



Topic: Adaptation of SMART Maintenance Technologies to Support SMART Railway Operations

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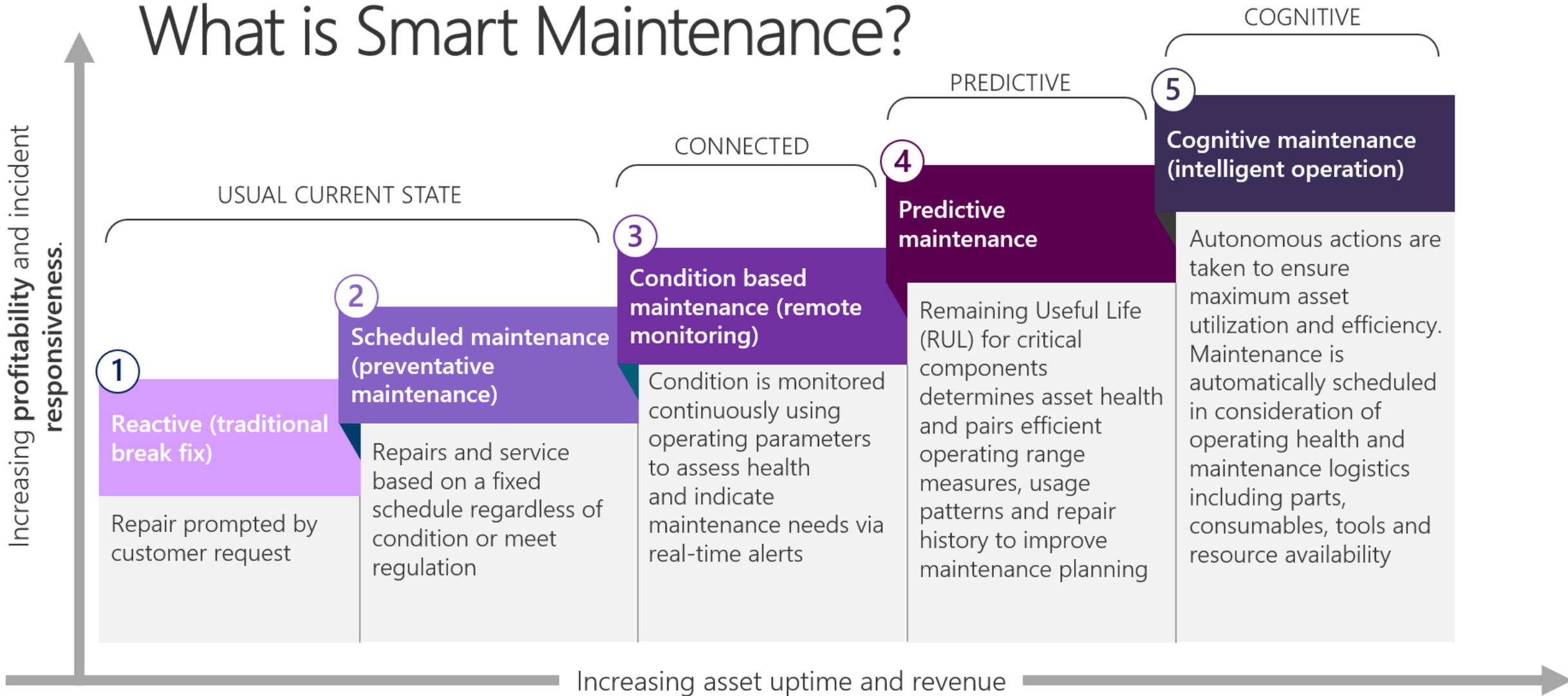


SMART Railway Operations

SMART is defined as **S**elf-**M**onitoring,
Analysis and **R**eporting **T**echnology



What is Smart Maintenance?

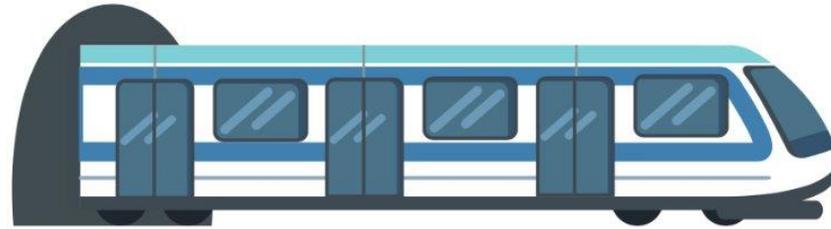


Why are these initiatives being implemented?



Streamline the workforce

Handheld devices are supporting the workforce in their duties, increasing productivity and streamlining data recording



Increase capacity

Advances in ERTMS, ETCS, GSM-R, CBTC and DAS can improve passenger and freight performance



Improve reliability of assets (Infrastructure and Rolling Stock)

Predictive maintenance and condition-based monitoring techniques can greatly reduce the downtime of assets

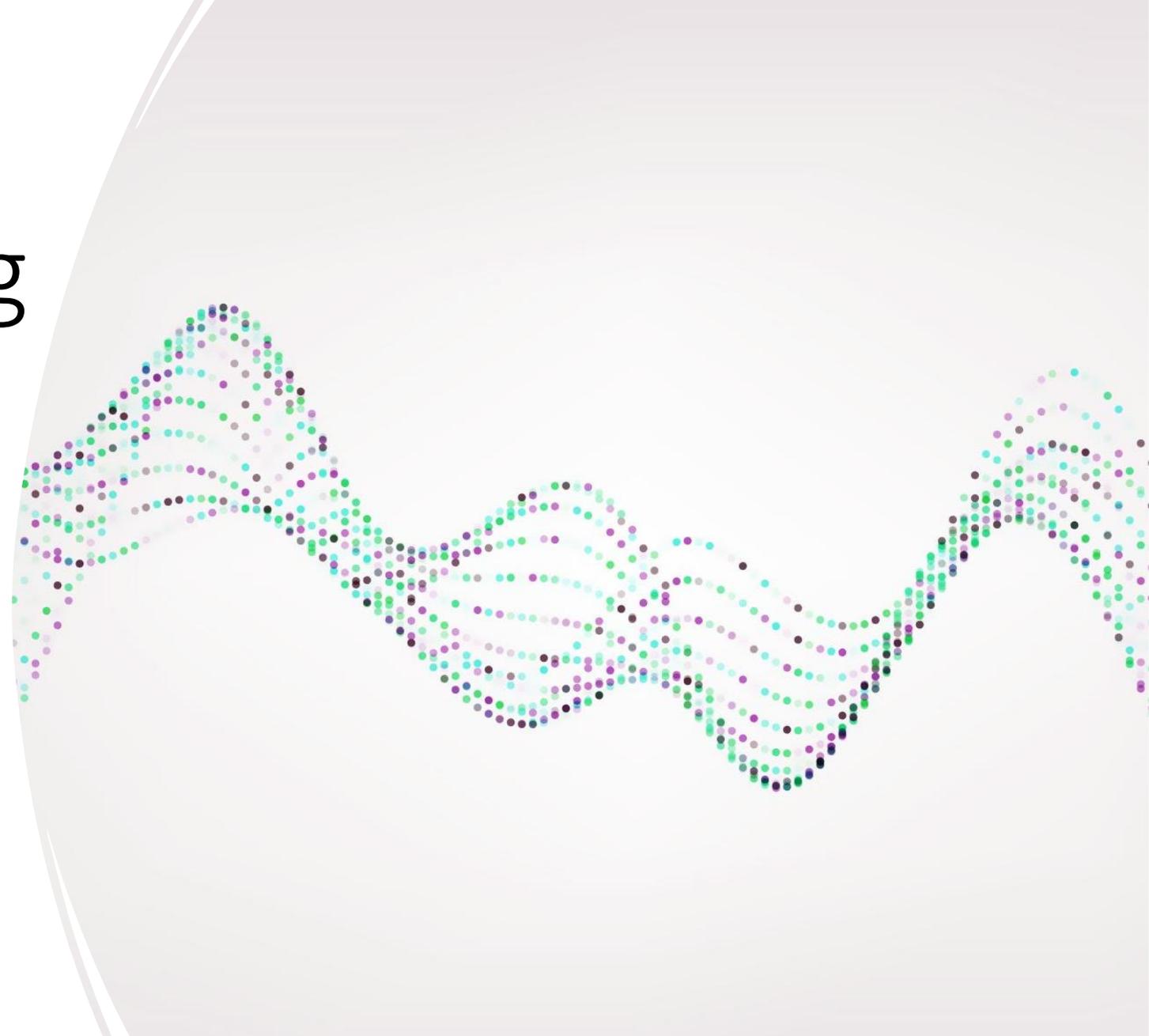
Deliver real-time accuracy

Smart systems can accurately monitor the health of our rail systems and help to reduce maintenance costs



Railway Signalling

Communication Based Train Control
– High Speed Rail, Metro & Light Rail
in Hong Kong



