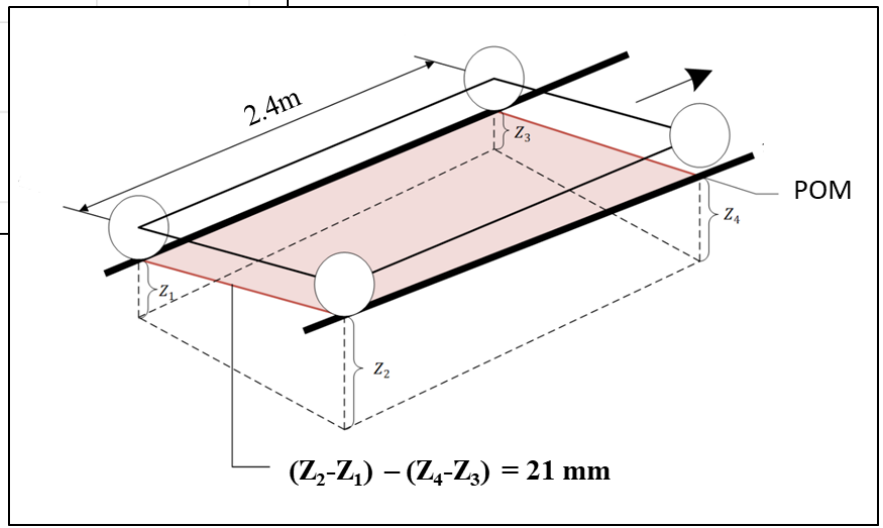

mm
80
70
60
50
40
30
20
55
Normal Maintenance
Train Direction
130
135
140
145
150
152
155
160
165
170
Point of Mount
Mileage (m)
Normal Maintenance

