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Norwegian Public Roads Administration

European Road Profile Users' Group 2023

Implementation of structural data in maintenance of national roads in Norway

Photo: Rambøll

ERPUG

Athens 25-27 October 2023, Per Otto Aursand, NPRA

Outline

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- The strategy of NPRA (The Norwegian Public Roads Administration) on TSDD measurements
- A short presentation of the RAPTOR-project
- Our ideas on how to utilize the data
- Challenges and possibilities

The Norwegian Public Roads Administration

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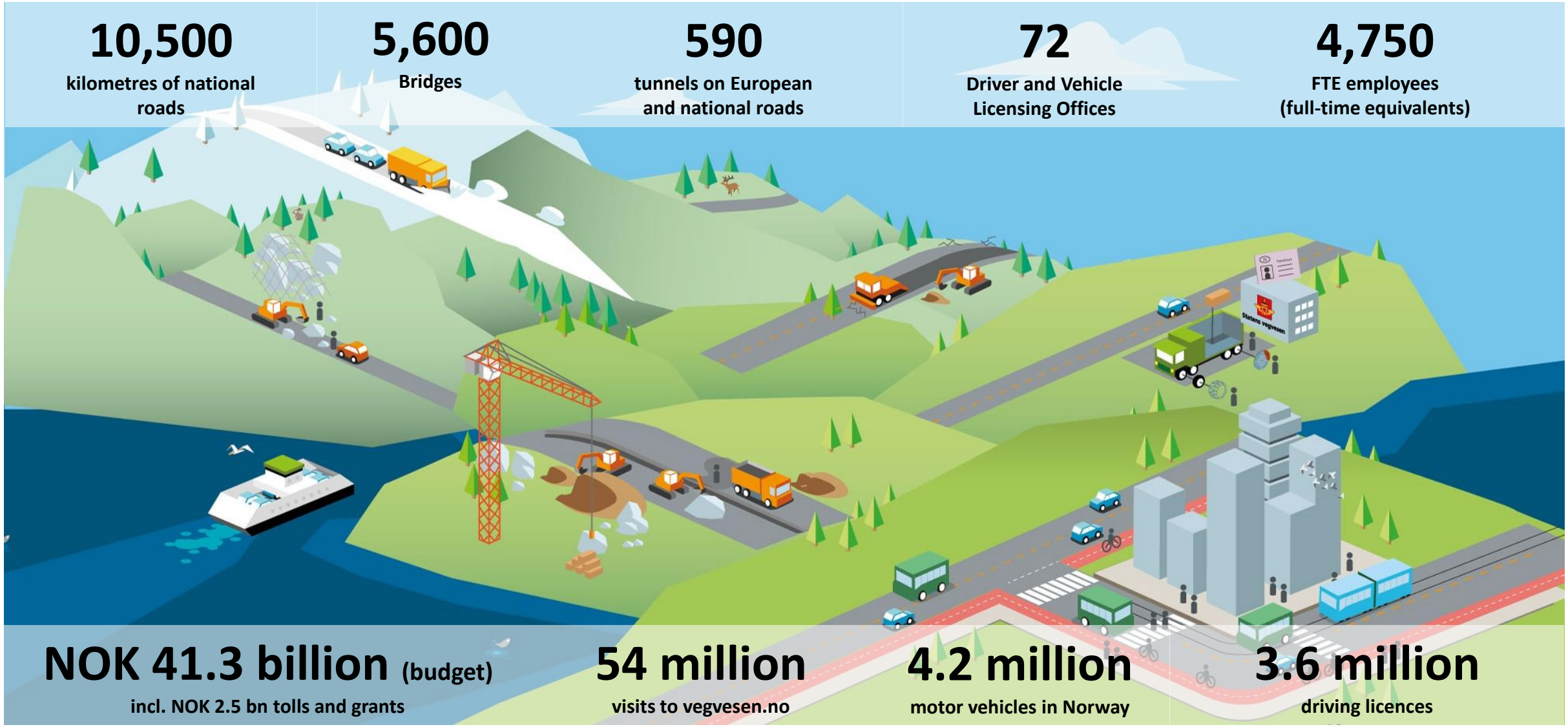
10,500
kilometres of national roads

5,600
Bridges

590
tunnels on European and national roads

72
Driver and Vehicle Licensing Offices

4,750
FTE employees (full-time equivalents)

