Magic Wear Rate

- Measuring methods
- Time series
- Forecast models

Procedure

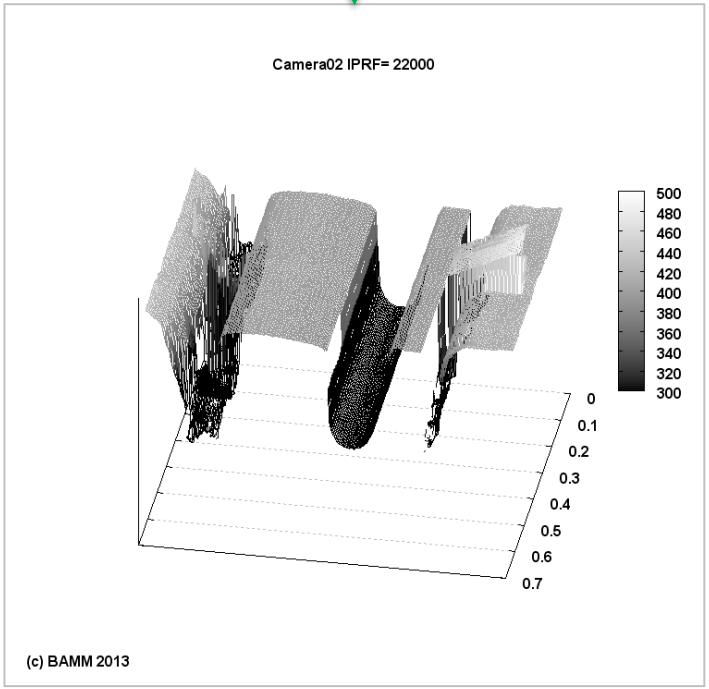
Quantitative description of the **wear behavior** of the tram and subway net.

Dependent on:

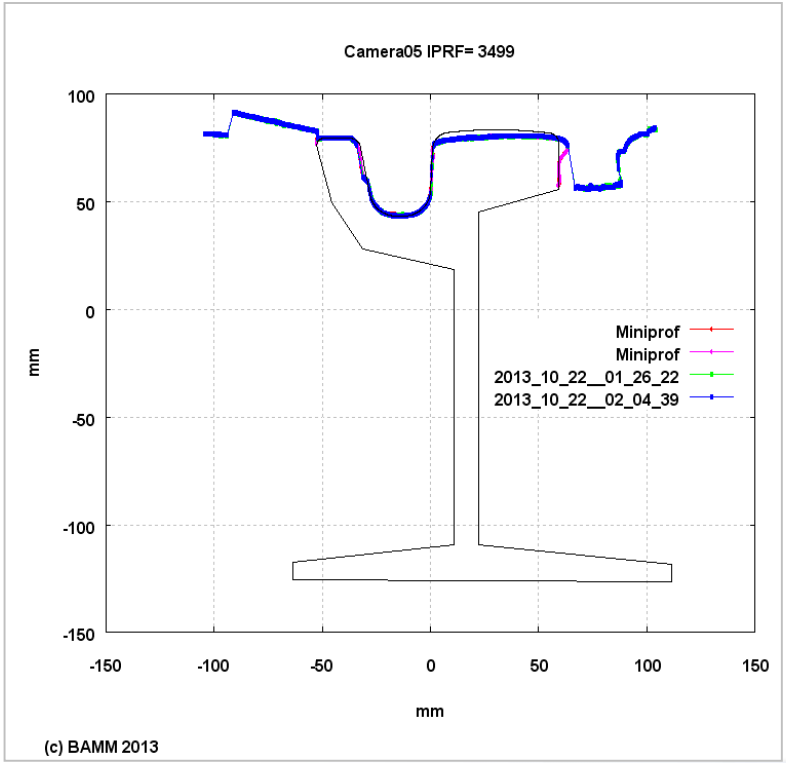
- Route layout (curvature)
- Inspection (vehicle dynamics and load)
- Rail system (nonballasted track, sleeper track)
- Steel grade (temper of steel)

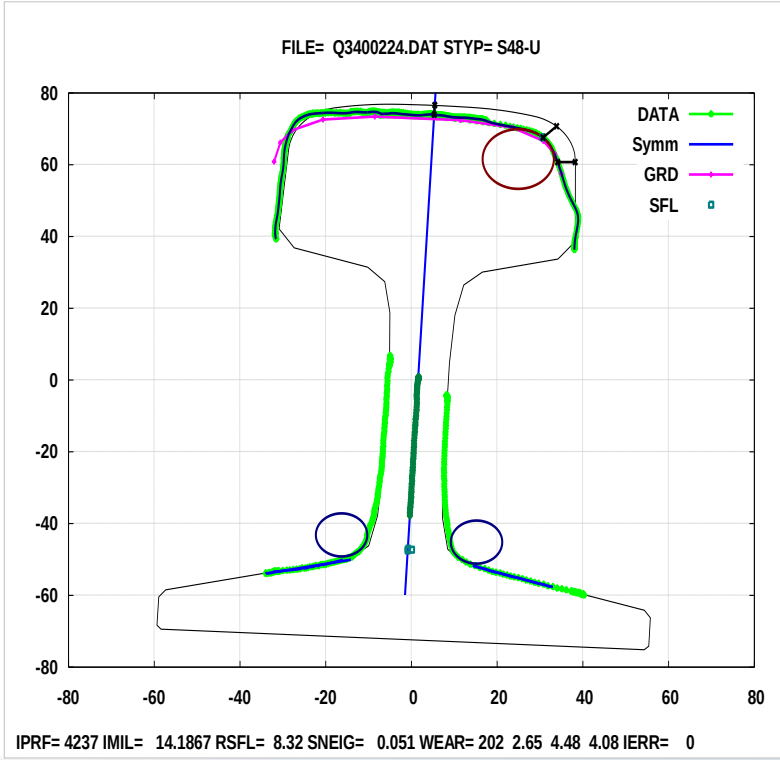
Aim is generation of time series and curvature dependent **wear rates formulae** by using the data of both track measuring cars

Track geometry car (Tram)



