TAMPERE UNIVERSITY OF TECHNOLOGY

Railway Track Structure Research at TUT

Transport Research Finland 2018

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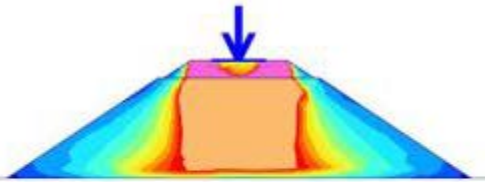
Heikki Luomala

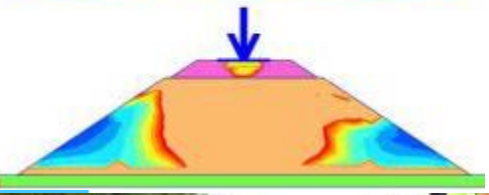
Outline

- Railway track structure research at TUT
- Recent research program TERA 2
- Current research program ETEVÄ
- Examples of research problems to solve
- Conclusions

Collaboration between TUT and Finnish Transport Agency (FTA)

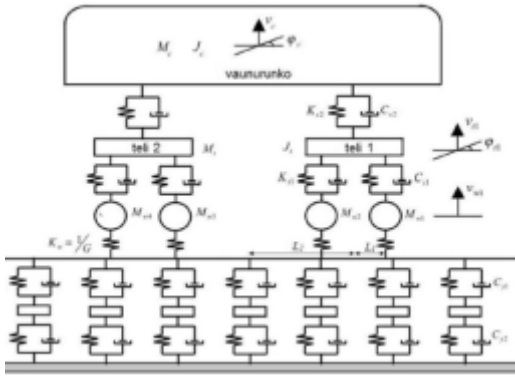
- Cooperation began in late 1990's with RHK by individual research project's
- Several research projects in 2000's
- 2008-2012 Research program **TERA**
- 2013-2016 Research program **TERA 2**
- 2017-2020 Research program **ETEVÄ**
  - Major research volume with FTA
  - Small-scale collaboration with industry, EU, Universities, etc.

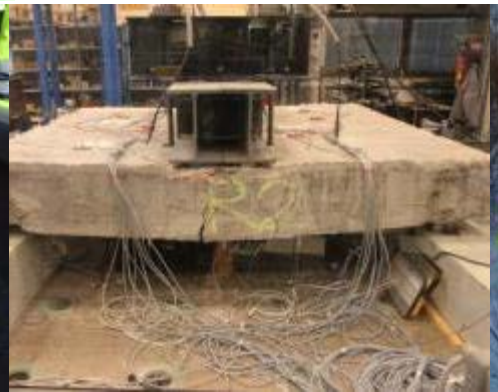




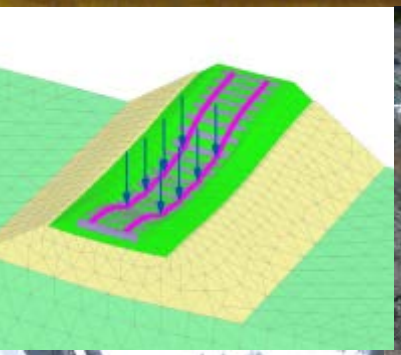
TUT Railway Engineering

- Project manager: Heikki Luomala
- Professors: Pauli Kolisoja, Tim Länsivaara and Anssi Laaksonen
- Track group: Tommi Rantala, Tiia Loponen, Riku Varis, Juha Latvala, Mikko Sauni, Antti Pelho, Ida Sangi.
- Subsoil group: Juho Mansikkamäki, Juha Selänpää, Mika Knuuti, Bruno DiBuo, Markus Haikola
- Bridge group: Olli Asp, Joonas Tulonen, Petteri Pakkala
- Research assistants





