



7th Railway Working Group Meeting

22–23 May 2023 • Tbilisi, Georgia

7-е заседание Рабочей группы по железнодорожному транспорту

22–23 мая 2023 года • Тбилиси, Грузия



7th Railway Working Group Meeting

22–23 May 2023 • Tbilisi, Georgia



**7-е заседание Рабочей группы по
железнодорожному транспорту**

22–23 мая 2023 года • Тбилиси, Грузия

Infrastructure Maintenance Management in Railways

Udo Sauerbrey
Railistics GmbH



DEFINE THE QUALITY

- The target **Quality** of Railway Infrastructure needs to be defined on government level !
- This definition requires answers regarding:
 - Budget available
 - Failures tolerated
 - Railway reliability and safety
 - Client satisfaction



DEFINE THE QUALITY

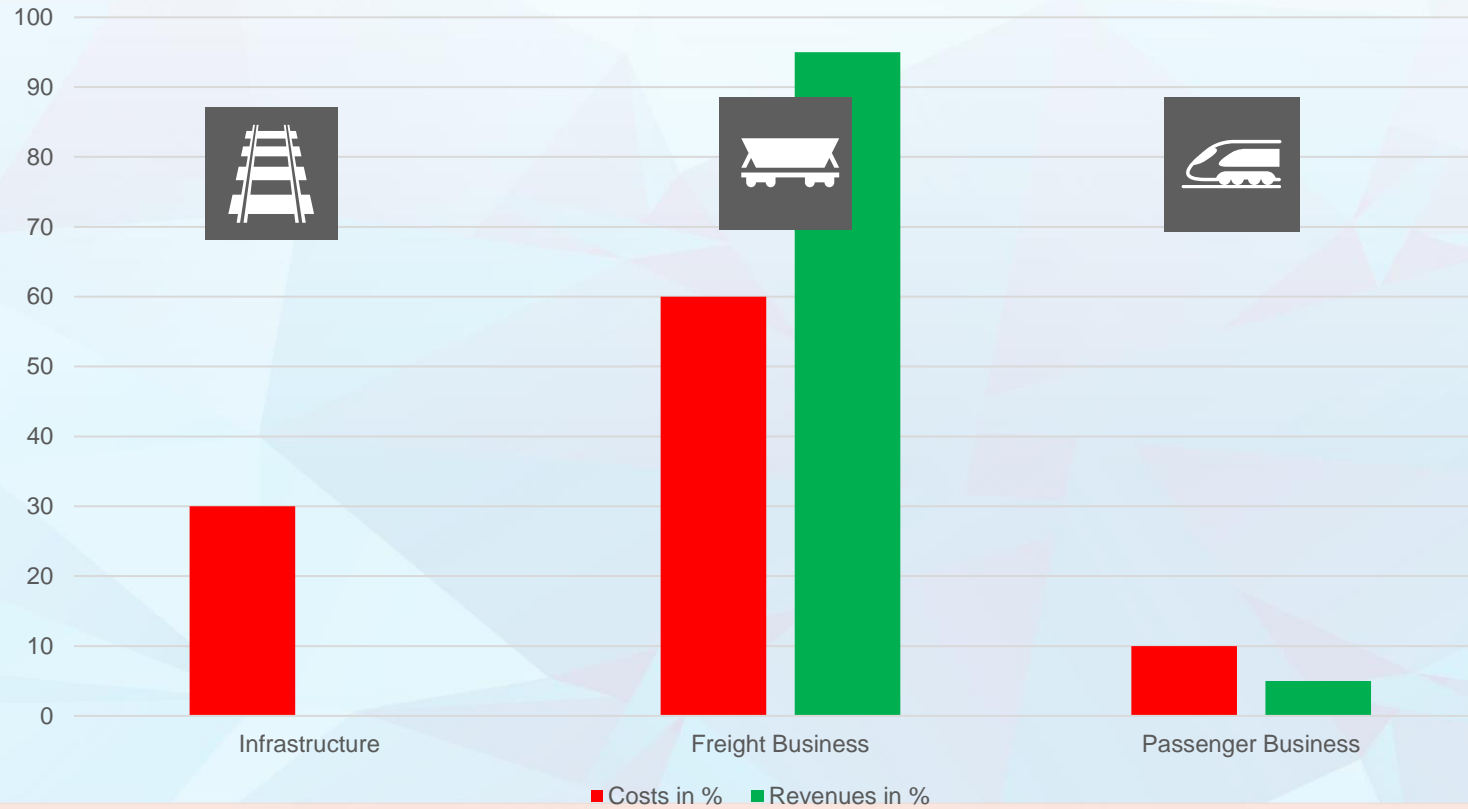
- Costs of maintaining rail infrastructure
- OECD in 2006 estimated a worldwide 49-58bn* \$ p.a. for rail infrastructure maintenance
- For 1.150.000 km this means 43.000 – 50.000 \$ per km
- In Europe 15-25bn € are spent p.a.
- Per km (300.000 km**) this amounts to 60.000 – 80.000 €

*No Metro etc. included

**high share electrified

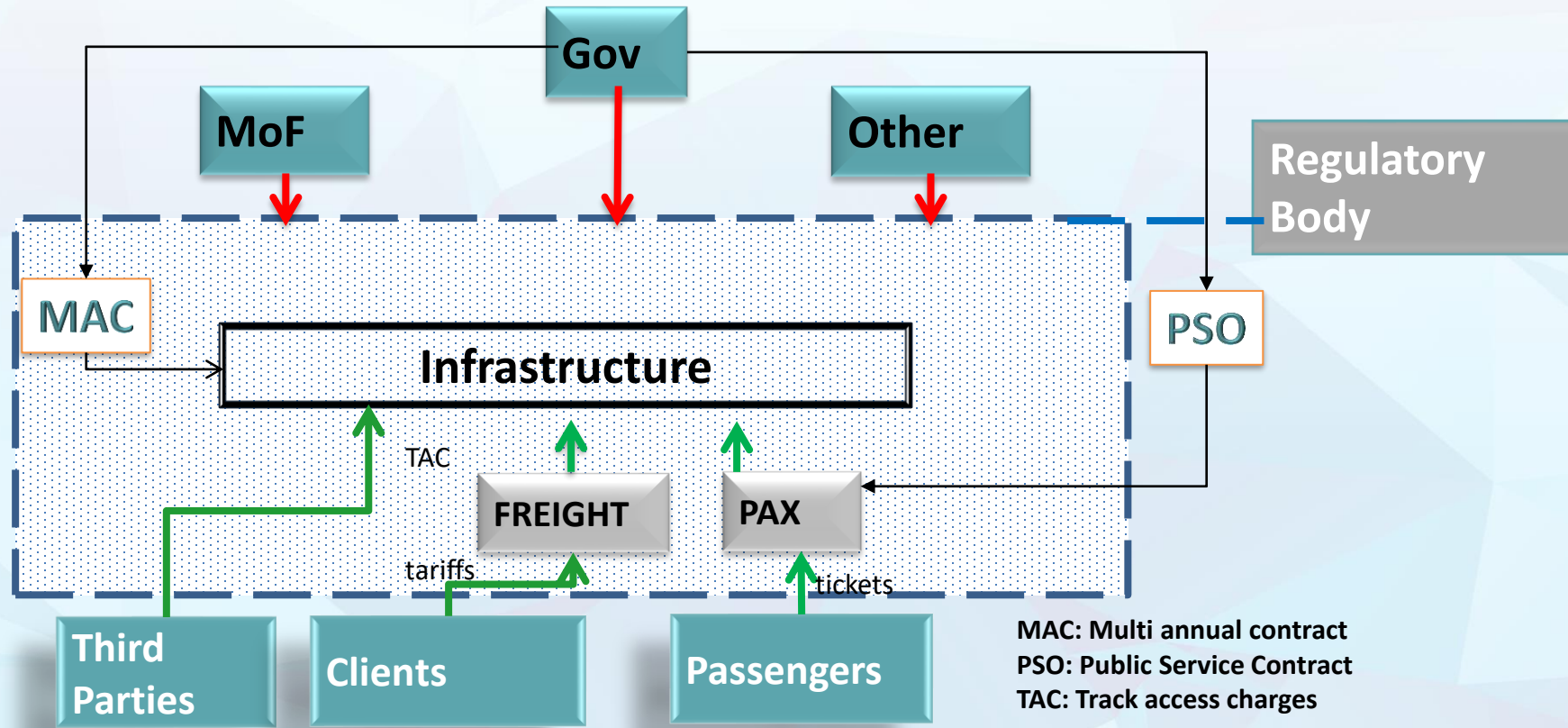
DEFINE THE QUALITY

Typical Rail Sector Costs & Revenues in %



Freight business is “**cash cow**” whereas passenger is unprofitable and infrastructure is cost centre only.

DEFINE THE QUALITY



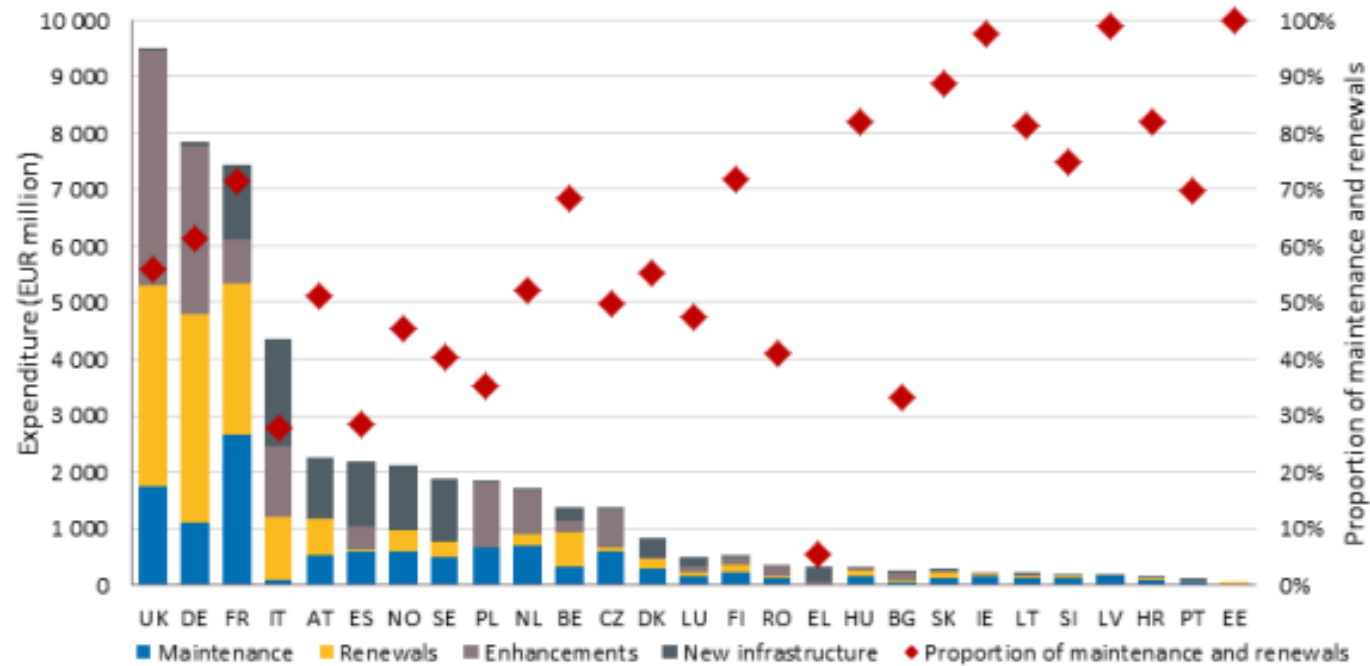
Subsidies through performance based contracts (MAC) help to improve the Quality of Railway Infrastructure



