

EFFECT OF HIGH CAPACITY VEHICLES ON PAVEMENTS - RESULTS FROM THE FINNISH FIELD TESTS

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FACTORS AFFECTING PAVEMENT PERFORMANCE UNDER HEAVY TRUCKS

Trucks:

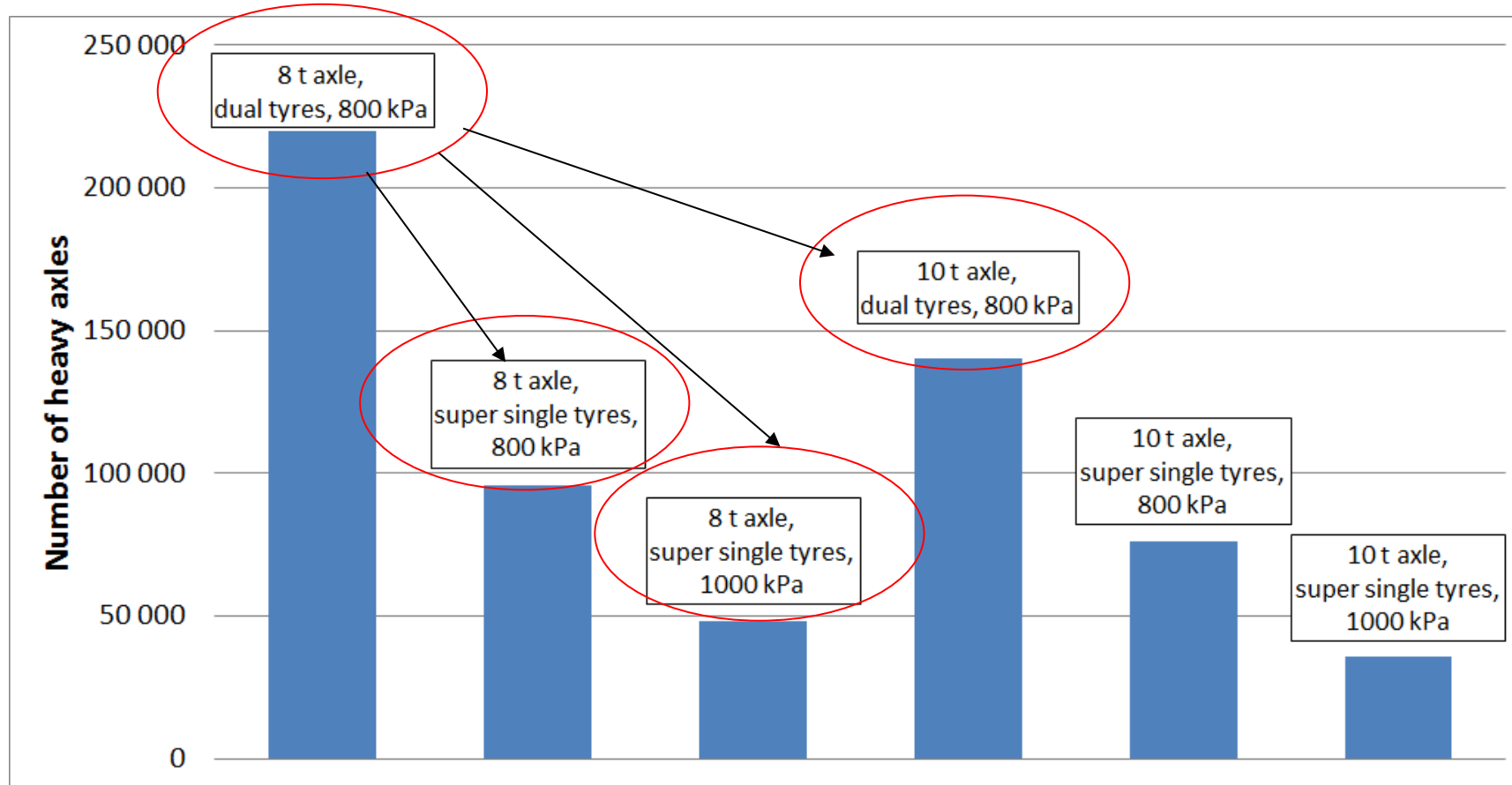
- Tyre type, tyre pressure, tyre size
- Axle load, axle configurations
- Total weight, number of axles
- Tyre wander, rebound