Laser based profile (wear) measurement





Modus operandi

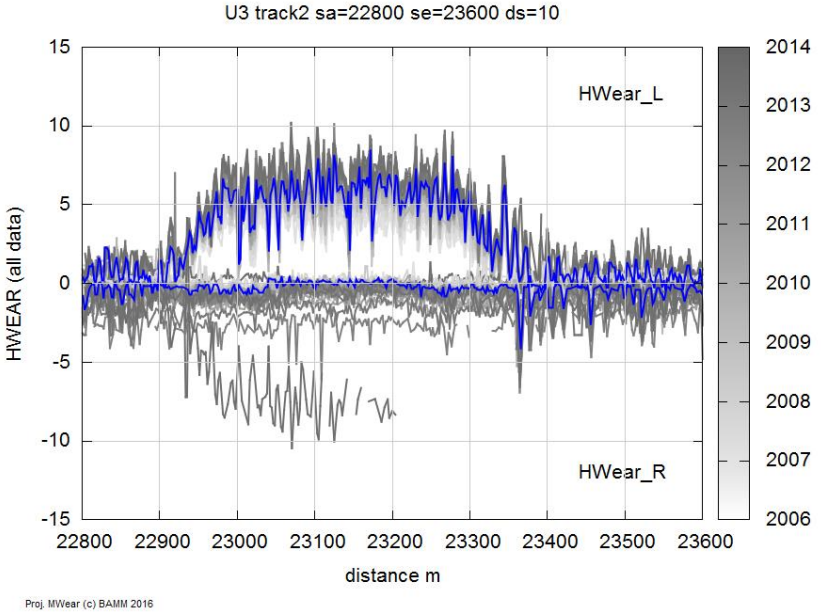
Calculation of wear rates of the subway:

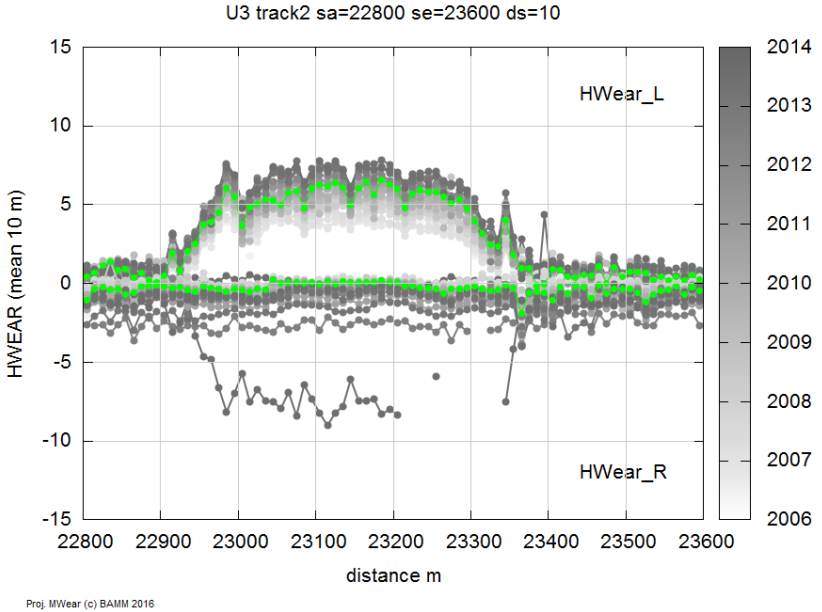
Analysis of measurement runs from 2006 to 2016

- Rail **wear horizontal, lateral** and **45°** (combined)
- Classification of routes into **discrete sections**
- Approximation in the **time domain**
- Categorization into 10 **curvature classes**
- Filtering by track types
- Statistical summarization (by subway lines)

Raw data

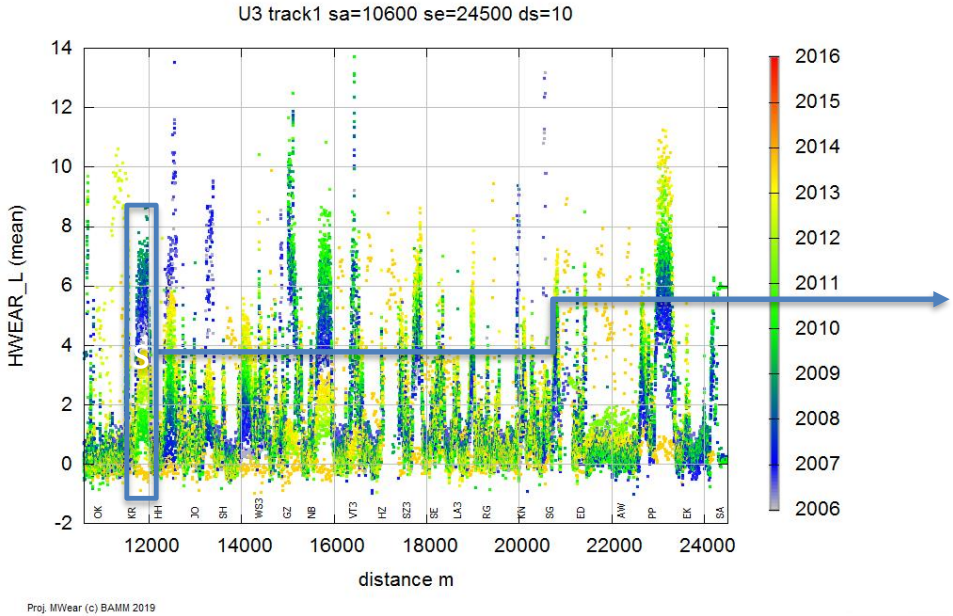
Single test run and time series of the horizontal wear