DEFINE THE QUALITY

- Maintenance – Renewals – New Infrastructure

Figure 11: Expenditure on infrastructure and proportion on maintenance and renewals per country, 2016

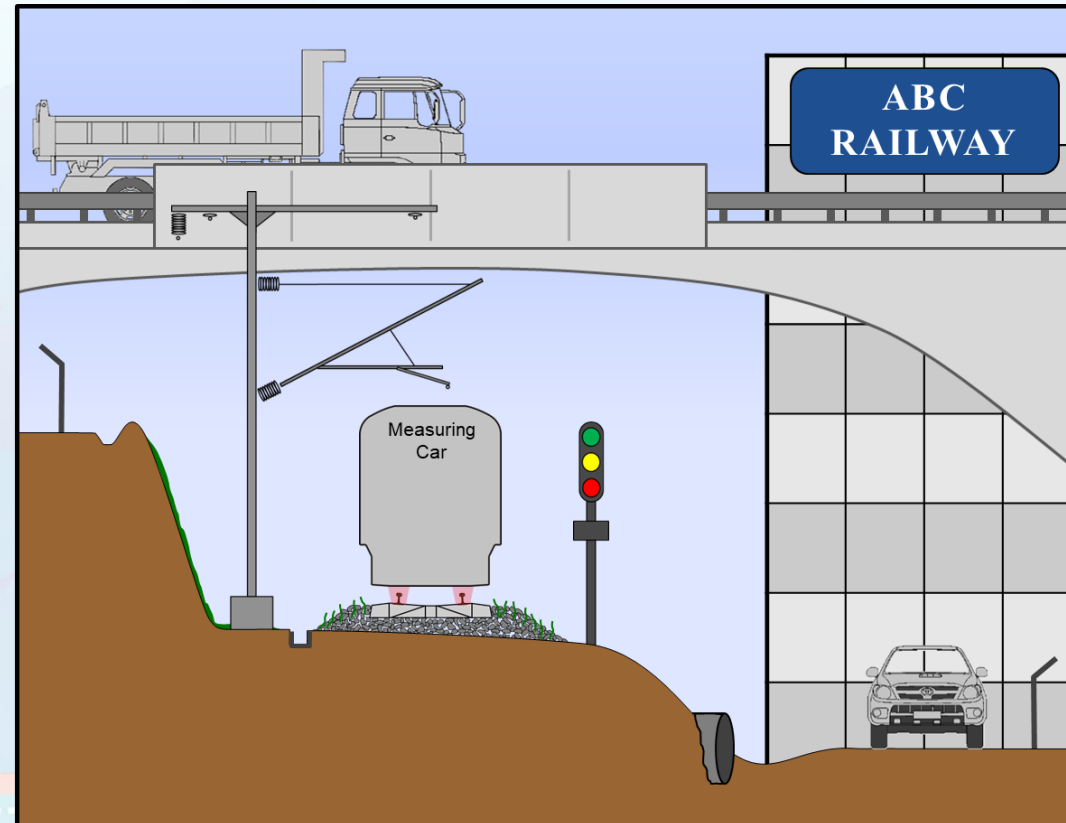


Source: RMMS, 2018. NO, SE included enhancements with renewals.

Enhancements are renewals with a significant extension of the infrastructure

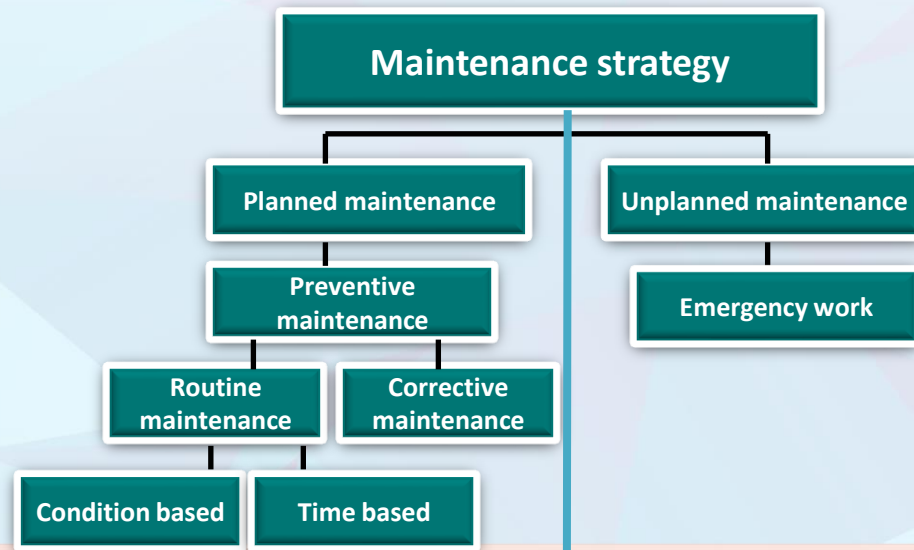
PLANNING MAINTENANCE

- Measuring & Recording
- Rail
- Sleepers
- Fastenings
- Ballast
- Formation
- Edge Drains
- Cuttings & Embankments
- Vegetation Control
- Switches & Crossings
- Curves
- Civil Structures
- Level Crossings
- OHTE (Overhead Traction Equipment)
- Signalling