Roads:

- Pavement thickness
- Subgrade quality (weak subgrades)
- Material quality (moisture susceptibility)
- Geometry and road width
- Optical guidance
- Drainage, winter maintenance



THEORETHICAL CALCULATIONS: EFFECT OF TYRE LOAD, TYRE TYPE AND TYRE PRESSURE ON PAVEMENT LIFE TIME FOR TYPICAL FINNISH PAVED ROADS



Made using
Bisar
software

... but they
match with
TUT
instrumented
road test
results

PAVEMENT DISTRESS DUE TO NEW HEAVY VEHICLES

Top Down Cracking



00013_127_2017



00013_127_2019



00013_127_2020

- Reasons:
1. Super single tyres, high tyre pressures
 2. Too stiff remix pavements

PAVEMENT DISTRESS DUE TO NEW HEAVY VEHICLES

Mode 2 rutting cracking



00633_001_2016

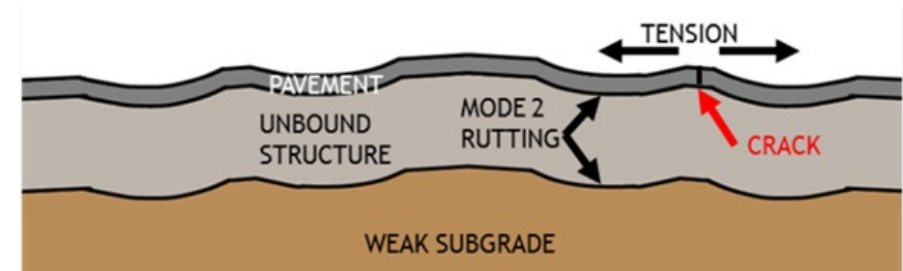


00633_001_2017



00633_001_2021

Reason: Pavement structure does not spread the load wide enough over weak subgrade soil



