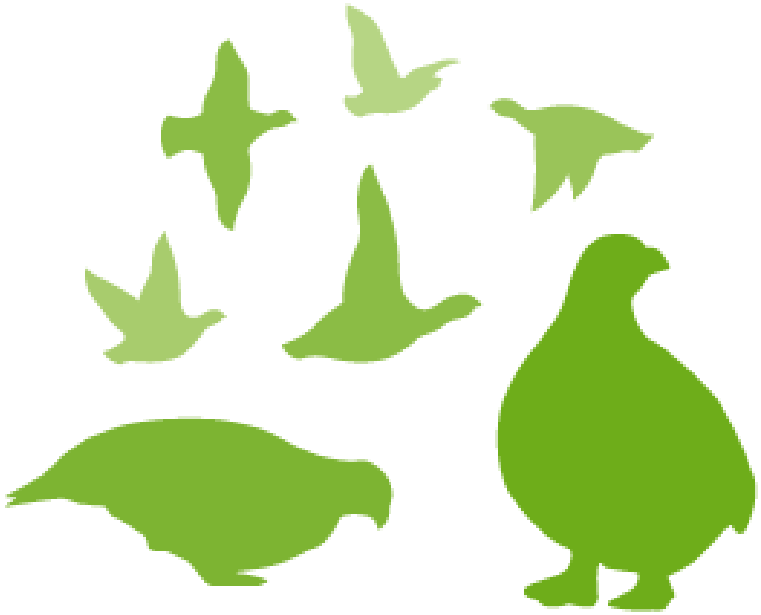

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The ROADEX IV Project

Ron Munro, Munroconsult Ltd

Timber Transport Forum Conference 2010

Perth, Thursday 11th March 2010

ROADEX Update

Outline:

- Background
- Demonstration projects
- Example: vehicle-human vibration
- FCE/ROADEX seminar Stirling 23 June 2010

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EU Northern Periphery Programme

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The ROADEX Partners:

Lead Partner, The Swedish Road Administration
Northern Region, The Swedish Forest Agency

The Finnish Road Administration, Lapland District

The Government of Greenland

The Icelandic Road Administration

The Northern Region, Norwegian Public Roads Administration

The Highland Council, The Forestry Commission,
Comhairle Nan Eilean Siar

National Roads Authority,
Department of Transport, Ireland

Associate Partner:
The Forest Engineering Research Institute of Canada, (FERIC)