Static Twist

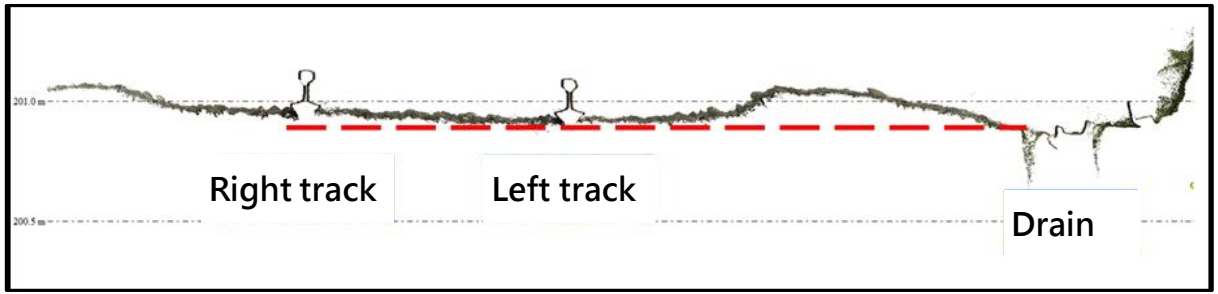


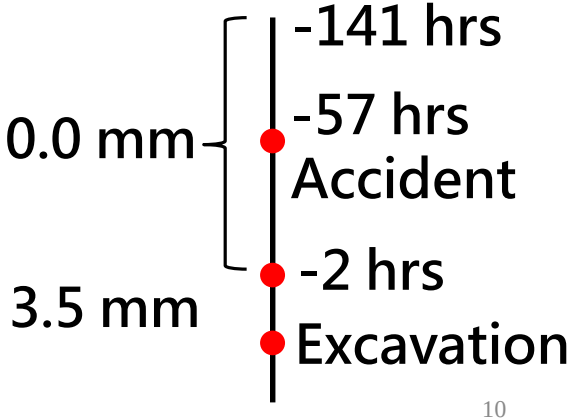
Dynamic Twist





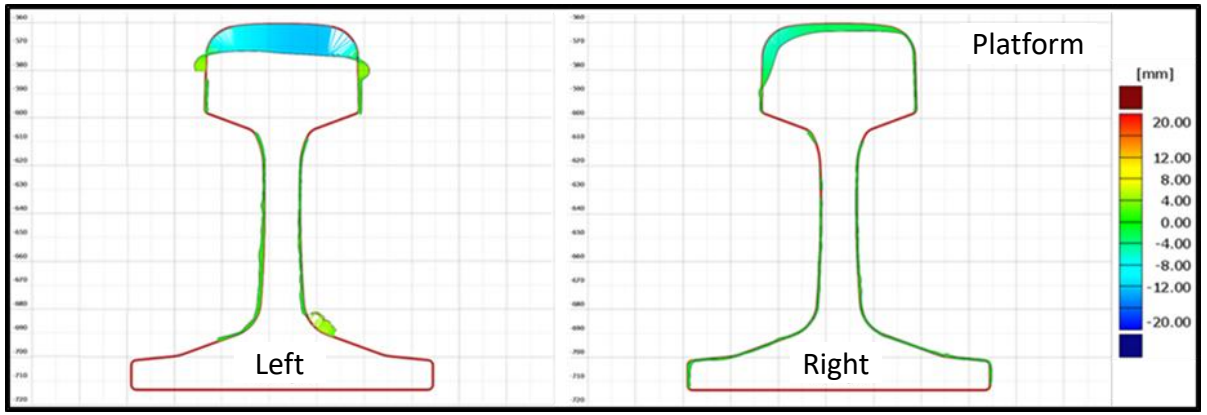
Ballast


Right track
Left track
Drain

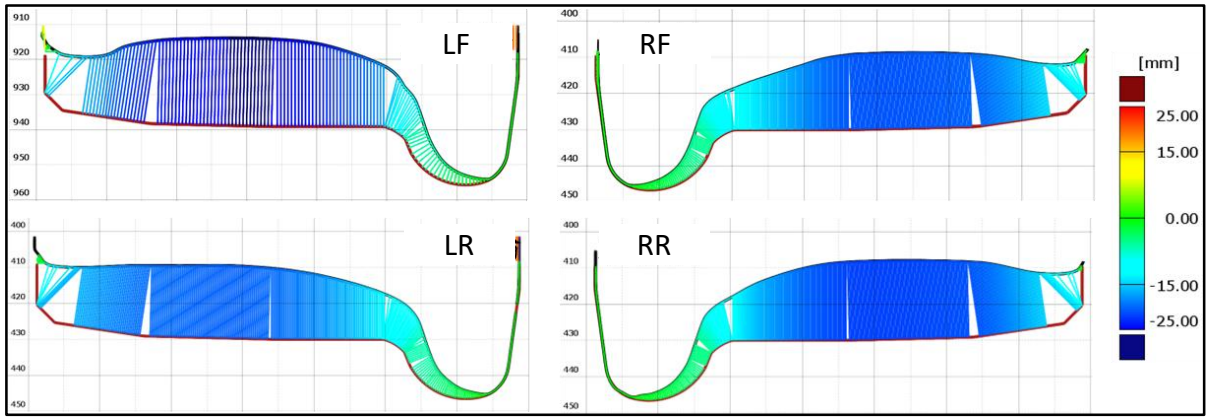

-141 hrs
-57 hrs
Accident
0.0 mm
-2 hrs