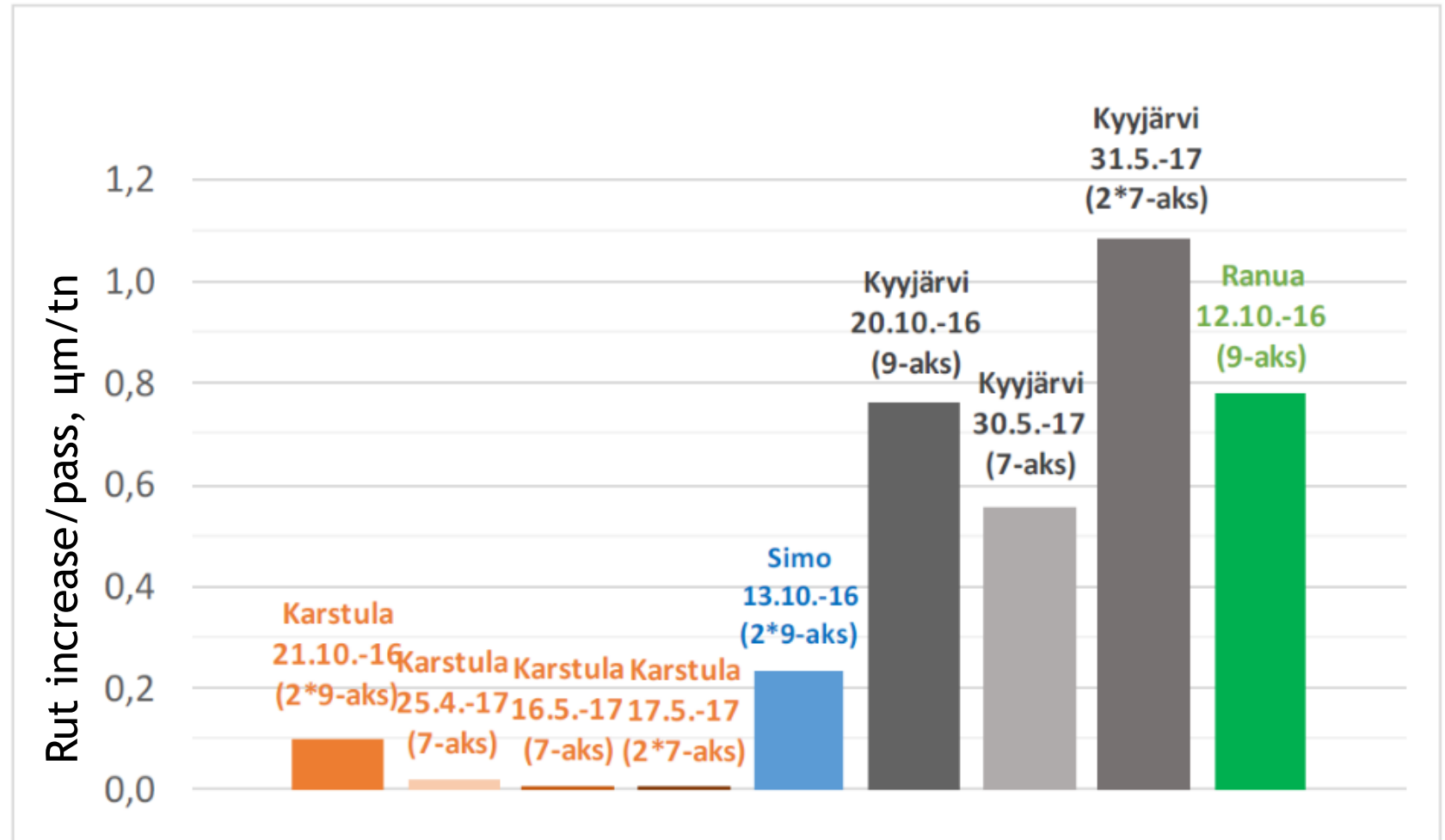
RUT INCREASE AFTER TEST TRUCK PASSES / TON