1. Data acquisition and transmission

Connected train



Integration layer



Data warehouse



4. Maintenance execution

2. Data analytics and user interface

Maintenance operations on infrastructure assets



CMMS - maintenance planning



Events, anomalies, alerts



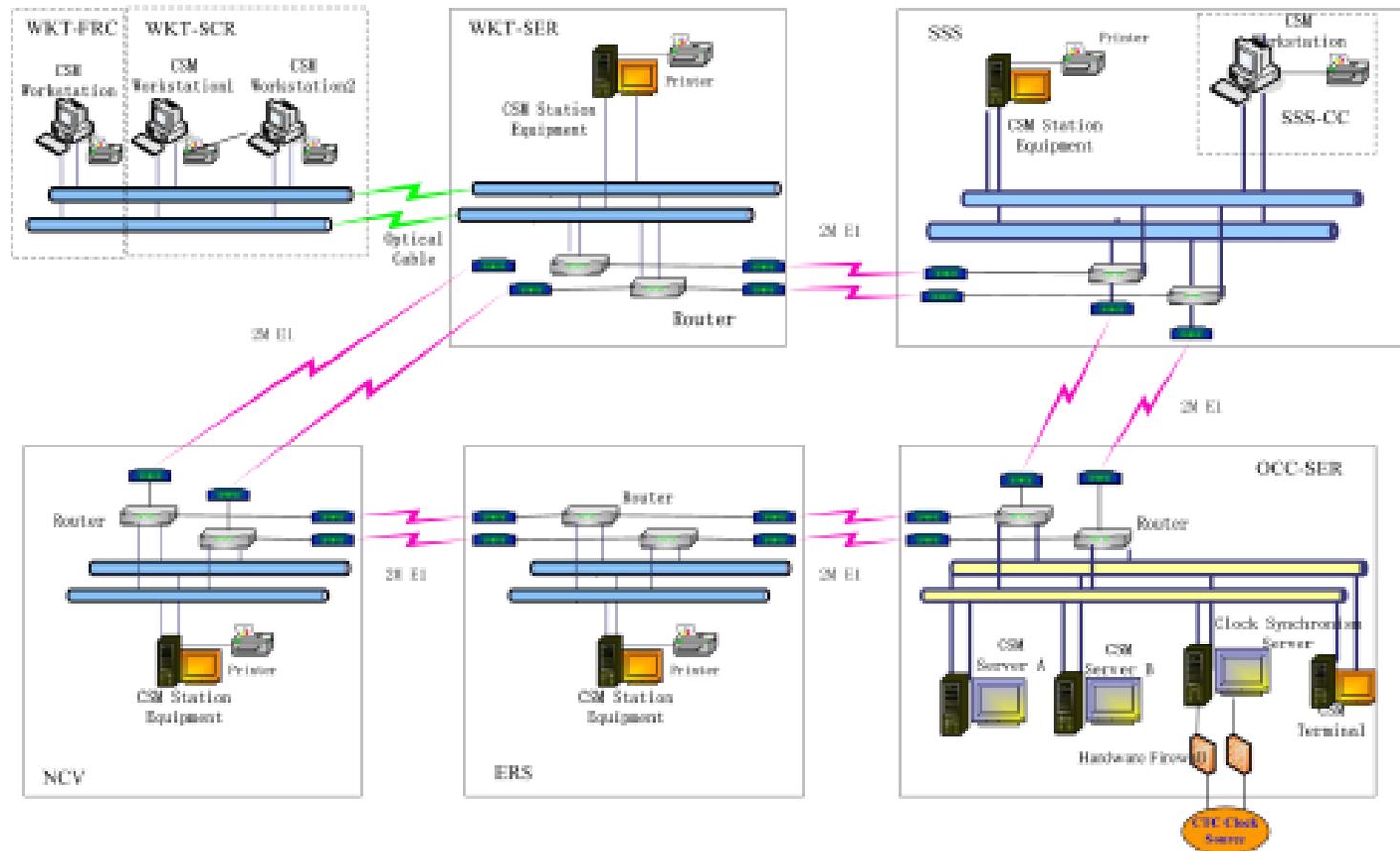
Data analysis

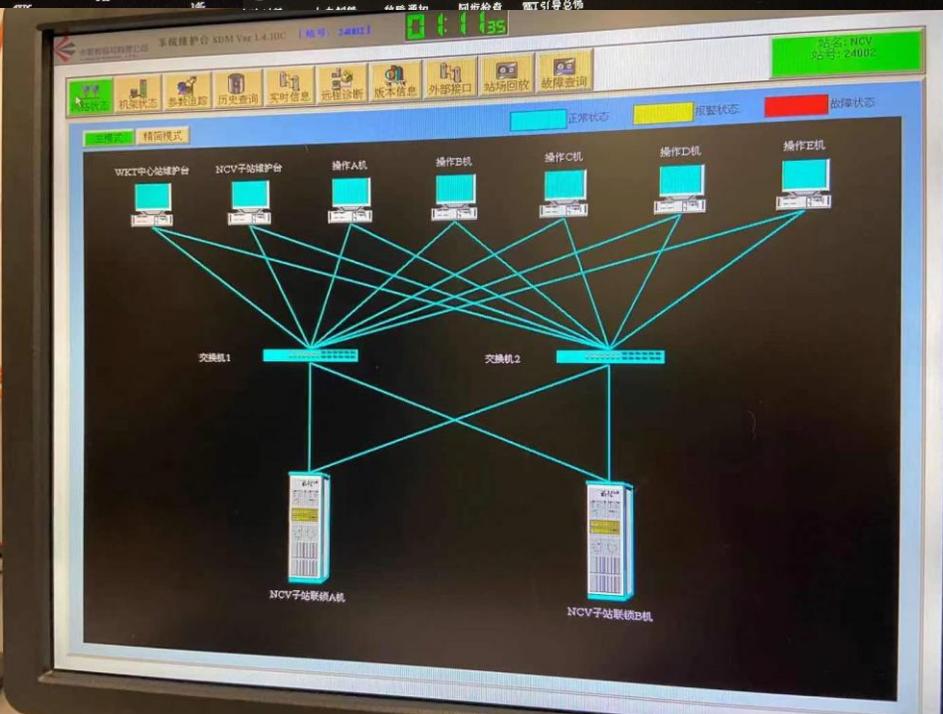
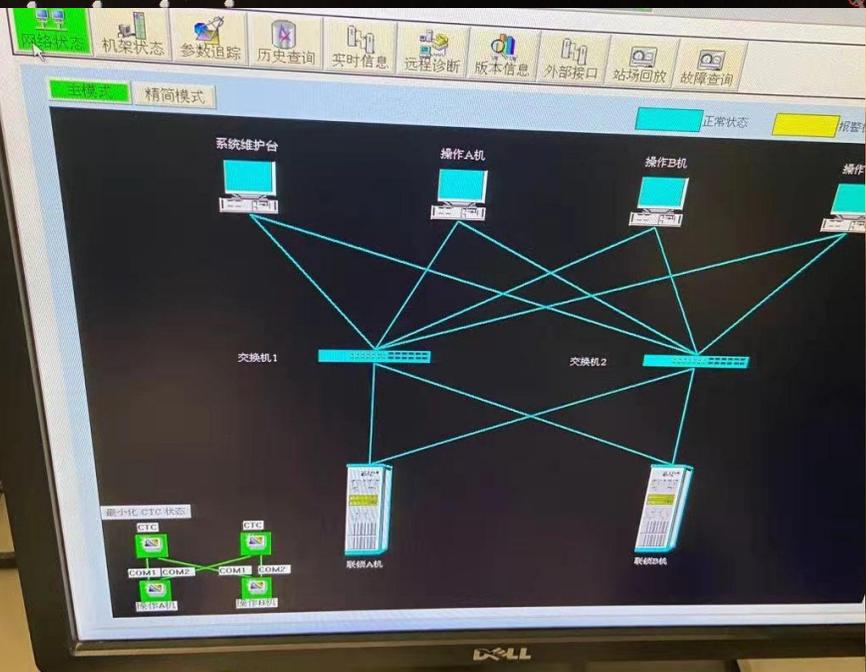
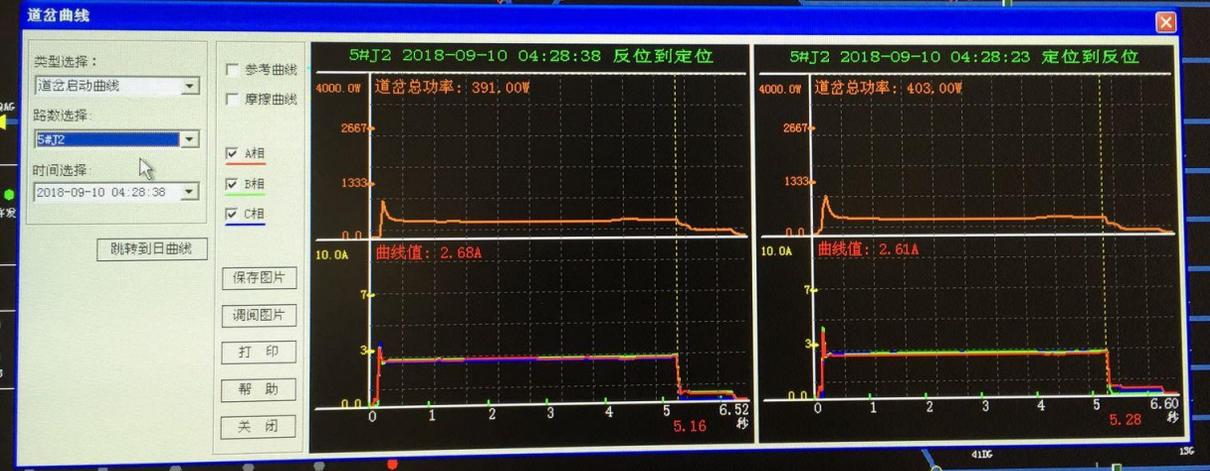
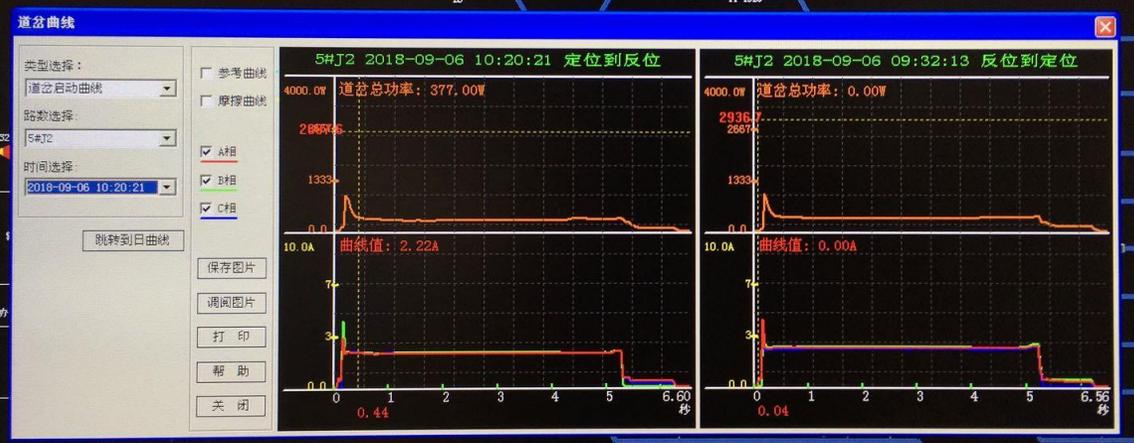
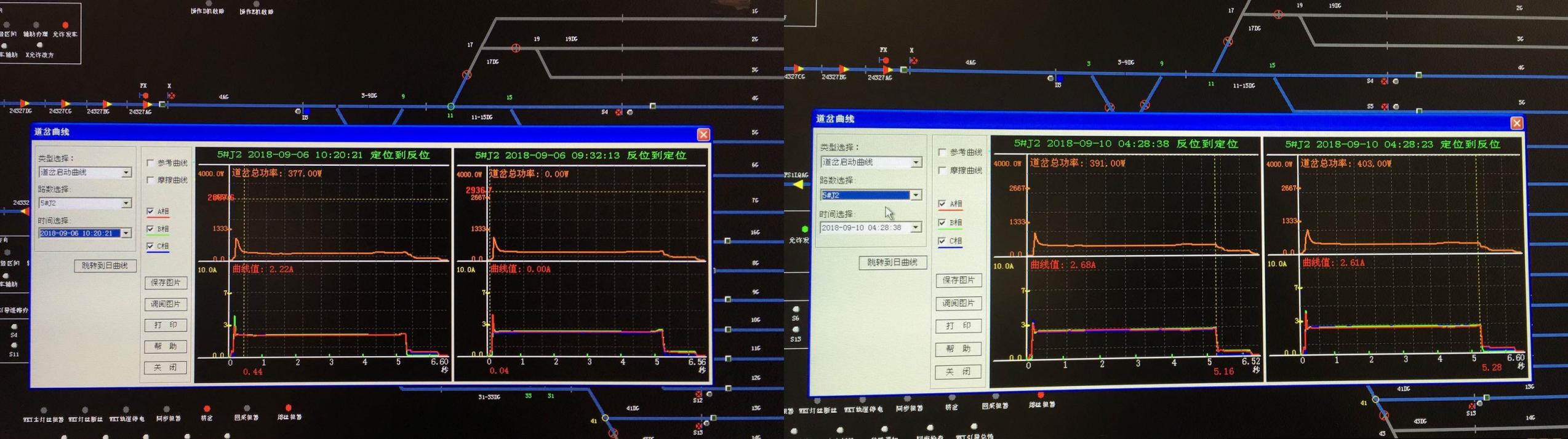


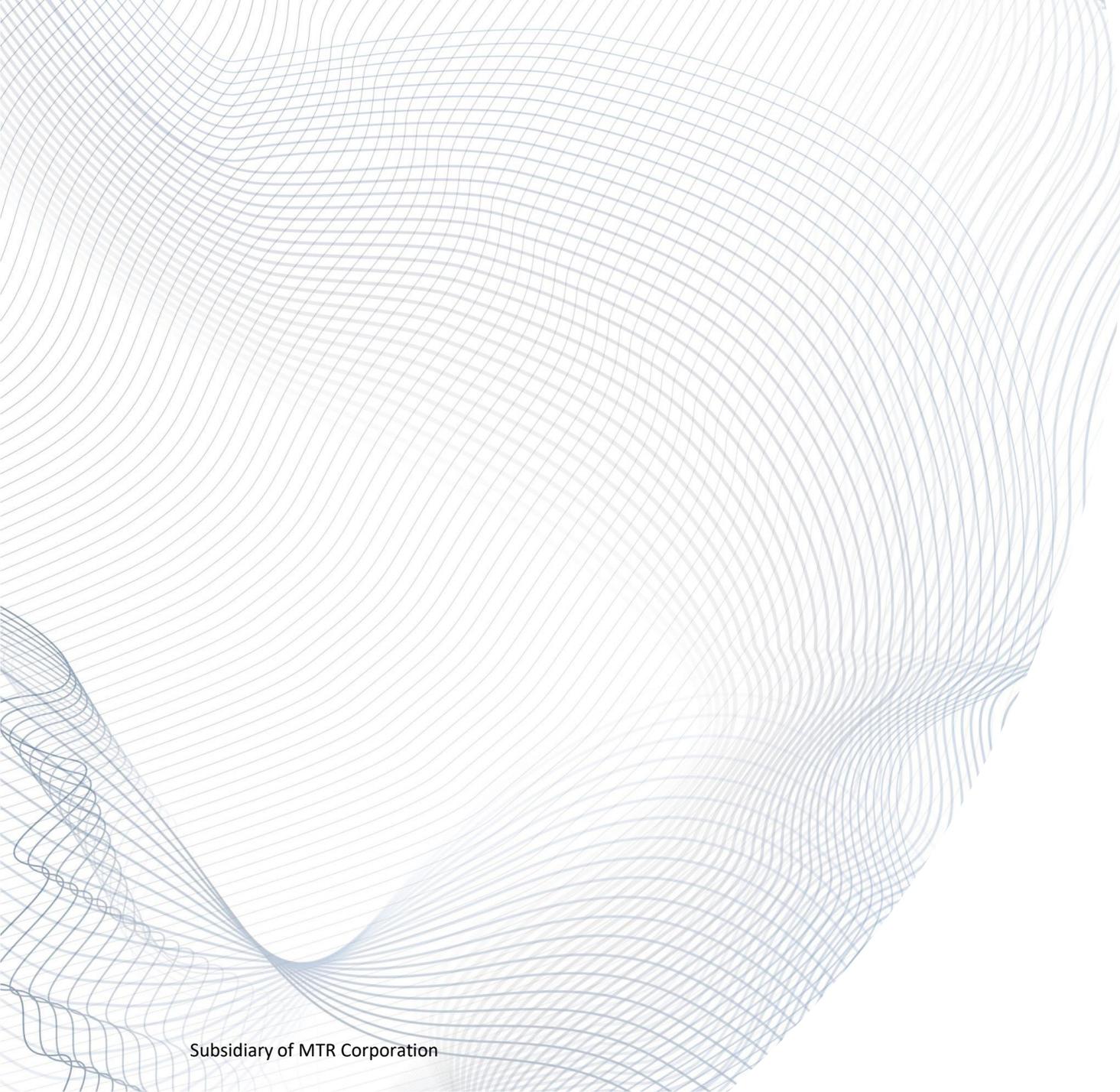
3. Maintenance management

Centralized Signalling Monitoring System (CSM)