3.5 mm
Excavation

Lacer Scan

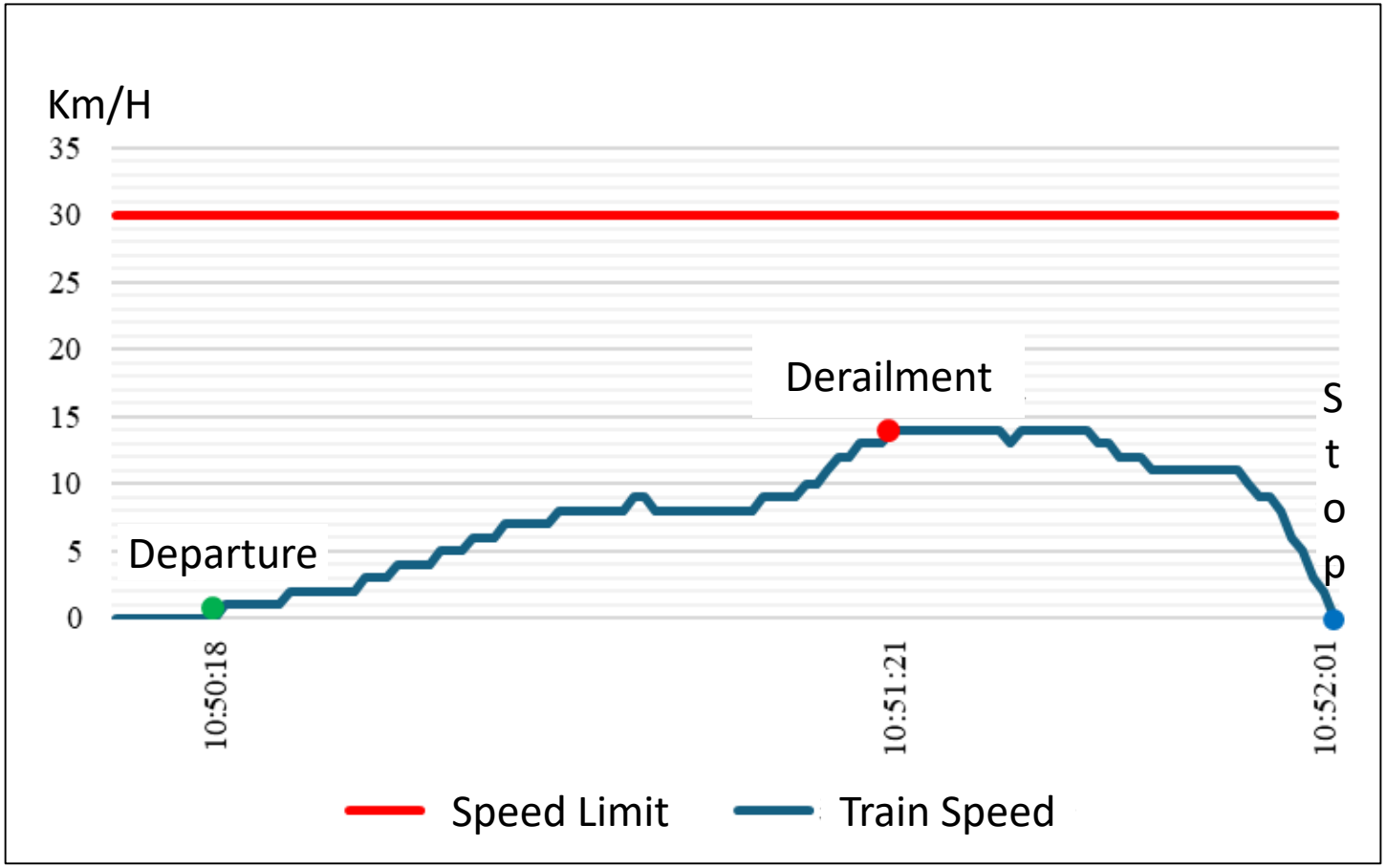
Point of mount



First bogie of the derailed car

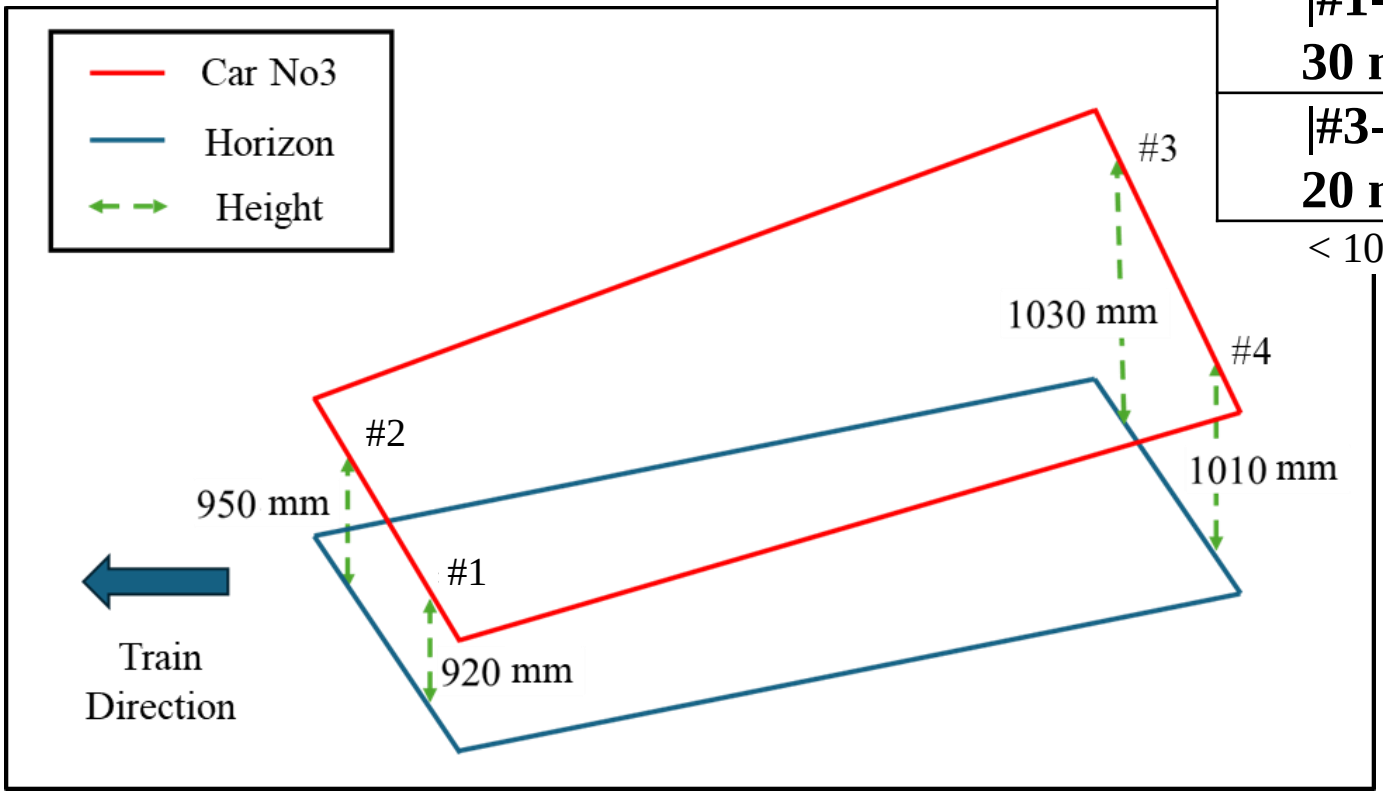


ATP Record


Km/H
35
30
25
20
15
10
5
0
Departure
Derailment
Stop
10:50:18
10:51:21
10:52:01
Speed Limit
Train Speed