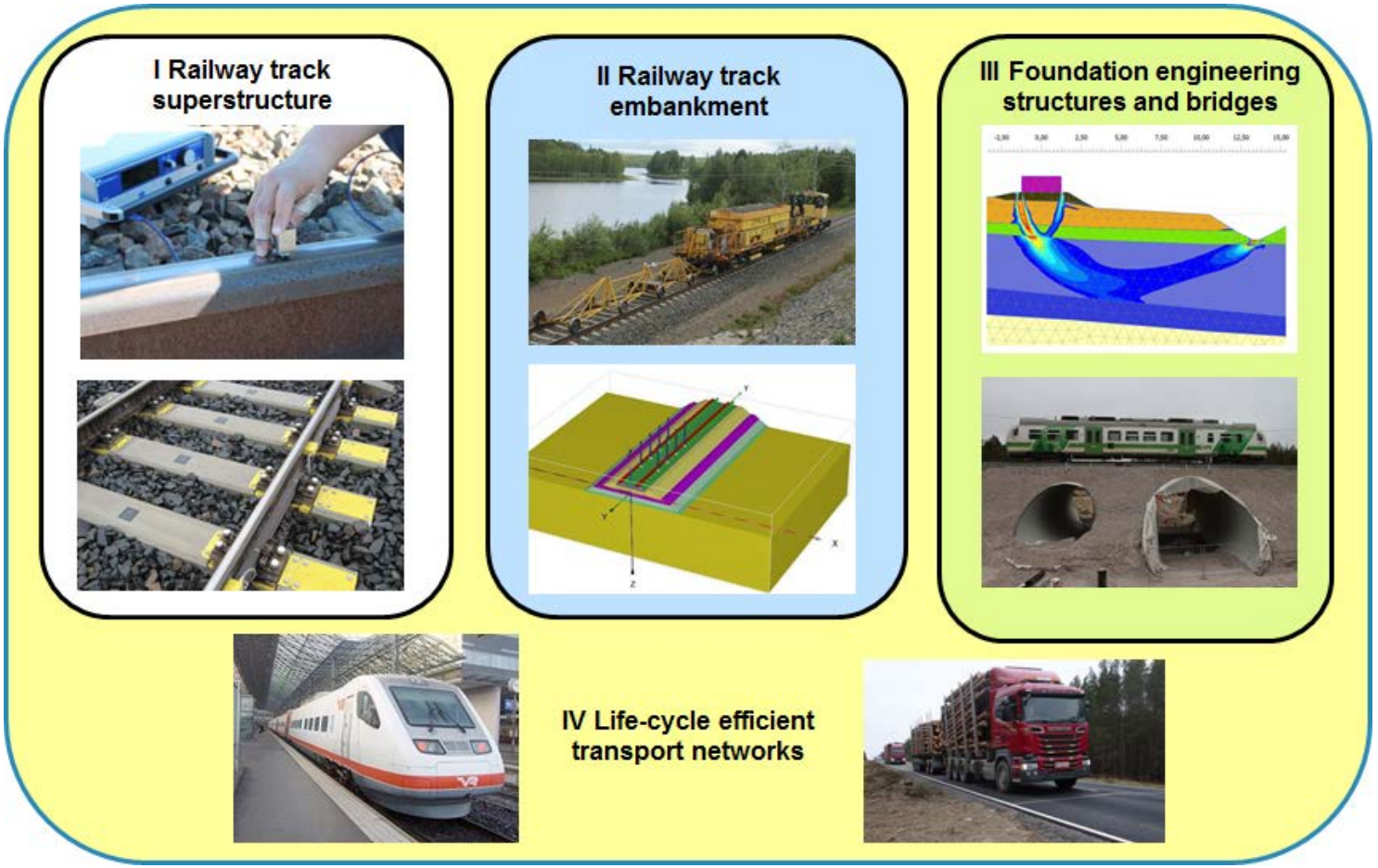
Research program *"Life-Cycle Cost Efficient Track (TERA II)" 2013-2016*


1. **<u>Train-track-interaction</u>:** stresses exerted on track
2. **<u>Rails</u>: degradation mechanisms and life-cycle management**
3. **<u>Switches and crossings</u>:** safety and degradation mechanisms
4. **<u>Sleepers</u>**: superstructure-embankment-interaction, track stability
5. **<u>Ballast</u>: degradation and management of track smoothness**
6. **<u>Frost</u>: frost action mechanism and frost protection** solutions
7. **<u>Embankment</u>: bearing capacity and track smoothness**
8. **<u>Subsoil</u>:** embankment stability management and foundation engineering solutions
9. **<u>Bridges</u>: bearing capacity** calculation and condition assessment
10. **<u>Overall economics</u>: life-cycle cost assessment**