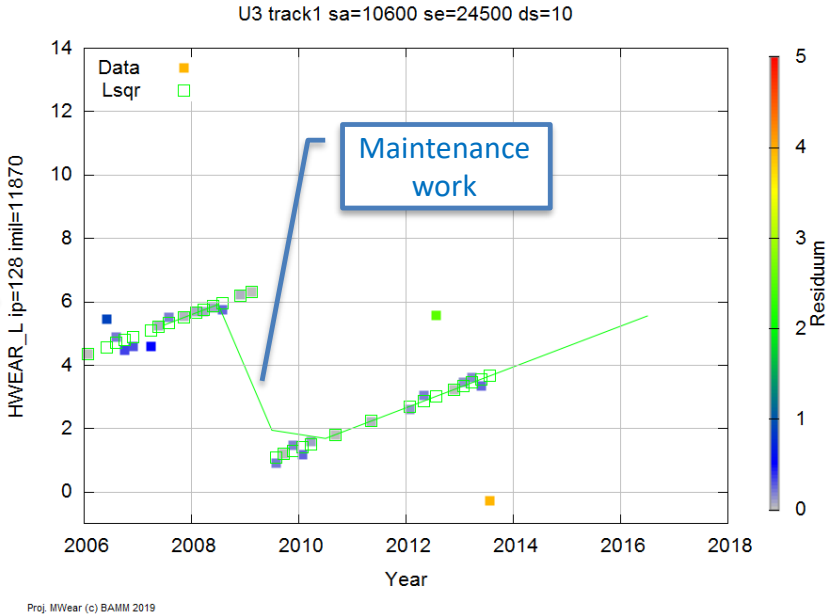




Evaluation method

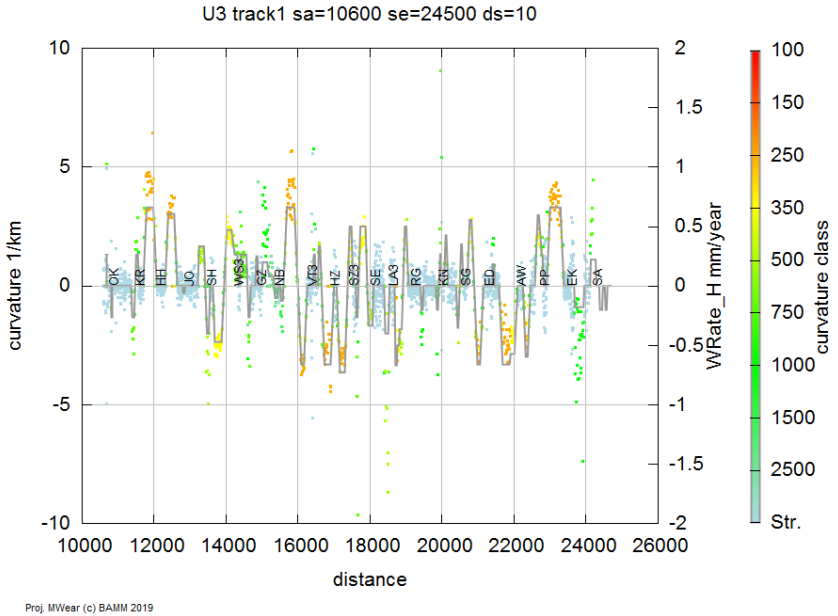
Wear and trend analyses considering the maintenance events

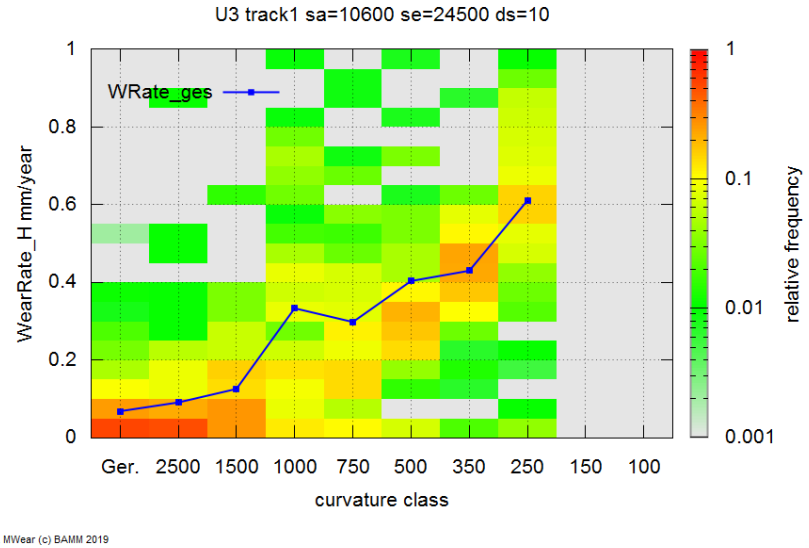




Influencing factor curvature

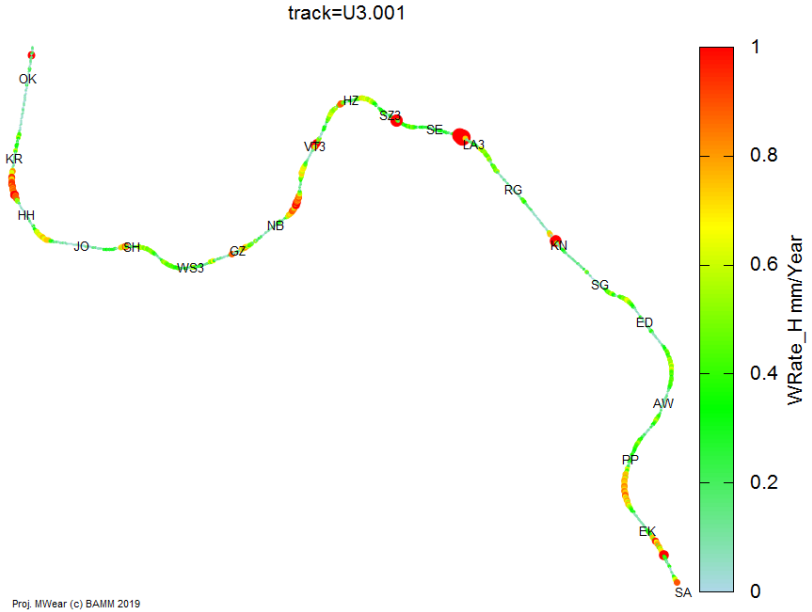
Location and curvature dependent distribution of wear rates