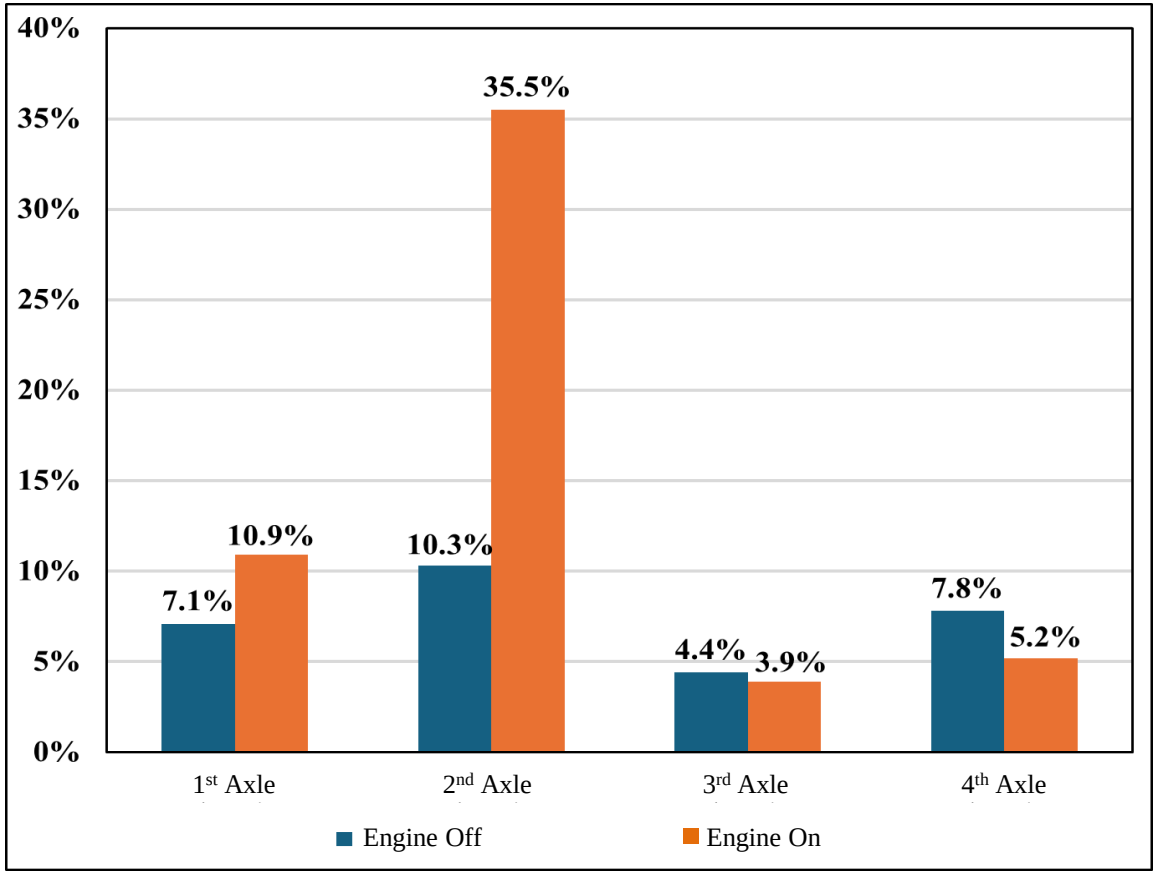
Car Level

Left – Right Difference	Diagonal Difference
|#1-#2|	|#2-#4|
30 mm	60 mm
|#3-#4|	|#1-#3|
20 mm	110 mm
< 10mm	< 20mm