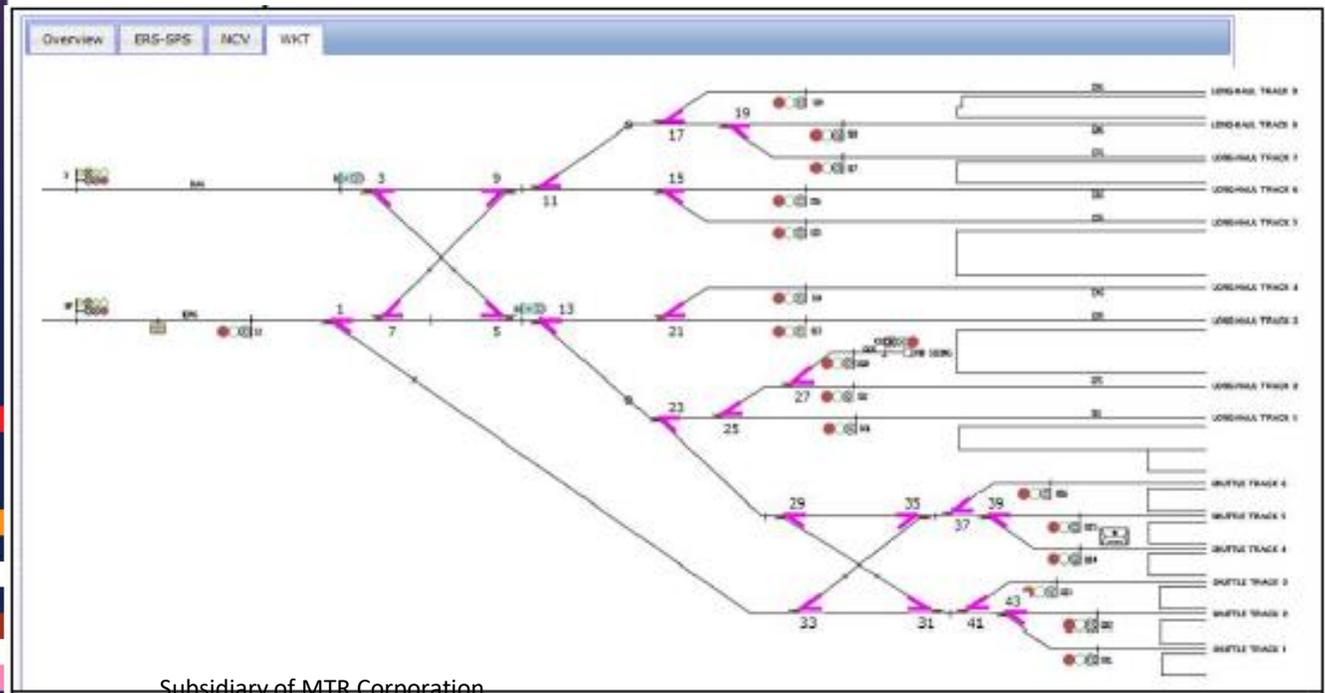
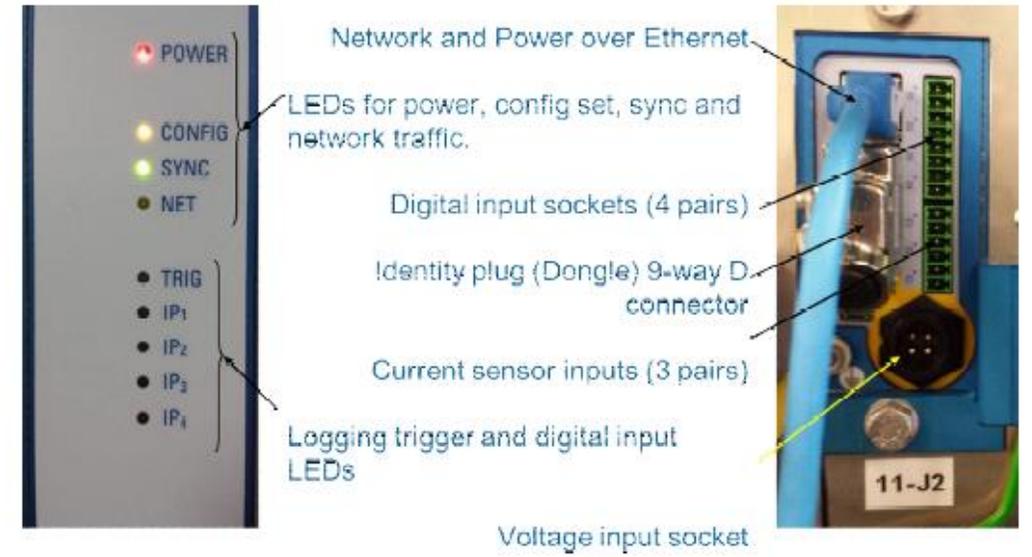
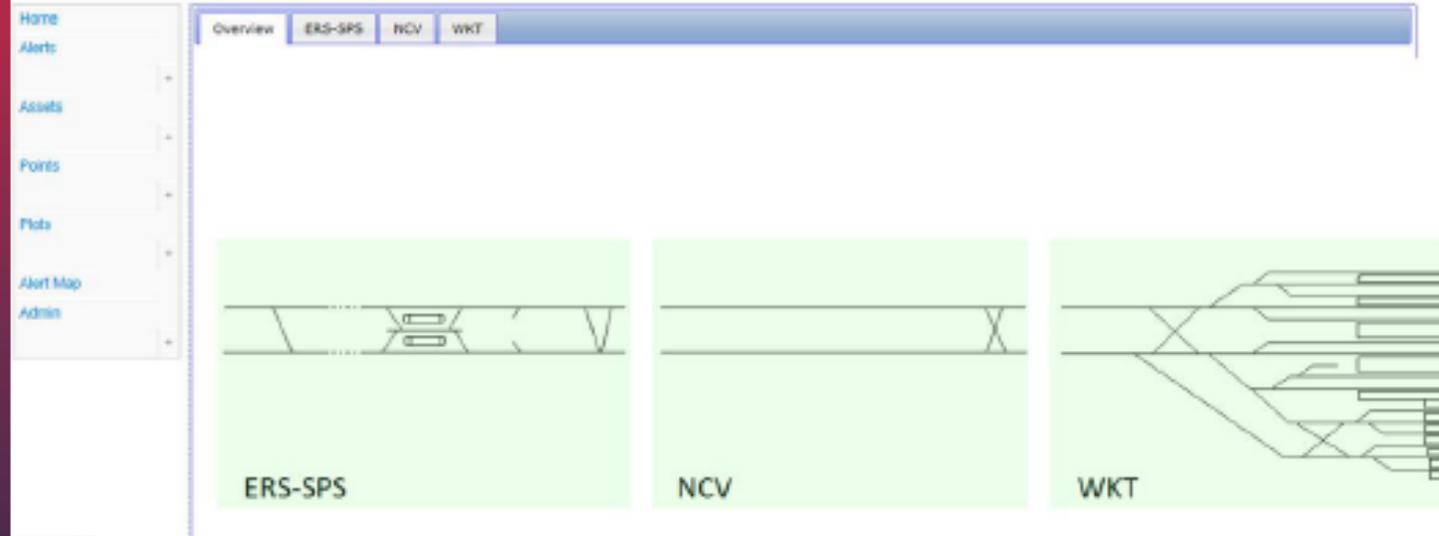
- CSM will be used to monitor and gather the status of TCC, Track Circuit, CBI, CTC, Point Machine, Power Supply, Signal, signal cable, etc. TCC, ZPW-2000A Track Circuit, CBI, CTC, Power Supply, etc will send the self monitoring information to CSM, including analog quantity, digital value, status information alarm information, etc, to realize centralized monitoring and remote diagnose, and to avoid gathering duplicated information.
- Monitoring method includes gathering, indication, storage, playback, remote test and monitoring, etc.



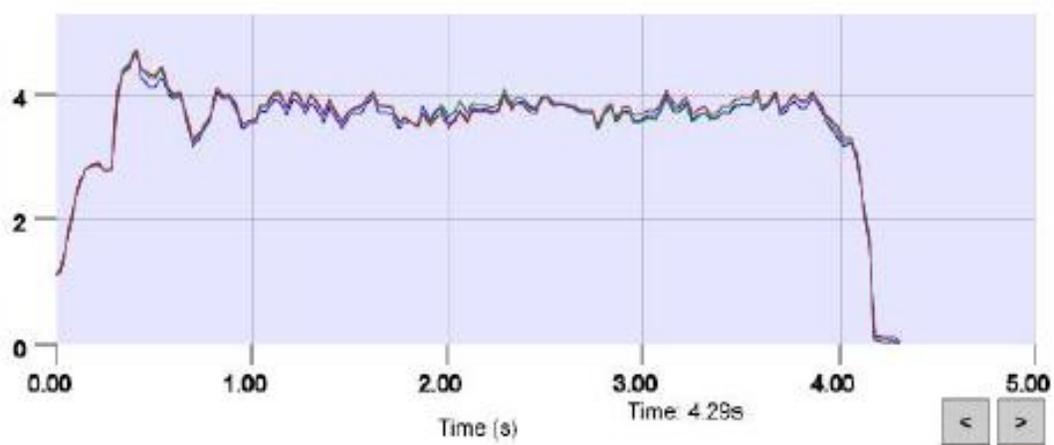




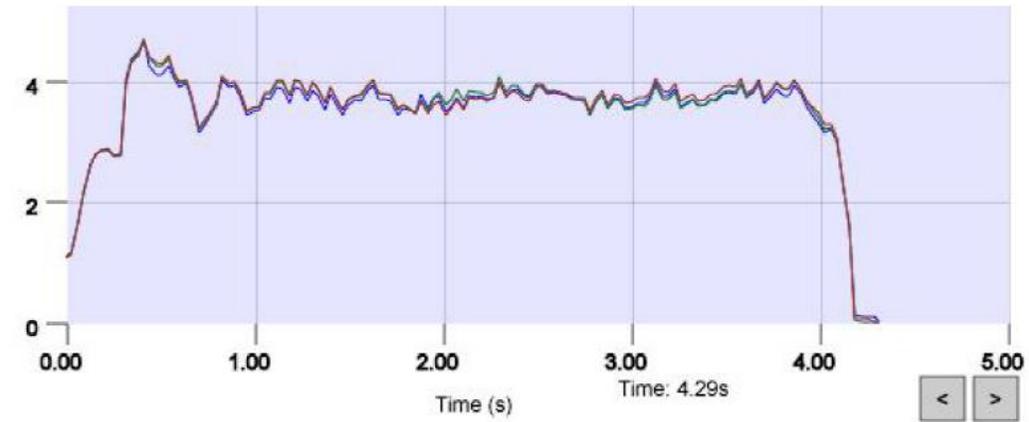
Point Monitoring System (PMS)



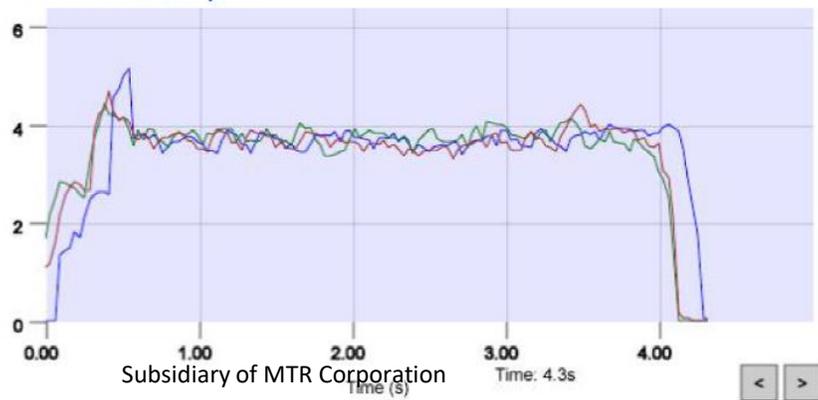
Graphic	Meaning	Explanation
	Not monitored	When a point end is not subject to monitoring there will be no associated graphics.
	Normal setting, no alert	The points are set normal (example shown is left hand switch normally closed) and working correctly.
	Reverse setting, no alert	The points are set reverse (example shown is left hand switch normally closed) and working correctly.
	No setting, alert raised	The points are not set correctly in either position. When an alert is raised (even when the points are detected correctly and shown in black) the point number will be shown with a background corresponding to the highest level of alert currently in progress.



Good Profile



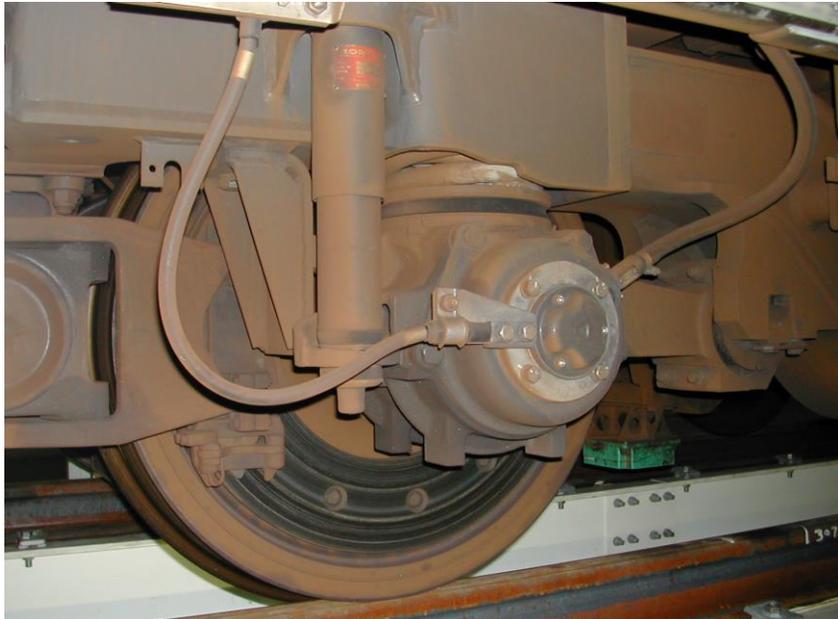
Practice Graphs



Subsidiary of MTR Corporation



Tacho Meter, Onboard Computer, Event Recorder, Train Integrity, Train Lines...