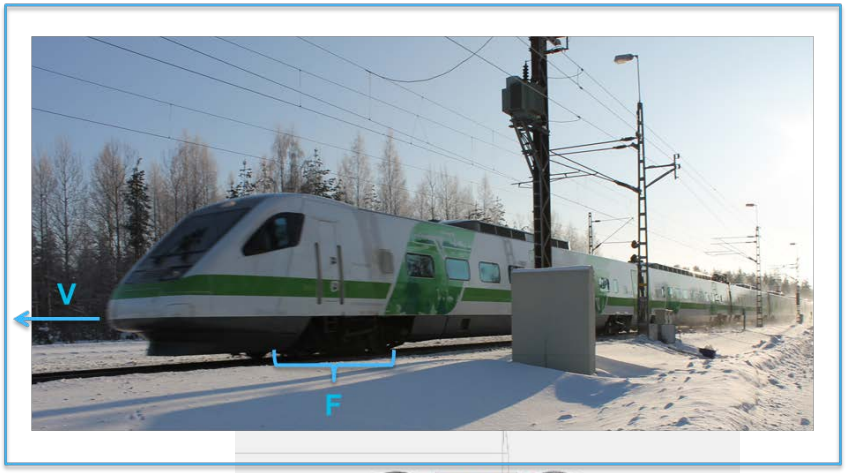
More information and reports: www.tut.fi/railway

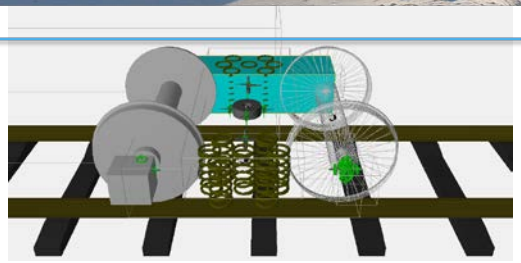
Research program "*Life-cycle cost efficient maintenance of traffic infrastructures (ETEVÄ)" 2017-2020*

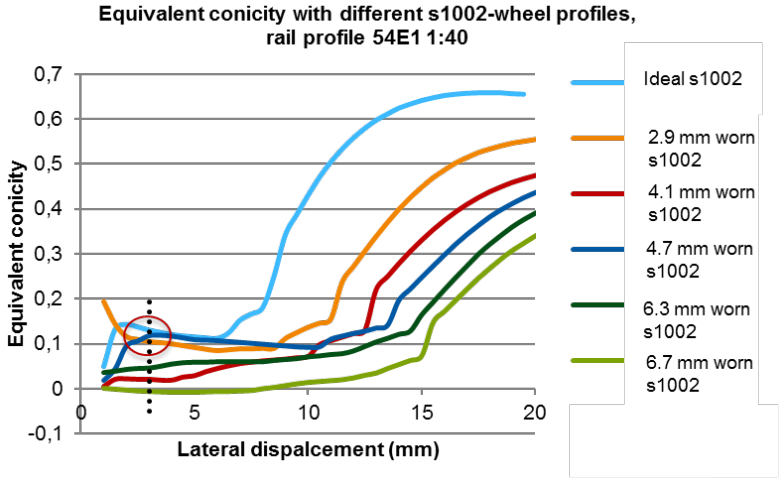


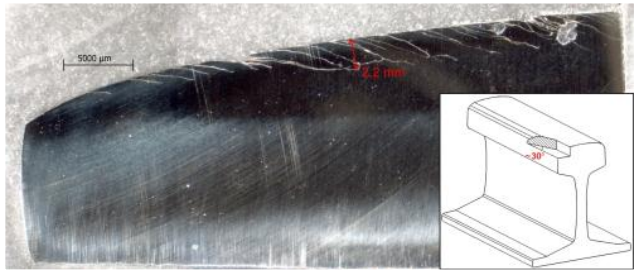
Train-track interaction and its dynamic modelling (Tiia Loponen)

- There is a continuous need to increase train speed and axle loads
- Increasing track loads causes problems to track structure but it also has negative effect on train movements and accelerations
- Research about finding reasonable methods to decrease track loads
- Research about wear, RCF, AHC-profiling, running behaviour, etc.
- *Effects of rail side wearing on running behaviour is in progress*