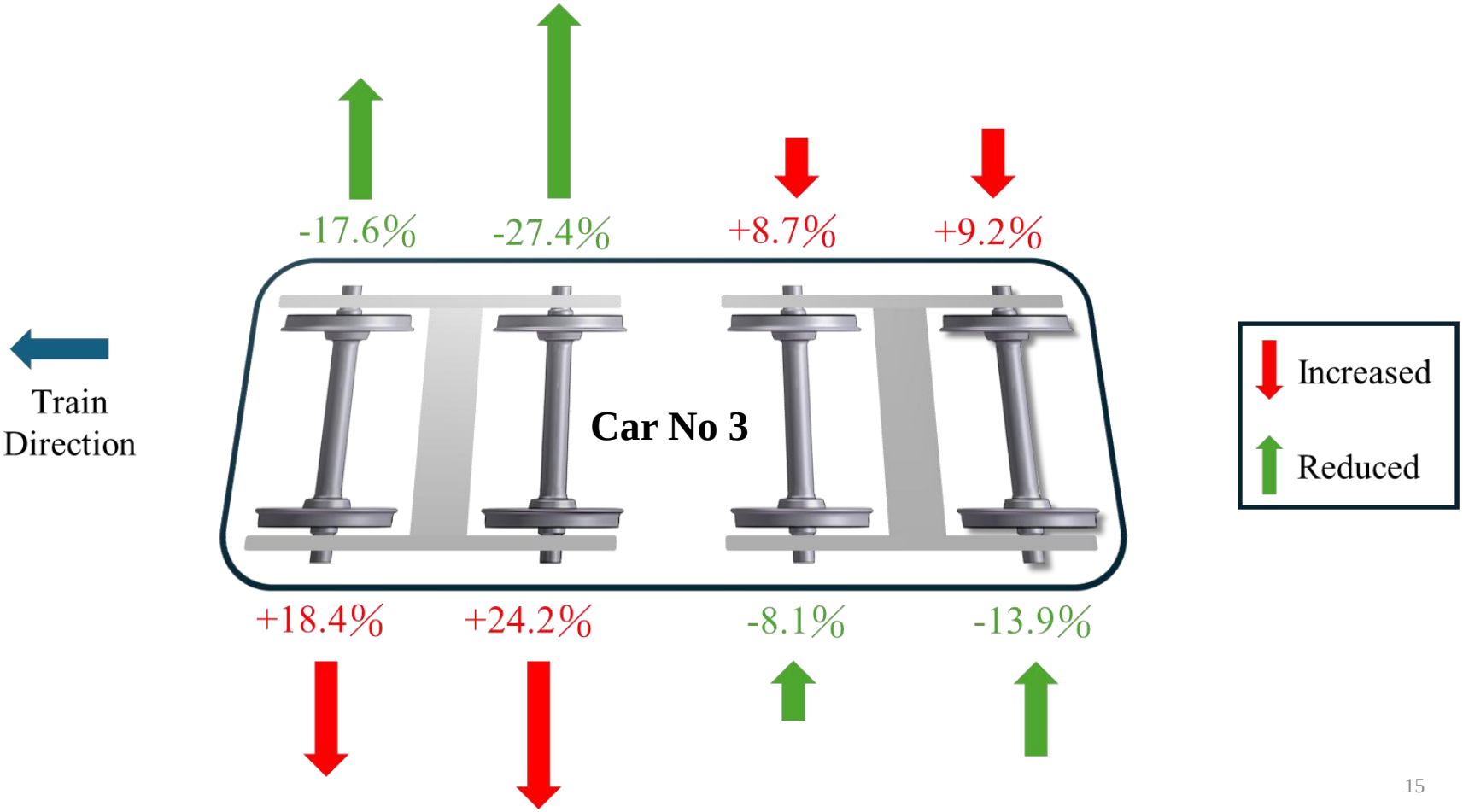


Static Wheel Load Ratio

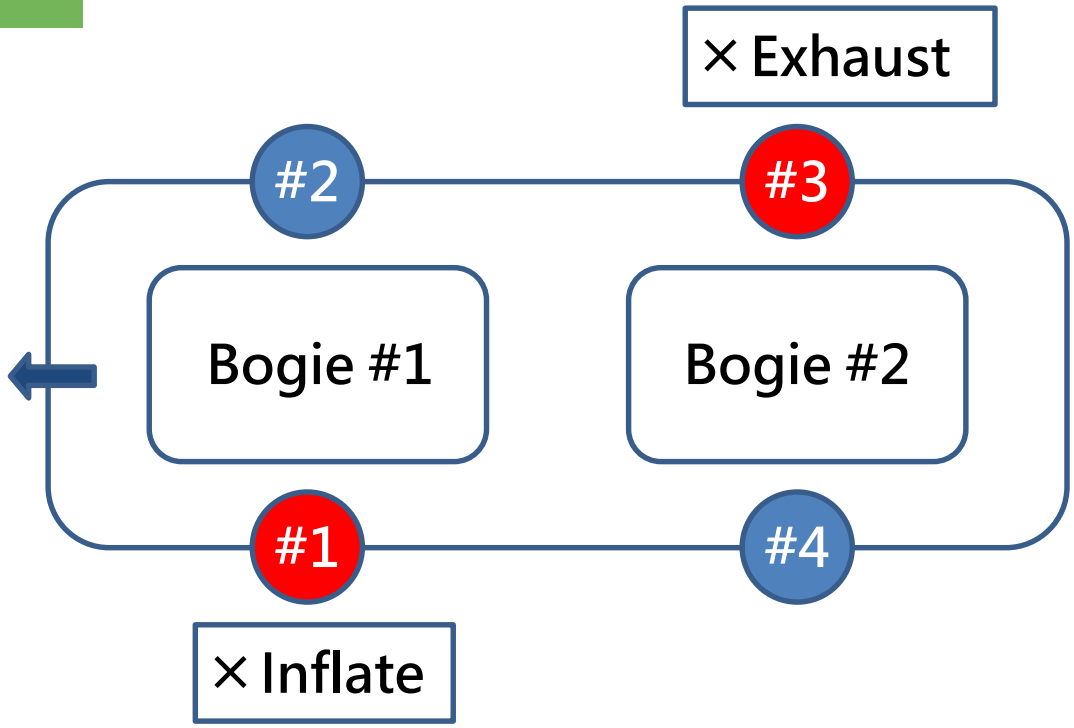
$$\left| 1 - \frac{\text{Single wheel load}}{\text{Average wheel load of both wheels}} \right| \times 100\%$$