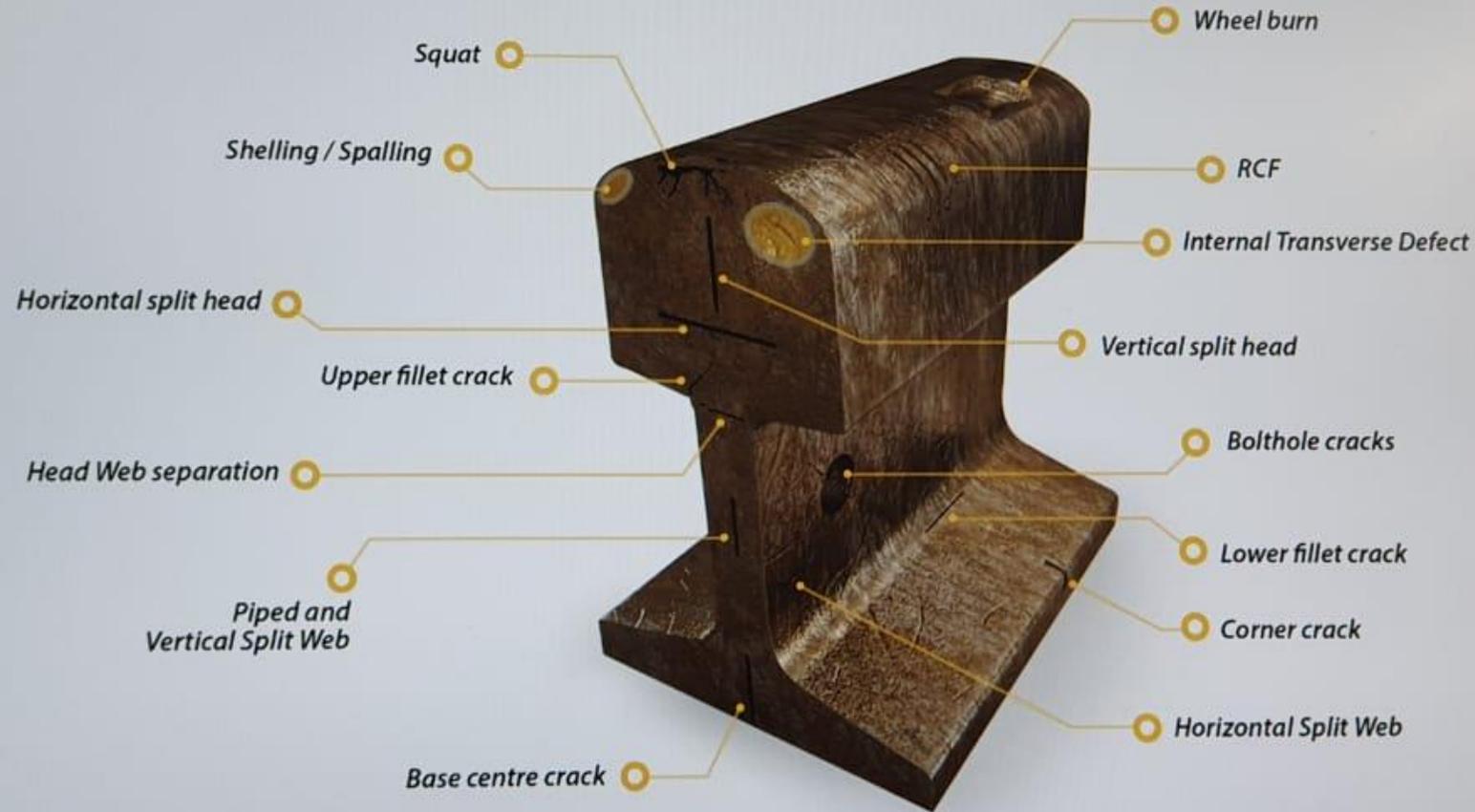


Subsidiary of MTR Corporation



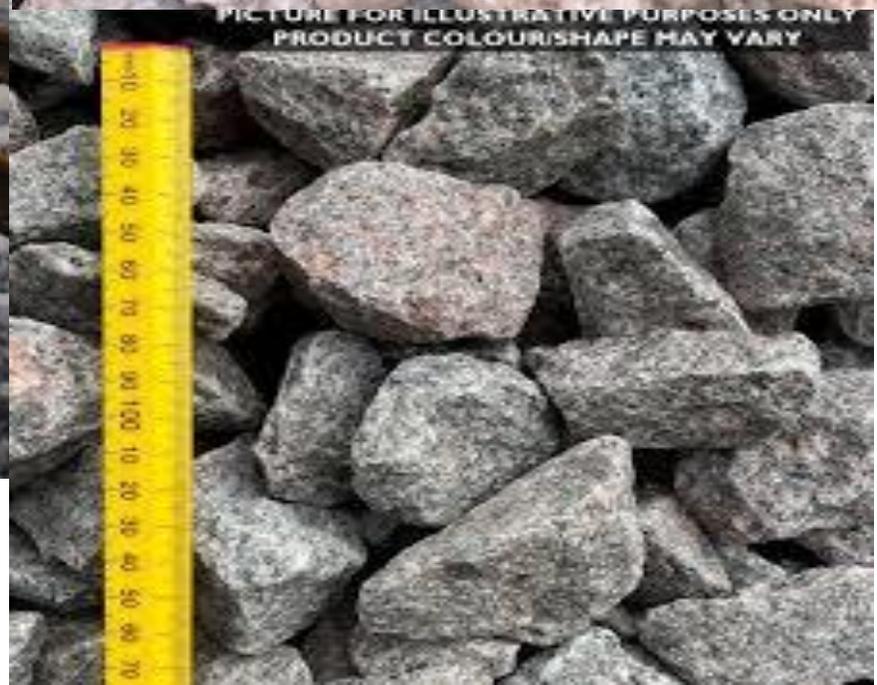
Permanent Way and Rolling Stock Maintenance

Rail Defects



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Ballast Track – Ballast Standard

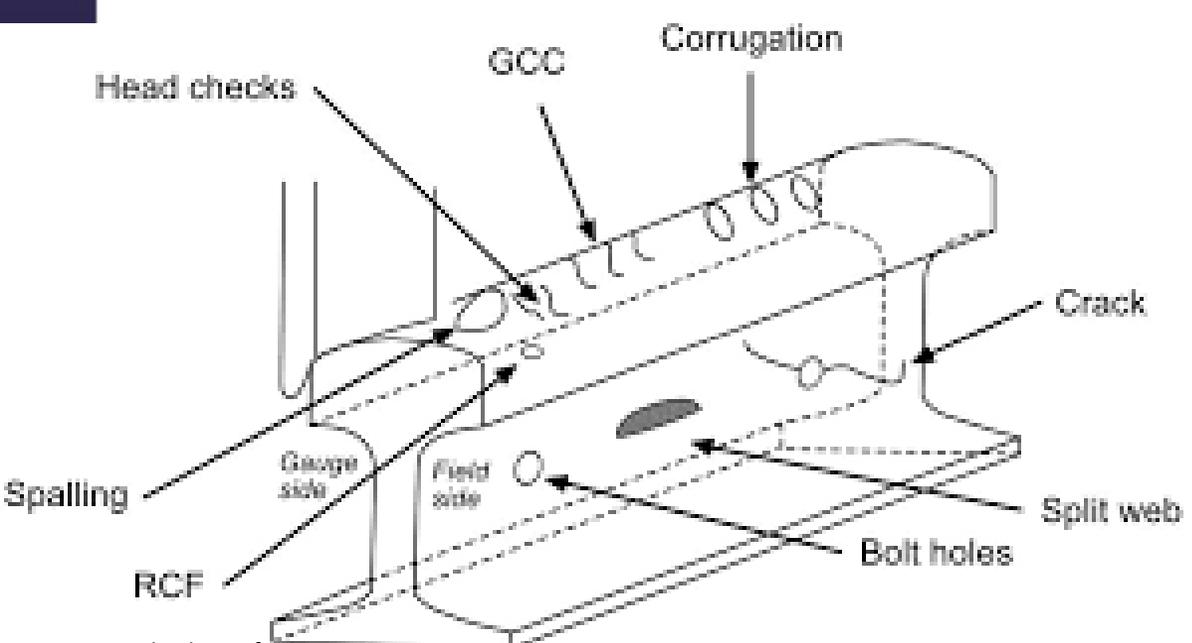
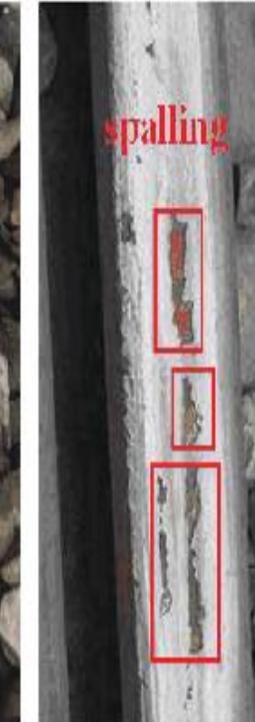
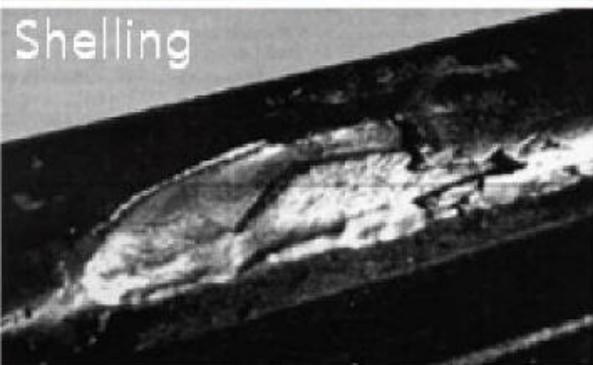


Broken Rail

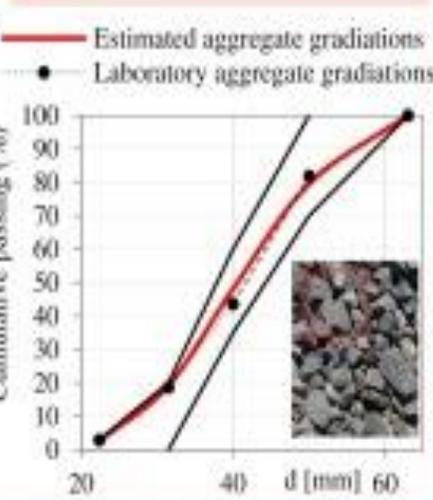
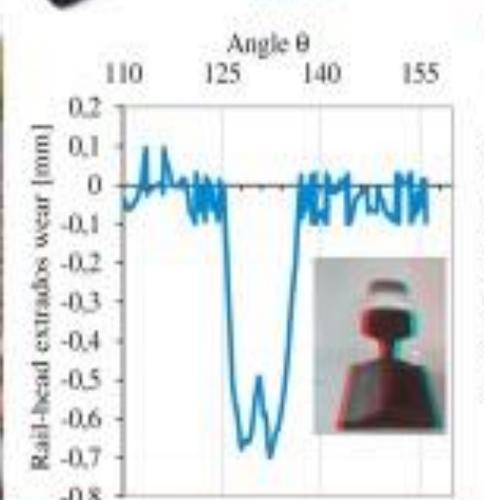


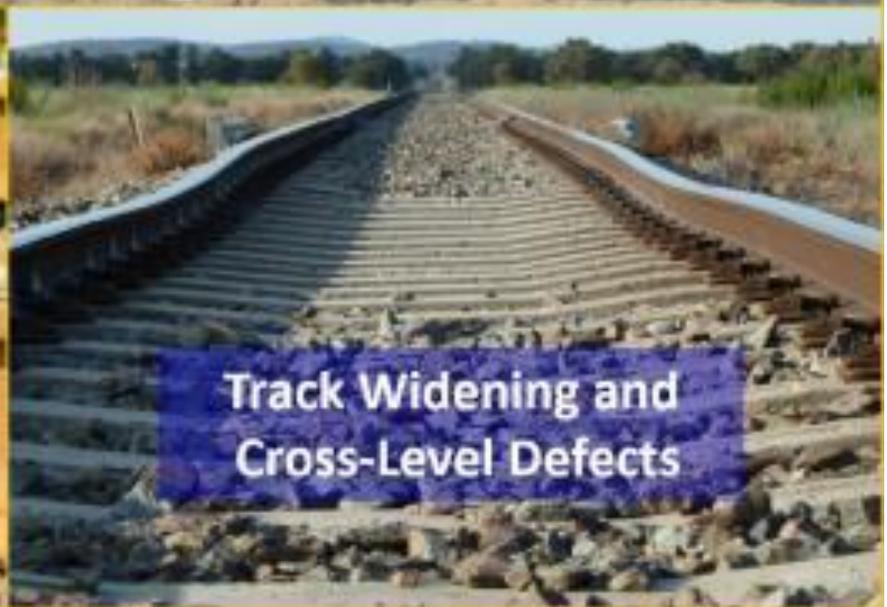
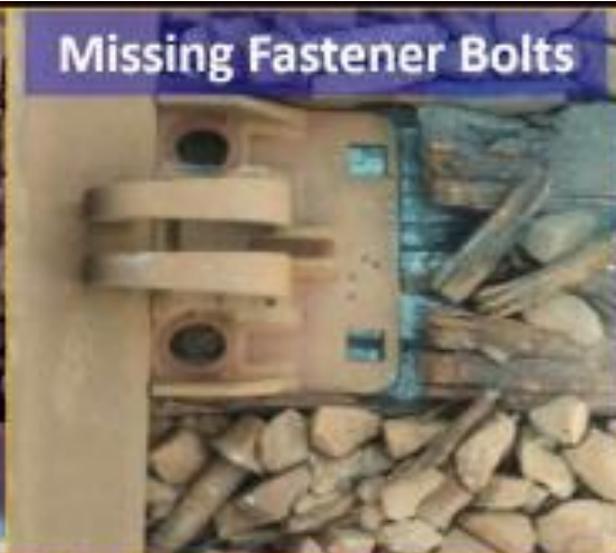
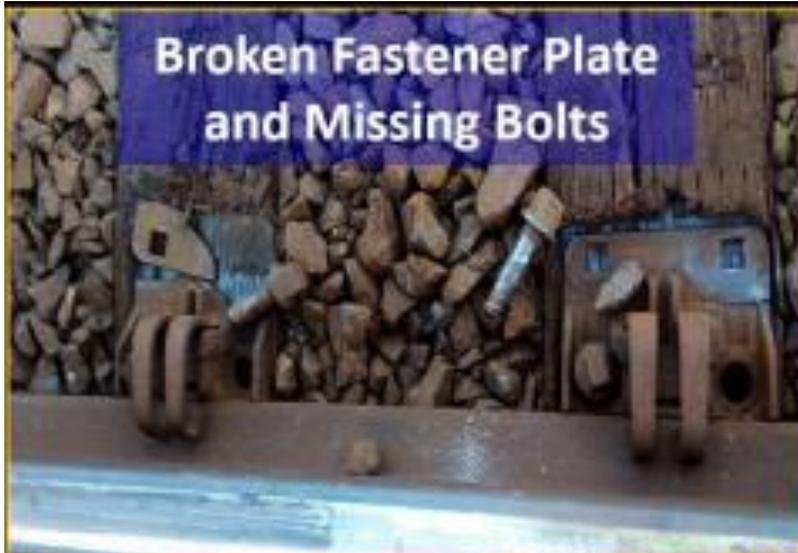
Extreme Cases Wheel & Rail Wear