Karstula:
Strong structure
Subgrade peat

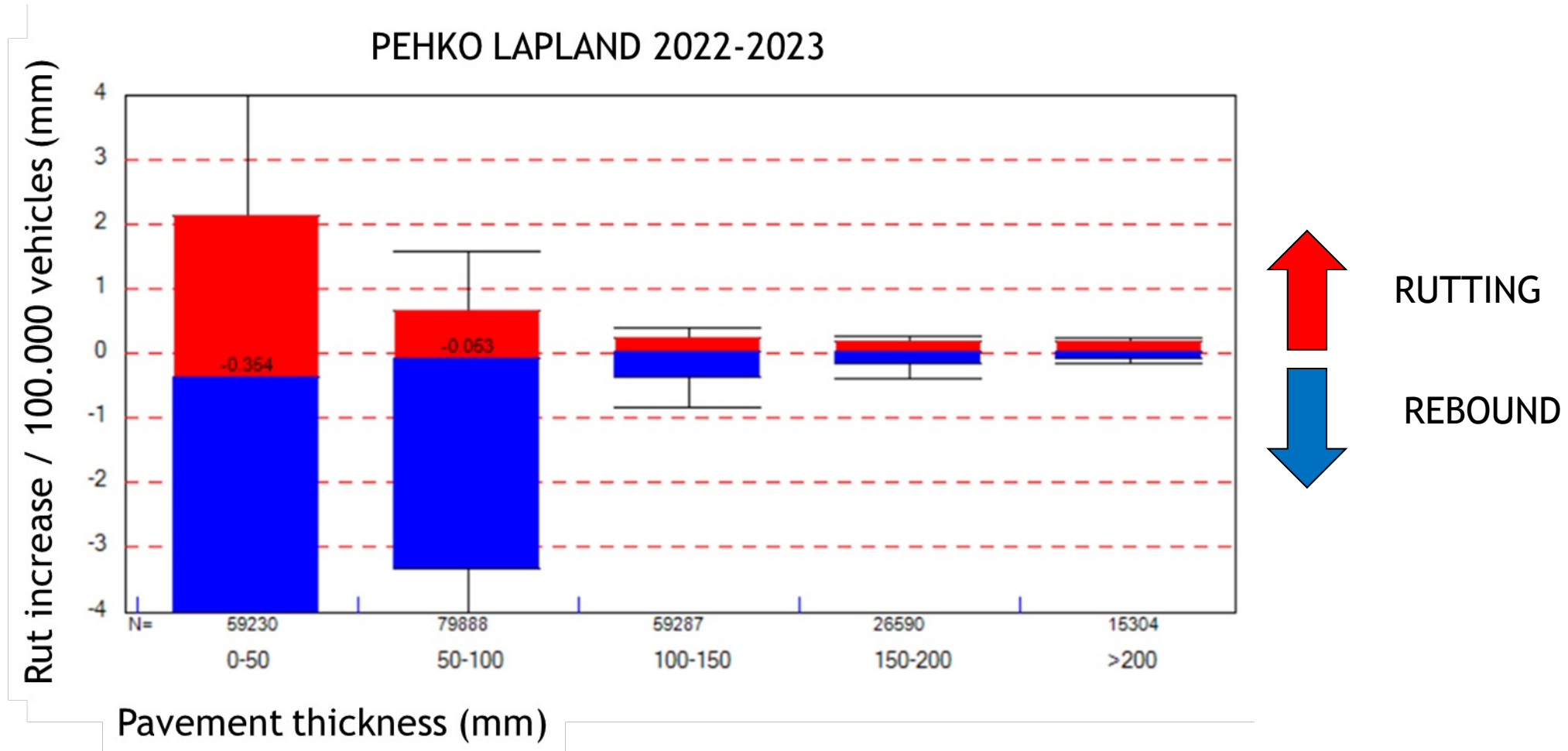
Simo
“Medium” structure
Subgrade silt

Kyyjärvi
Weak structure
Subgrade peat

Ranua
“Medium” gravel road
Subgrade silt / peat



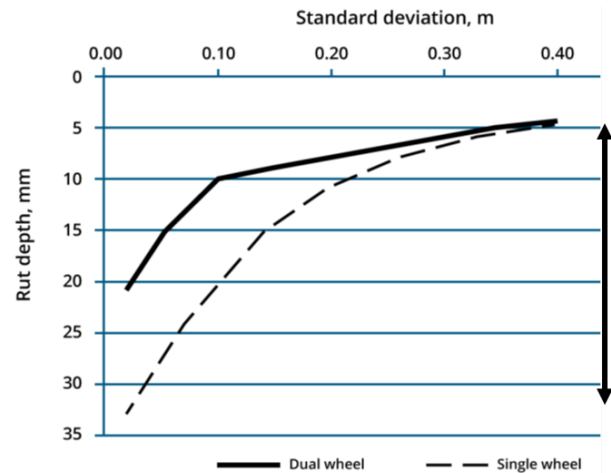