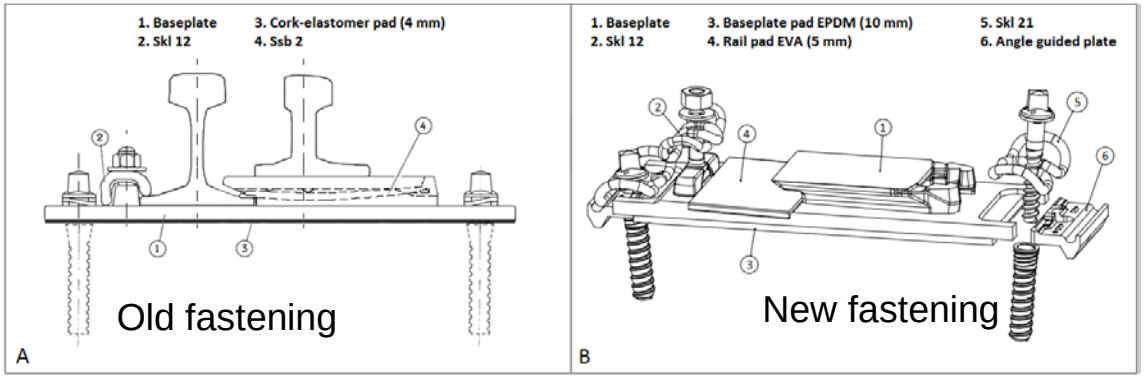




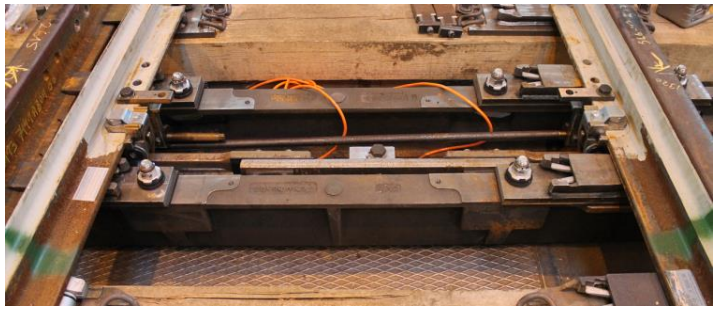


More elastic turnout structures
(Riku Varis)

- Development of new more durable and elastic turnout solutions
- Elasticity of the turnout structure was modified with many different components, but the foremost change was to use the proper rail pads in every fastening.
- Other new features was under sleeper pads, angle guided plates, new bearer design and also hollow bearers for actuators etc.



Hollow steel bearer



Concrete sleepers replacing wooden sleepers (Tommi Rantala)

- Most of the sleepers are wooden on low volume tracks
- EU-legislation will eventually deny use of creosote oil as impregnanting agent
- One solution is to replace wood with concrete
- Concrete sleeper is stiffer
- Individual concrete sleeper may carry more load than it holds

=> study for softer rail pads, wooden sleeper size concrete sleepers and full scale testing

Drainage of railway track
(Juha Latvala)

- The role of drainage on geometry problems
  - Lab tests on frost protection layer materials: frost susceptibility, drainability, strength properties, dynamic loading properties
  - Full scale monitoring, 3 sites
  - The effect of drainage improvement on geometry errors