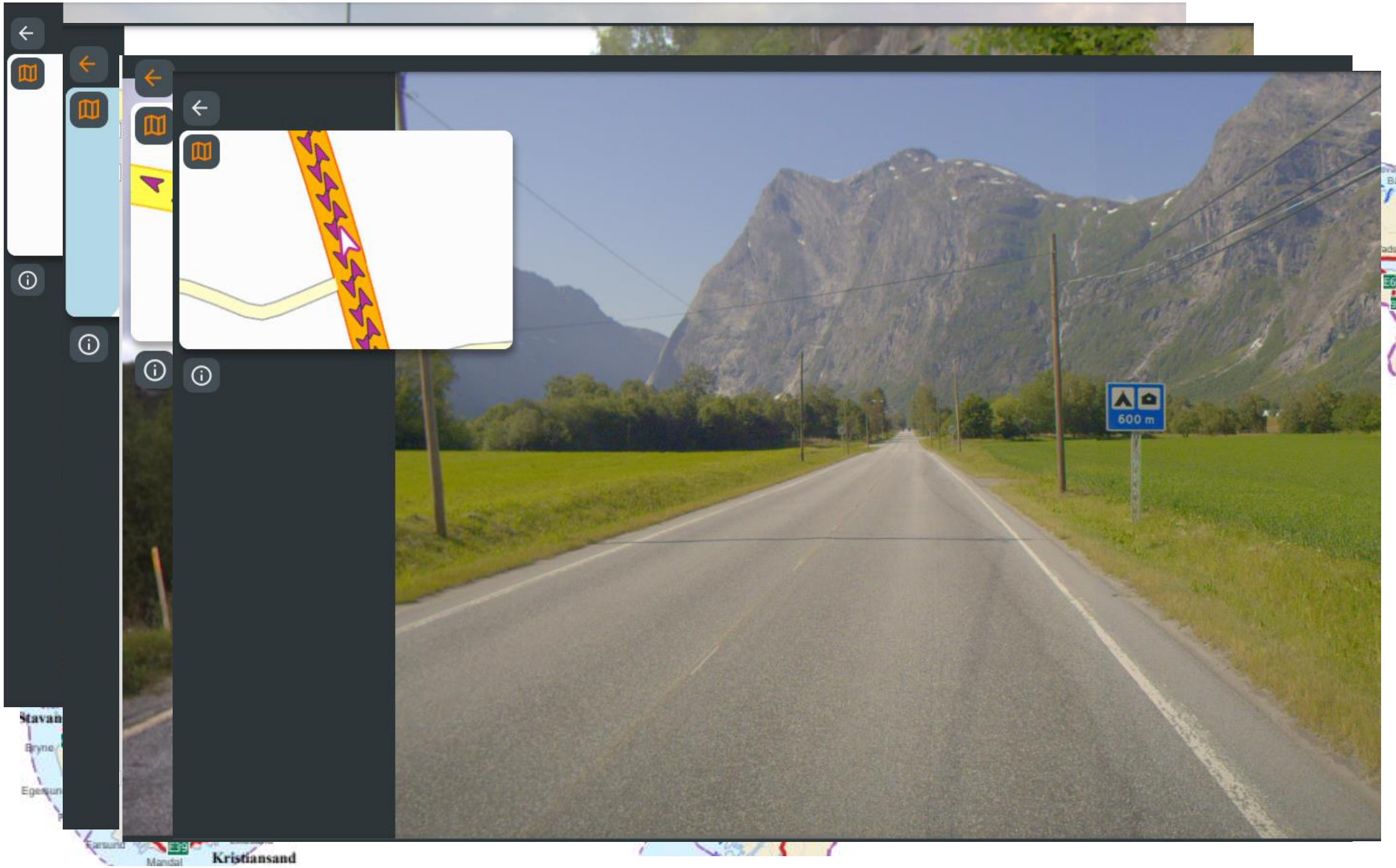


NOK 41.3 billion (budget)
incl. NOK 2.5 bn tolls and grants

54 million
visits to vegvesen.no

4.2 million
motor vehicles in Norway

3.6 million
driving licences



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The strategy of NPRA on TSDD measurements - Goals

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- Get knowledge on the structural condition.
- Basis for national priority-lists and systematic work on strenghtening measures.
- Data-driven pro-active maintenance.
- Overall asset management in a life cycle perspective.
- Improve pavement lifetime.
- Contribute to fulfil the goals in the national transport plan.

More value for money

Efficient use of new techniologies

Contribute to Norway's fulfilment of its climate and environment goals

Vision Zero for road fatalities and serious injuries

Easier everyday mobility and increased competitiveness for business and industry

The strategy of NPRA on TSDD measurements – why do we do this?

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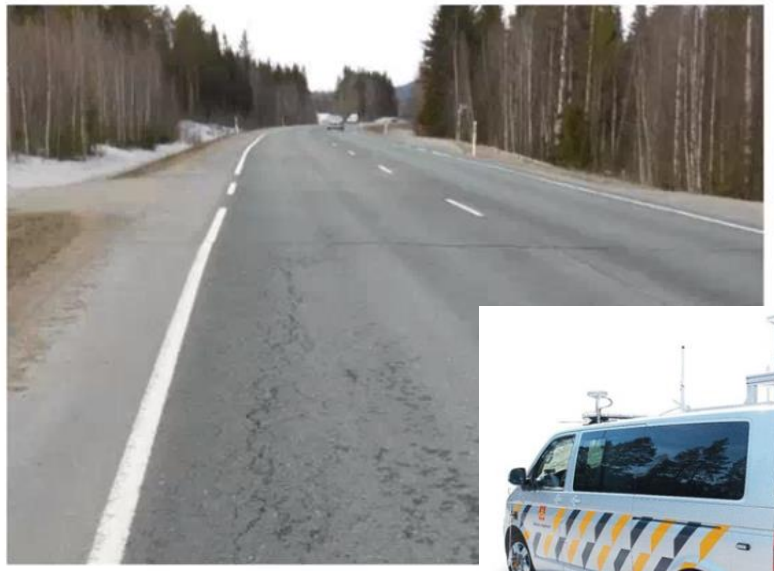
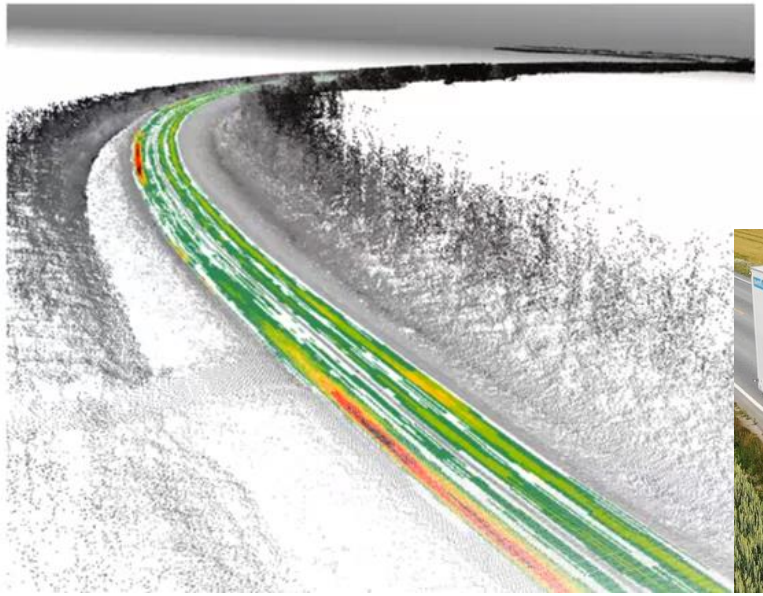
What is Intelligent Asset Management

ROADEX Network
For better rural roads

1. **Reactive:** measures are taken based mainly on the surface condition monitoring results (=symptoms)



2. **Proactive:** monitoring is made to detect root causes of the surface condition problems (diagnostics) and measures are taken before damages appear



Raptor Project

Three year project to measure the entire Norwegian state owned road network with a Rolling Weight Deflectometer (RWD). Georadar (GPR) as a complimentary service.

2021:

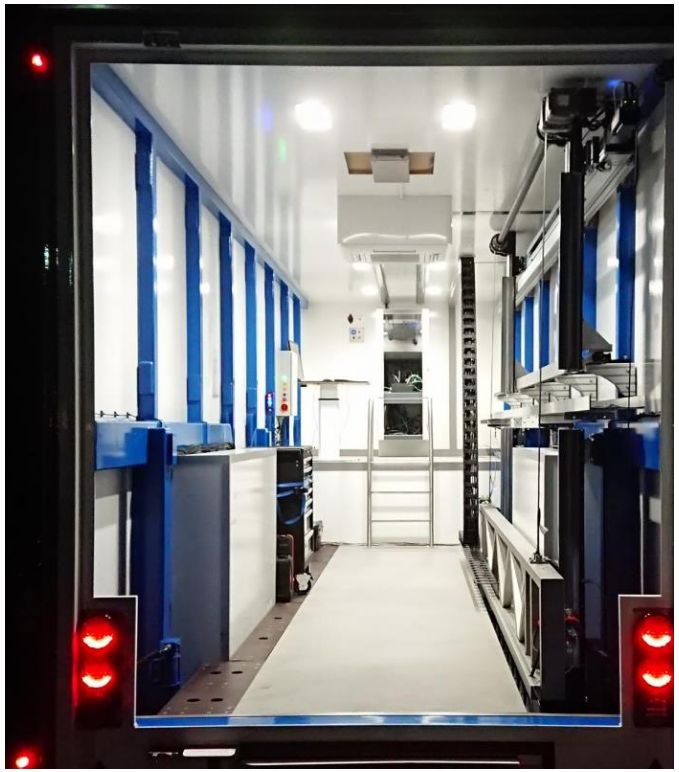
- Procurement for TSDD measurements
- Contract signed with Rambøll
- Option for GPR included (high frequency)
- Comparative measurements with FWD
- Measured 6000 km