PLANNING MAINTENANCE

- Corrective & Preventive Maintenance



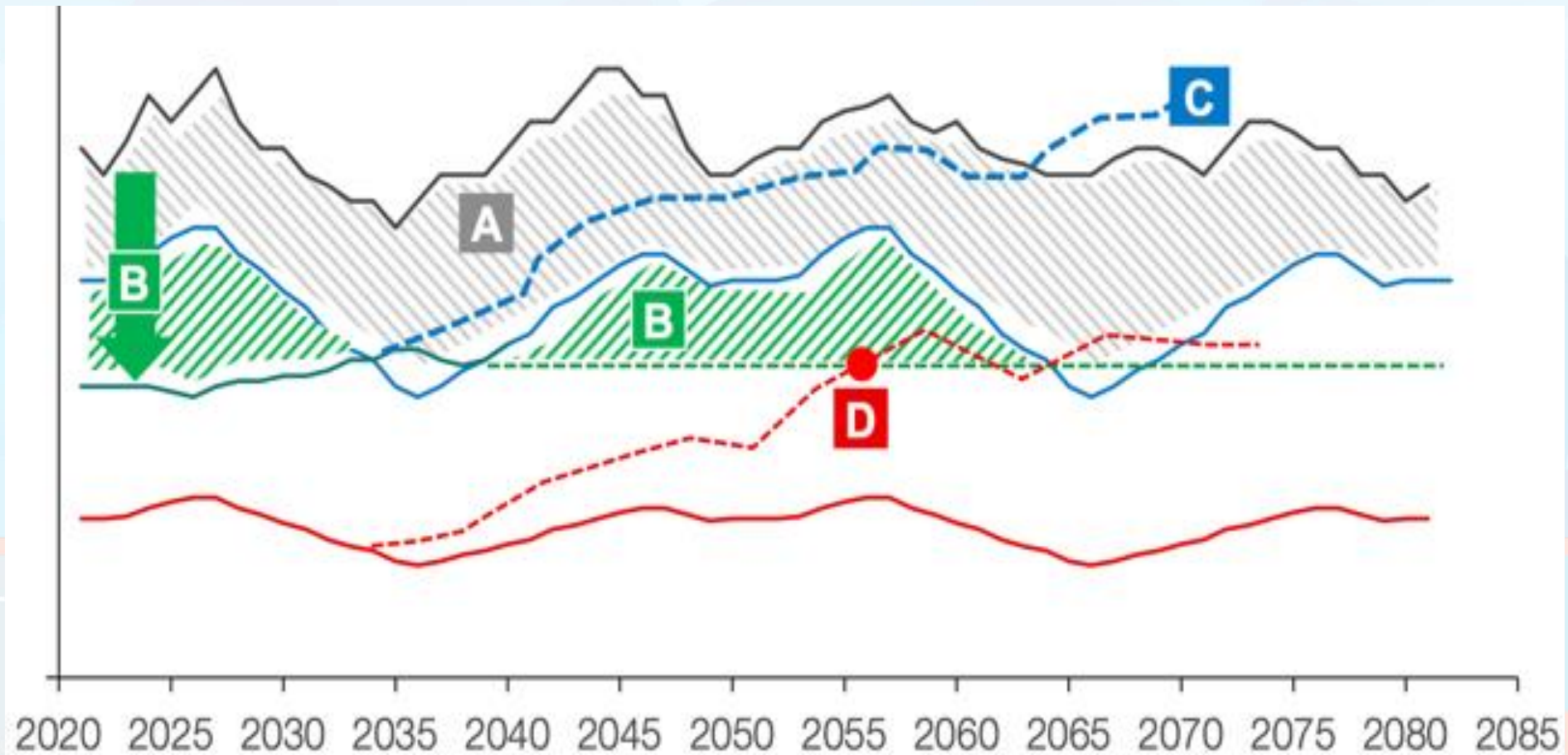
80%

20%

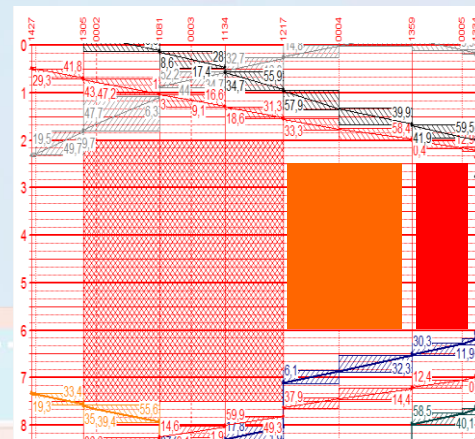
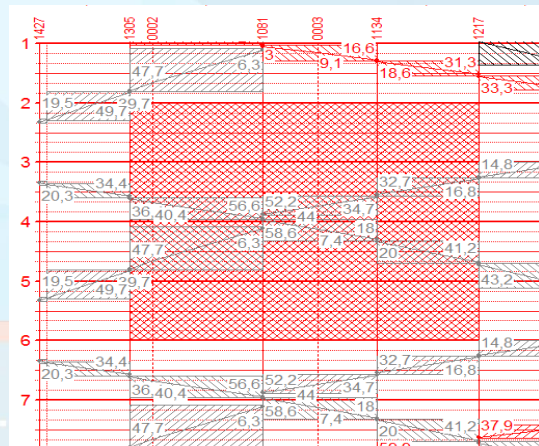
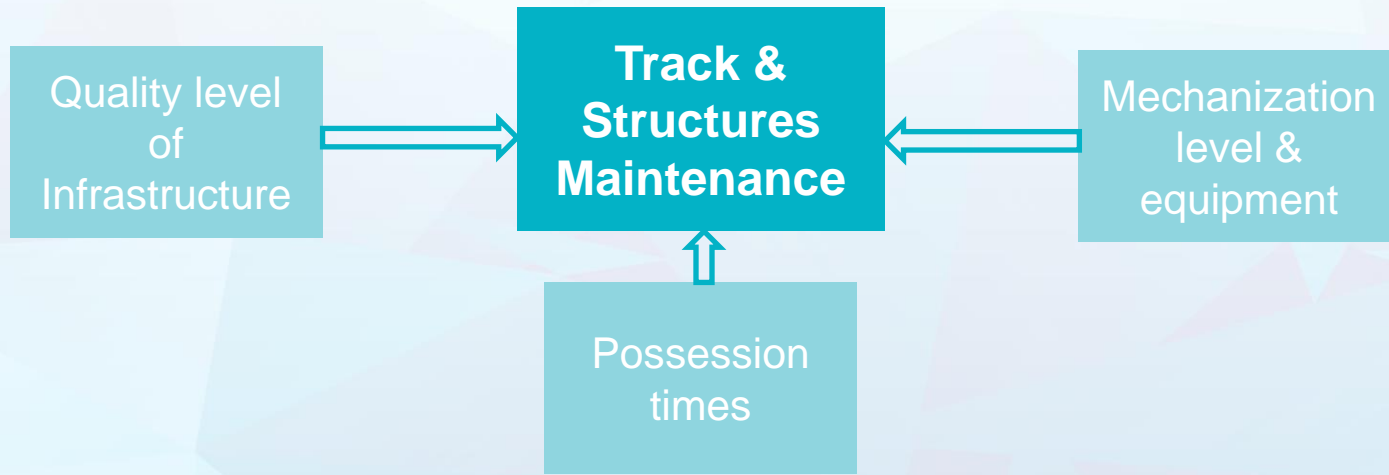


PLANNING MAINTENANCE

- Example Swiss Railways – 60 year plan



PLANNING MAINTENANCE



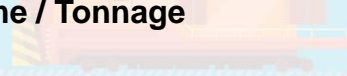
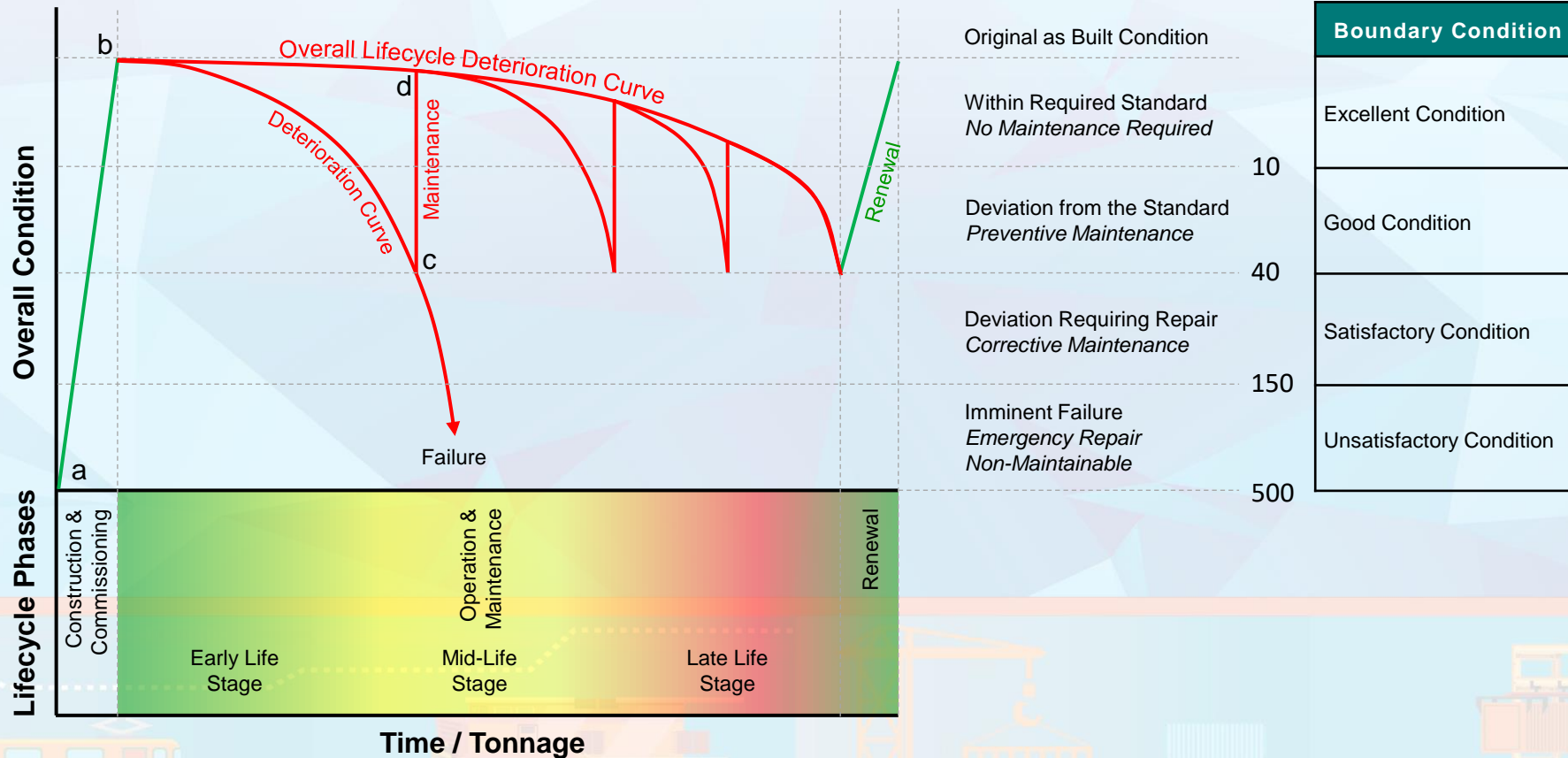
PLANNING MAINTENANCE

The 'KPI Cockpit' for infrastructure maintenance



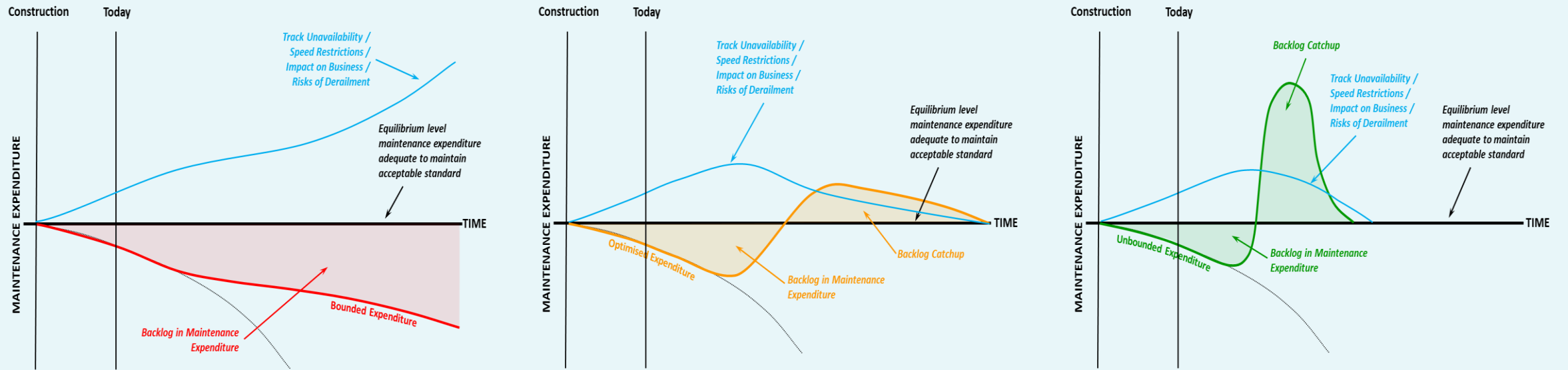
Measure and observe their development!