PEHKO RESULTS- REBOUND AND PAVEMENT THICKNESS



FUTURE RISKS: EFFECT OF TYRE WANDER TO PAVEMENT FATIGUE

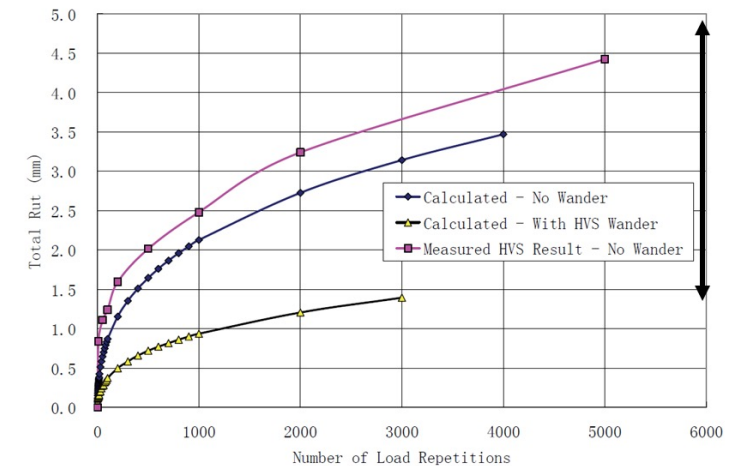
TYRE WANDER

- When human is driving: 300 mm
- Autonomous trucks or trucks with steering assists: 10-30 mm