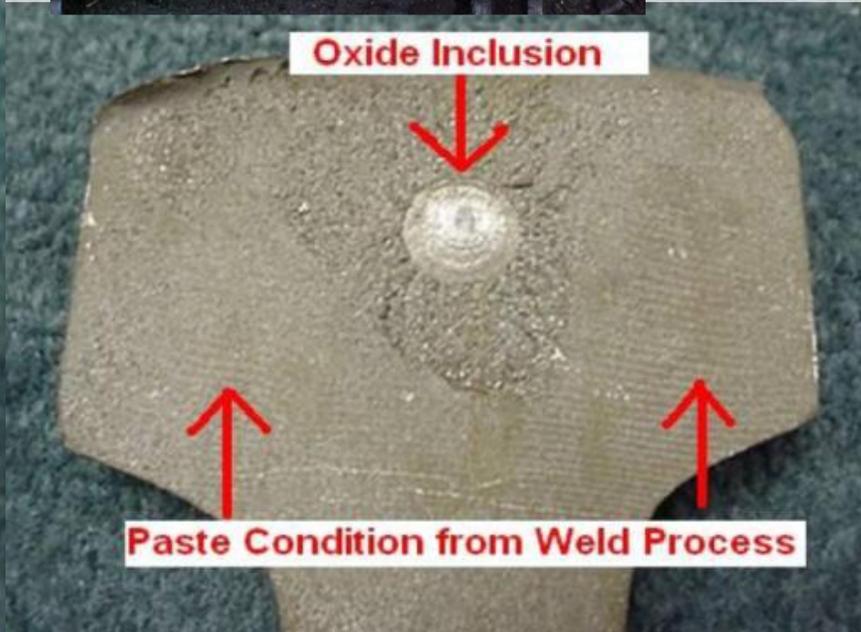




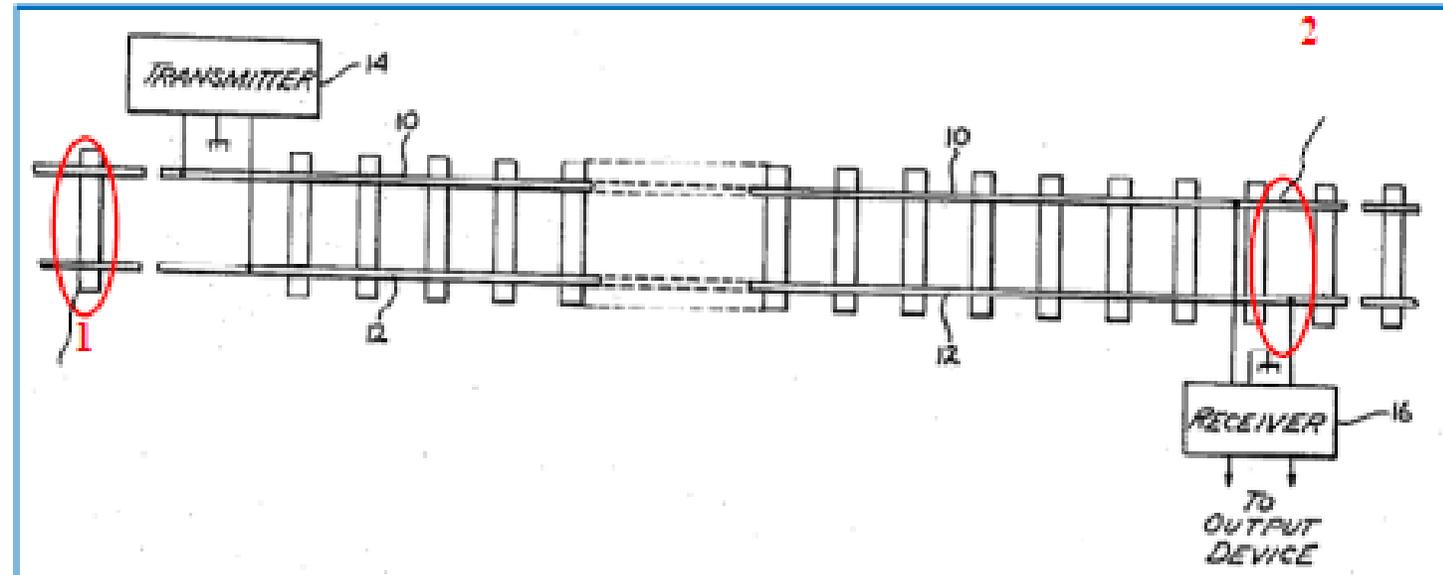
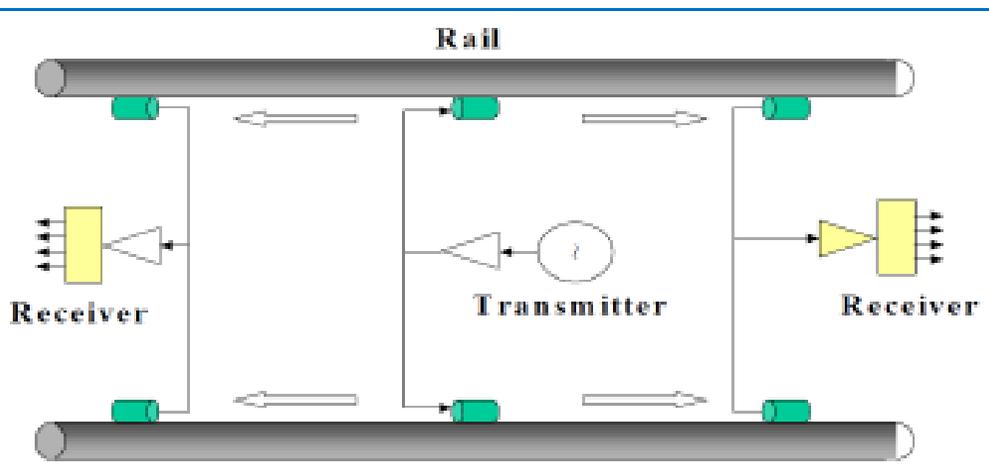
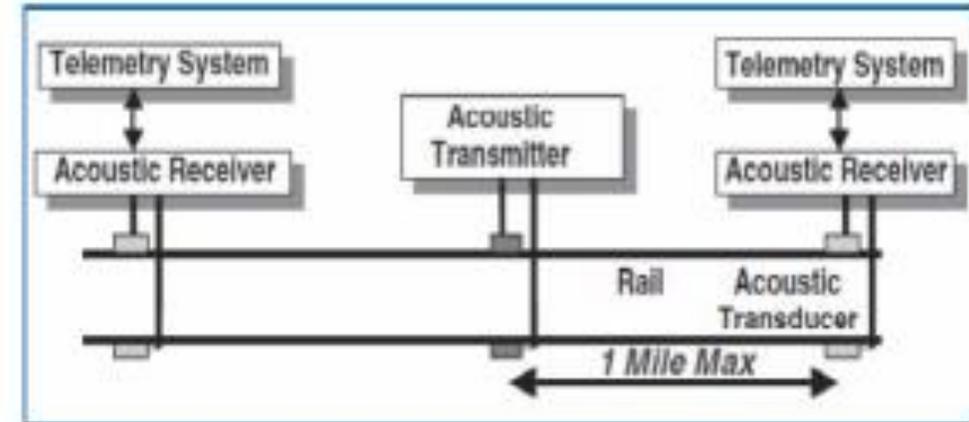
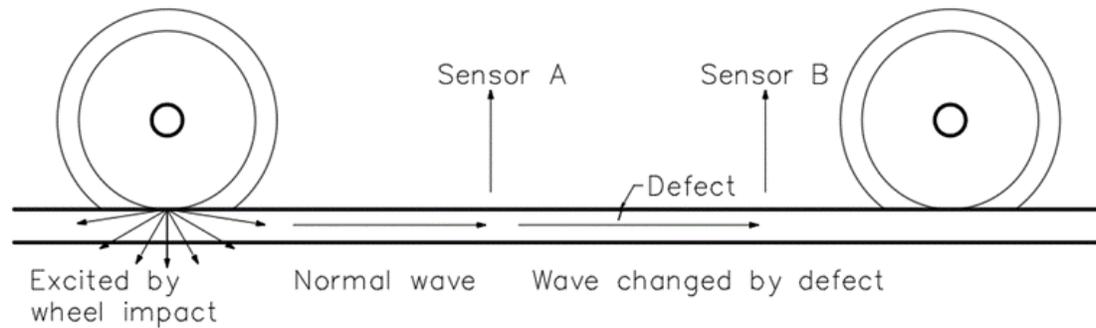
EVALUATION OF RAILWAY TRACK DEFECTS AND BALLAST GRADATION







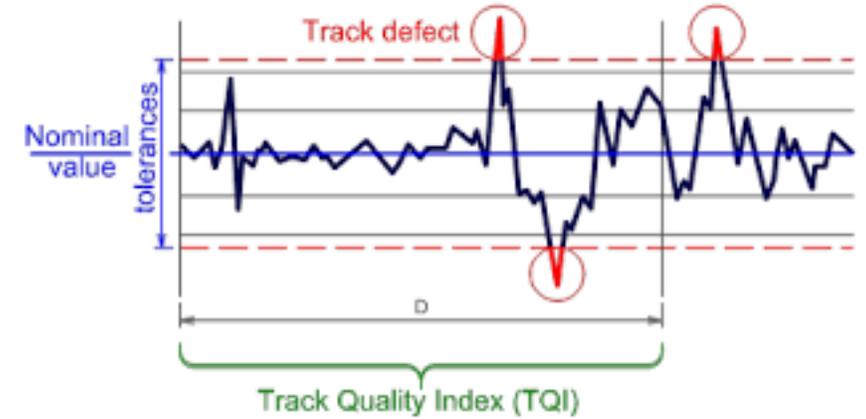
Theoretical Consideration of Passive Extraction of Defect Information



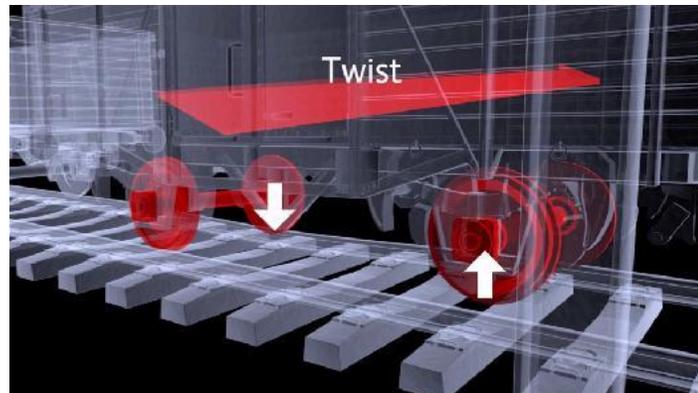
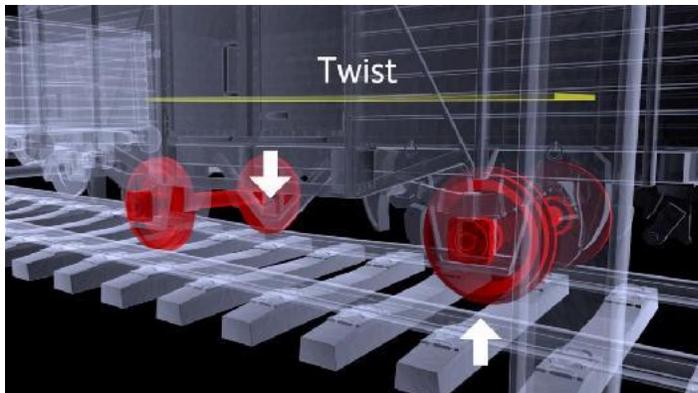


Track Recording Coach

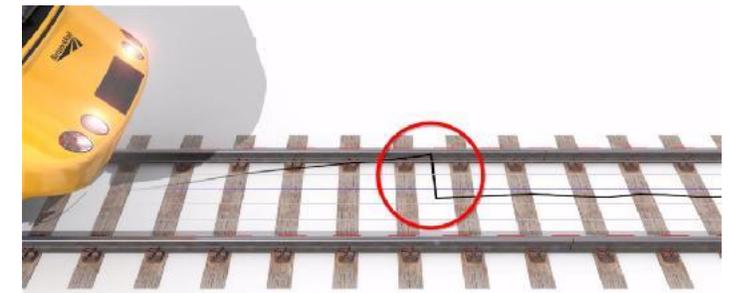
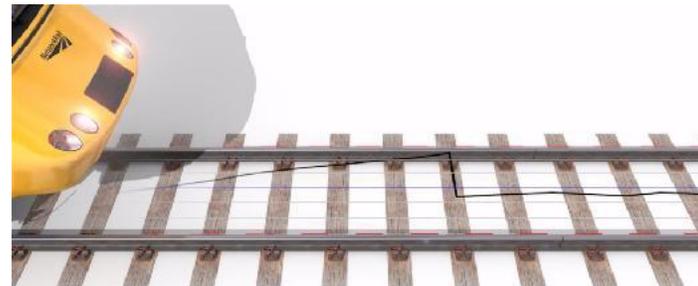
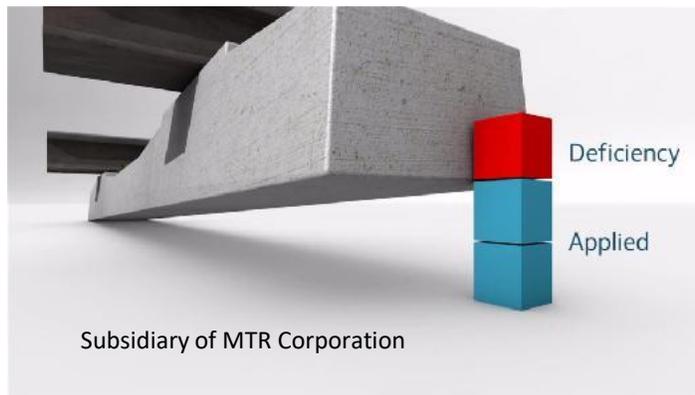
Twist



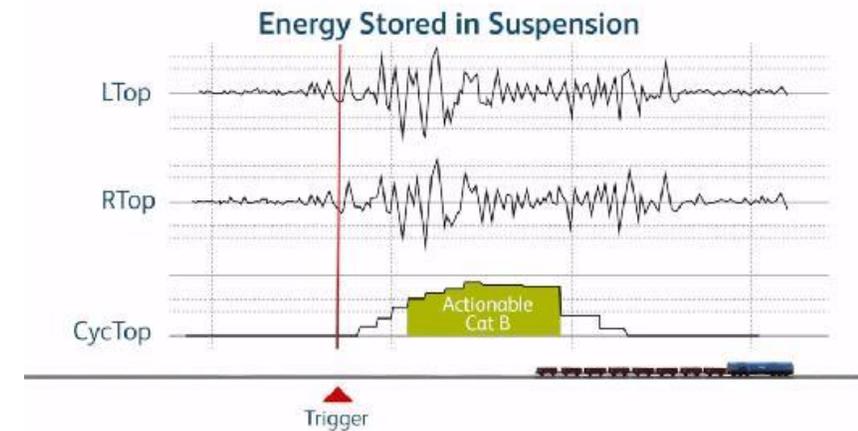
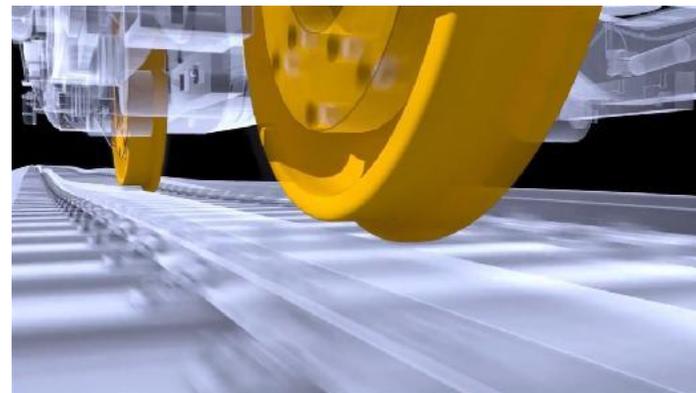
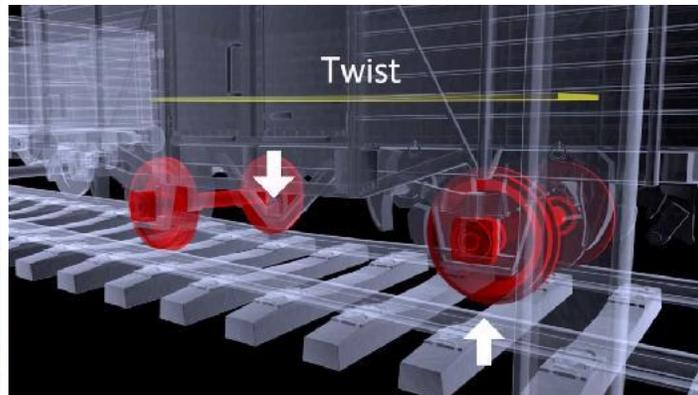
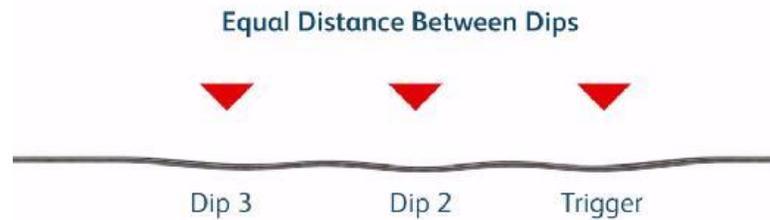
Twists lead to
Flange Climb
& Derailment