2022:

- Comparative measurements with FWD and GPR
- Low-frequency GPR antenna added
- Measured 7500 km

2023:

- Finished measuring the whole road network
- Comparative measurements with FWD and GPR
- Tests with spring-thaw measurements
- Measured 6000 km



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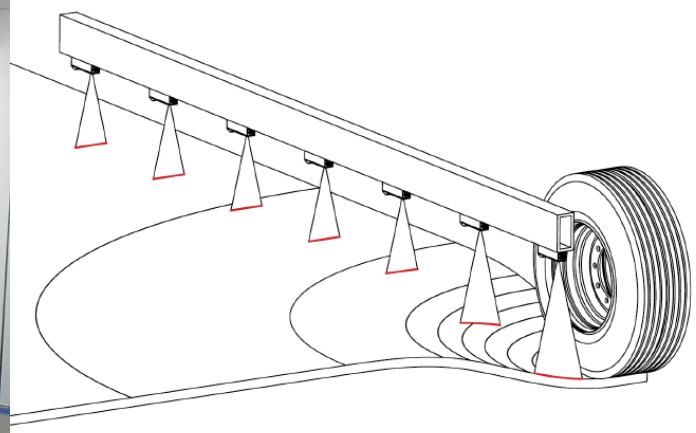

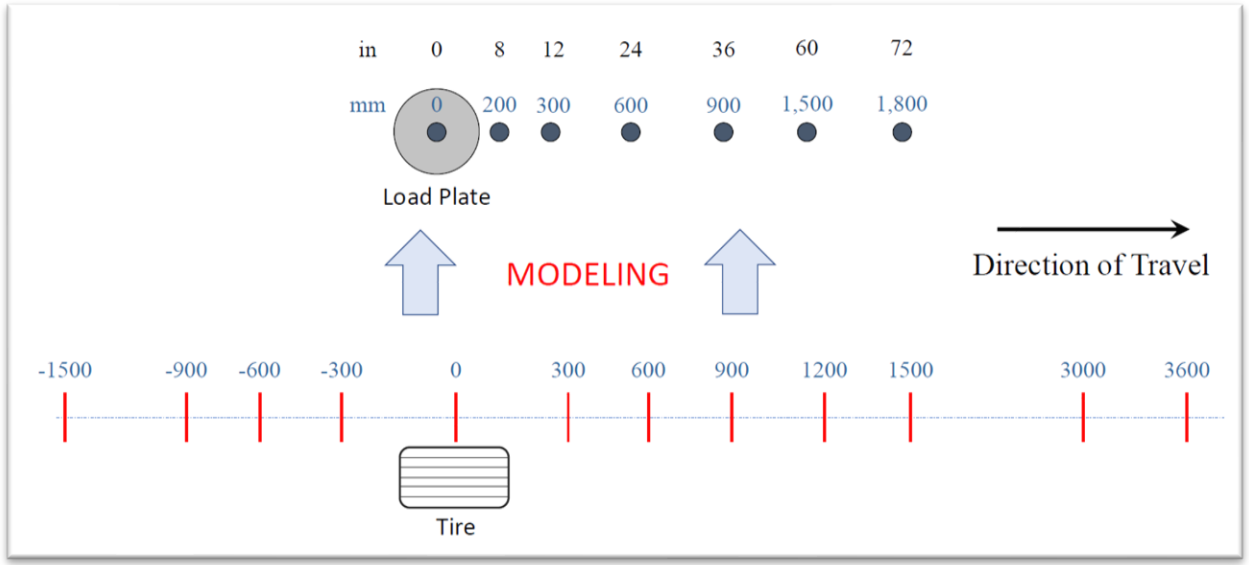

Comparison measurements with FWD