Source: Said 2012

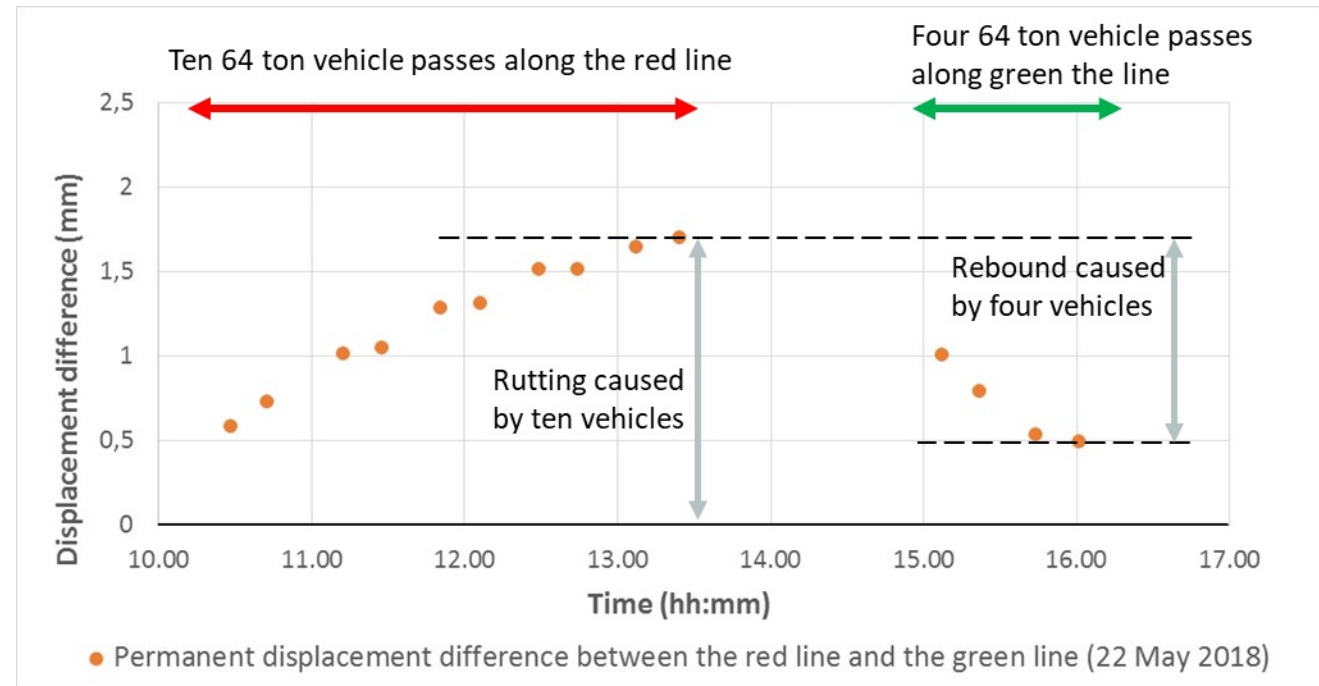
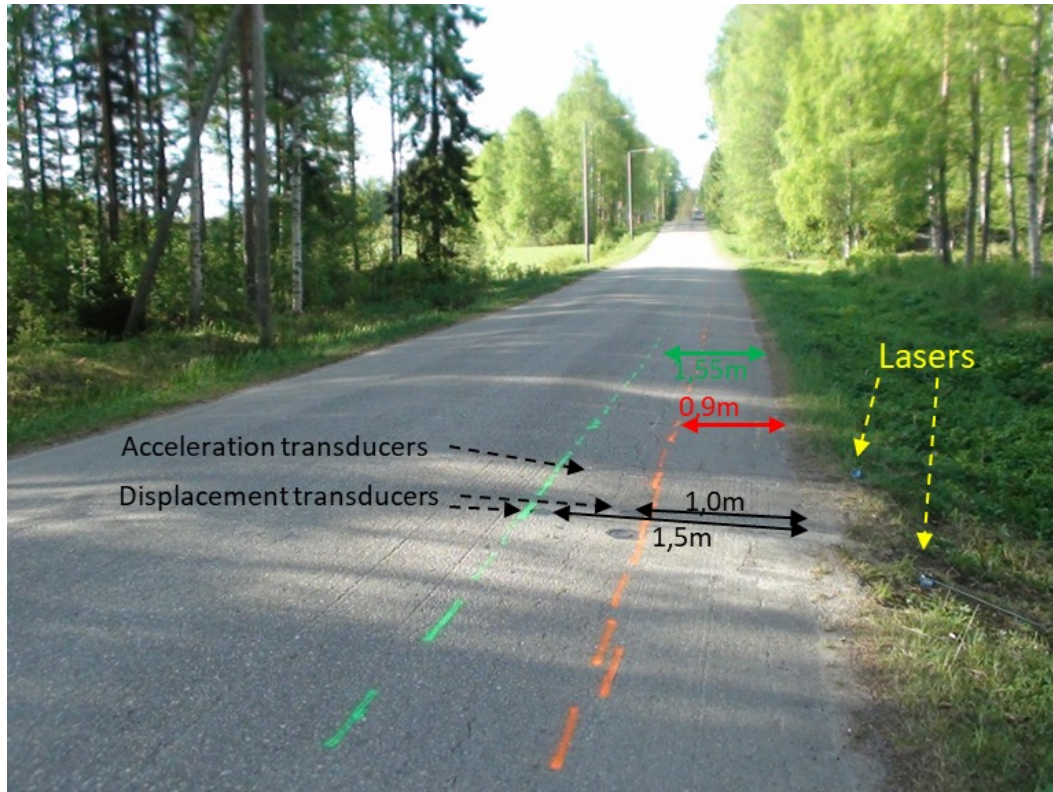
Factor:
4-5
(single tyre)