PLANNING MAINTENANCE



PLANNING MAINTENANCE

RAIL INFRASTRUCTURE MAINTENANCE BACKLOG - SCENARIOS



PLANNING MAINTENANCE

MAINTENANCE INTERVALS

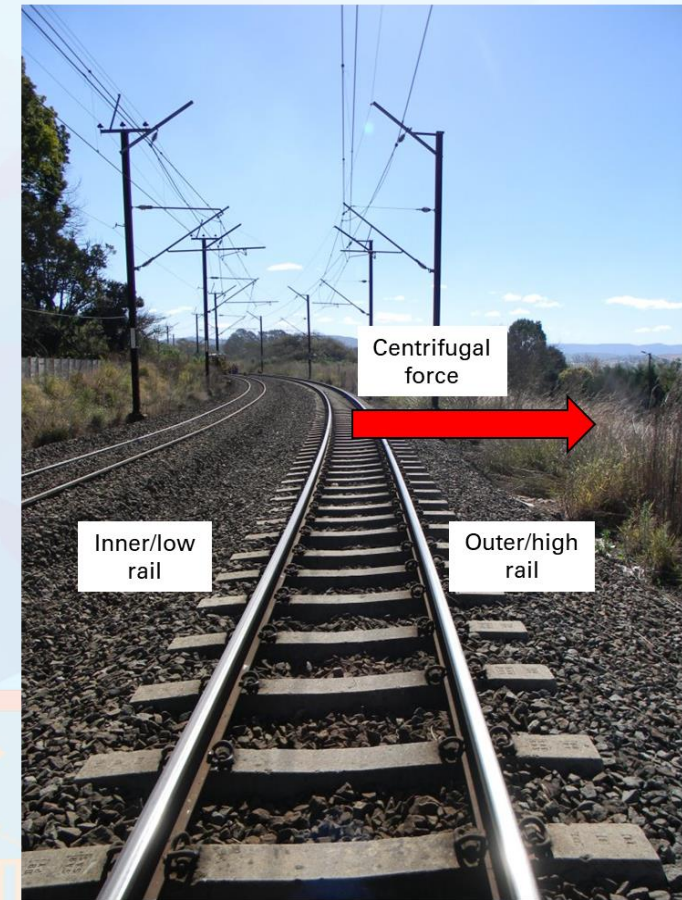
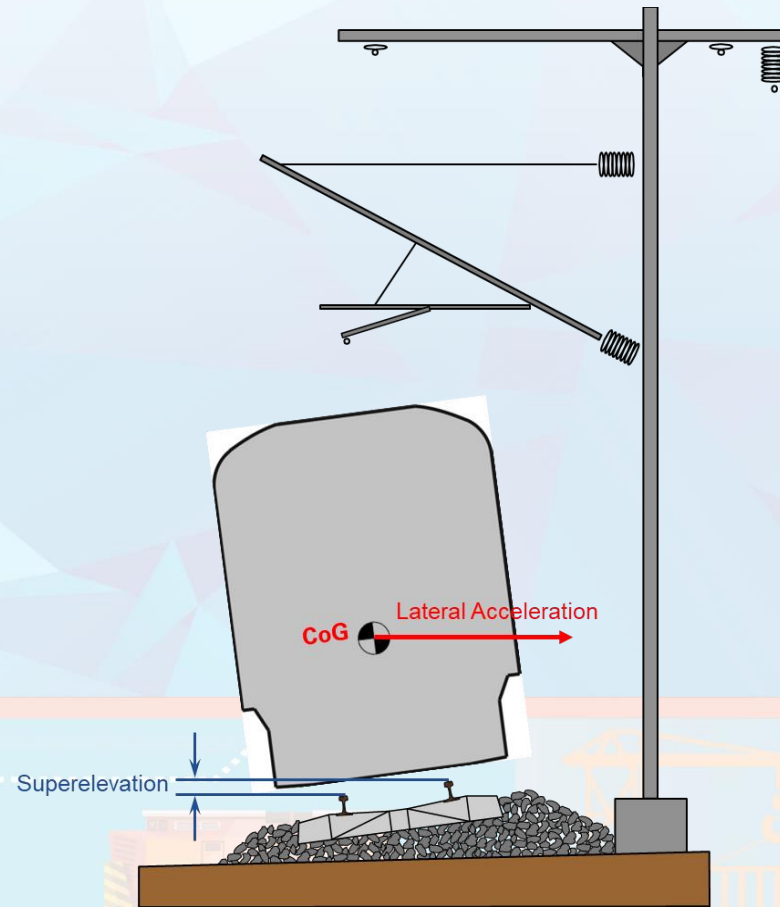
Maintenance/Repair	Traffic	Maintenance Intervals
Tamping	40 - 70 Mio. tons	3 - 5 years
Track grinding	20 - 30 Mio. tons	1 - 3 years
Track renewal	300 - 1000 Mio. tons	10 - 15 years
Renewal of wooden sleeper	250 - 600 Mio. tons	20 - 30 years
Renewal of concrete sleeper	350 - 700 Mio. tons	30 - 40 years
Fixings	100 - 500 Mio. tons	10 - 30 years
Ballast renewal	200 - 500 Mio. tons	20 - 30 years
Substructure renewal	> 500 Mio. tons	> 40 years



PLANNING MAINTENANCE

Infrastructure Measuring & Recording

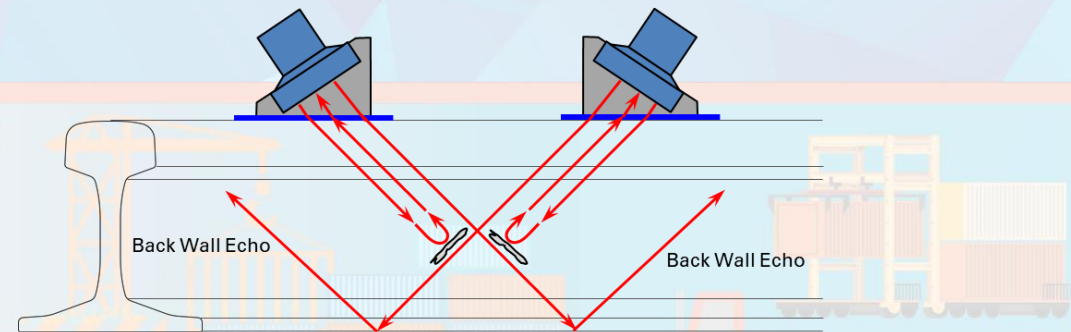
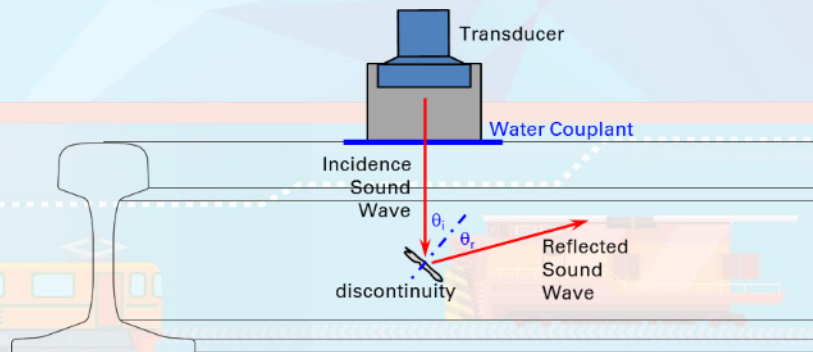
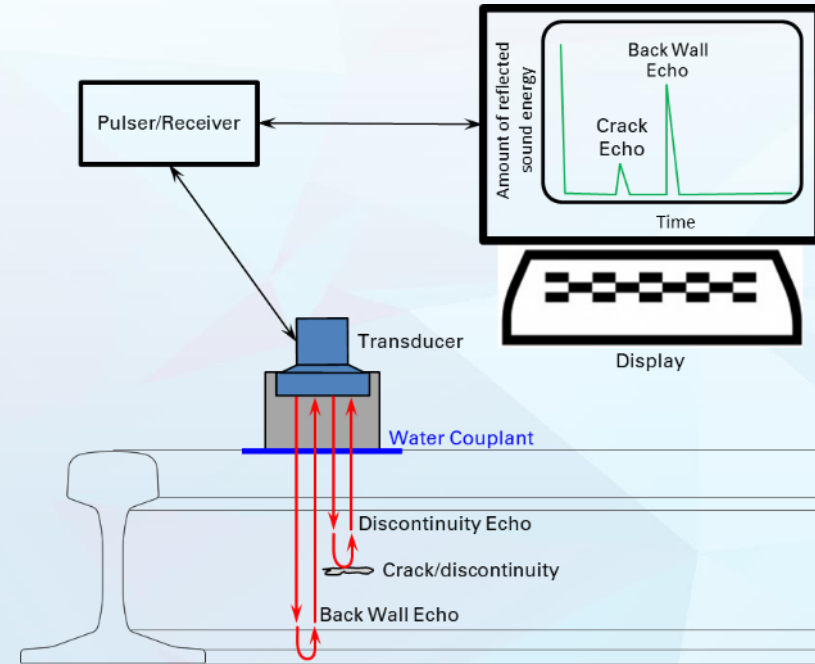
- Visual Inspection
- Trolley Inspections
- Geometry – Track & OHTE
 - Horizontal Alignment
 - Vertical Alignment
 - Twist
 - Gauge
 - Superelevation



PLANNING MAINTENANCE

Infrastructure Measuring & Recording

- Visual Inspection
- Trolley Inspections
- Geometry – Track & OHTE
- Rail Wear
- Rail Corrugations
- Structure Clearance
- Ballast Profile
- Ground Penetrating Radar
- Ultrasonic Rail Flaw Detection



PLANNING MAINTENANCE

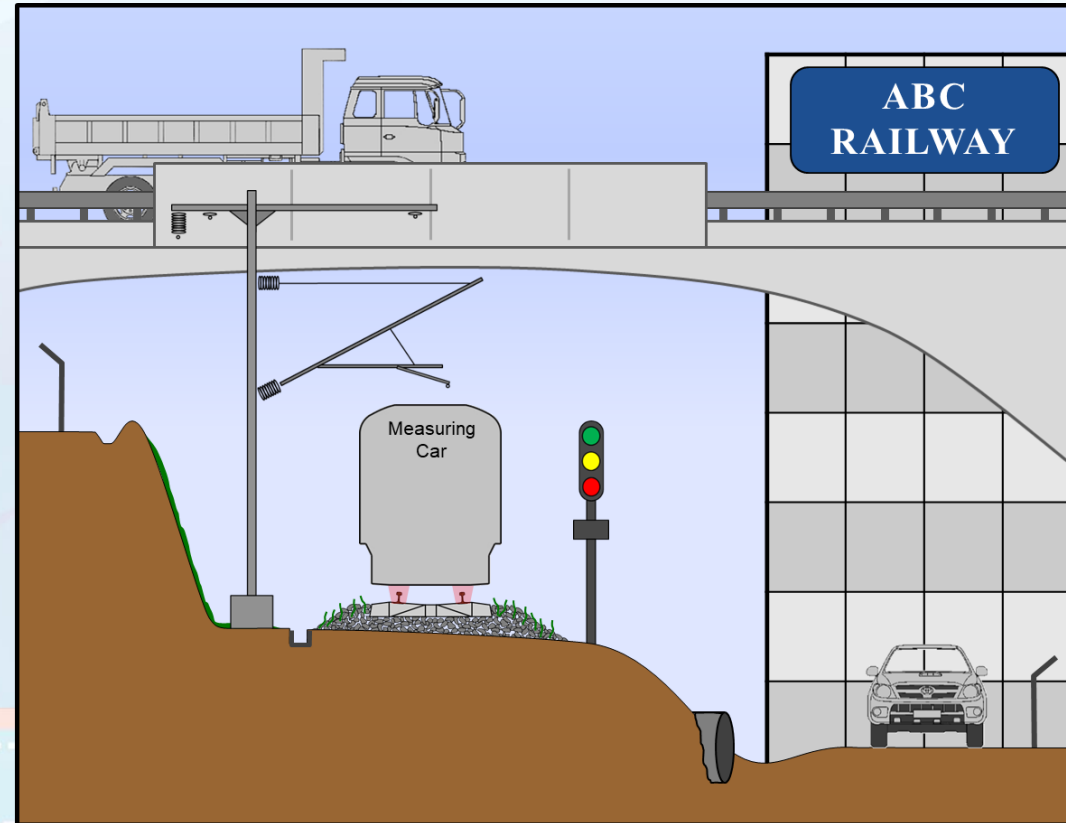
- Analysis of measuring and inspections lead to:
- **TRACK QUALITY INDEX (TQI)**
- and creates basis for **planned maintenance actions**