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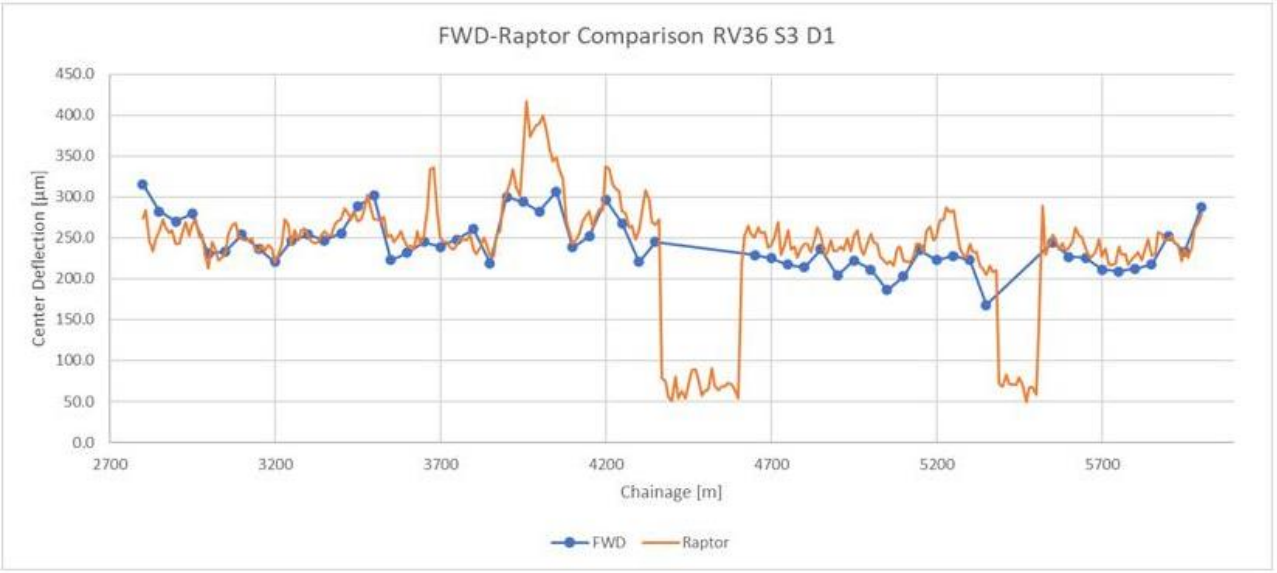
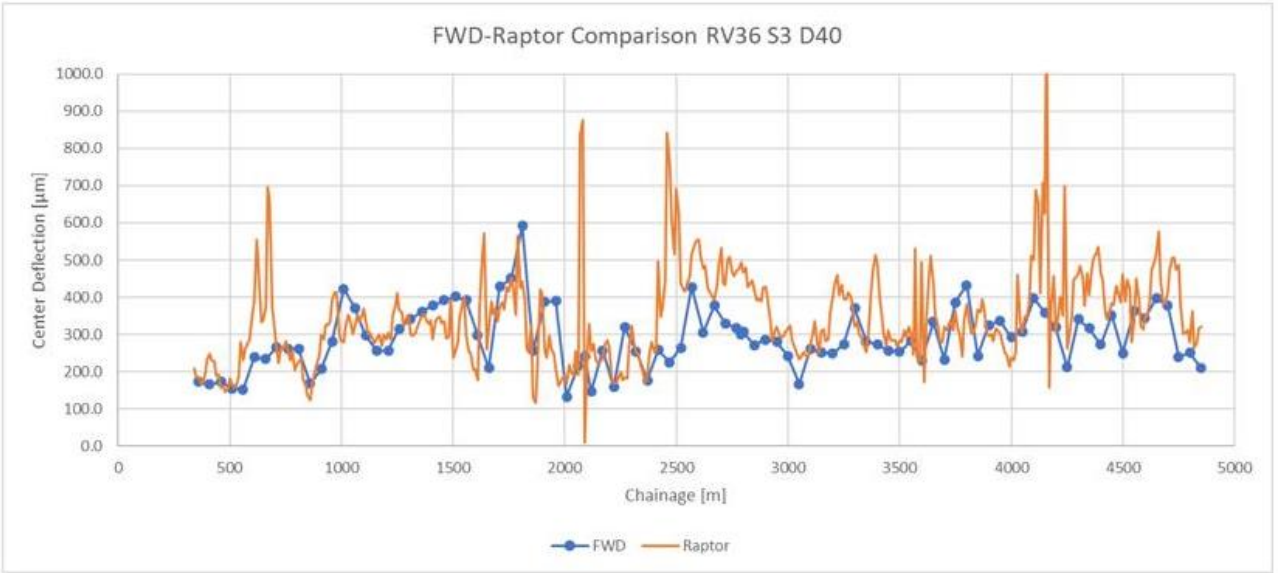
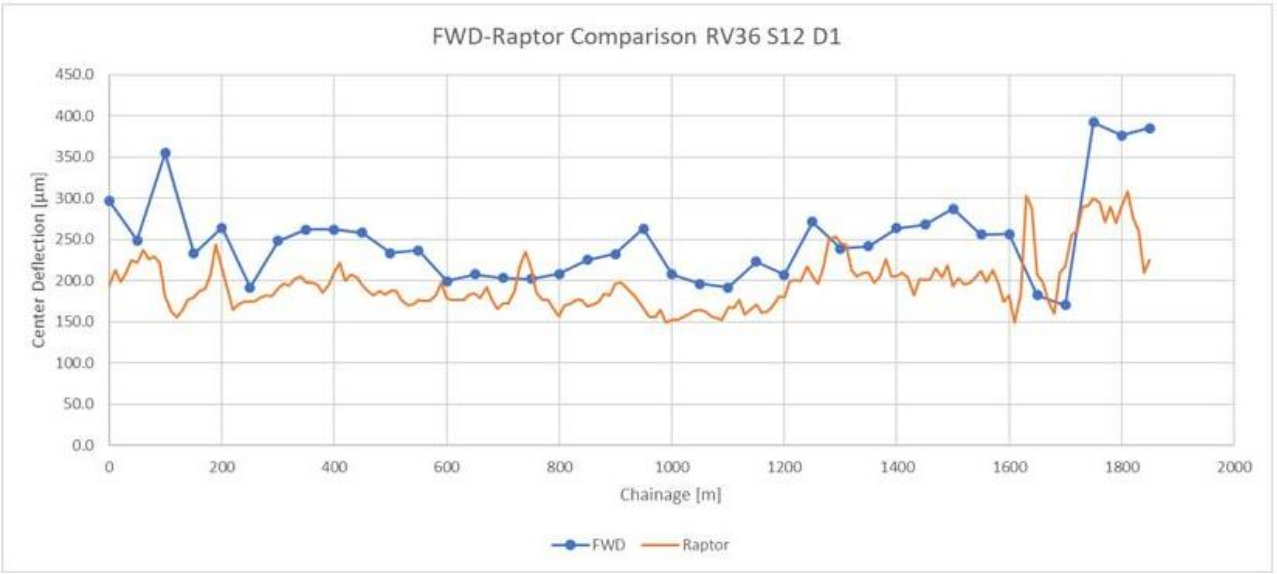
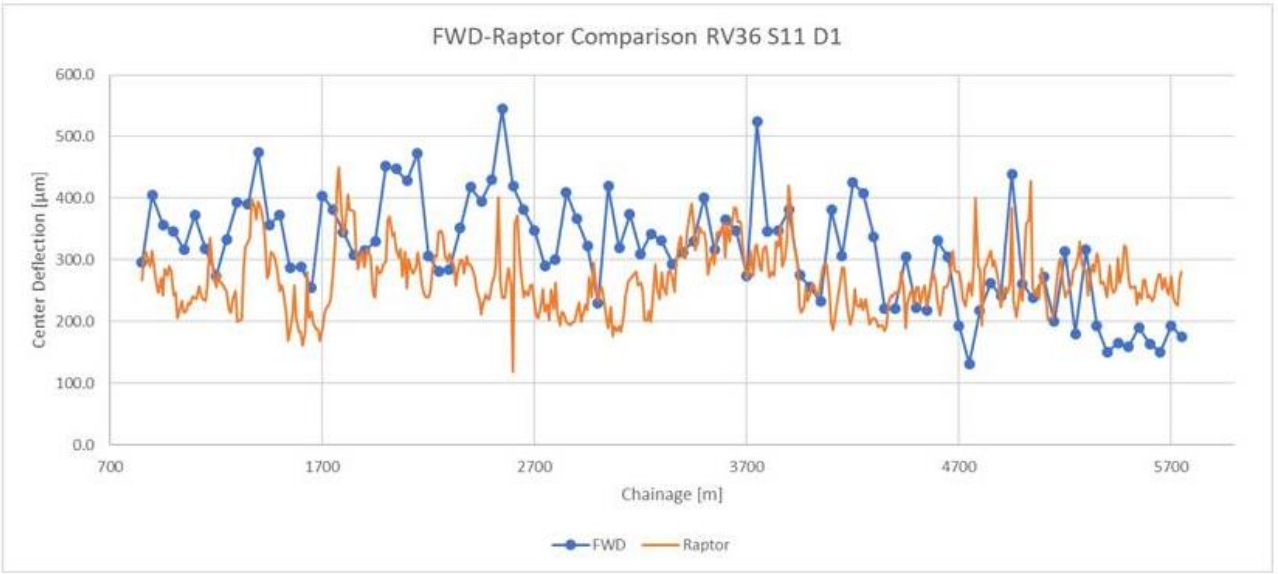








Structural parameters

- **Bearing capacity in tonnes:***

$$B_{asfalt} = 11 \cdot \left(\frac{E_{dim}}{200}\right)^{0,6} \cdot \left(\frac{50}{\text{ÅDT}_T}\right)^{0,072}$$