Km 44

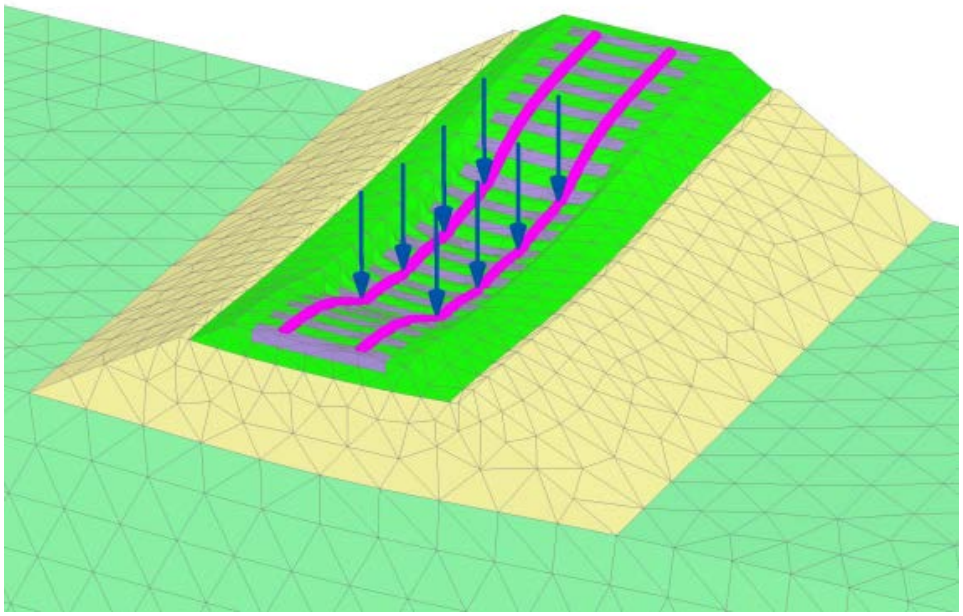
Km 98

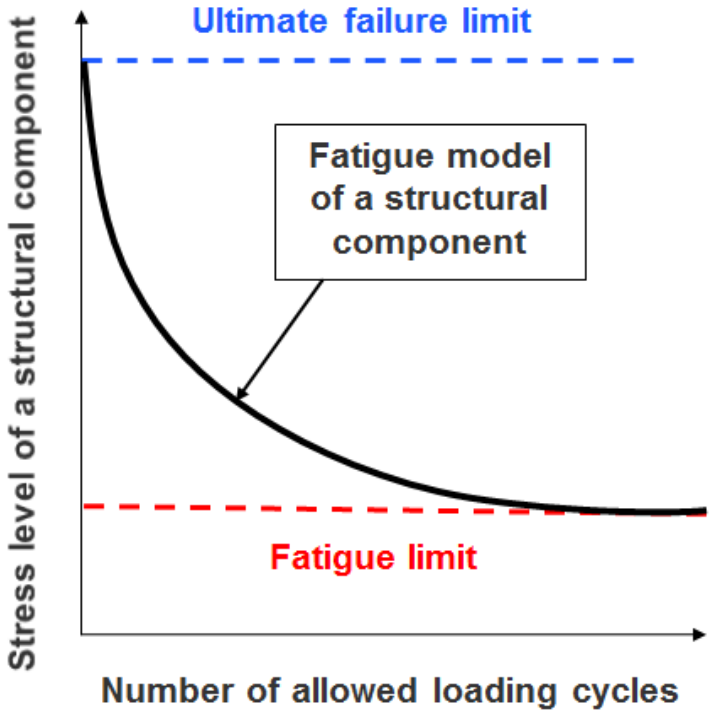
Km 137

Track stiffness measurements and load bearing capacity (Heikki Luomala)

- Development of track condition evaluation methods
- Too low track stiffness causes ballast degradation, embankment widening, fatigue of superstructure components,…
- Too high track stiffness concentrates loads to the superstructure; causes high ballast and sleeper loading
- The measurement device is based on vertical geometry measurement of loaded and unloaded track