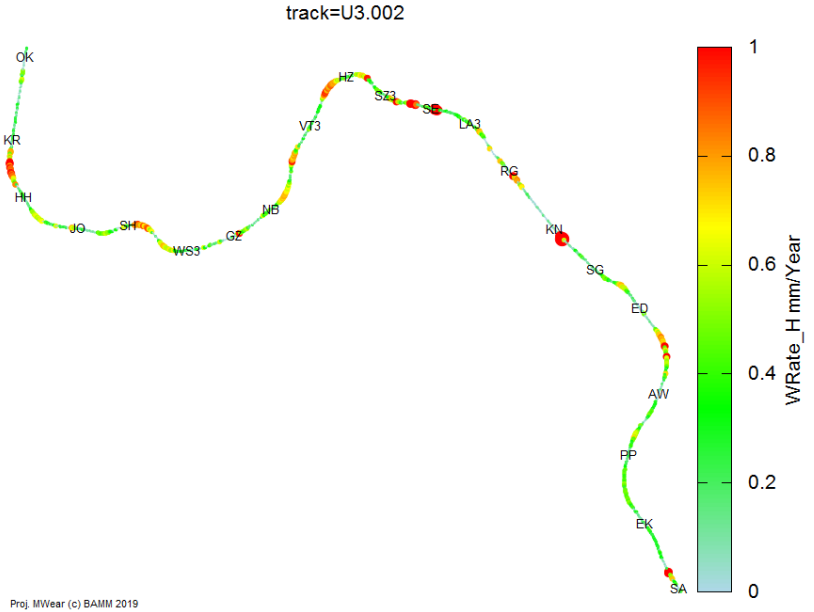




Line U3

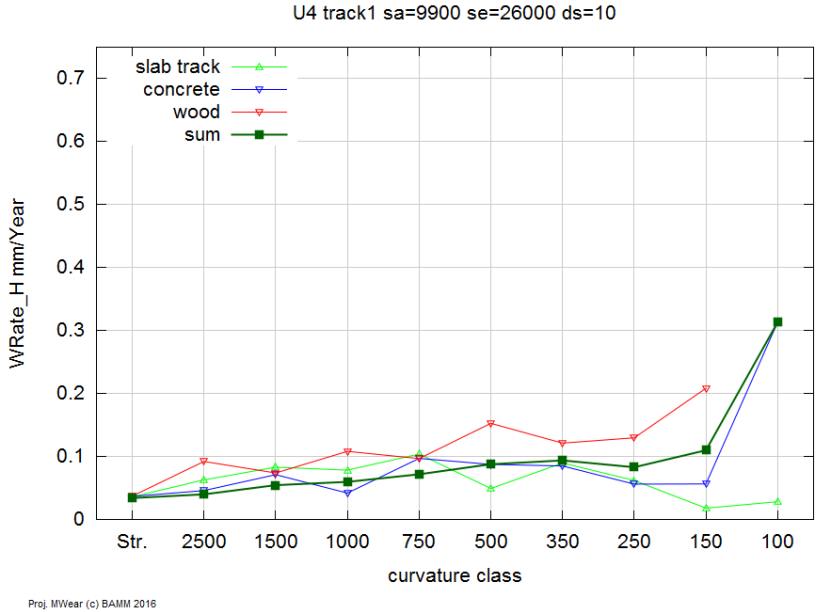
Same line, different tracks

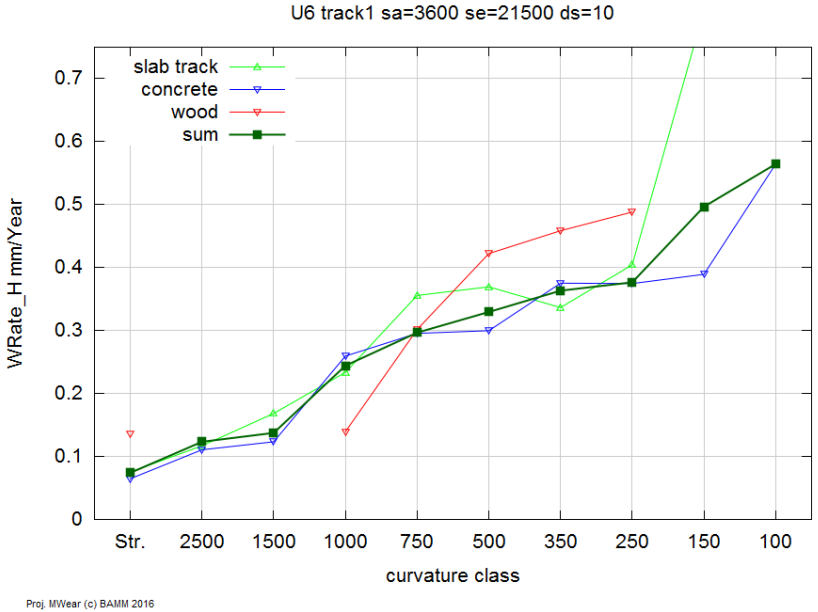




Railway track layout

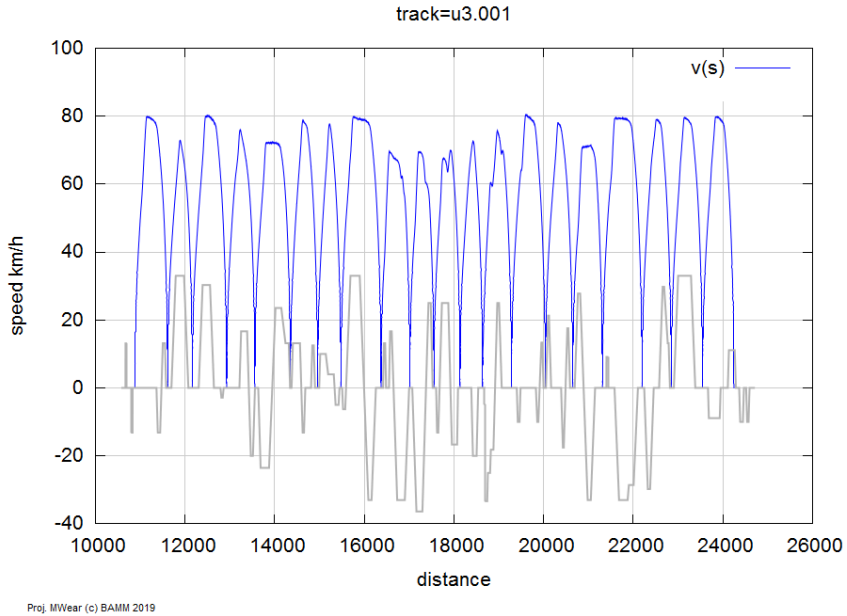
Wear rate: slab track, concrete or wooden sleeper