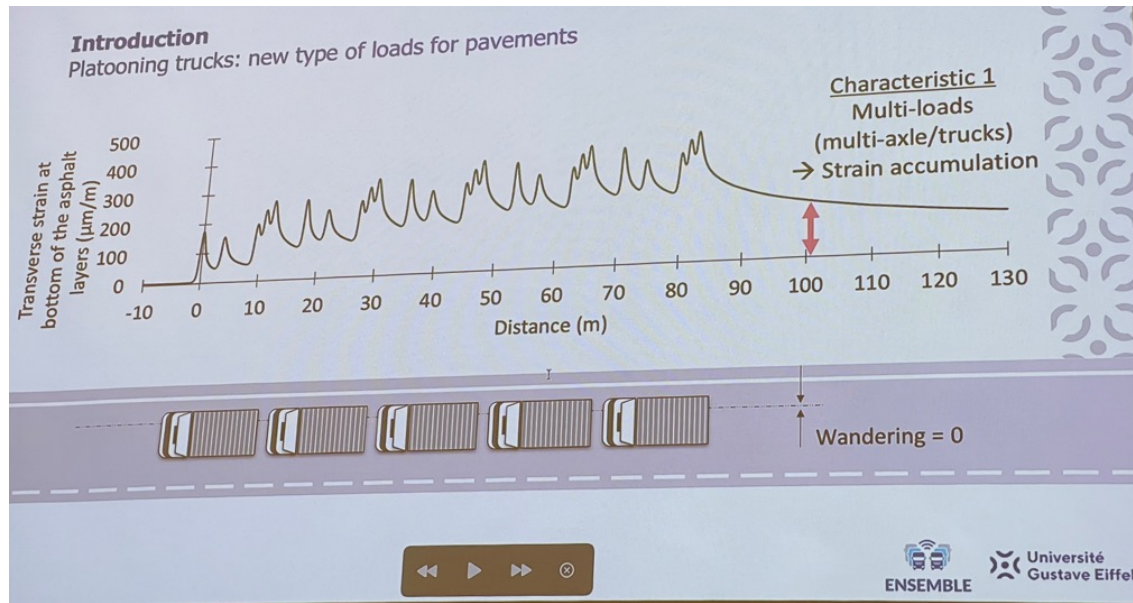
Source: Wu and Harvey 2008

Factor:
3-4

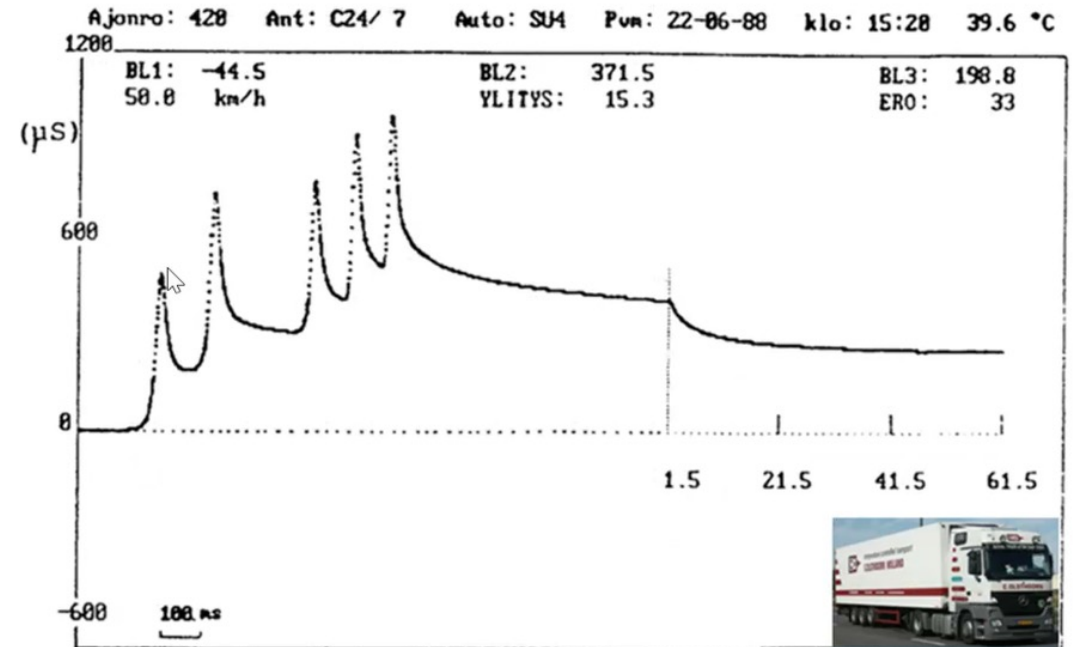
REBAOUND / PERMANENT DISPLACEMENTS - ROAD 16863



MULTIPLE AXLES AND INCREMENTAL TRANSVERSE STRAINS



Gustav Eifel results, France



VTT, Matti Huhtala 1992

FINNISH EXPERIENCES ABOUT THE AXLE WEIGH INCREASE

(Timo Saarenketo's expert opinion)

- Increase of single axle load increase is smaller compared to effect on **tyre type** and **tyre pressures**
- Fourth power rule can be applied in Finland only on well built major highways - and even there the biggest problem is wear due to studded tyres
- Instead of single axles, higher focus should be on the impact of dual or triple boggy configurations and their weighs (and tyre pressures)
- Higher single axle weight increases also risk for failure during spring thaw on thin pavements (<200 mm)
- **Truck total weight does matter** and it cannot be compensated with more axles
 - Highest risk of total weigh increase on road failures is on roads built over weak subgrades and road pavement thickness is < 150 mm
- **In the future reduced tyre wander** will be a much **bigger risk issue**
- Finally more research is needed on **incremental transverse pavement strains** by multiple axles