Project Consultant: Roadscanners Oy, Finland

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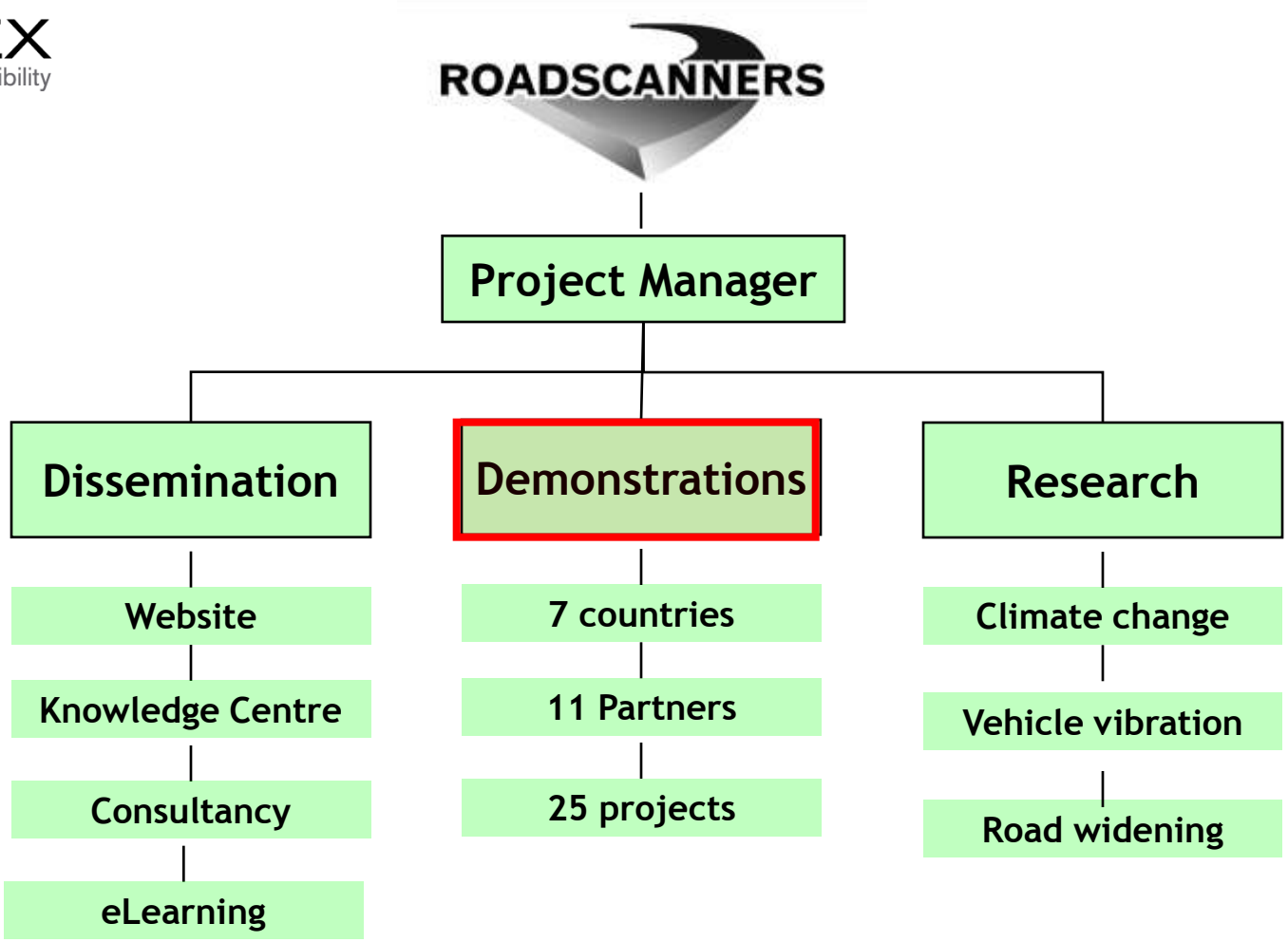
Project structure



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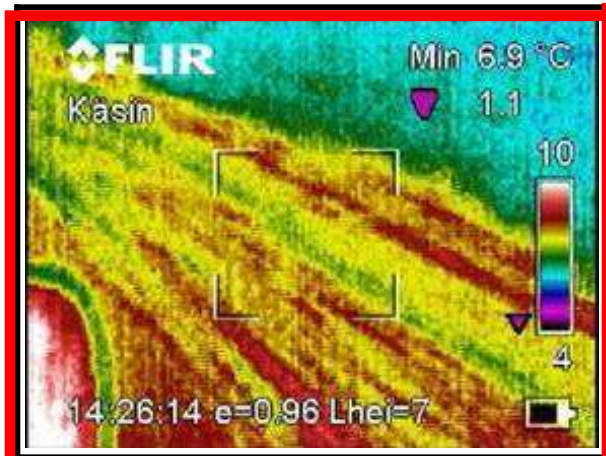
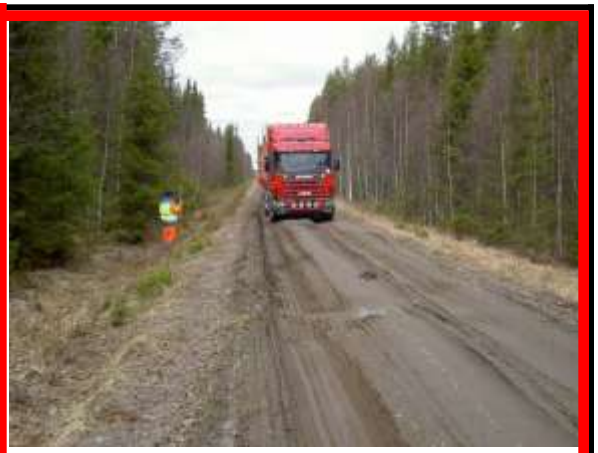
Demonstration categories