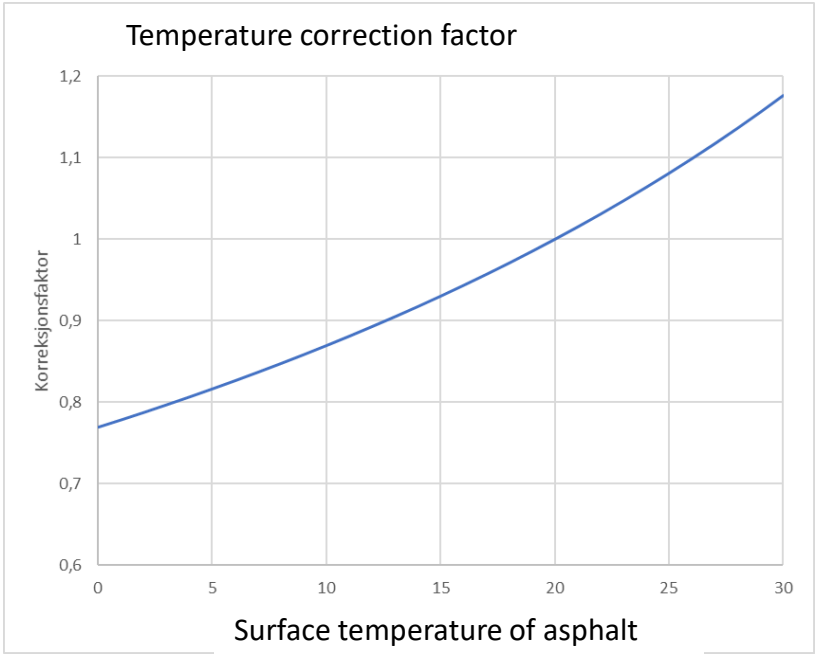
$$E_{dim} = \frac{110 \cdot p}{\sqrt{d_0 \cdot (d_0 - d_{20})}} \text{ [MPa]}$$

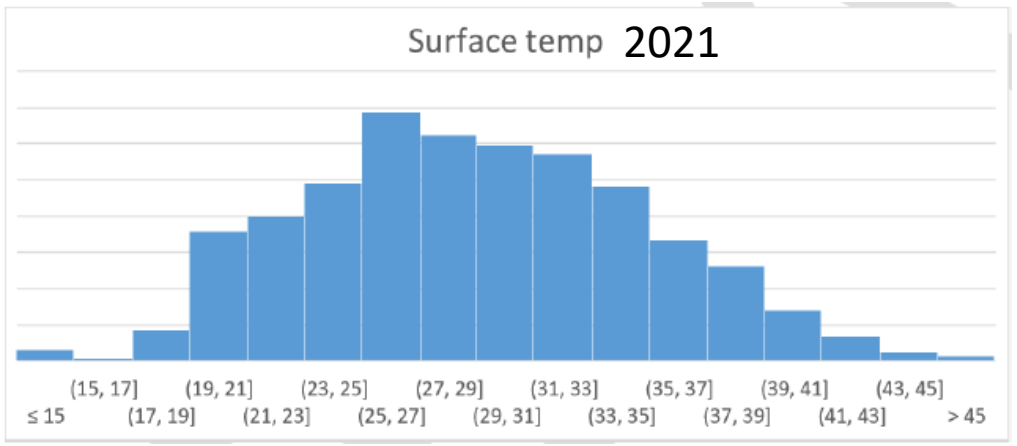
- **Simple temperature correction formula for bearing capacity:**

$$B_{Temp.korr.} = \frac{B}{1,3 - 0,015 \times T}$$

- **SCI (D0-D200)**
- **BCI (D900-D1200)**
- **Other paramters**

* The largest axel load a road can carry over a period of time witout the road condition falling under a defined axeptable limit (normal maintenace inclued).





Verifying the temperature correction formula formula

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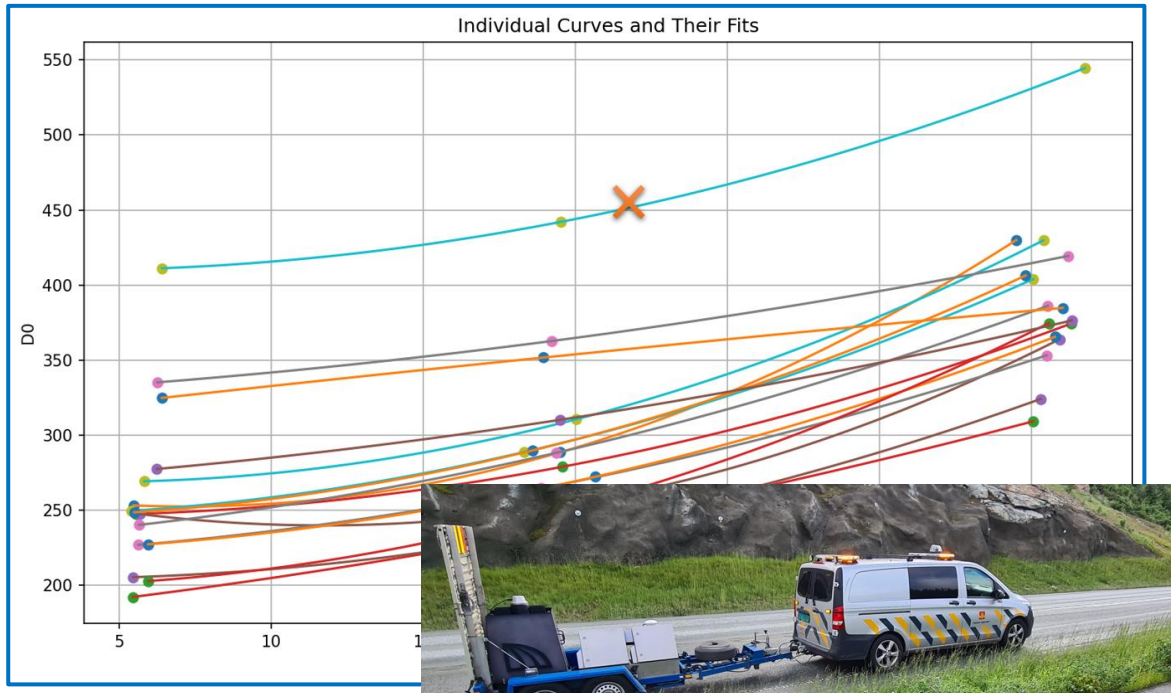


Current formula:

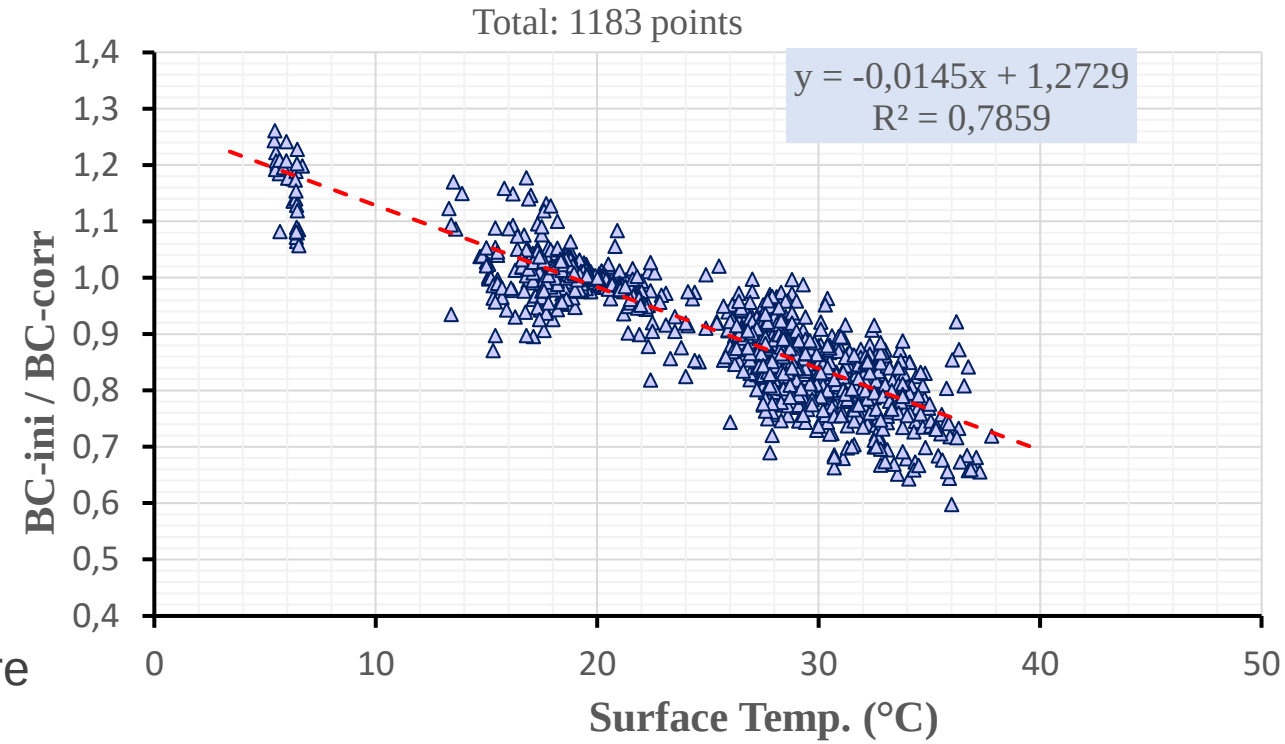
$$BC_{temp,corr.} = \frac{BC}{1.3 - 0.015 \times T}$$

T: Temperature in the mid-layer

Verified formula:

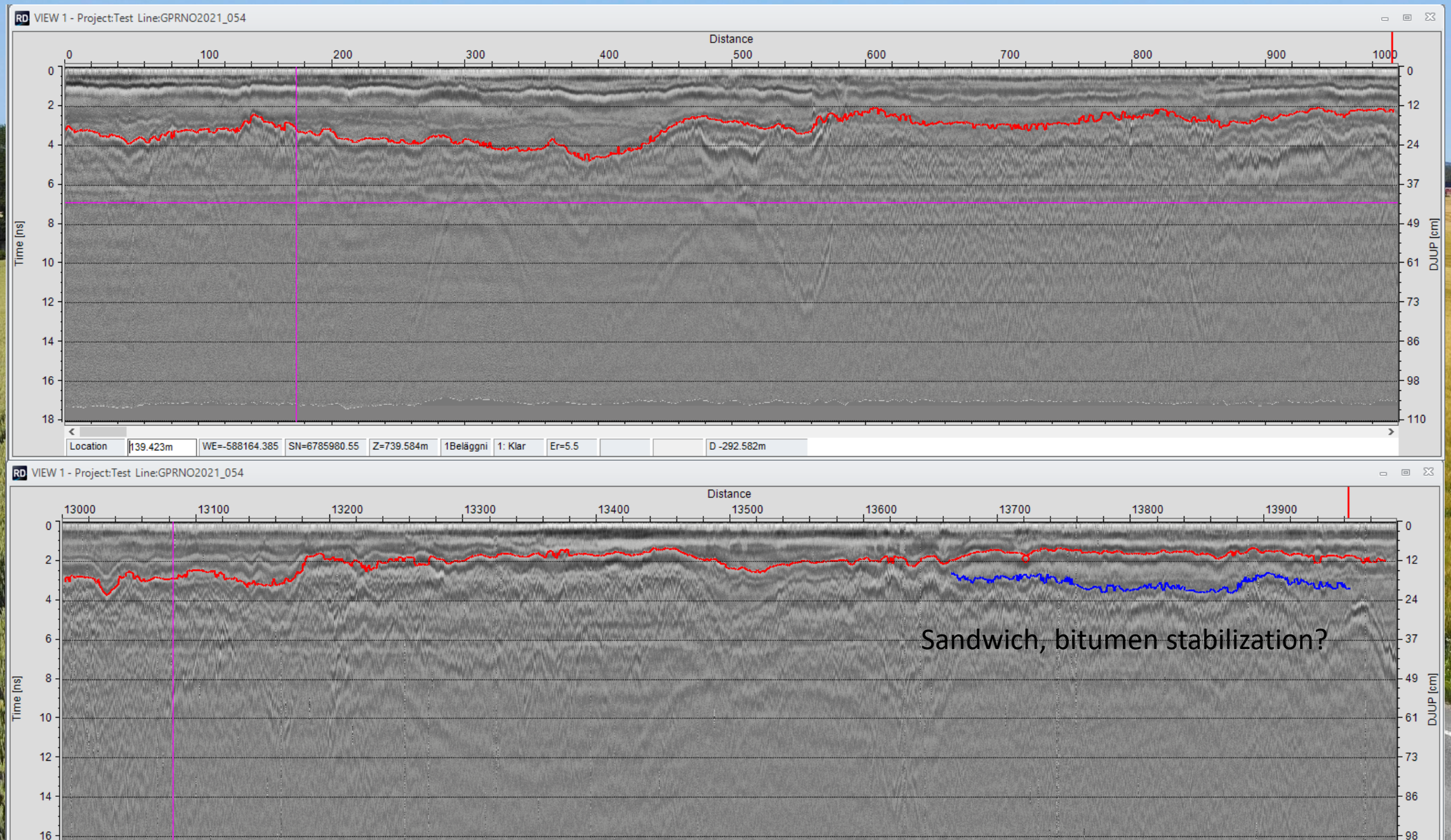
$$BC_{temp,corr.} = \frac{BC}{1.273 - 0.0146 \times T}$$

All our measurements are based on surface temperature



RAPTOR - GPR

NB: No support from drill cores

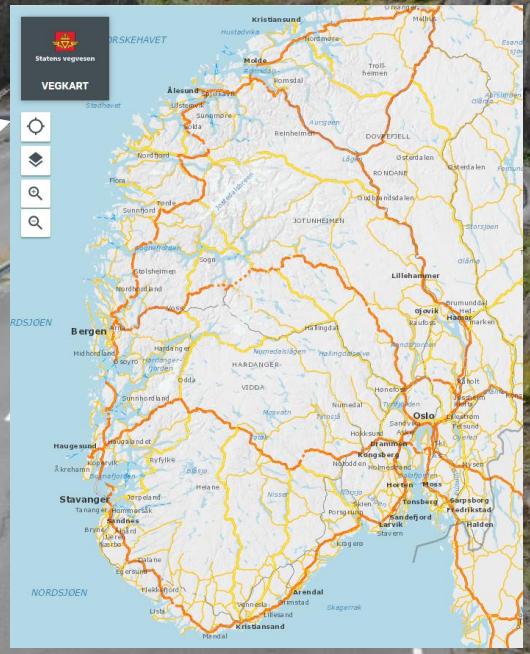


Data handling

Position + Chainage
FWD equivalent deflections
Structural parameters
Layer thicknesses

NVDB API

ASSET MANAGEMENT DASHBOARD



Measurements done in the right whell path in two directions.