MECHANIZATION

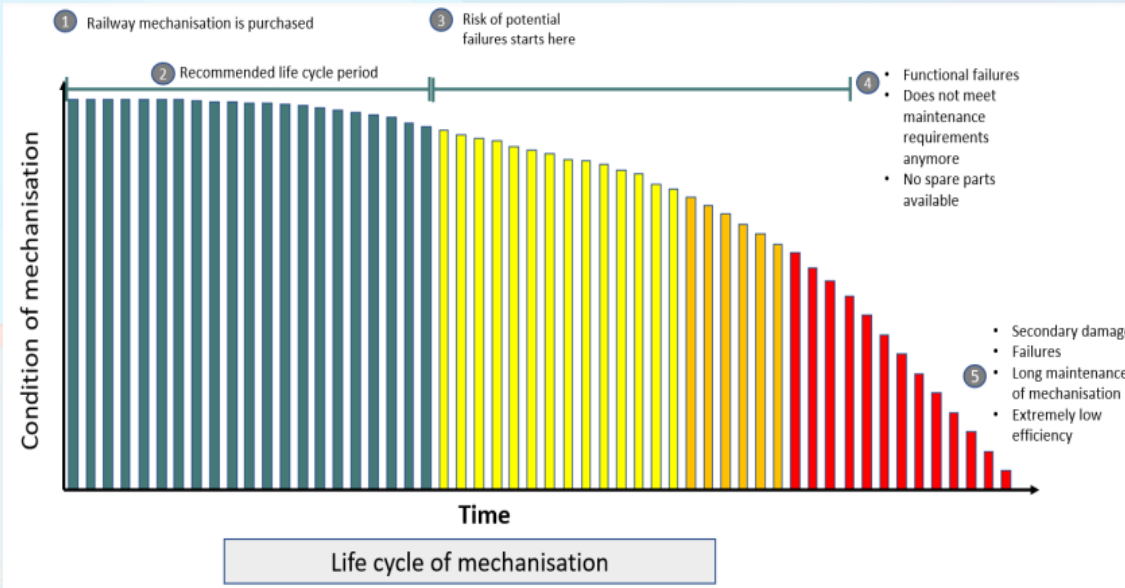
Activities with specialized machine support

- Measuring & Recording
- Rail
- Sleepers
- Fastenings
- Ballast
- Formation
- Edge Drains
- Cuttings & Embankments
- Vegetation Control
- Switches & Crossings
- Curves
- Civil Structures
- Level Crossings
- OHTE (Overhead Traction Equipment)
- Signalling

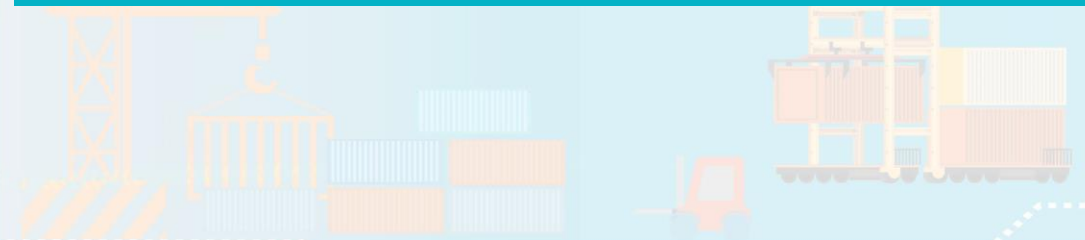


MECHANIZATION

Rail Infrastructure Maintenance Equipment Costs Example: Tamping



Capital expenditure	new (costs in \$/km)	old (costs in \$/km)
Depreciation	114,26	-
Financing cost	51,42	-
Overhaul	7,62	37,55
Repayment	-	-
Total CAPEX	173,30	37,55
Operating expenditure		
Maintenance cost	85,70	422,47
Personnel cost	240,64	790,86
Energy cost	29,07	63,00
Total operating costs	355,41	1.276,33
Total costs per km	528,71	1.313,88



MECHANIZATION

Rail Infrastructure Maintenance Equipment Costs



- Modern tamping machines can tamp up to 4-5 km per day
- The higher the machine utilization, the lower the cost per km

Machine	km performed	No of days worked	km per working day
CSM 3006	163,5	170	0,96
CSM 6486	213,45	195	1,09
CSM 6782	379,9	288	1,32

2019 situation

	Preventive Tamping	BaU Tamping	
Total tamping	770	252	km/a
Costs per km per year	1.254	3.614	AZN/km
Total costs per year	965.580	910.728	AZN

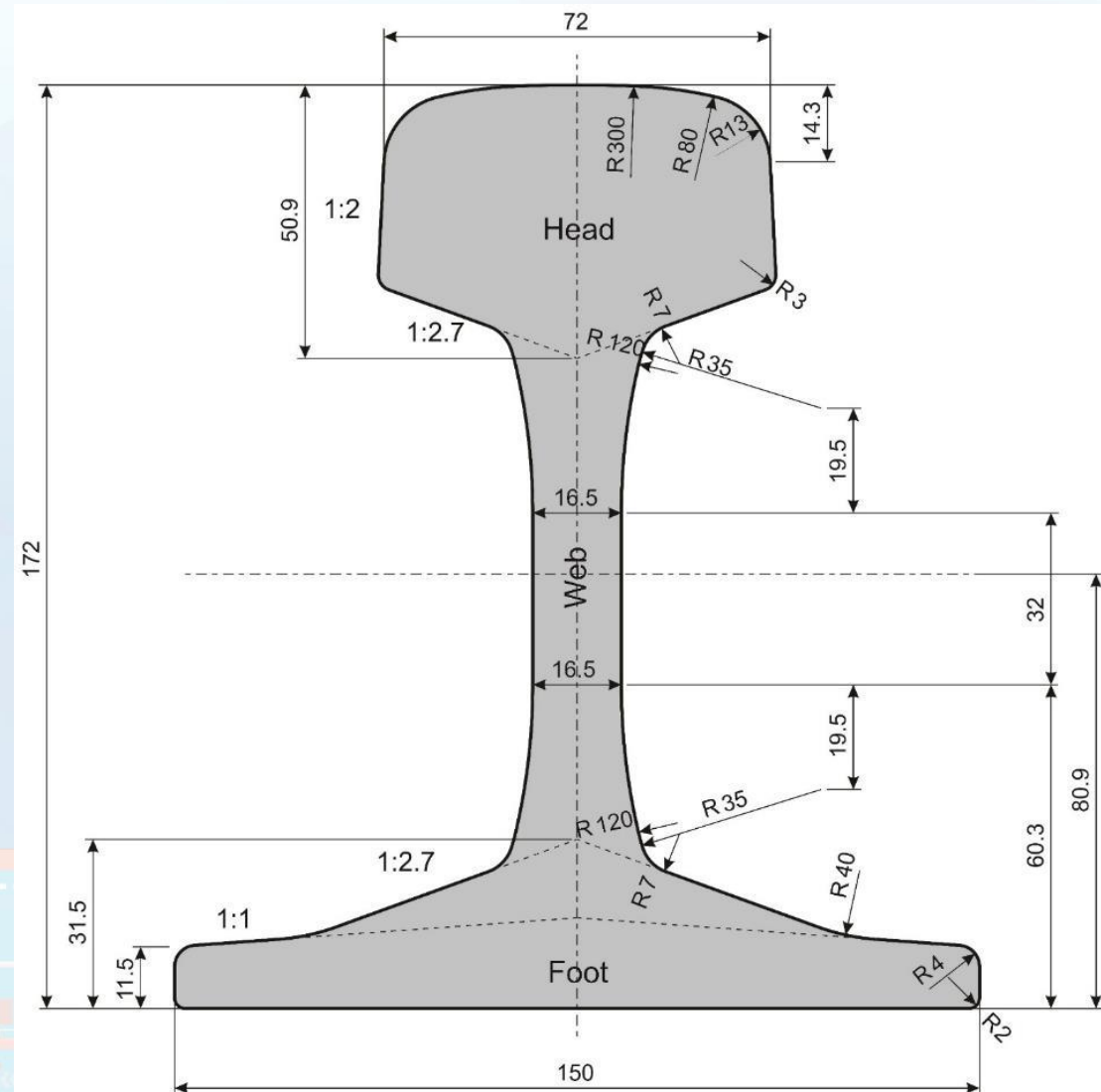
Suggested improvement

MECHANIZATION

Rail Profiling

The rail profile is important for:

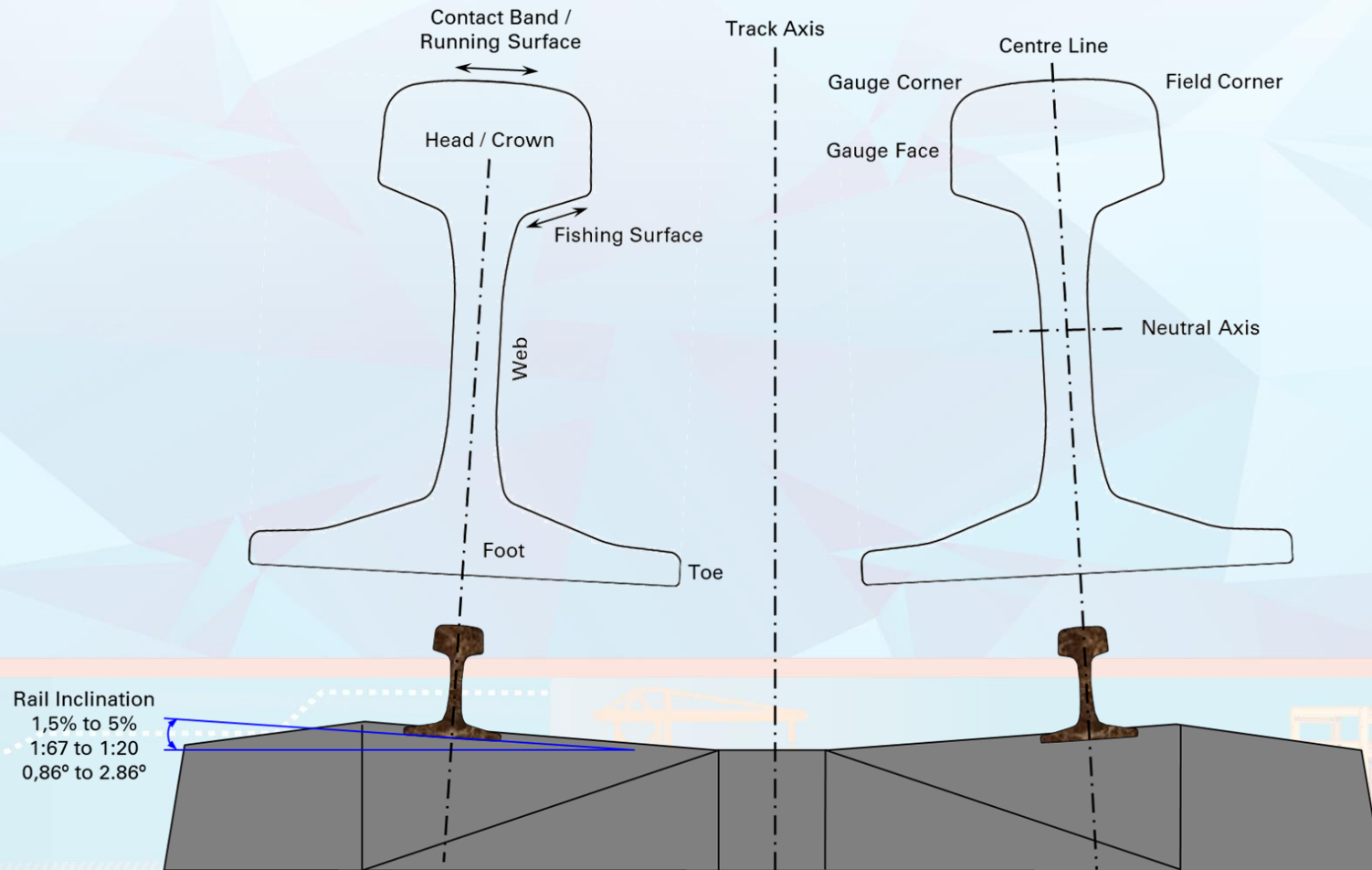
- riding quality
- wear and tear of rails and wheels
- foundation