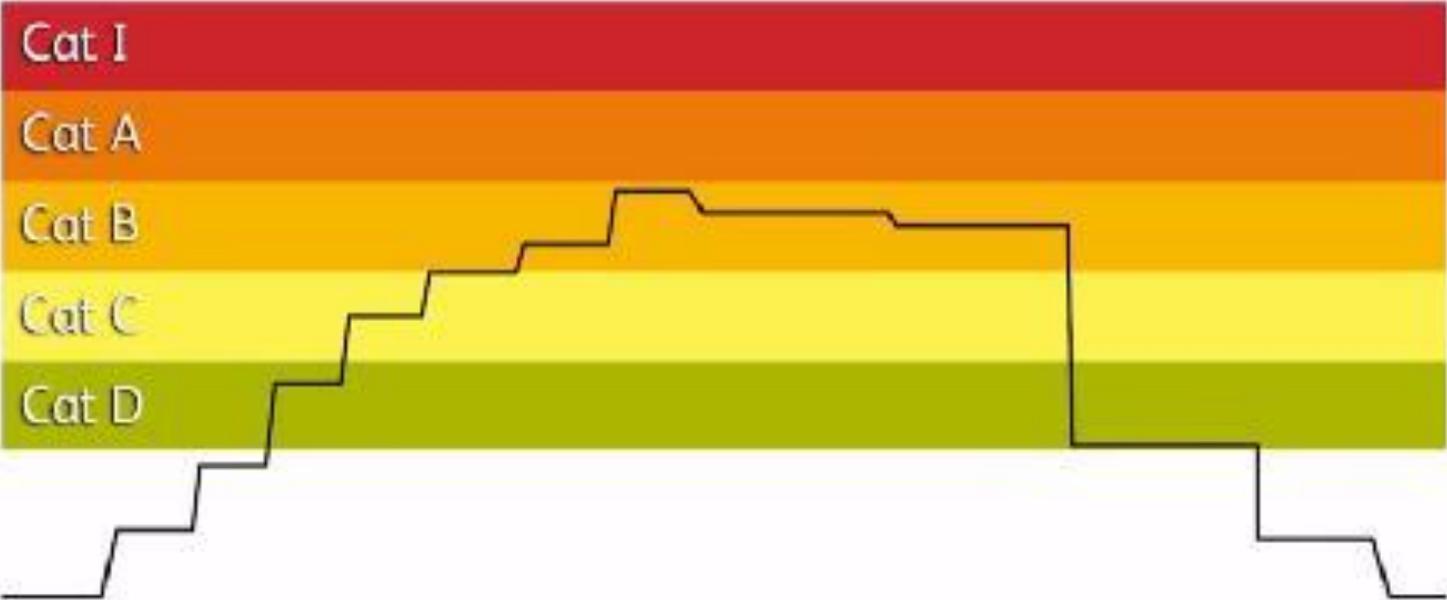
Cant Deficiency



Cyclic Top

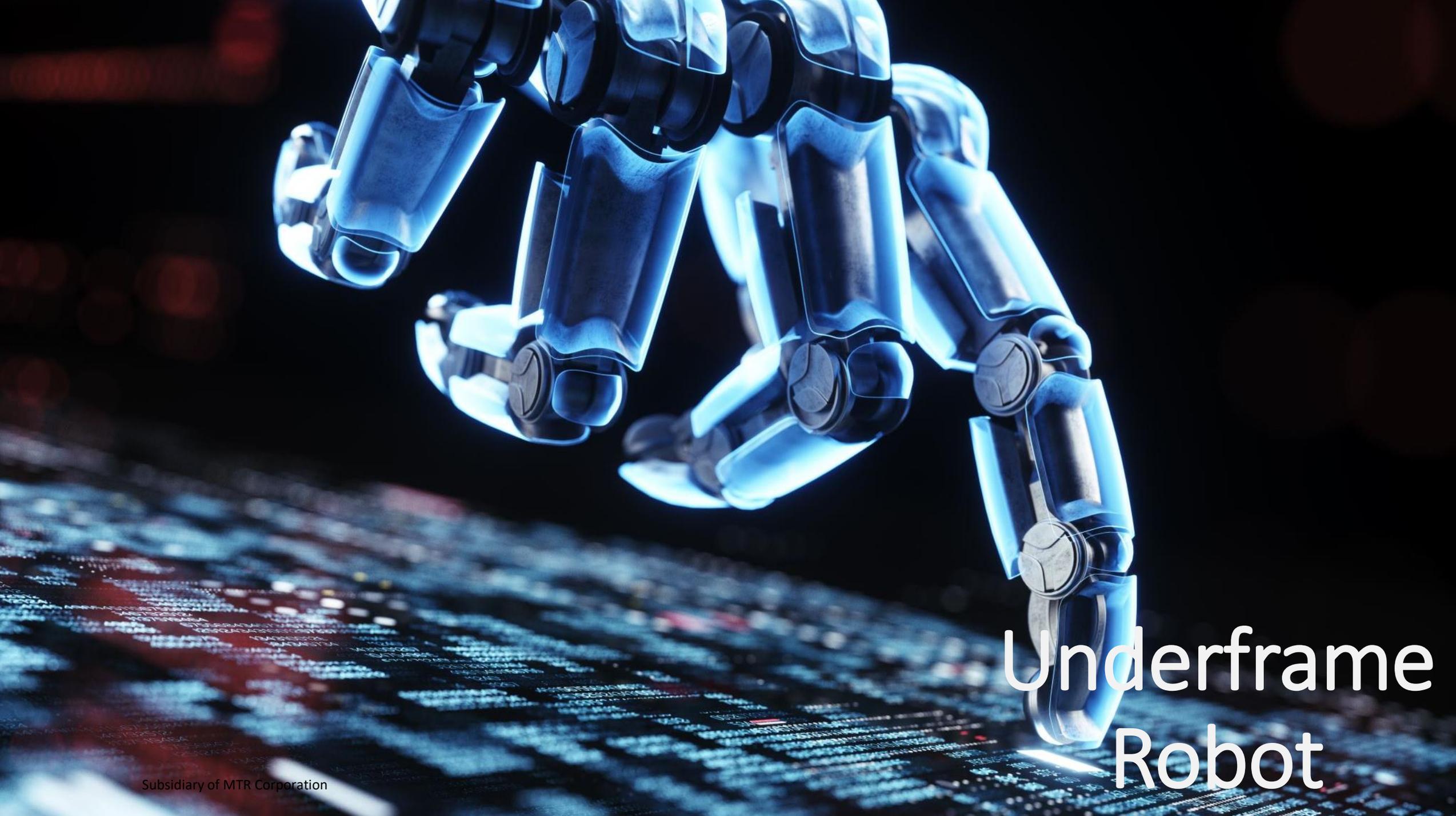


Cyclic Top Categories





Rolling Stock Maintenance Mechanical Defects



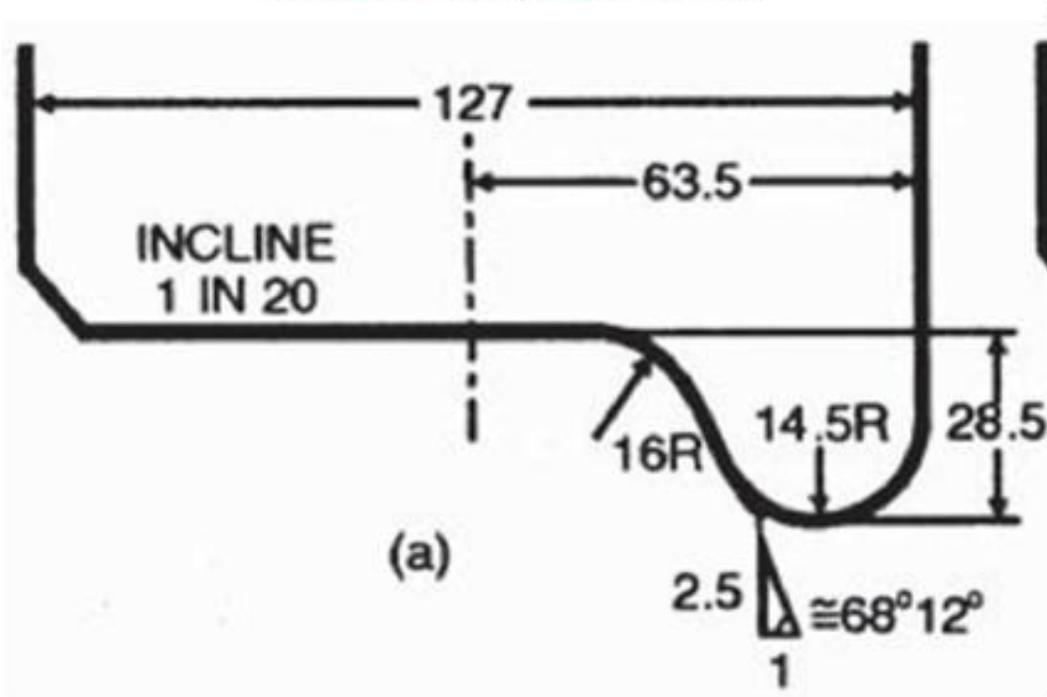
Underframe Robot

Subsidiary of MTR Corporation

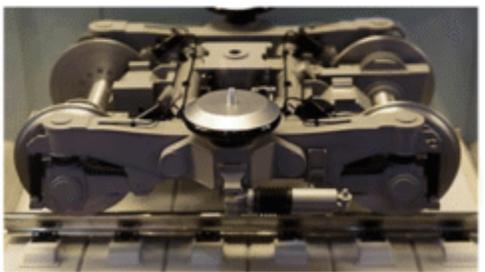
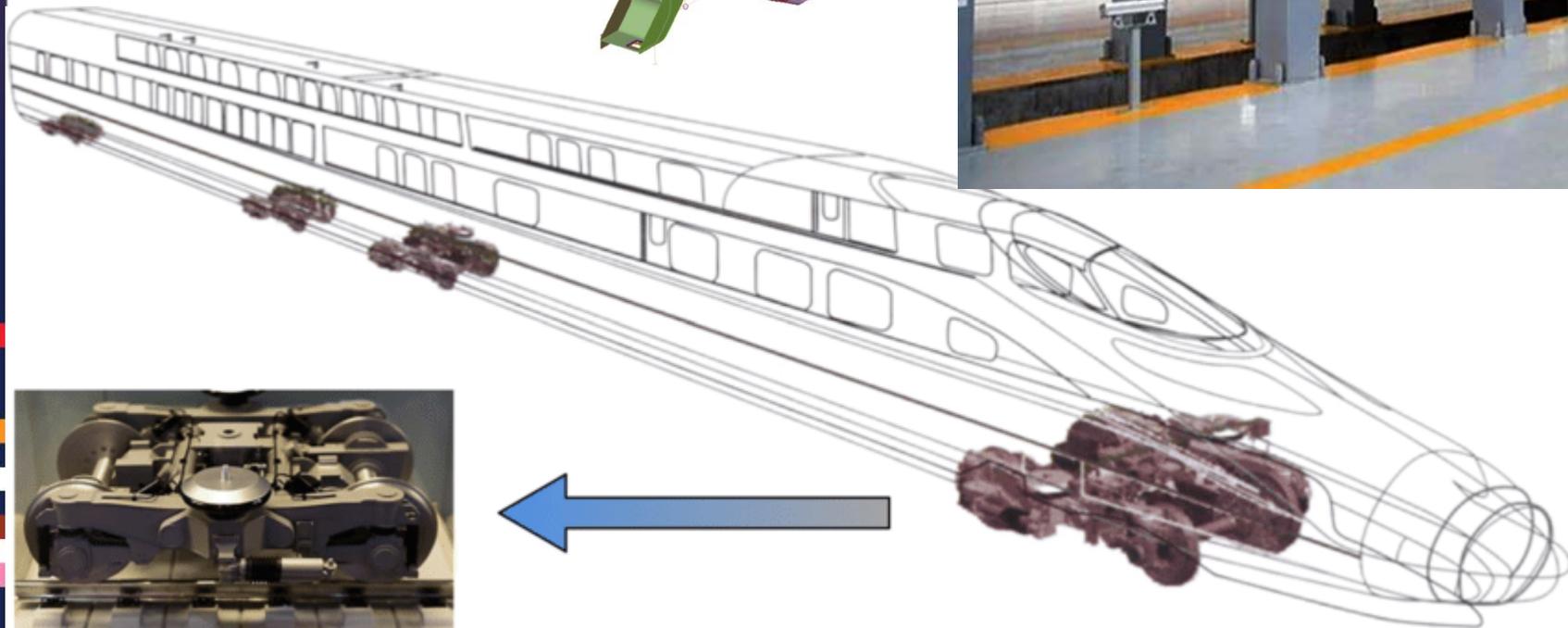
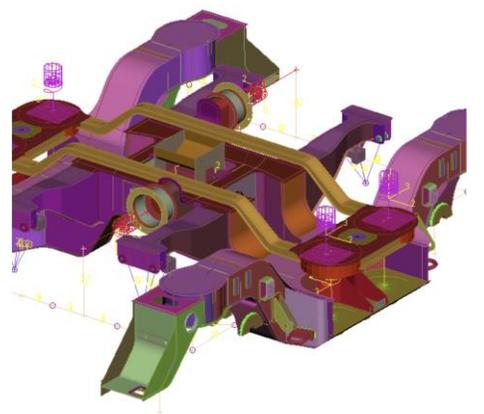
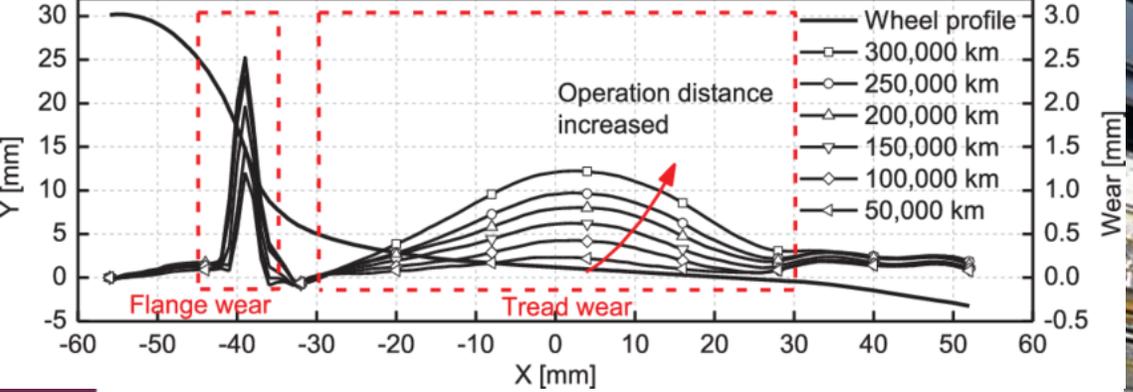