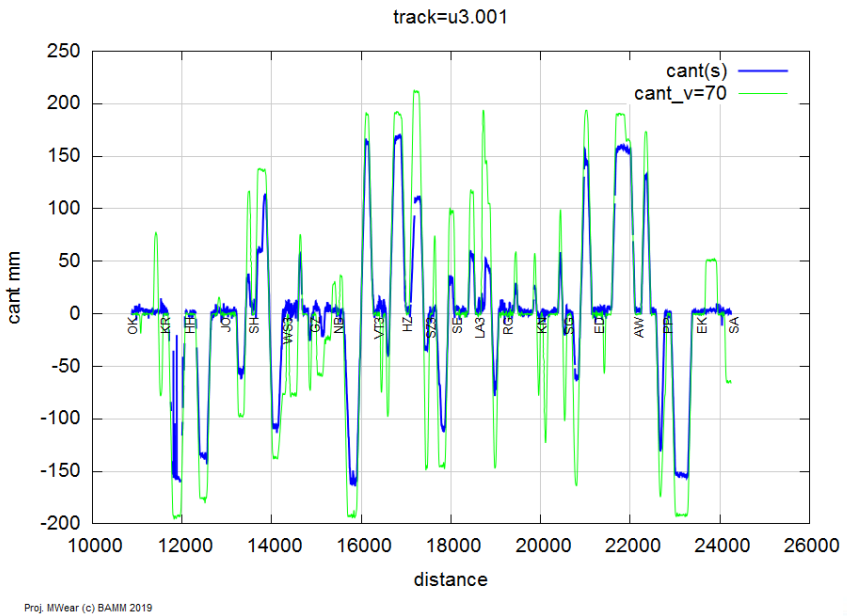




Kinematics

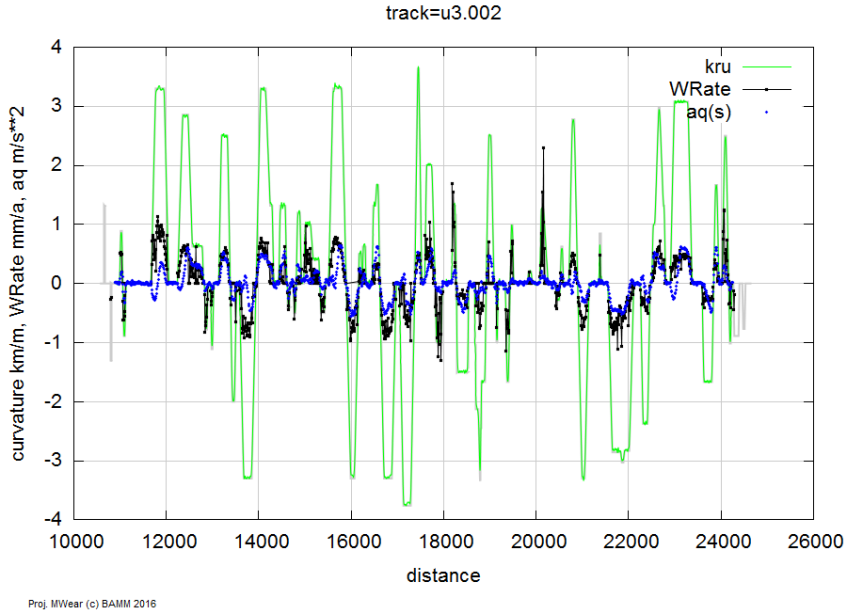
Influence of speed and cant

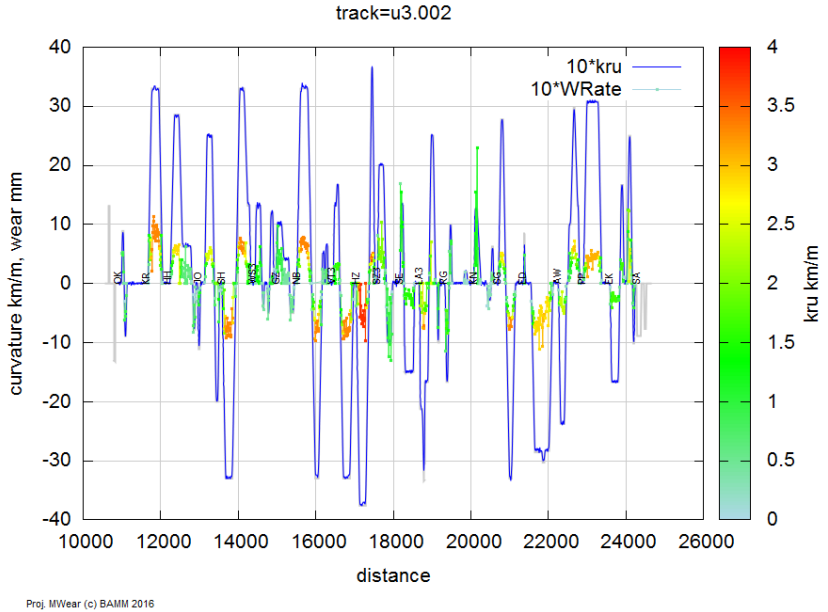




Kinematics and kinetic

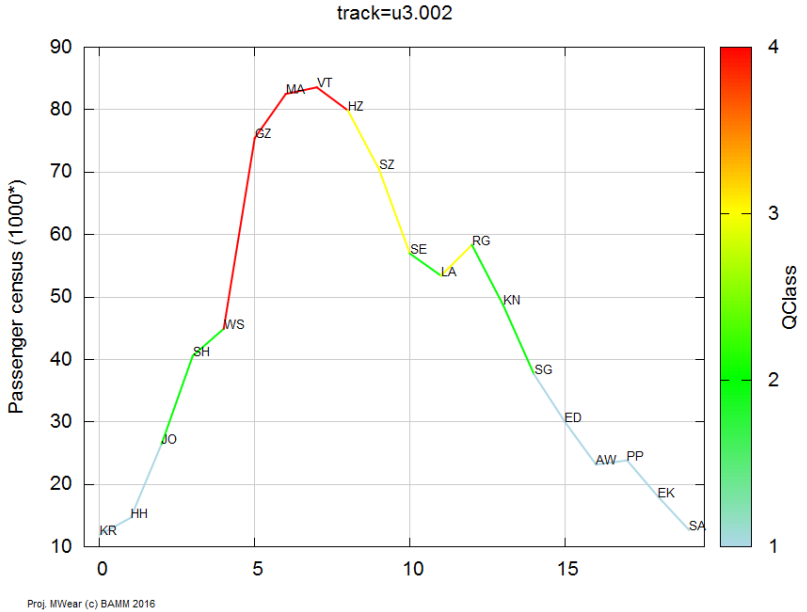
Free lateral acceleration and load (estimated)