MECHANIZATION

Rail Profile

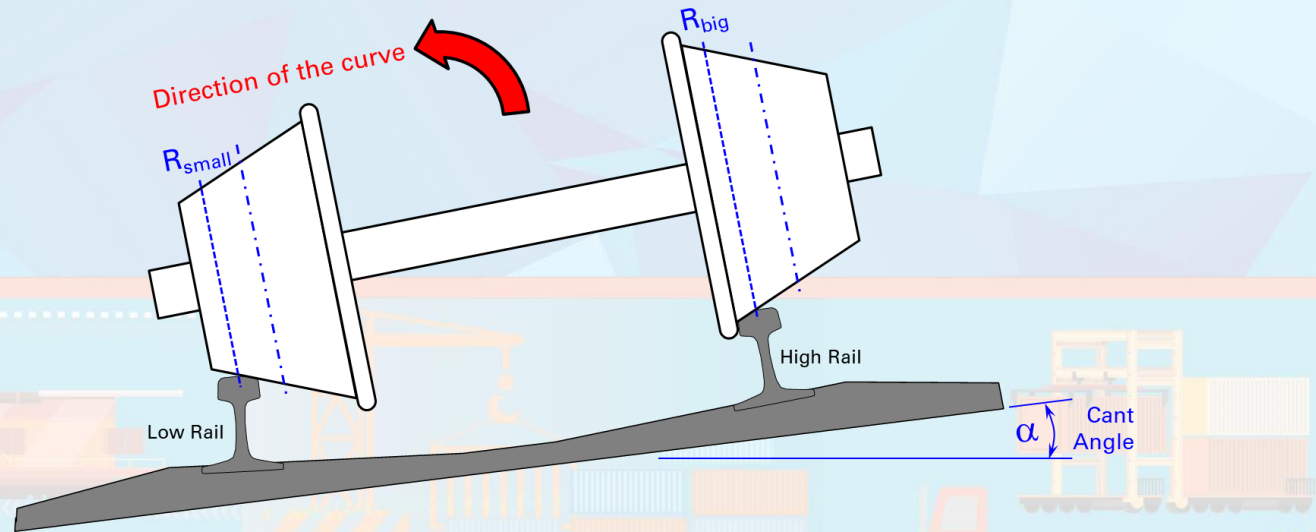
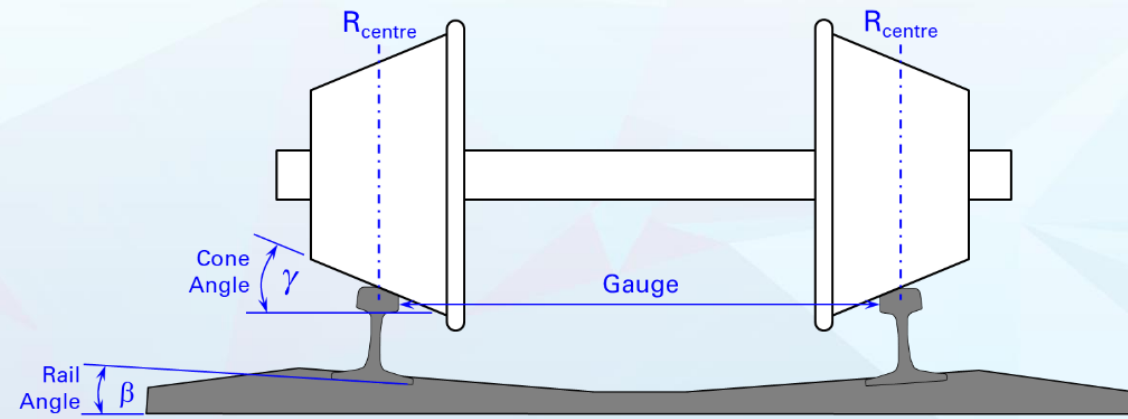
- Rail profiles
- Rail Inclination