Results normalized to data points covering 10m of road.

Some results (2021-2022 data)

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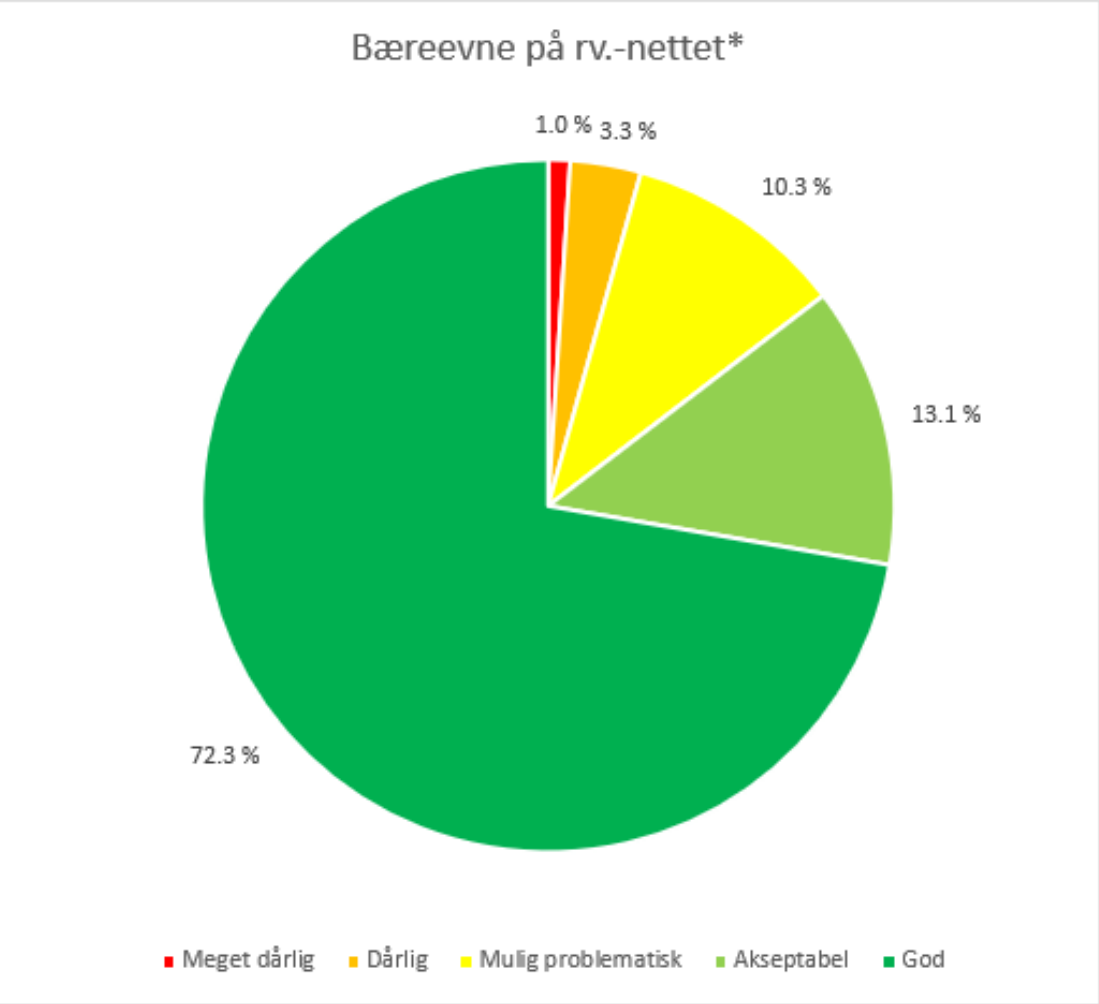
- ~15 % of the road network has bearing capacity less than fair.
- Improvement of bearing capacity is estimatet to cost 3,7 billion NOK.



* Data fra ca. halvparten av rv.-nettet, hovedsakelig i Sør og Nord.

Bearing capacity (tonnes)*	Classification
> 16	Good
14-16	Fair
12-14	Warning
10-12	Bad
< 10	Very bad

Combining bearing capacity and rutting-data

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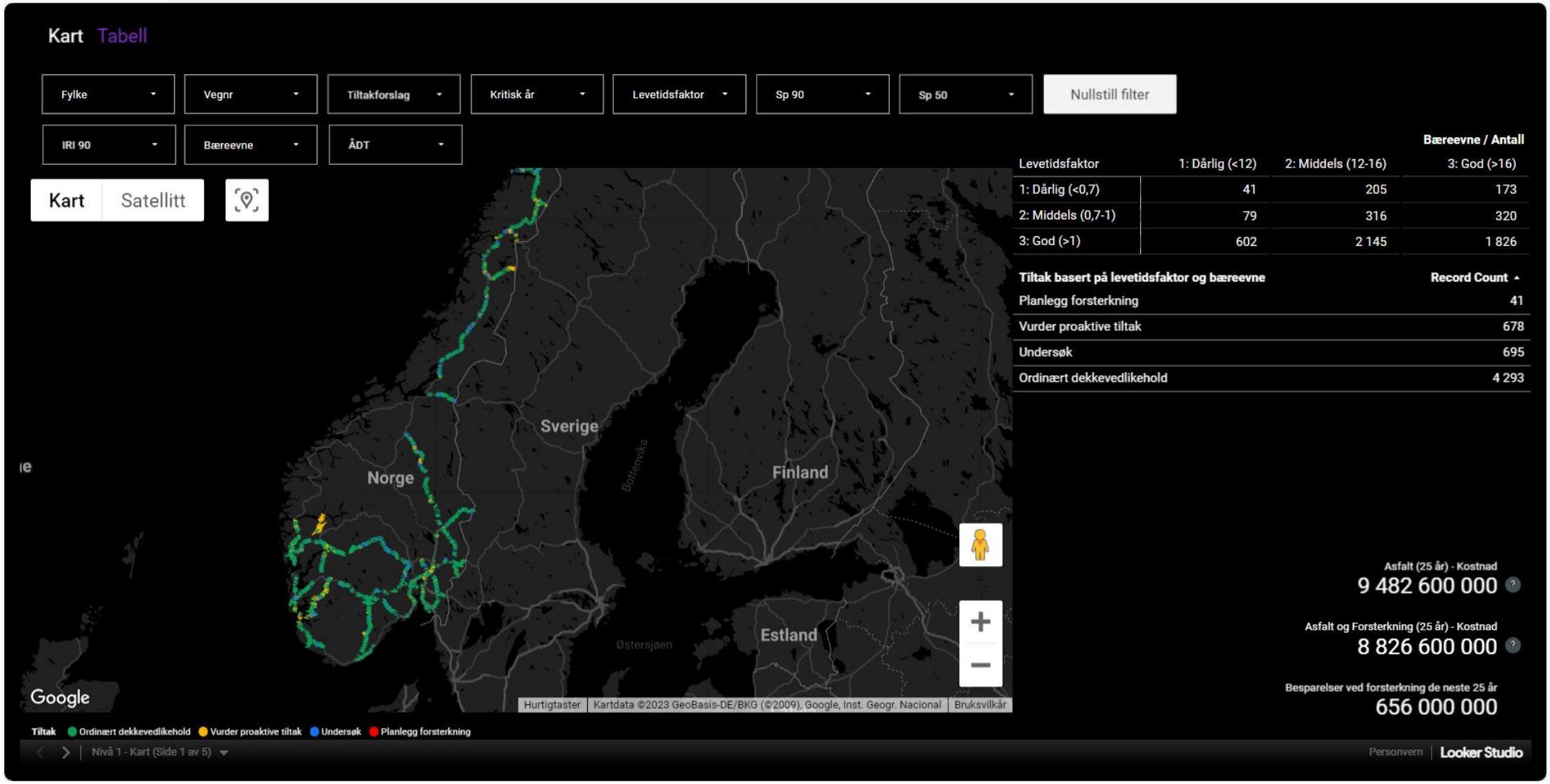
Bearing capacity	Rut developement	
	Good	Bad
Good	**No problems**, follow ordinary paving programme	**Problems in the asphalt or BC in sping thaw**, investigate cause, improve drainage
Bad	**Potential future problem**, investigate cause and preform pro-active maintenance to avoid consequential damage.	**Bigger problems**, strengthening might be necessary, investigate cause and plan measures