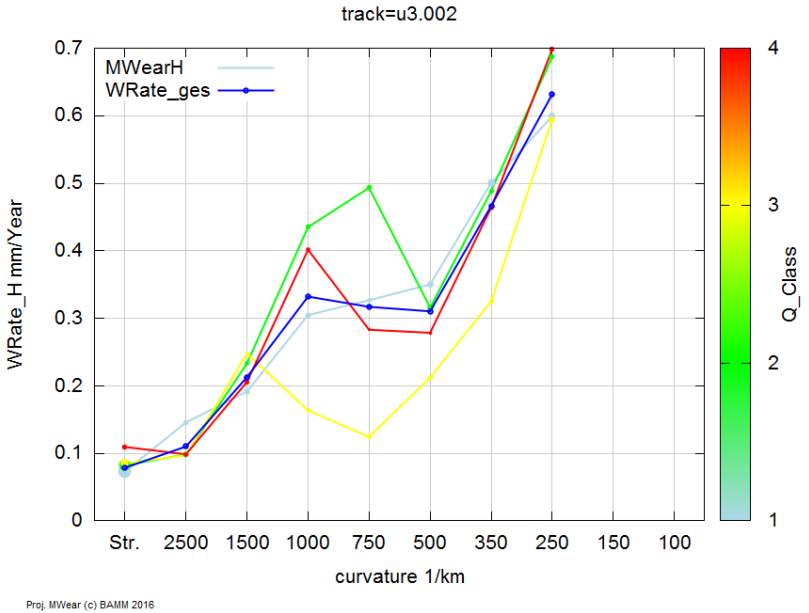




Load

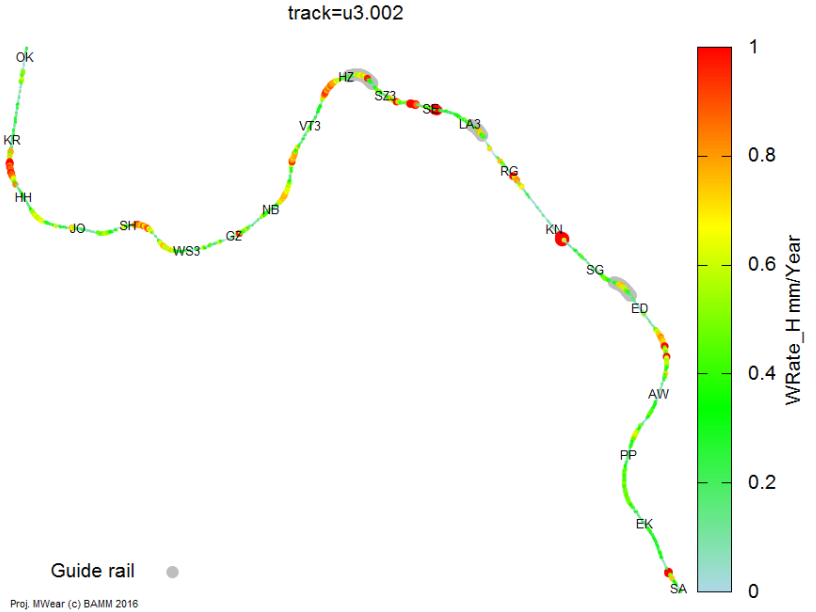
Influence of number of passengers

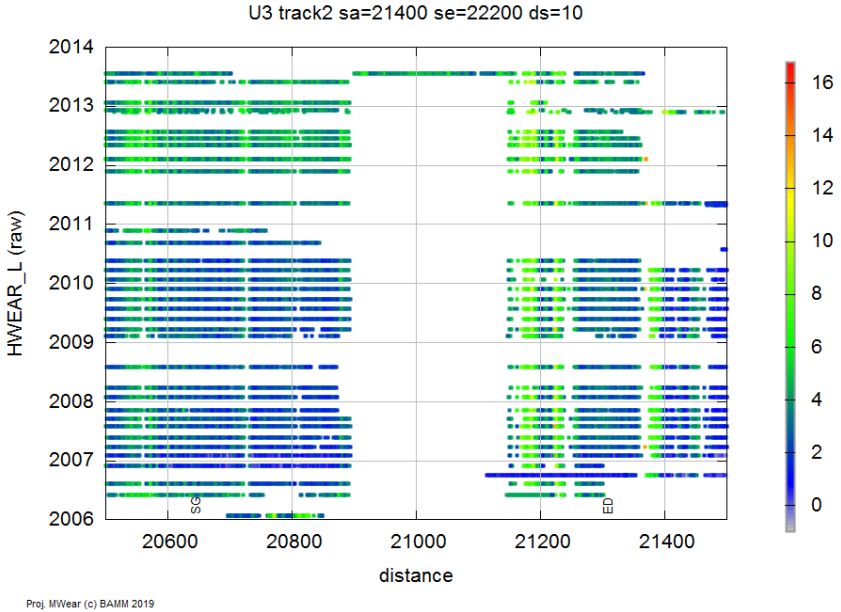




Further influencing factors

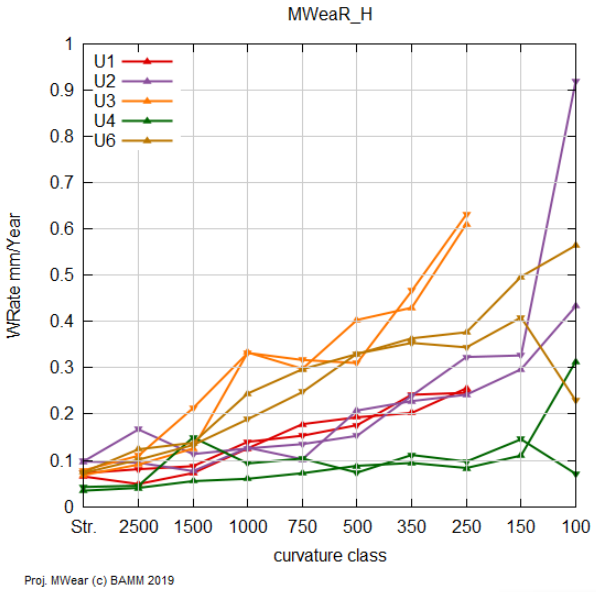
Guide rail, type of track system, steel grade



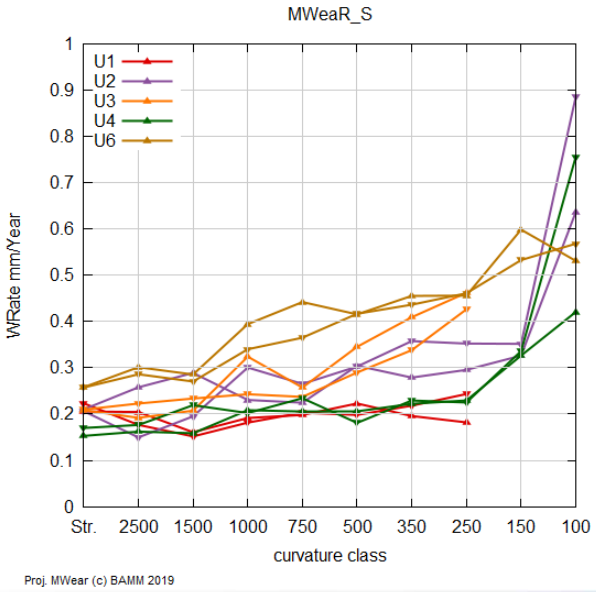


Comparison of wear rates

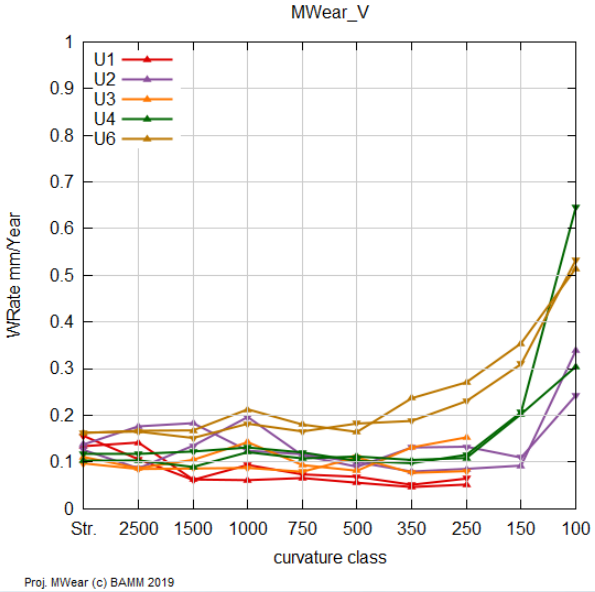
Horizontal wear rate (H)