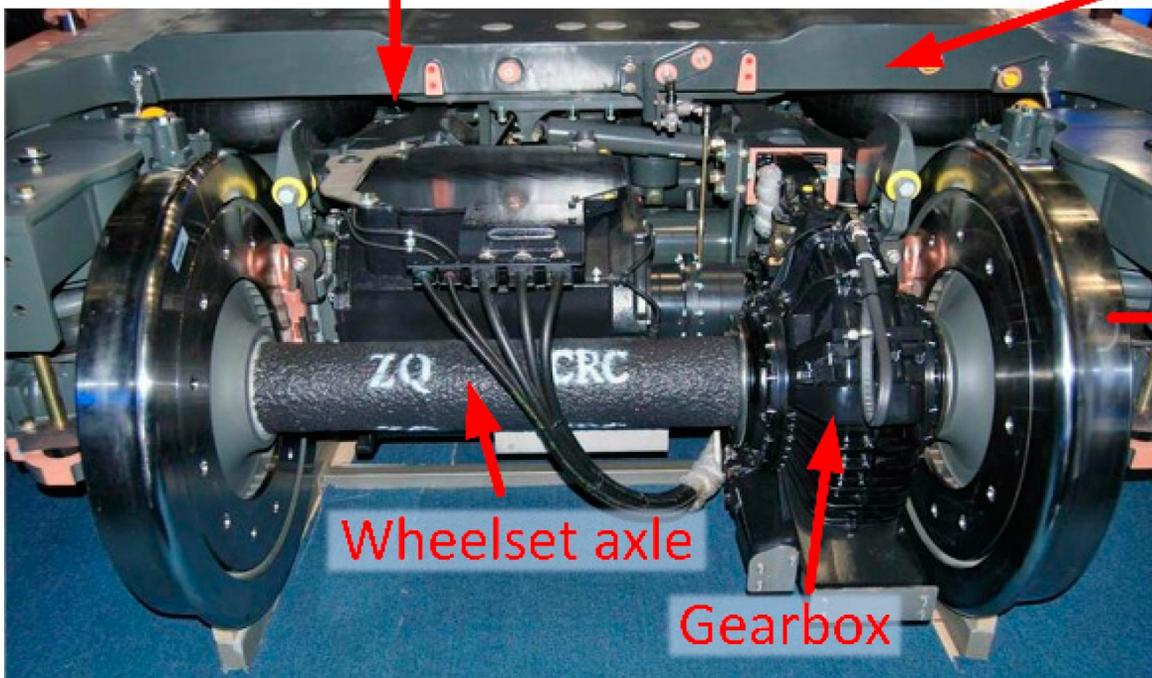
Wheel Defects

IRS BG Wheel Profile



- Defects In Wheel And Flange :
 - THIN FLANGE
 - SHARP FLANGE
 - RADIUS TOO SMALL AT THE ROOT OF FLANGE
 - DEEP FLANGE
 - FLAT TYRE
 - HOLLOW TYRE





Bogie



Wheel

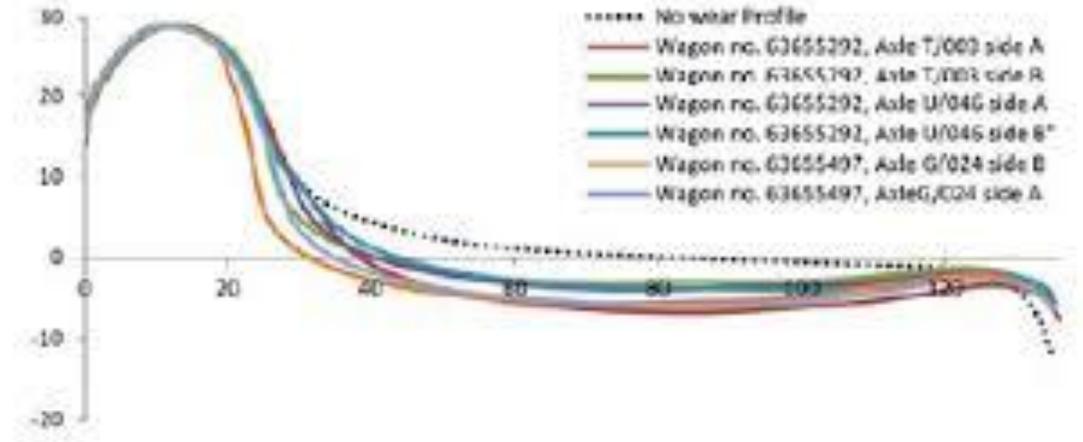
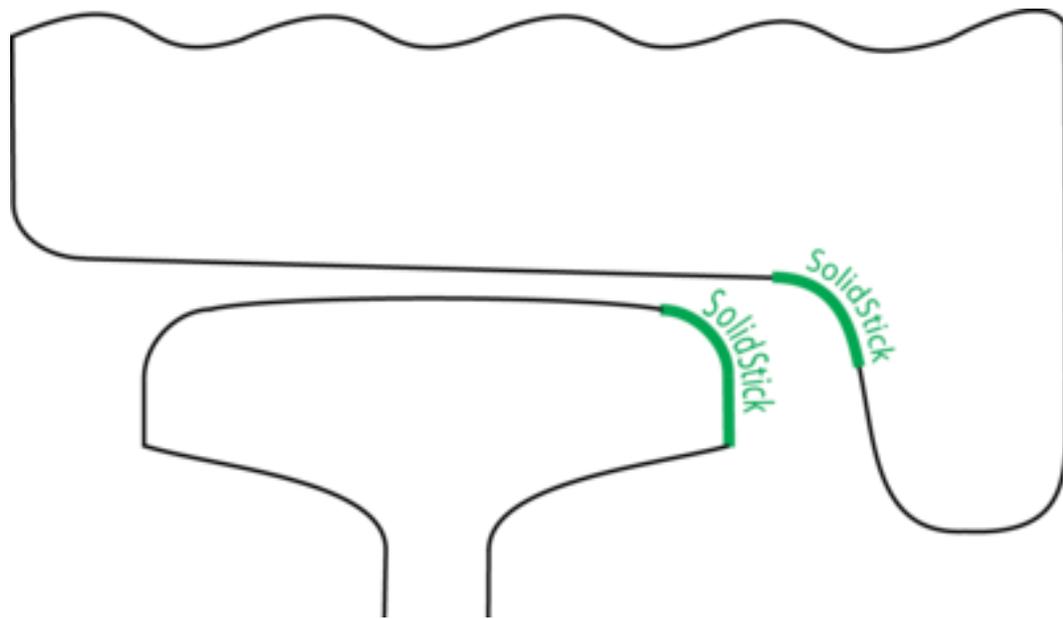
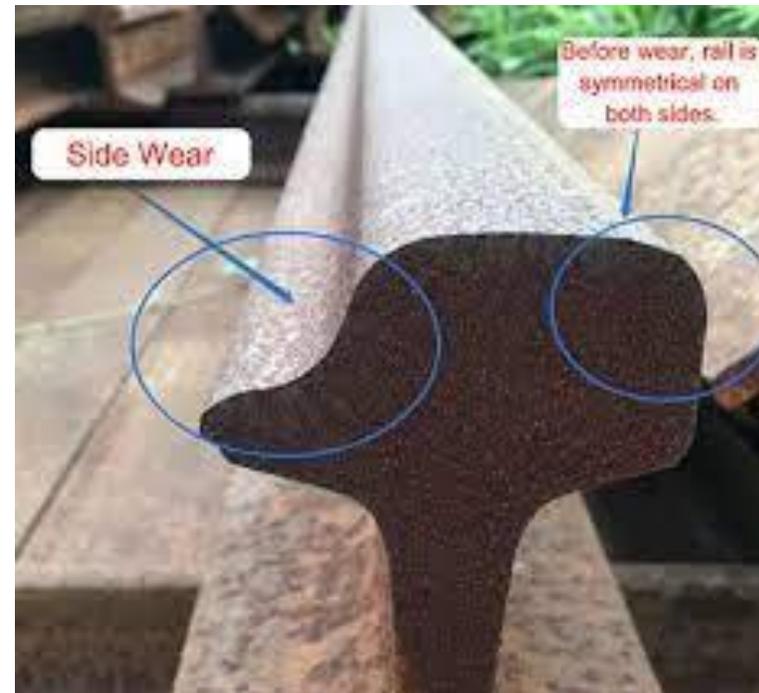
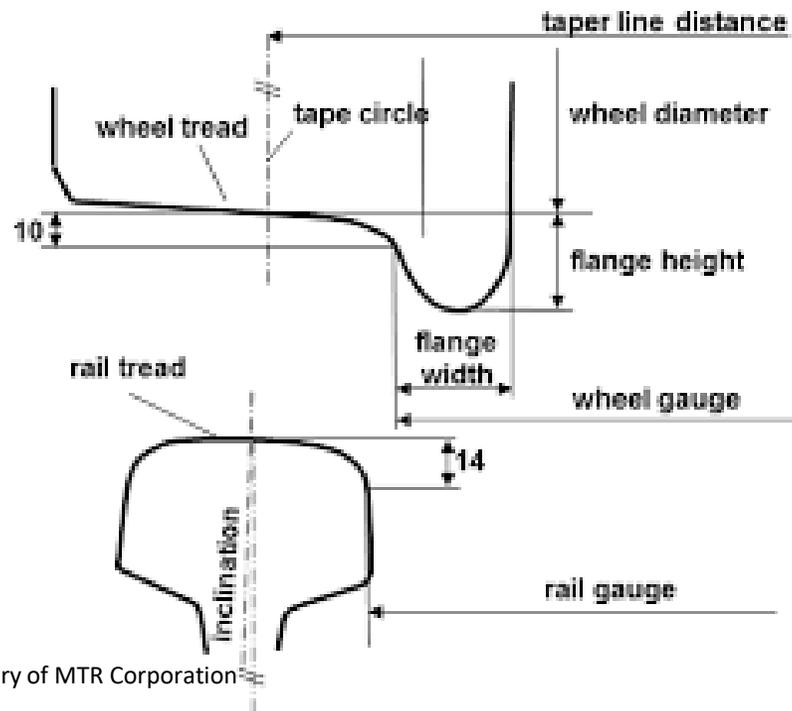
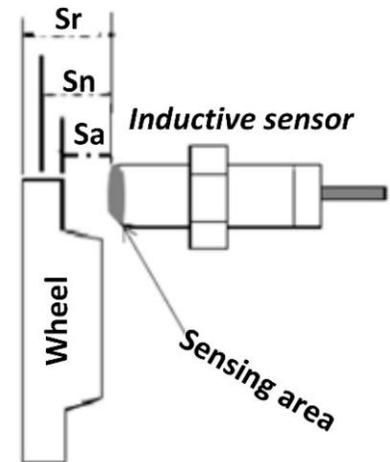
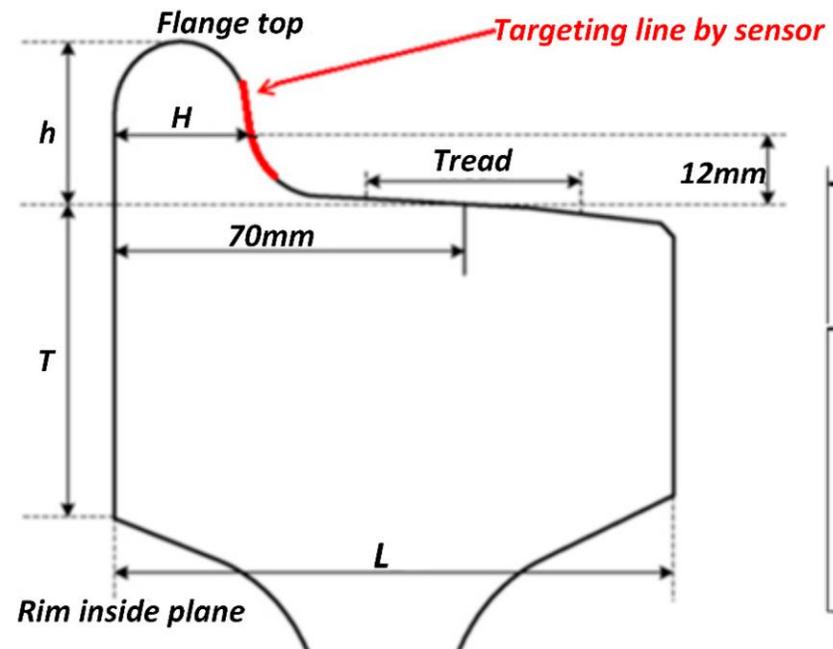
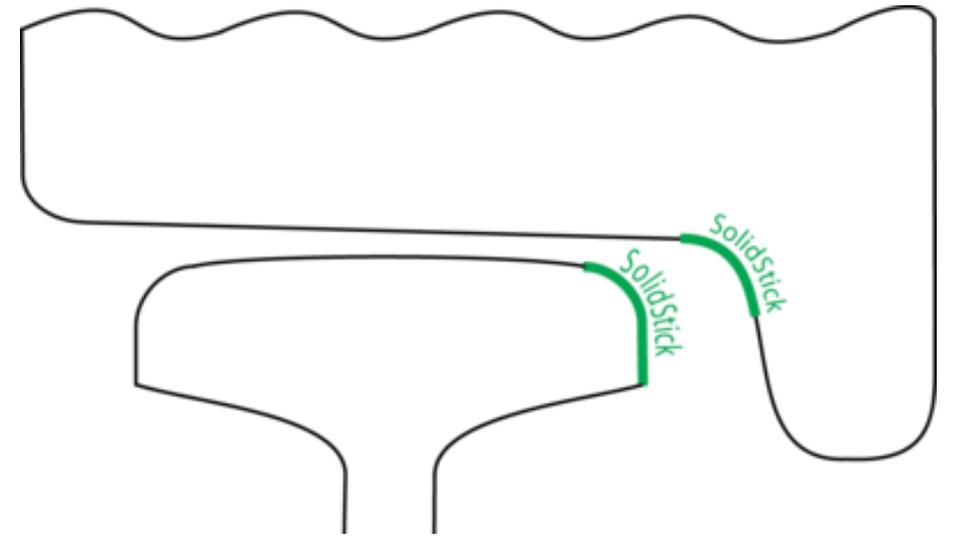
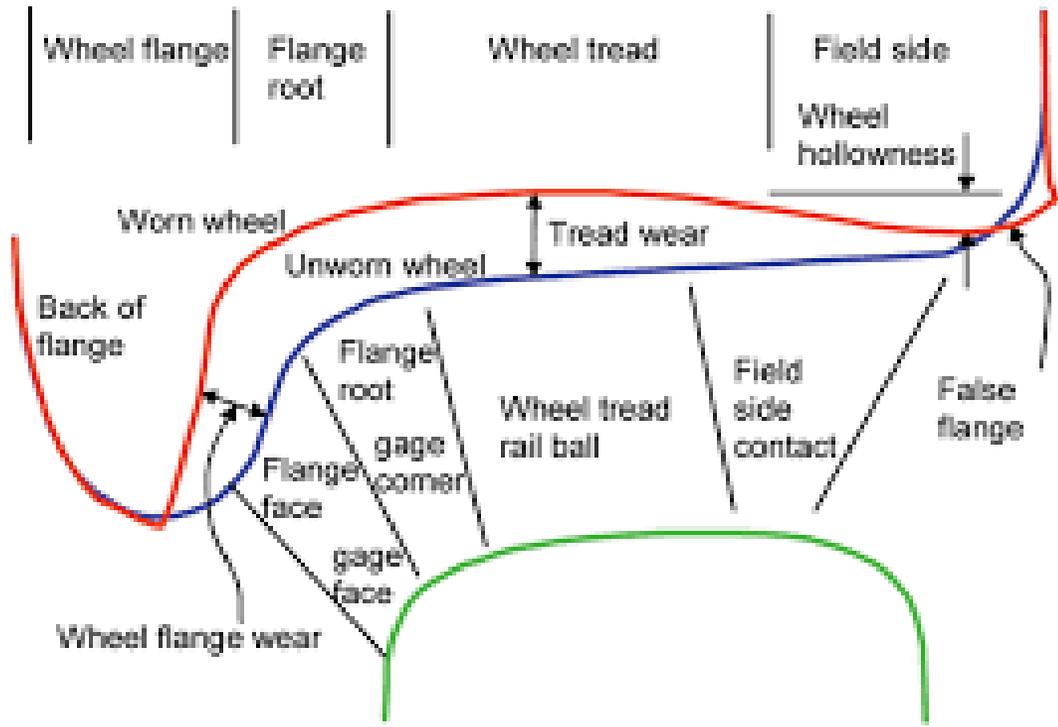
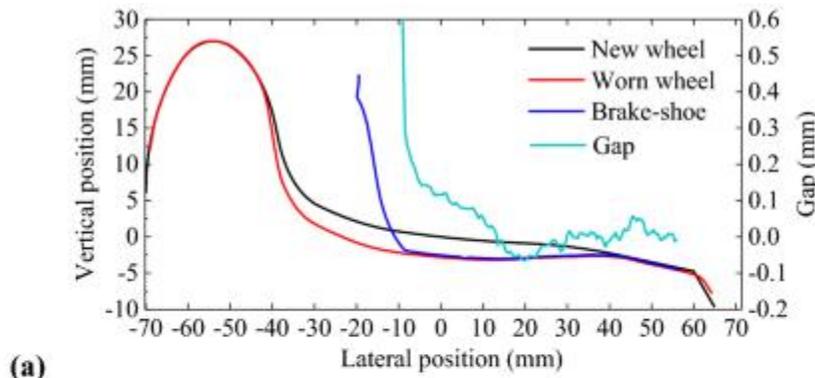
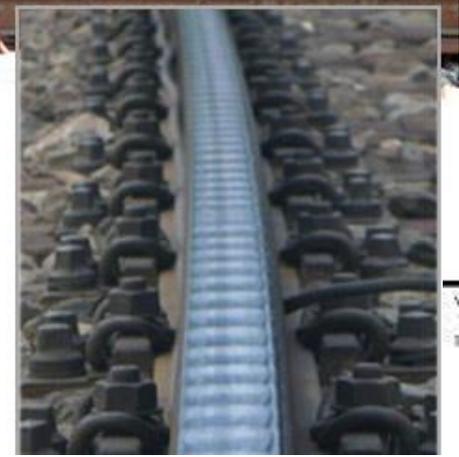
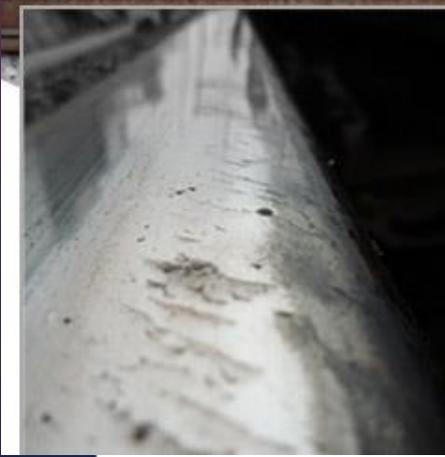
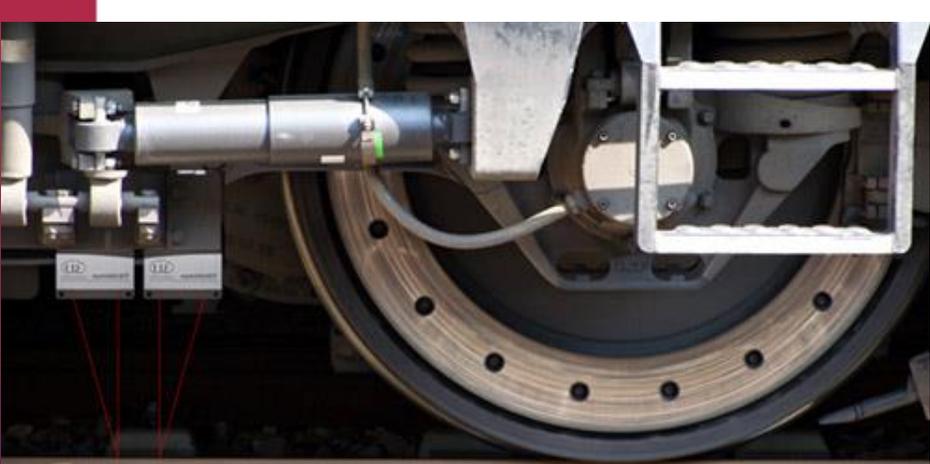