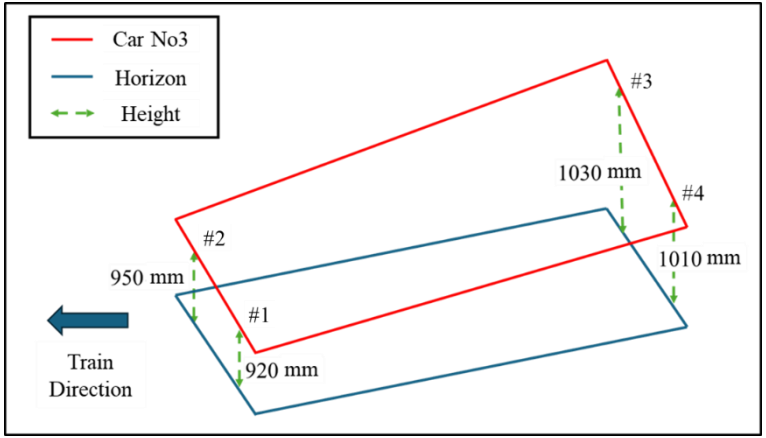


Wheel Load Change Ratio



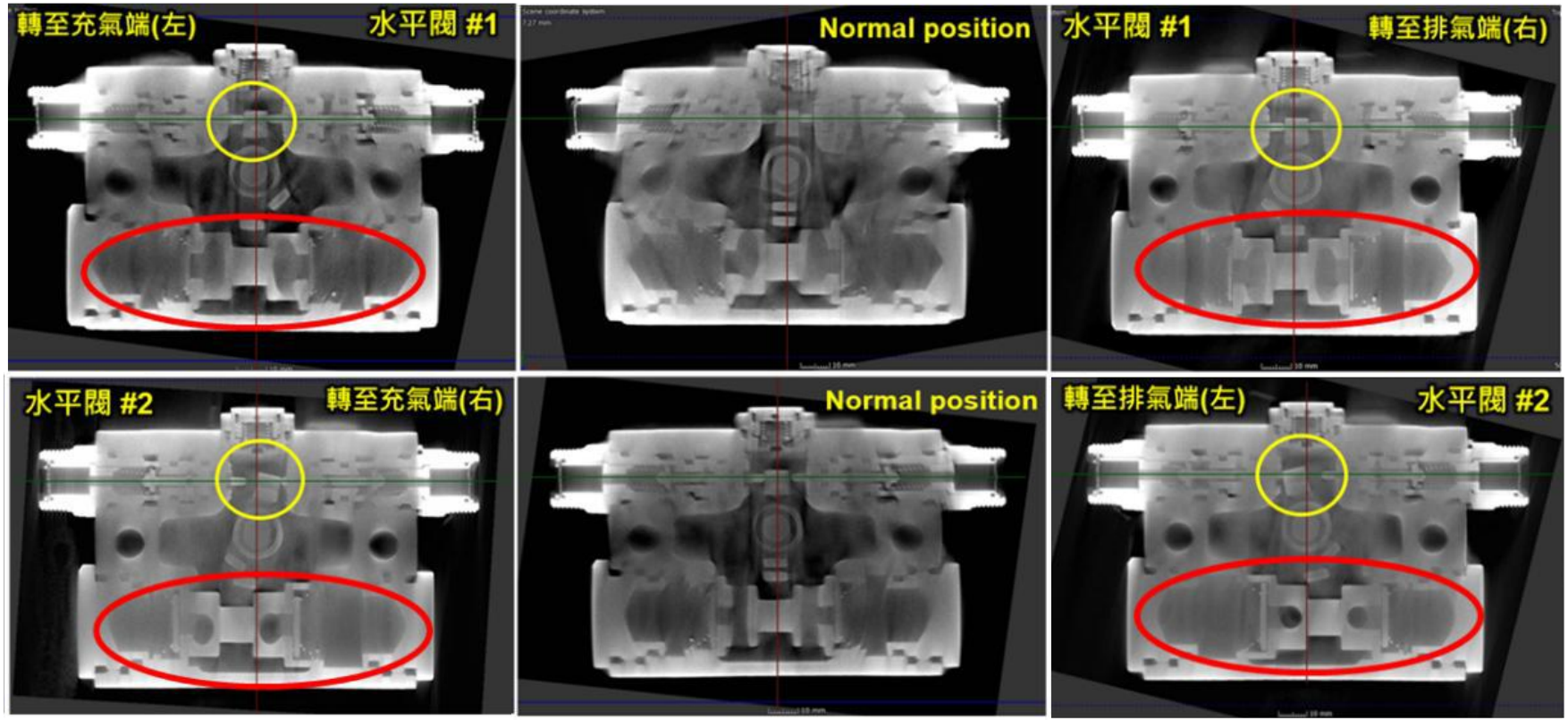
Leveling Valve



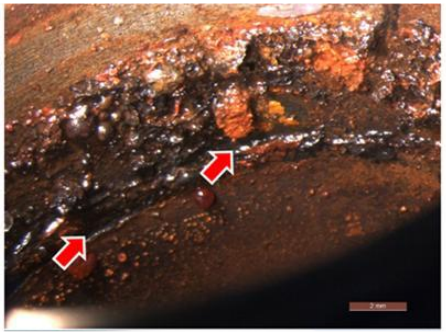


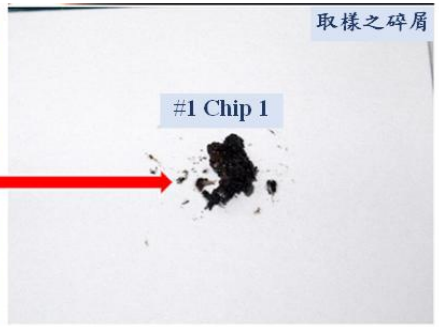
Leveling Valve Failure Analysis

Inflate position | Normal | Exhaust position



Leveling Valve Failure Analysis