Combined wear rate (S)

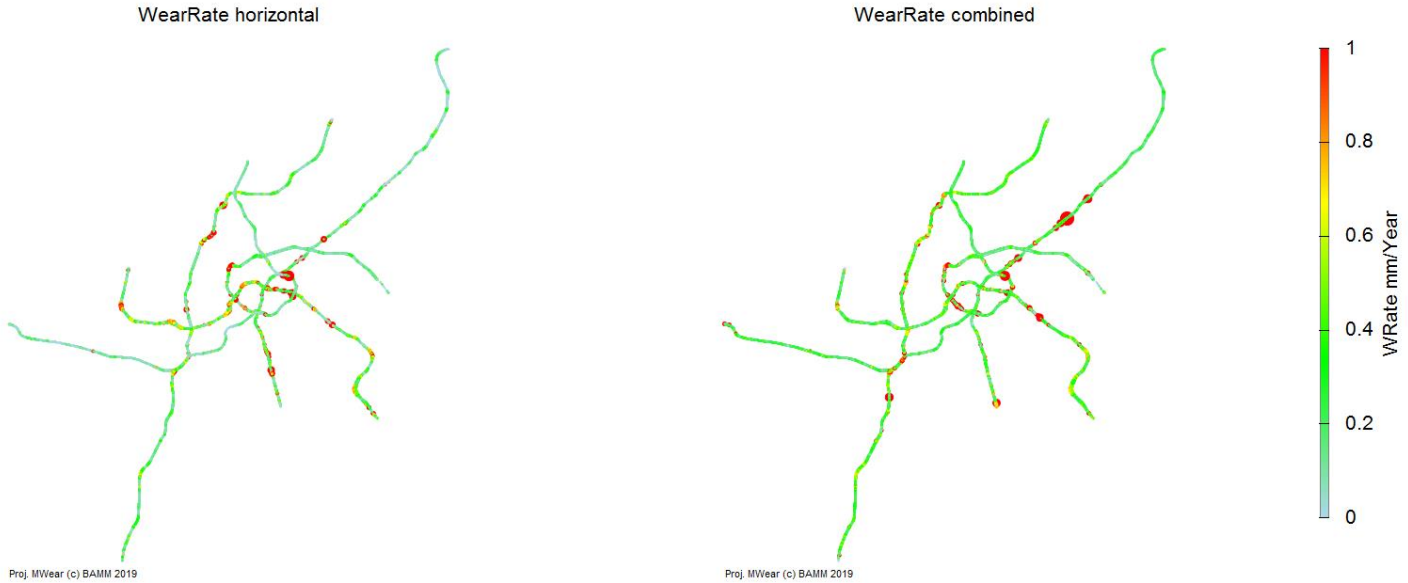


Vertical wear rate (V)



Hot spots

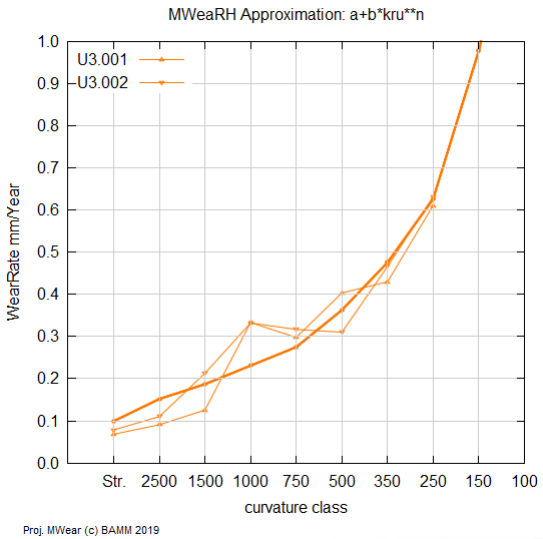
Summary and hotspots for the entire subway net