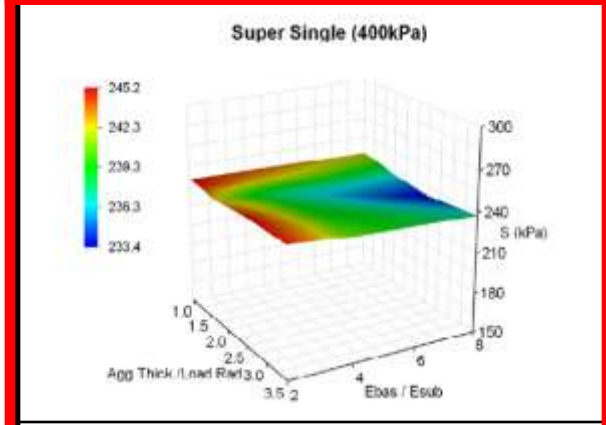


Drainage maintenance
Timo Saarenketo

Low Impact Vehicles & TPC
Pauli Kolisoja



Forest road policies
Svante Johansson

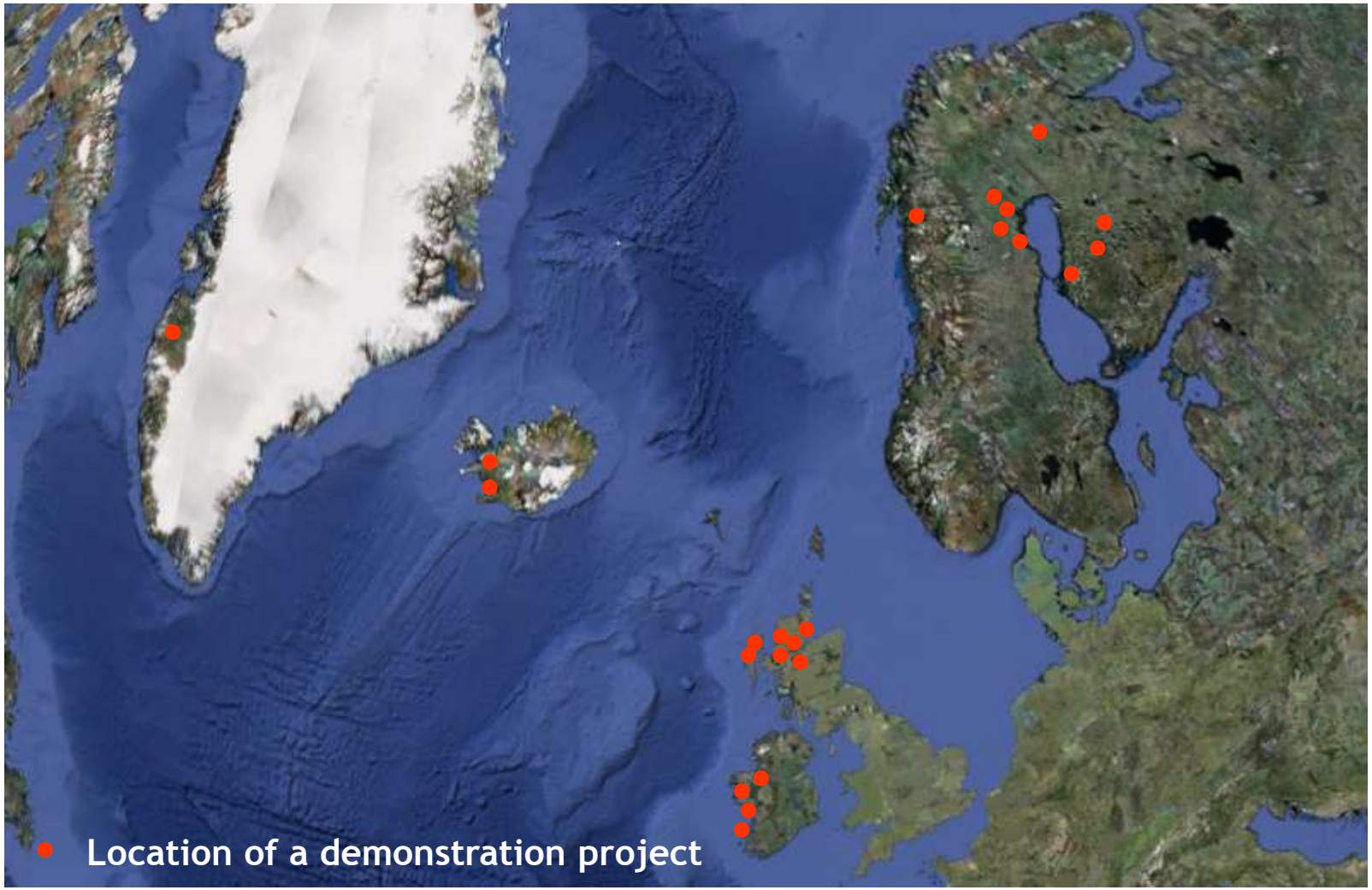


Design against rutting
Pauli Kolisoja

Roads on Peat
Haraldur Sigursteinsson

Vehicle-human vibration
Johan Granlund

Locations of the demonstrations



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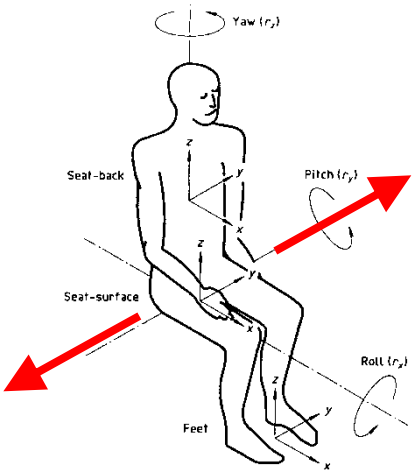
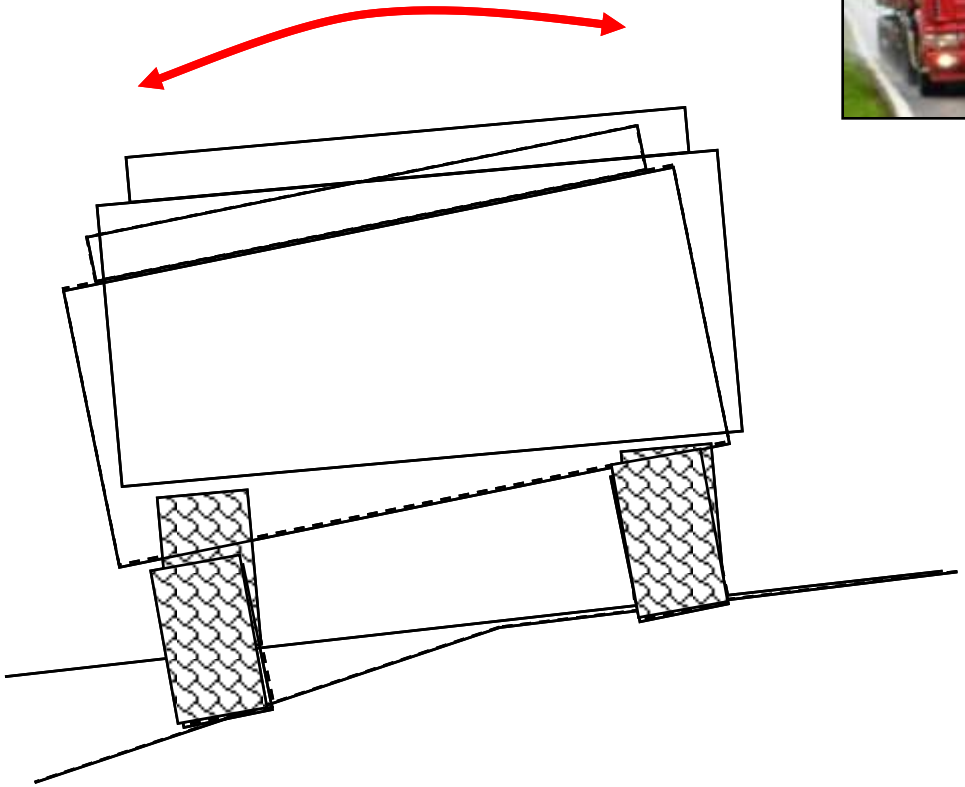
Demonstration D6: Vehicle-human vibration
Lateral vibration due to road condition





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Health effects due to ride vibration & shock

- **Ride vibration (bounce, pitch and roll) 0.5 – 80 Hz:**
- **Resonance in eye globes, head, spine, stomach,**
- **Pain in neck, shoulders and back**
- **Lower back pain elated to annual mileage**
- **Bumps cause spinal stress**
- **Undulations create drowsiness**

Whole-Body Vibration

EU 2002/44/EC
Physical Agents Directive (Vibration)

- **Covers workers only – not passengers**
- **Refers to ISO 2631-1***
- **Based on a ”daily exposure” of 8 hours A(8)**
- **Truck drivers exposure often exceeds the Action Value of 0.5m/s^2 which requires Employers to *“take technical and/or organisational measures to minimize vibration exposure”***
- **All work that exceeds the A(8) exposure limit of 1.15 m/s^2 is prohibited**