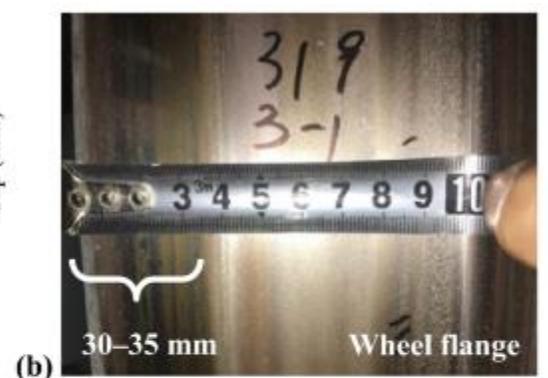
Figure 2 – Excessive wheel wear profile







(a)



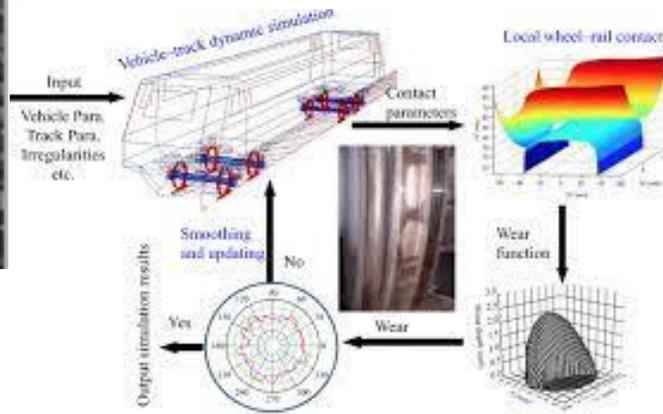
(b)



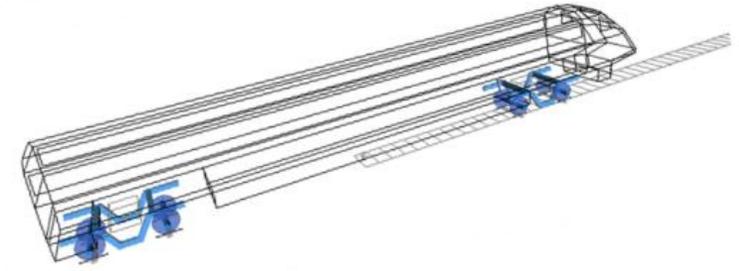
(c)



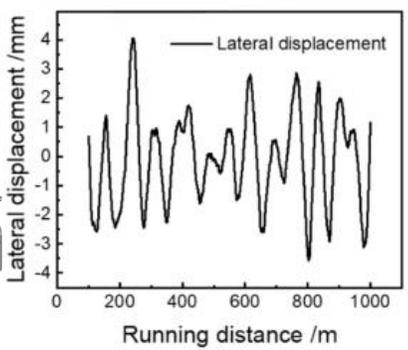
(d)



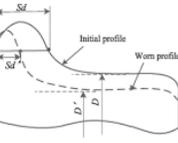
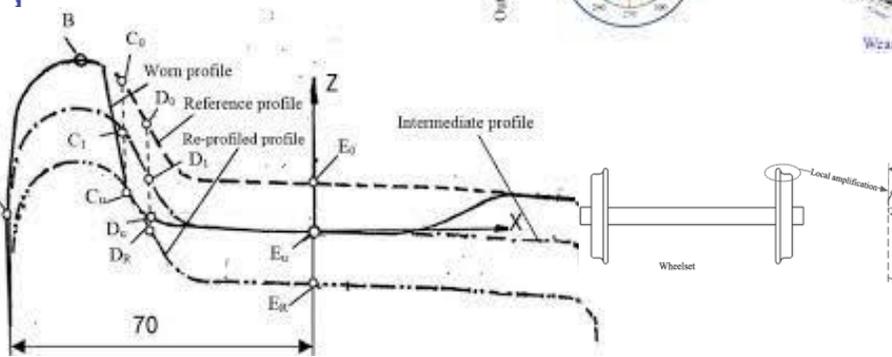
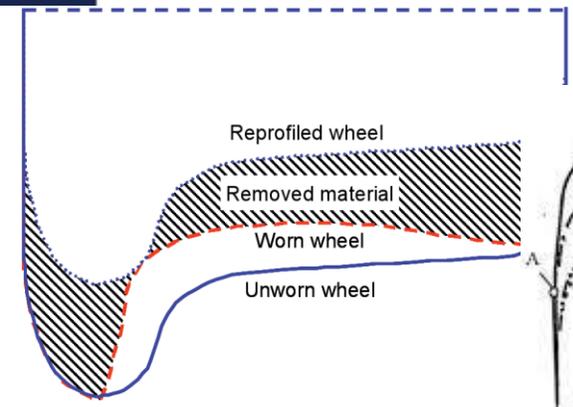
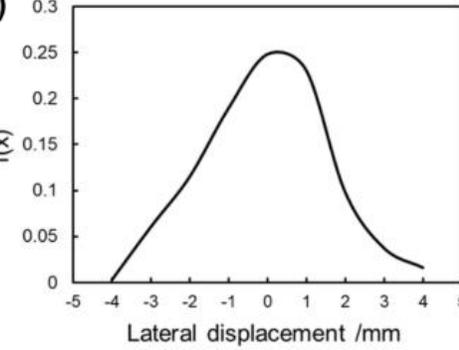
(a)

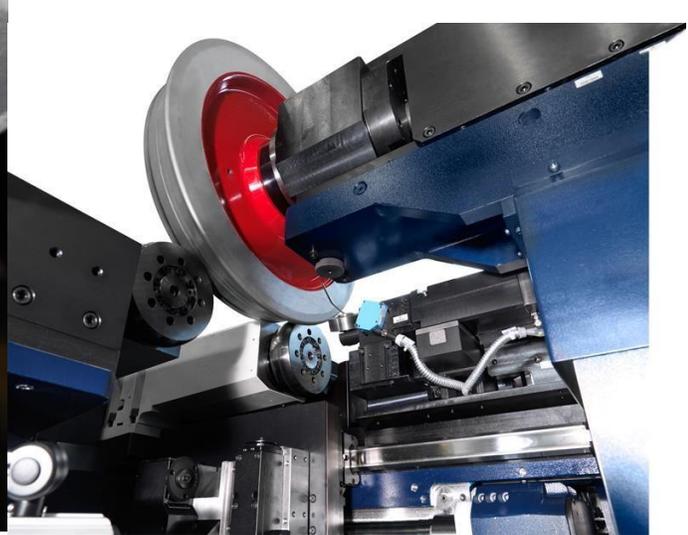


(b)



(c)





Q & A



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