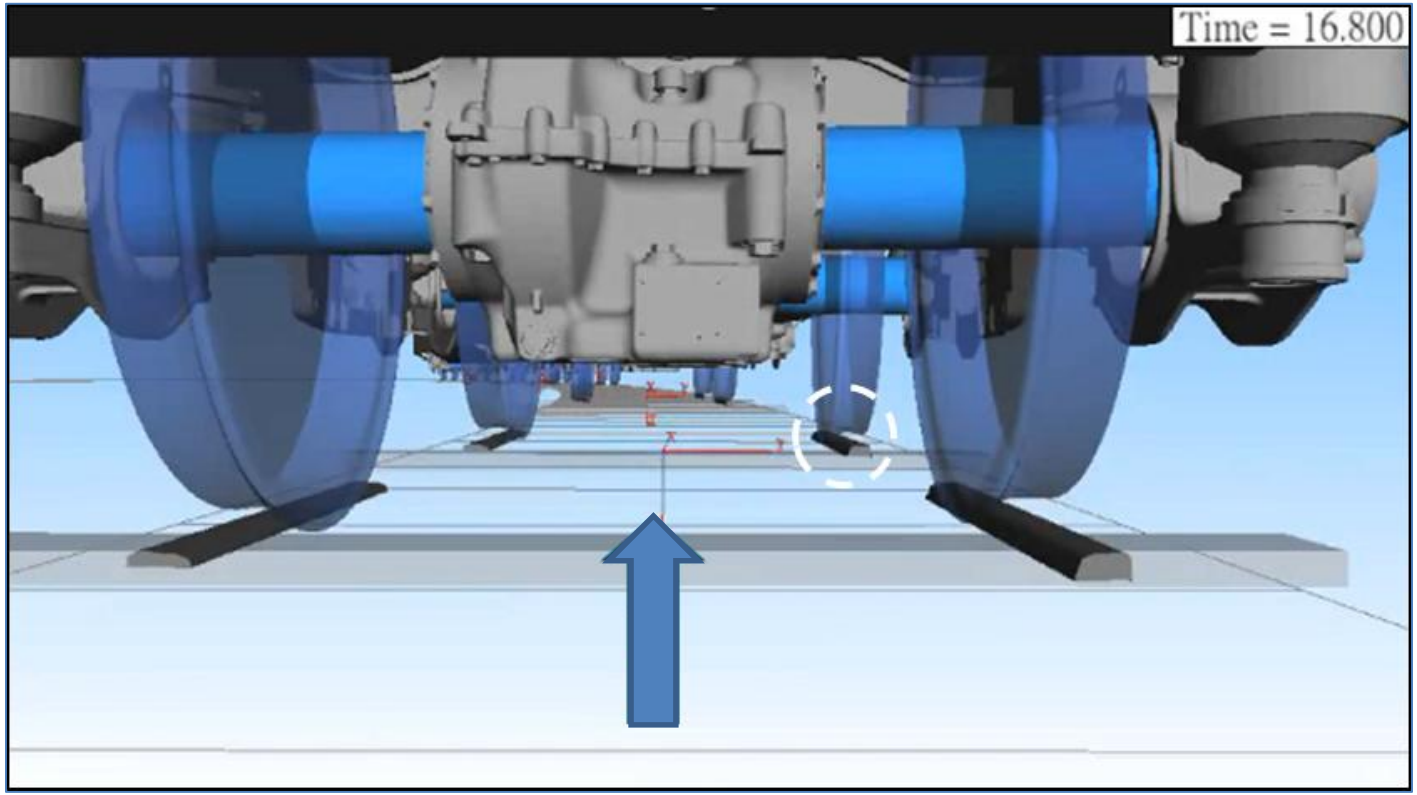


- Rust ➡ Chips ➡ Piston stuck ➡ Leveling valve failure

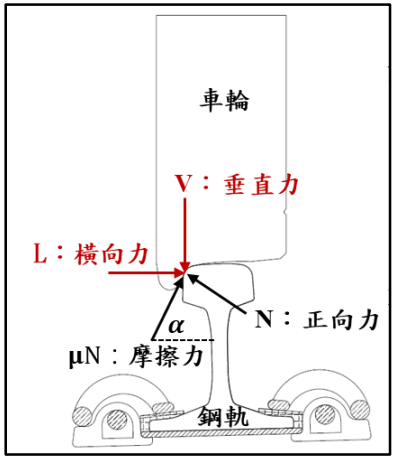
Energy-dispersive X-ray Spectroscopy, EDS

- Chips contain non-metallic elements
  - C、O ➡ Metal corrosion
  - Si ➡ Silicon oil
  - Small amounts of corrosive element: S ➡ From outside