Load bearing capacity design of a track

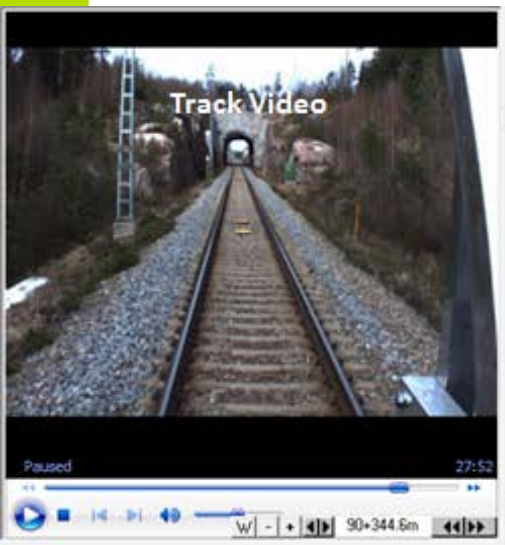


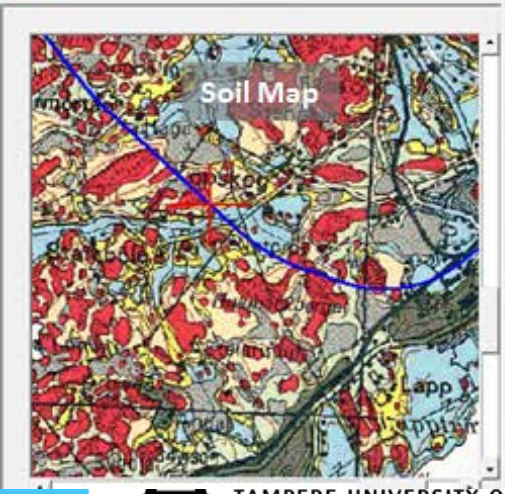


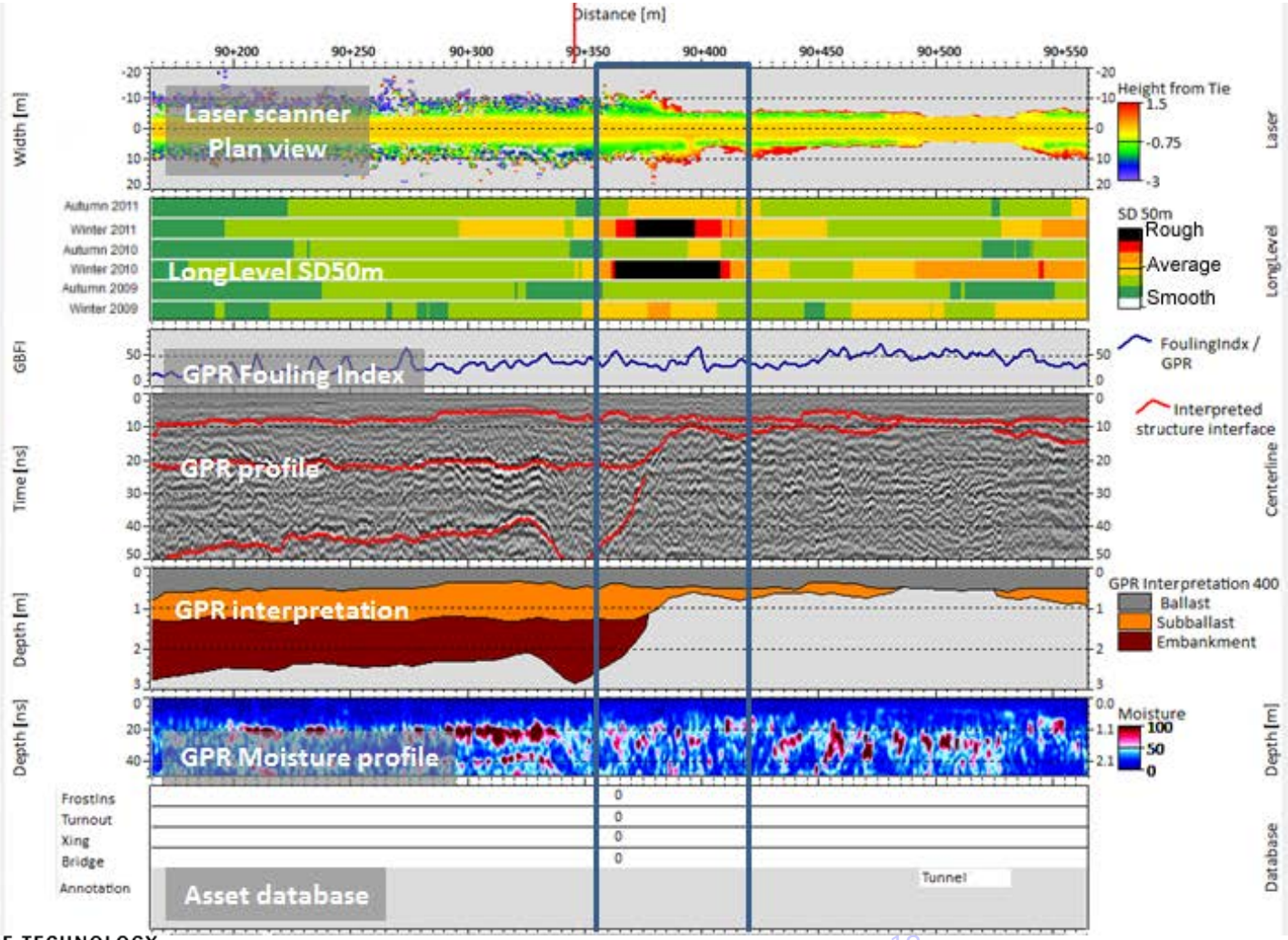
- Whole track 3D-model enables evaluation of mutual interaction of various structural components of track (for example: certain change in subsoil stiffness → magnitude of the change in rail stresses)
- Incorporation of modelled stresses and fatigue models → ”technical life-cycle design” !!

Data mining of big data, better understanding of track behavior

(Mikko Sauni, cooperation with TUT mathematics)







And cooperation with Roadscanners Oy

Conclusions

- TERA and ETEVÄ research programs aim to reduce railway track maintenance costs by
  - Understanding the behaviour and lengthening the service life of individual components and the whole structure
  - Developing new design, dimensioning, monitoring and data analysing methods
  - Utilization of new technology
  - Implementing research findings to whole network and producing useful information for the decision makers

Thank you for your attention!

heikki.luomala@tut.fi

http://tut.fi/railway