Dashboard combining structural and functional data (1. screening)



[Vegtilstand (vegvesen.no)]

Kart Tabell

Fylke | Vegnr | Tiltakforslag | Kritisk år | Levetidsfaktor | Sp 90 | Sp 50 | Nullstill filter

IRI 90 | Bæreevne | ÅDT

Kart Satellitt

Tiltak Planlegg forsterkning

Levetidsfaktor	Bæreevne / Antall 1: Dårlig (<12)	2: Middels (12-16)	3: God (>16)
1: Dårlig (<0,7)	41	205	173
2: Middels (0,7-1)	79	316	320
3: God (>1)	602	2 145	1 826

Tiltak basert på levetidsfaktor og bæreevne	Record Count ▲
Planlegg forsterkning	41

Asfalt (25 år) - Kostnad
167 300 000

Asfalt og Forsterkning (25 år) - Kostnad
123 600 000

Besparelser ved forsterkning de neste 25 år
43 700 000

Kart Tabell

Fylke | Vegnr | Tiltakforslag | Kritisk år | Levetidsfaktor | Sp 90 | Sp 50 | Nullstill filter

IRI 90 | Bæreevne | ÅDT

Tiltak ● Ordinært dekkevedlikehold

Levetidsfaktor	Bæreevne / Antall		
	1: Dårlig (<12)	2: Middels (12-16)	3: God (>16)
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3: God (>1)	602	2 145	**1 826**

Tiltak basert på levetidsfaktor og bæreevne	Record Count ▲
Ordinært dekkevedlikehold	1 826

Asfalt (25 år) - Kostnad
2 563 100 000

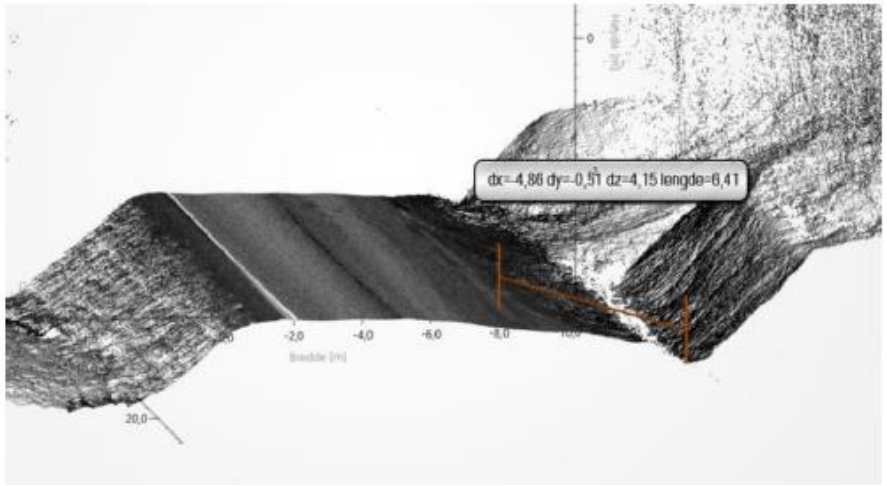
Asfalt og Forsterkning (25 år) - Kostnad
2 563 100 000

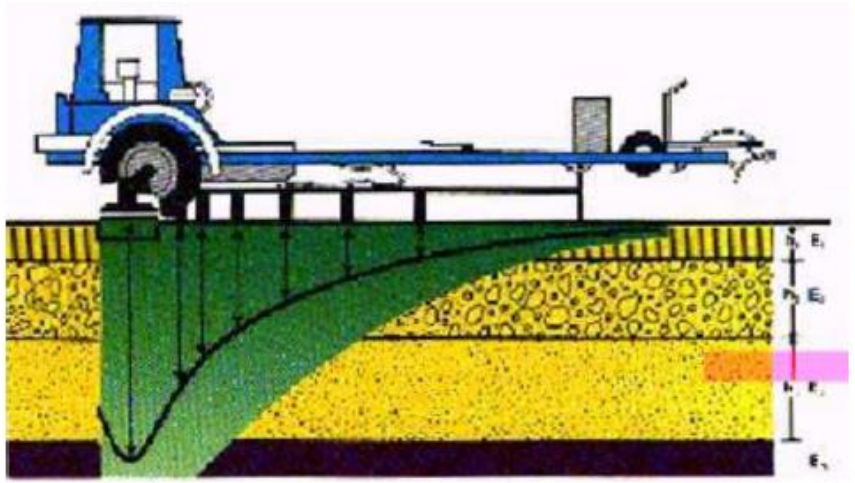
Besparelser ved forsterkning de neste 25 år
0

Looker Studio

2. stage: further investigation of problematic sections

- Deeper analysis of Raptor data
- Spring-thaw FWD measurements
- Drill cores/excevations
- Interpretation of GPR data
- Drainage inspection (laserdata can be useful)
- Integrated analysis to find reasons and select proper action





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Proactive maintenance sections:

- Early resurfacing
- Drainage improvements
- Patching, crack sealing, surface treatments.

Strengthening need sections:

- Put section in long-term plan for strenghtening measures.
- Preform supplementary investigations and analysis.
- Allocate money for larger mainteance works.

Implementing 4-years paving plans:

- [Foreløpige asfaltplaner | Statens vegvesen]

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Challenges

- Established routines are hard to turn
- Need of new routines and requirements for pavement management
- Lack of expertice/pavement engineers
- Need of education within the road authorities about the use of TSDD data.

Opportunities

- Great interest in TSDD measurement and the data
- Several county’s has also preformed TSDD measuremnts
- Educational establishment focus on structural data
- Master and PhD-students
- R&D opportunities
- More for less

Conclusions

Structural data is the missing, but very important part of a modern PMS system

Combining structural and functional data gives advantages.

Presentation of the data in understandable and practical format is important.

There are challenges implementing data, but also possibilities.

How to utilize data in the best way?

There is a need of education.

Thank you for your attention!