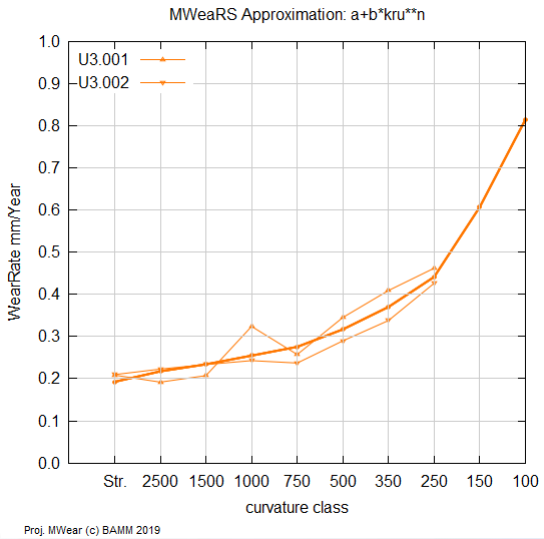
Approximation

Approximation of wear rates line U3

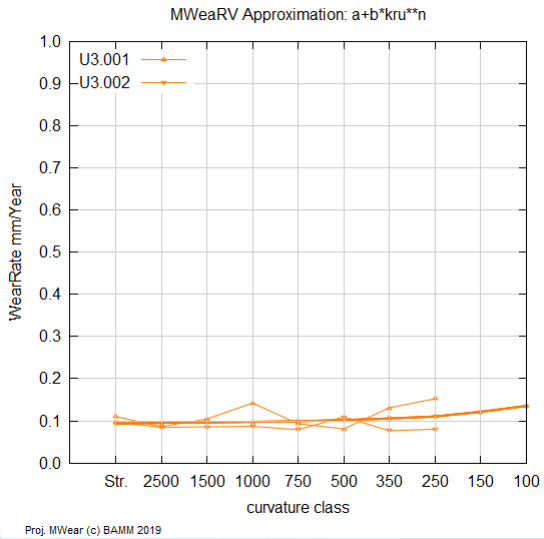
Horizontal wear rate



Wear rate 45°

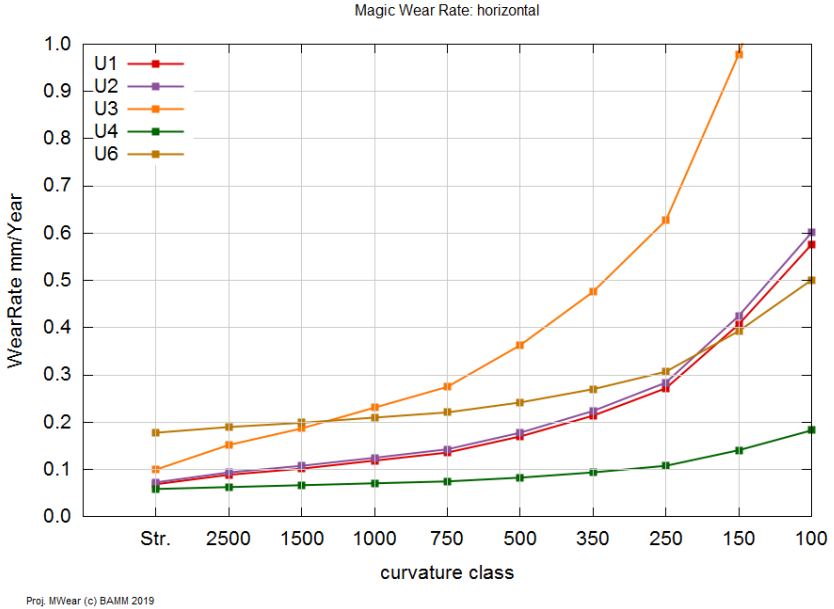


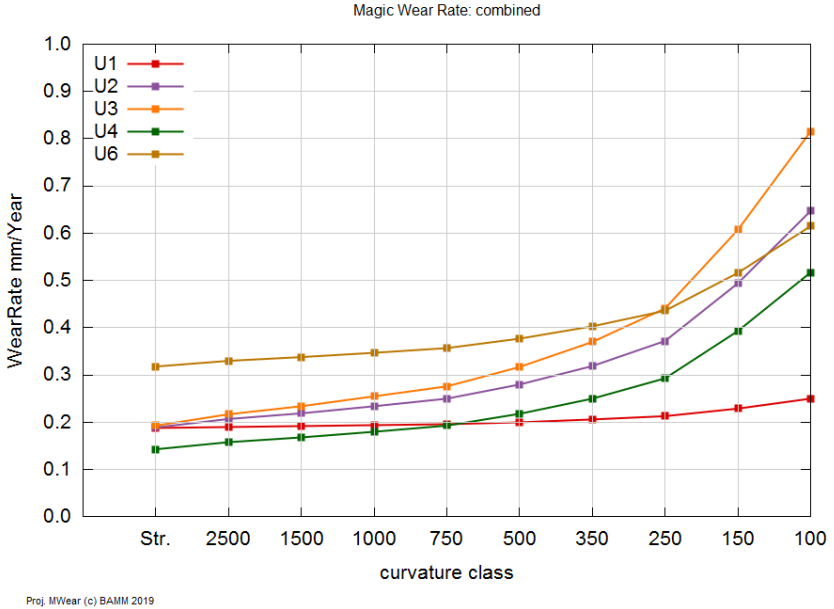
Vertical wear rate



All lines

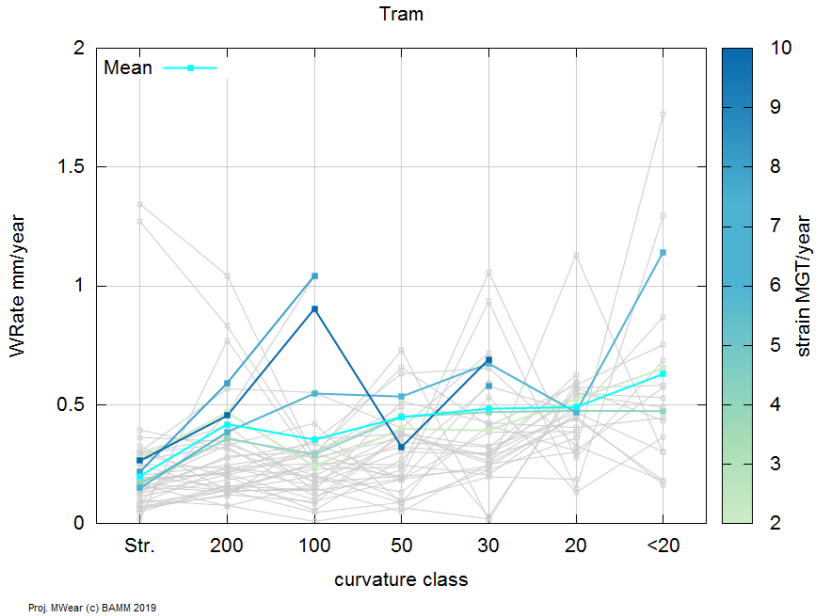
Magic Wear Rate for Subway horizontal and 45°

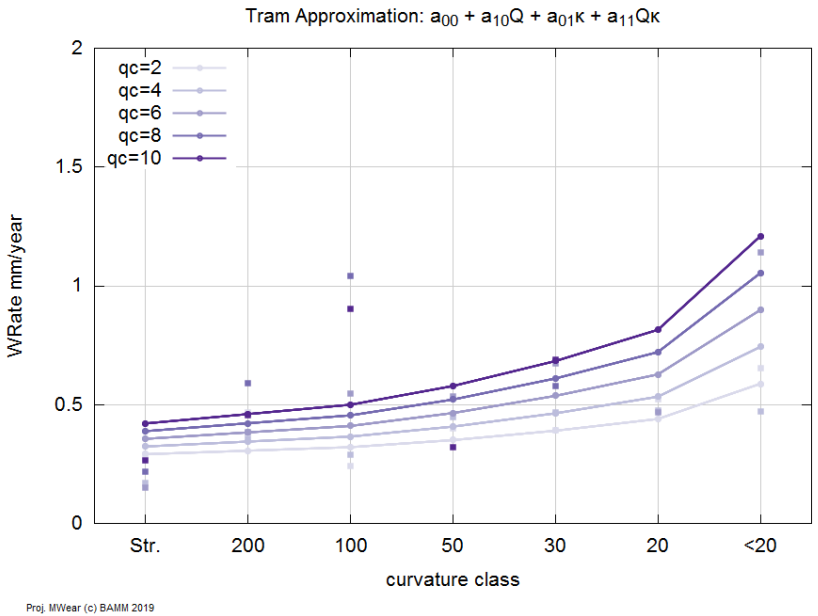




Wear Formula tram

Wear rates measured data and Magic Wear Rate





Conclusion

A quantitative description of the wear behavior of rails of the tram and subway net can be given in dependence of

- Line routing (curvature)
- Inspection (vehicle dynamics and load)
- Rail system (nonballasted track, sleeper track)

by an analytical formula („Magic Wear Rate“).

For single subway lines significant differences occur in the wear behavior. The horizontal wear turned out to be an essential influence parameter. Different types of the track system play a minor role.

Conclusion

For the tram the dominating dependence on the curvature is clearly visibly as well; the influence of the inspection is essential. Obviously the arc lengths are shorter and the differences in the amount of available data larger. This leads to higher ranges.

Thank you for your attention!

Dr. Paul Mittermayr, EURAIL-ING

Bureau of Applied Mechanics and Mathematics

Dr. Mittermayr Scientific GmbH & Co KG

https://www.bamm.at