MECHANIZATION

- Rail profiles
- Rail Inclination
- Rail Wheel Interaction

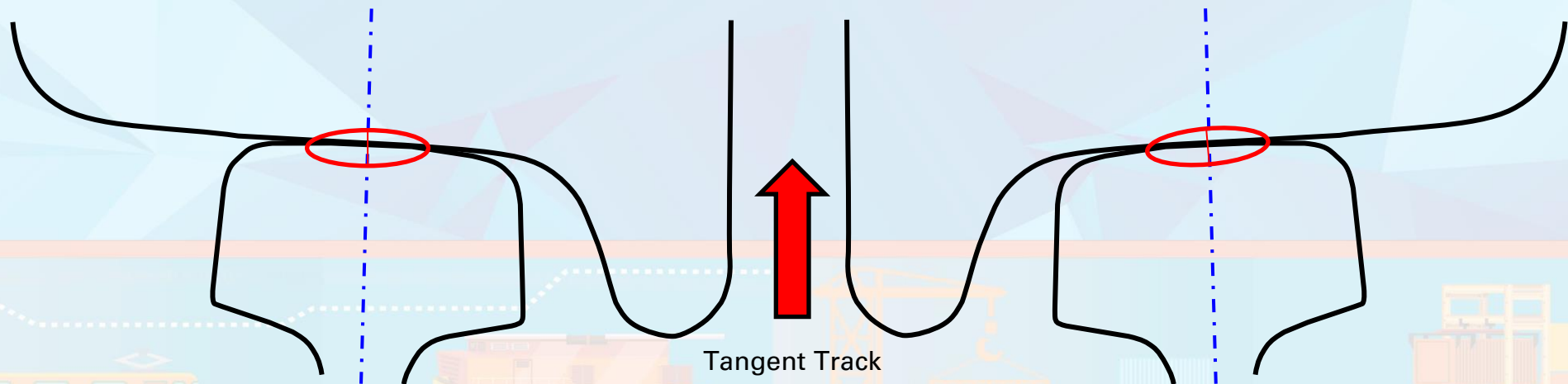
Rail Profile



MECHANIZATION

Rail

- Rail profiles
- Rail Inclination
- Rail Wheel Interaction



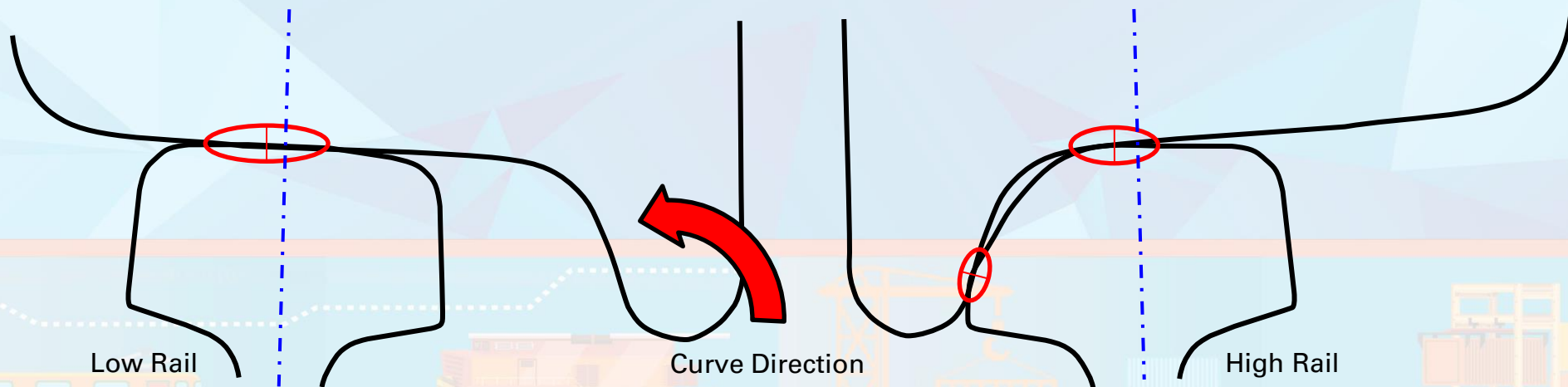
MECHANIZATION

Rail

- Rail profiles
- Rail Inclination
- Rail Wheel Interaction



Centrifugal Force 



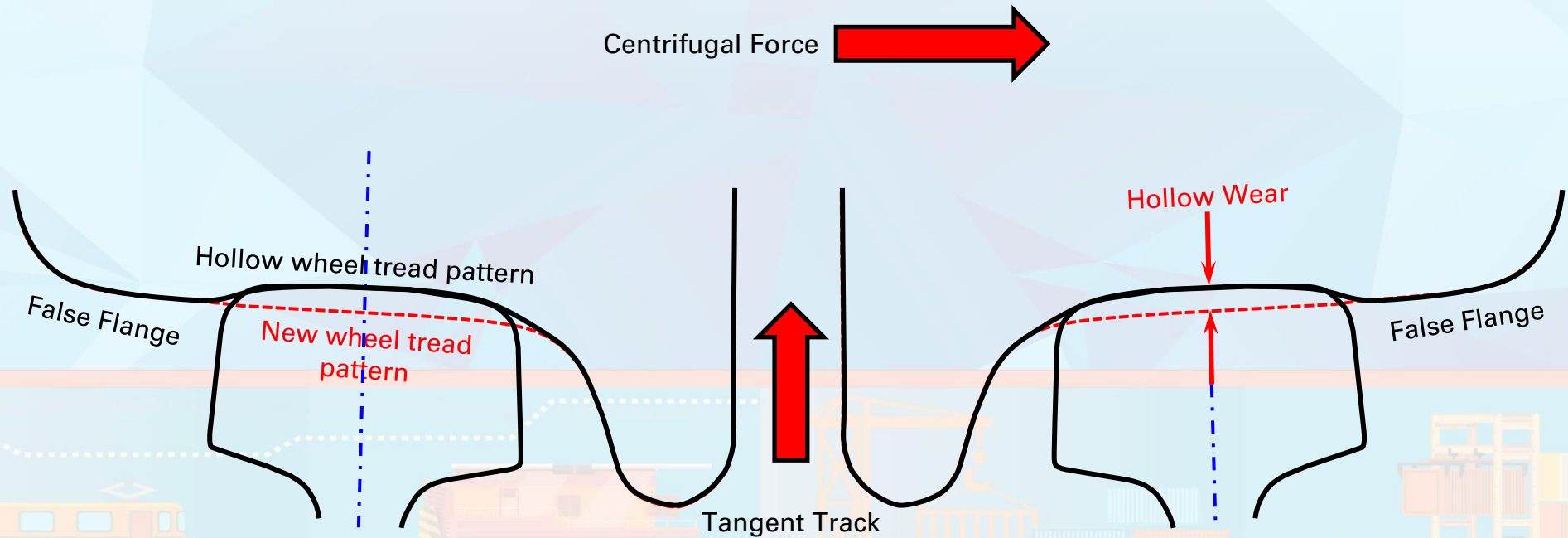
Low Rail

Curve Direction

High Rail

MECHANIZATION

- Rail profiles
- Rail Inclination
- Rail Wheel Interaction

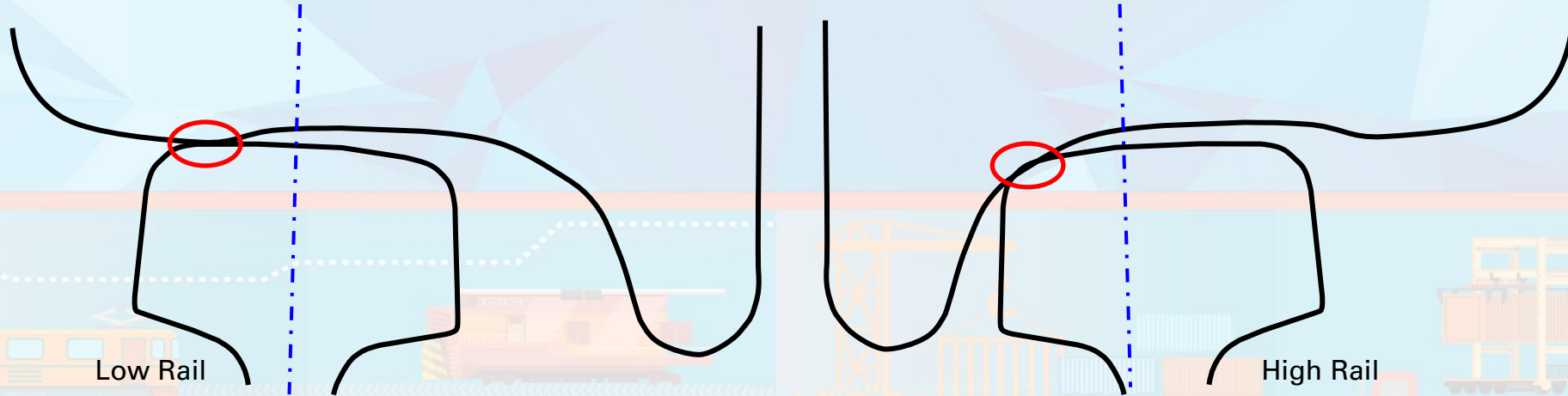


MECHANIZATION

Rail

- Rail profiles
- Rail Inclination
- Rail Wheel Interaction

Centrifugal Force 



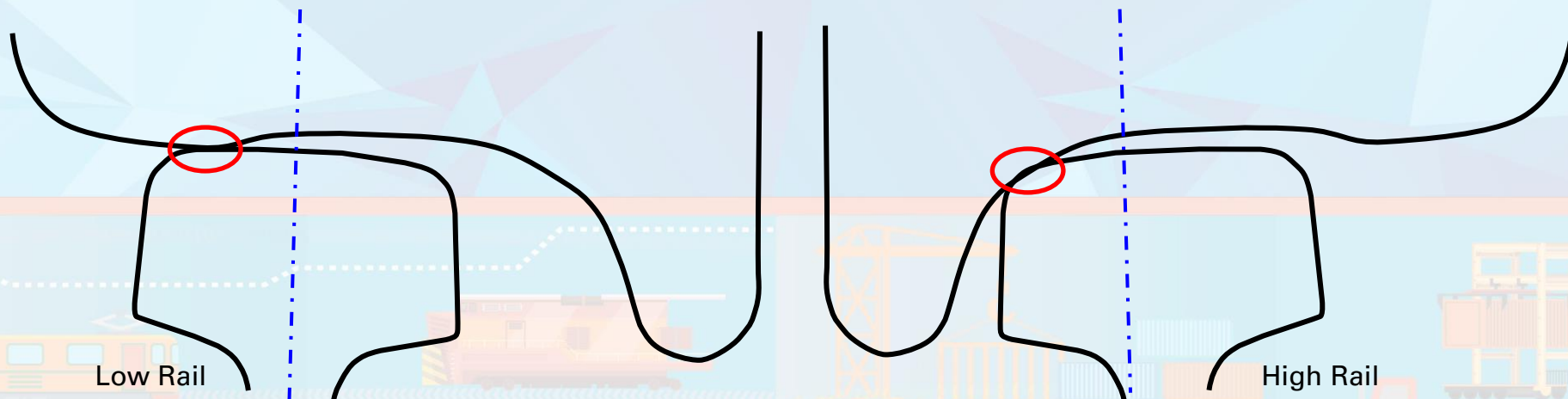
MECHANIZATION

Rail

- Rail profiles
- Rail Inclination
- Rail Wheel Interaction

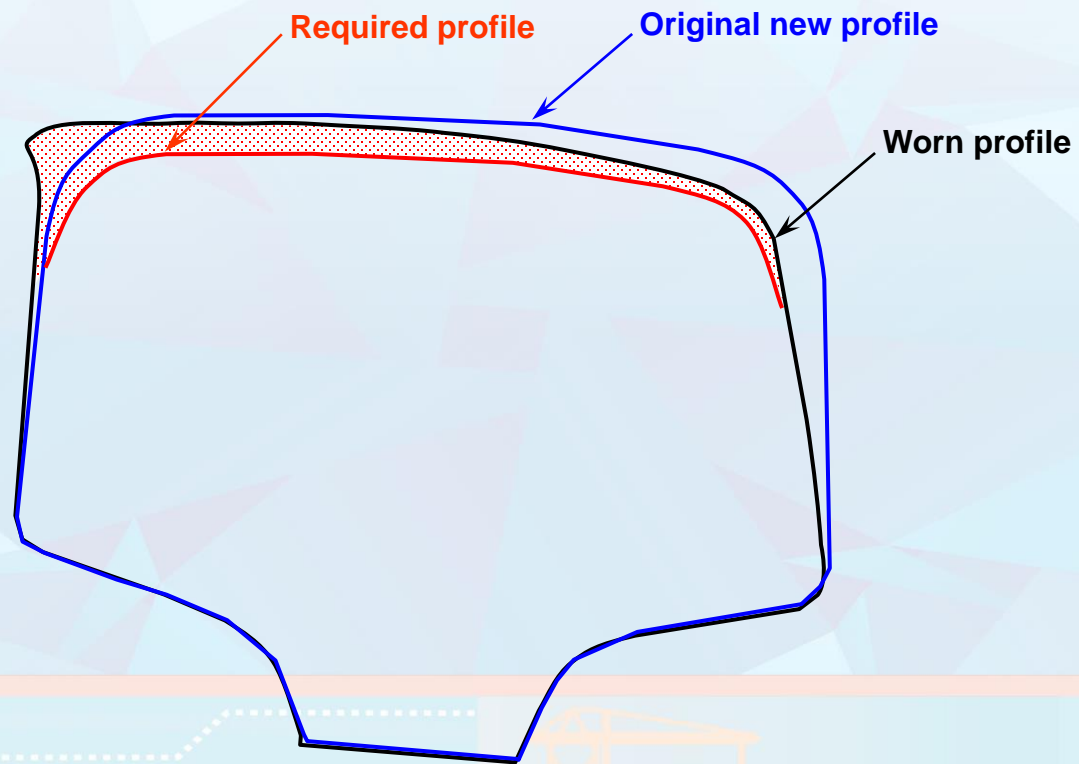


Centrifugal Force 



MECHANIZATION

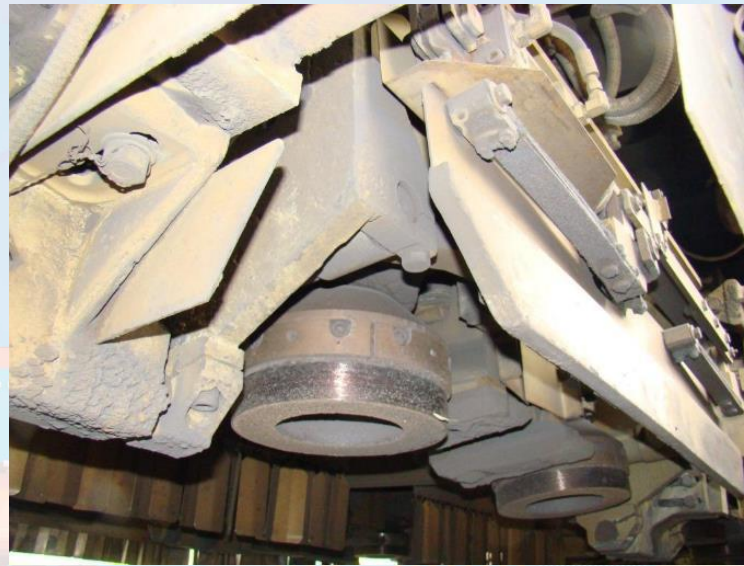
Rail Maintenance



MECHANIZATION

Rail Profiling

- Rail Grinding