Simpack Rail Simulation



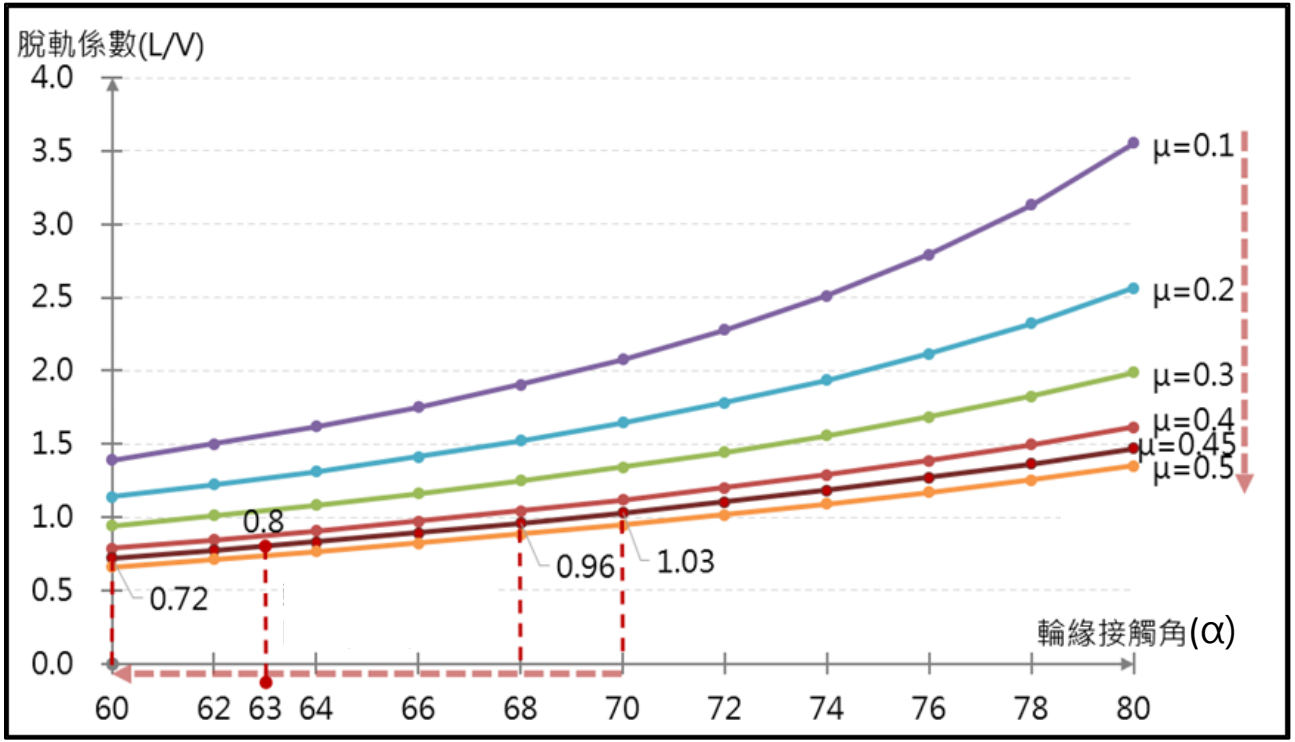
Derailment Coefficient Threshold



Nadal Formula

$$\frac{L}{V} \geqslant \frac{\tan(\alpha)-\mu}{1+\mu\tan(\alpha)}$$

L: Lateral force at wheel flange
V: Vertical load on the wheel
α: wheel flange angle at plane of contact
μ: Coefficient of friction at flange/rail contact point



Findings Related to Probable Causes

Malfunction of the air spring leveling valves (#1 & #3)

+

Poor track geometry (Twist)

+

No guard rail

+

The minimum derailment coefficient threshold dropped below international safety standards

Findings Related to Risk

No guard rail

- Inconsistent installation criteria
  - Mainline track curve radius is less than 400 meters.
  - The line shall be designated for both passenger and freight operations, and classified as a commuter electrified railway corridor.
- The TRC's interpretation
- TRC also thought:
  - Train speed is low when arriving and departing Lingjiao Station.

Findings Related to Risk

Rolling Stock

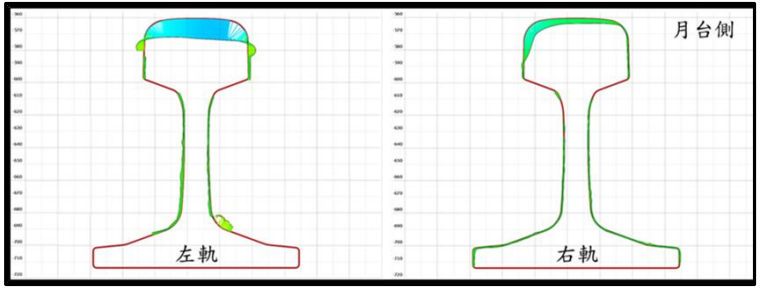
- No wheel load management measures

Track

- Post-maintenance inspections are conducted only at isolated points
- No established time limits
- Ineffective drainage

Findings Related to Risk

- The TRC's inspection systems are unable to detect the reduction rate of rail cross-sectional area, from Category A inspections to routine track patrols.



- The Railway Bureau's periodic and non-periodic inspection frequencies on the Pingxi Branch Line were insufficient to identify this segment as high-risk promptly and to mandate corrective action from the TRC.

Safety Recommendations

To the Ministry of Transportation and Communication

- Review and revise the "Track Maintenance and Inspection Regulations for 1067 mm Gauge" to clearly define the criteria for guard rail installation and to include standards for railhead wear.

To the Railway Bureau

- Review and strengthen the inspection mechanisms for both track maintenance on the Pingxi Branch Line and maintenance practices of DRC1000 series rolling stock.

Safety Recommendations

To the Taiwan Railway Corporation, Ltd.

- Evaluate incorporating wheel load as a vehicle maintenance indicator and establishing a wheel load management system.
- Improve drainage functionality along the Pingxi Branch Line.
- Establish repair deadlines for rectifying track irregularities exceeding emergency maintenance thresholds and reinforce post-maintenance inspection procedures.
- Review and improve rail wear inspection methods to ensure compliance with regulatory standards.

Thank you for your attention

Executive Summary in English

Full report in
Traditional Chinese

國 家 運 輸 安 全 調 查 委 員 會
Taiwan Transportation Safety Board