MECHANIZATION

Rail Profiling

- Rail Milling



Oszillating finisher

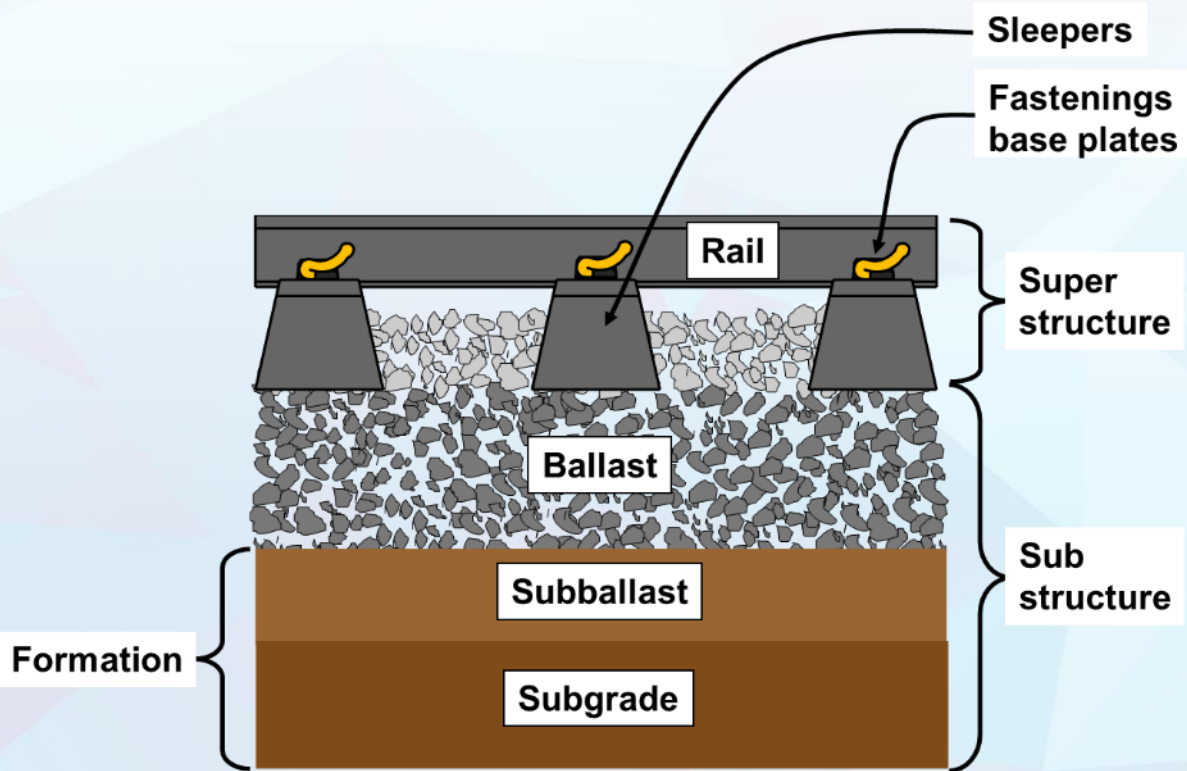


Milling Unit

MECHANIZATION

Presentation Topics

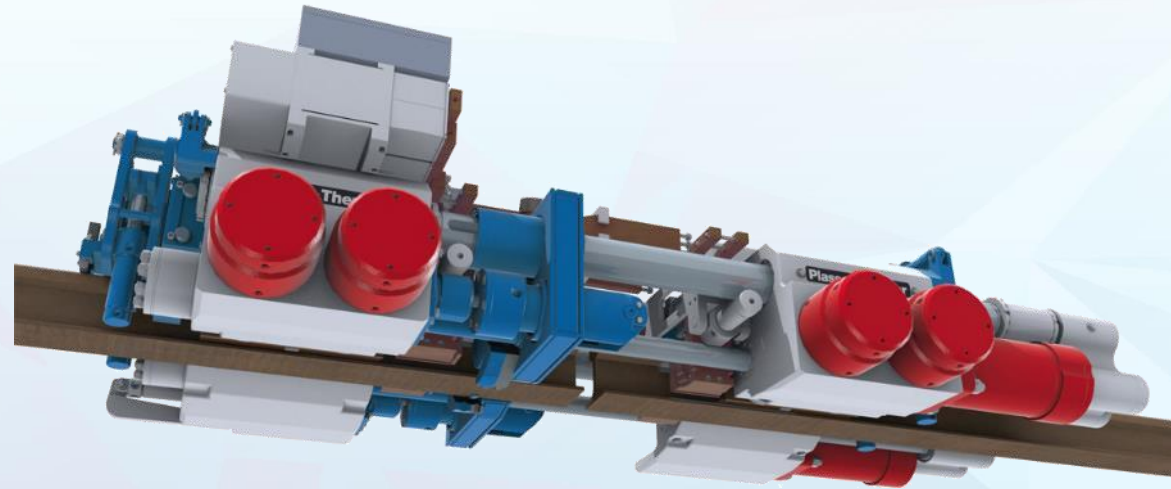
- ✓ Measuring & Recording
- Rail
- Sleepers
- Fastenings
- Ballast
- Formation
- Edge Drains
- Cutting & Embankments
- Vegetation Control
- Switches & Crossings
- Curves
- Civil Structures
- Level Crossings
- OHTE (Overhead Traction Equipment)
- Signalling



MECHANIZATION

Continuous Welded Rail (CWR)

- Rail Welding
 - Flash Butt Welding



MECHANIZATION

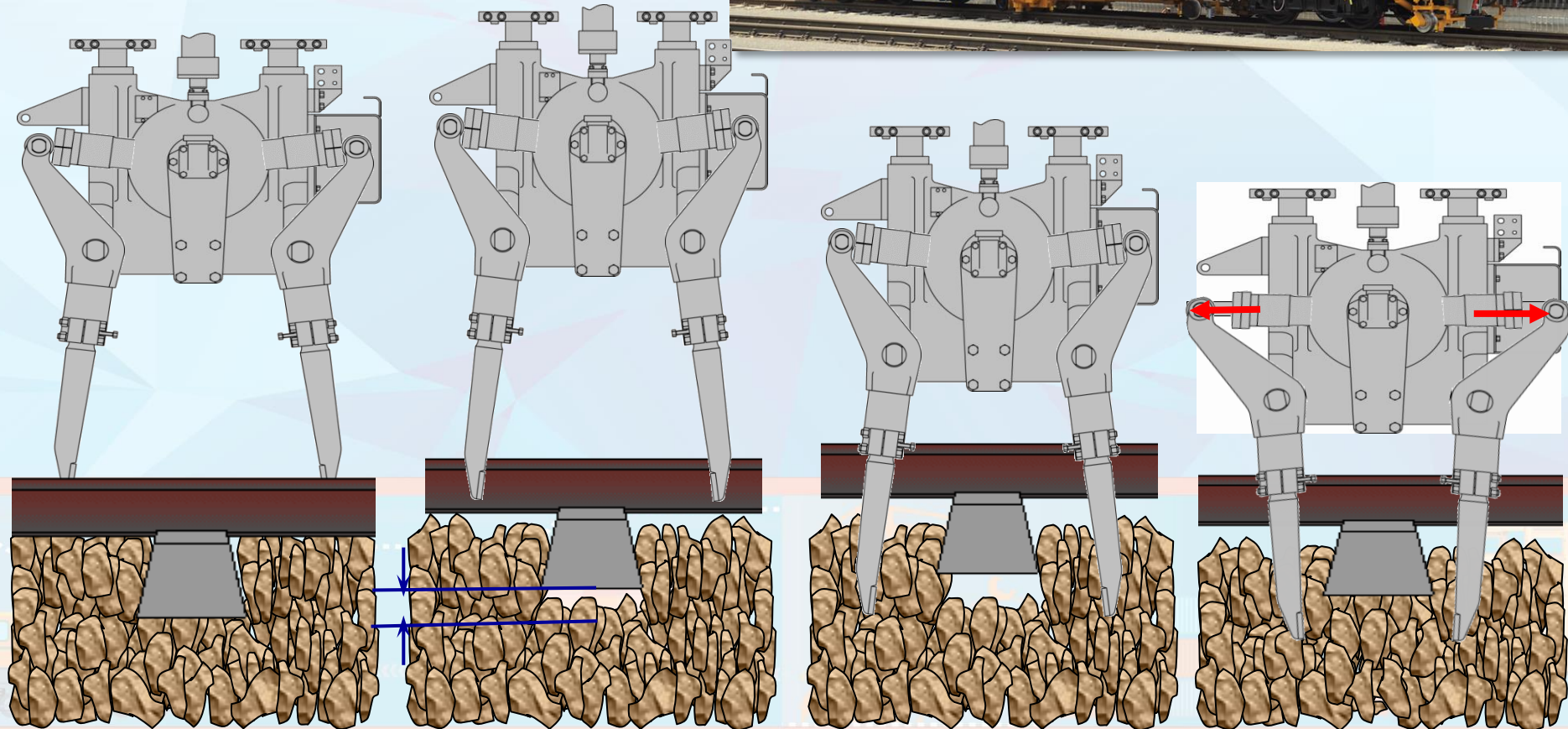
- Single Sleeper Installation



MECHANIZATION

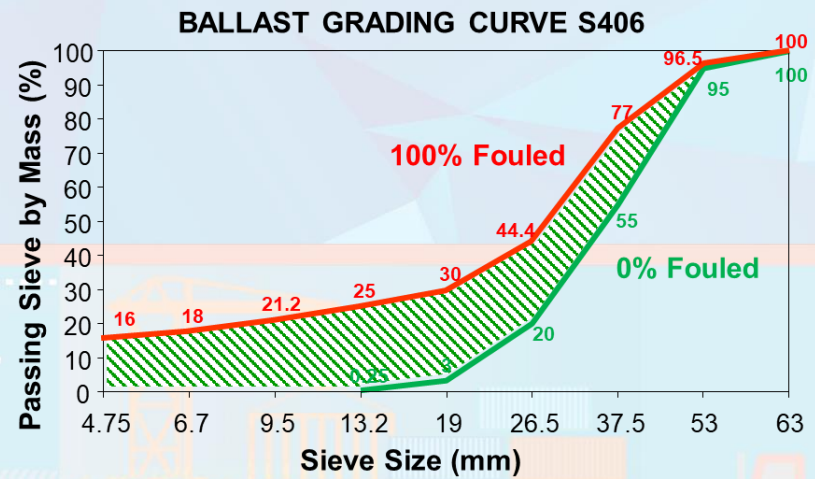
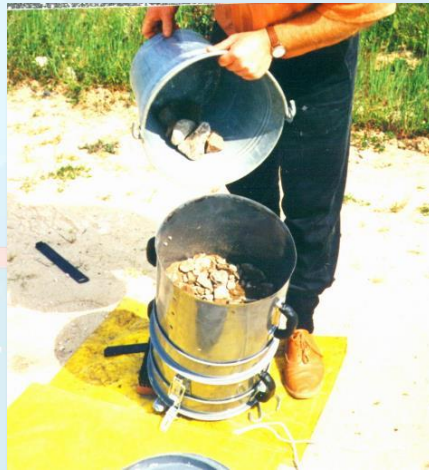
Ballast

- Tamping



MECHANIZATION

Ballast



MECHANIZATION

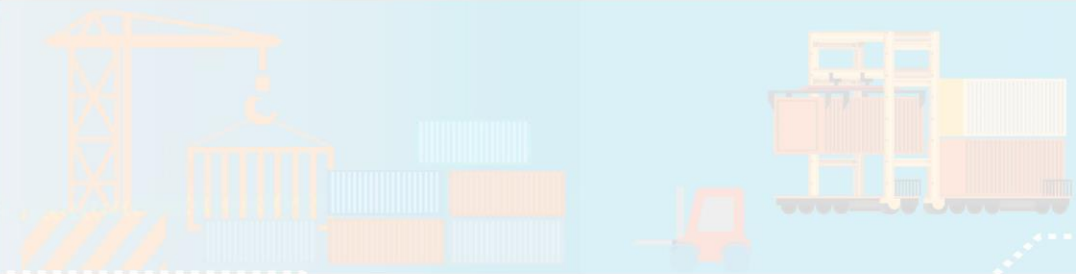
- Ballast Cleaning

Ballast (Maintenance)



MECHANIZATION

- Vegetation control



MECHANIZATION

Civil Structures



THANK YOU