* ISO 2631-1:1997 “Mechanical vibration and shock - Evaluation of human exposure to whole-body vibration”

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Typical ride vibration levels

From ISO 2631-1*:	**< 0.3 m/s² is ”not uncomfortable”**
	> 0.5 m/s² is ”fairly uncomfortable”
	> 2 m/s² is ”extremely uncomfortable”
EU Action Value	**A(8) = 0.5 m/s², average over 8 hours**
Heavy trucks	**0.2 to 1.6 m/s² average for route**
	> 2 m/s² at bumps
Passenger cars	**0.1 to 1 m/s² average for route**
	up to 2 m/s² at bumps

* ISO 2631-1:1997 “Mechanical vibration and shock - Evaluation of human exposure to whole-body vibration”

Vibration tests on Road 331
"The Beaver Road", northern Sweden

- **170 km 2 lane regional route**
- **Daily traffic of 350 to 2,000 vehicles per day.**
- **Speed limits of 70 and 90 km/h, 50 km/h through villages.**

Haulage company: Brorssons Åkeri AB

- **2 mobile cranes**
- **14 timber logging trucks with trailers**
- **Each truck runs 18 hrs/day (8 hrs on Fridays)**
- **Annual mileage 200,000 km/truck**
- **All trucks and trailers are changed every 3 - 4 years**
- **ROADEX test: 4 days of 2 x 140 km**

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The truck ride sensors:

Z-axis 1 kHz at L and R frame.

Z-axis at L and R front wheel axles.

GPS + 6-axis 100 Hz inertial unit in the cab.

X, Y, Z-axis 1 kHz seat pad.

Videocamera for visual reference.

Microphone for interior noise < 5 kHz.

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Road surface measurement

A laser/inertial Profilograph scanned the test road´s surface condition 20,000 times per metre.

Photo: Mats Landerberg

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“Rock n’ Roll” at Backe:

Note the warping between the truck and the trailer.

In-truck data:

3.5°/s change in cab roll angle

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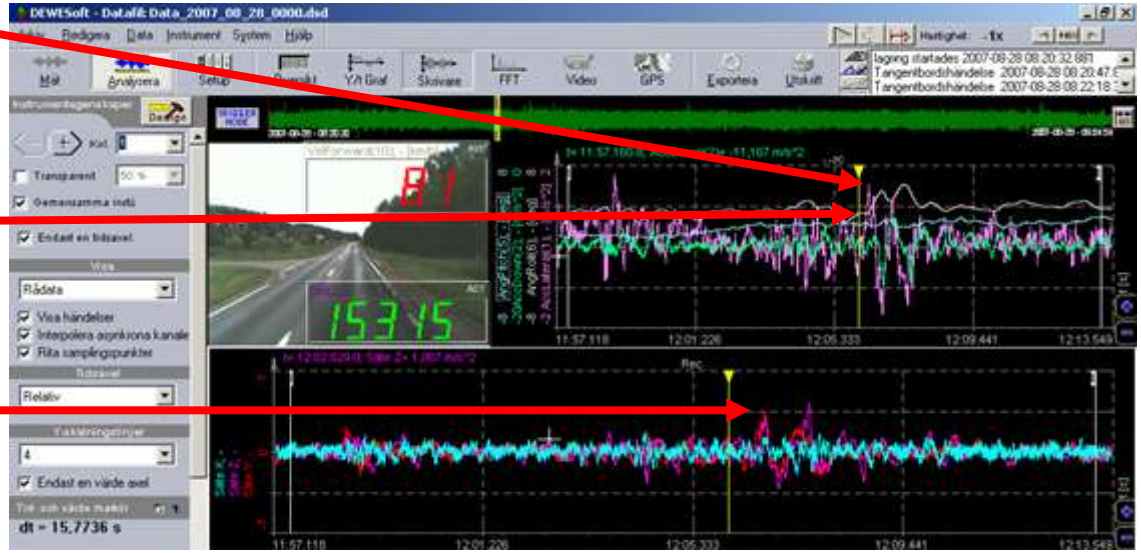
“Rock n’ Roll” on the Åkerö straight:

Truck cab roll angle:
- Very high rate;
5°/s (at high freq).

High lateral acc in cab: 2 m/s².

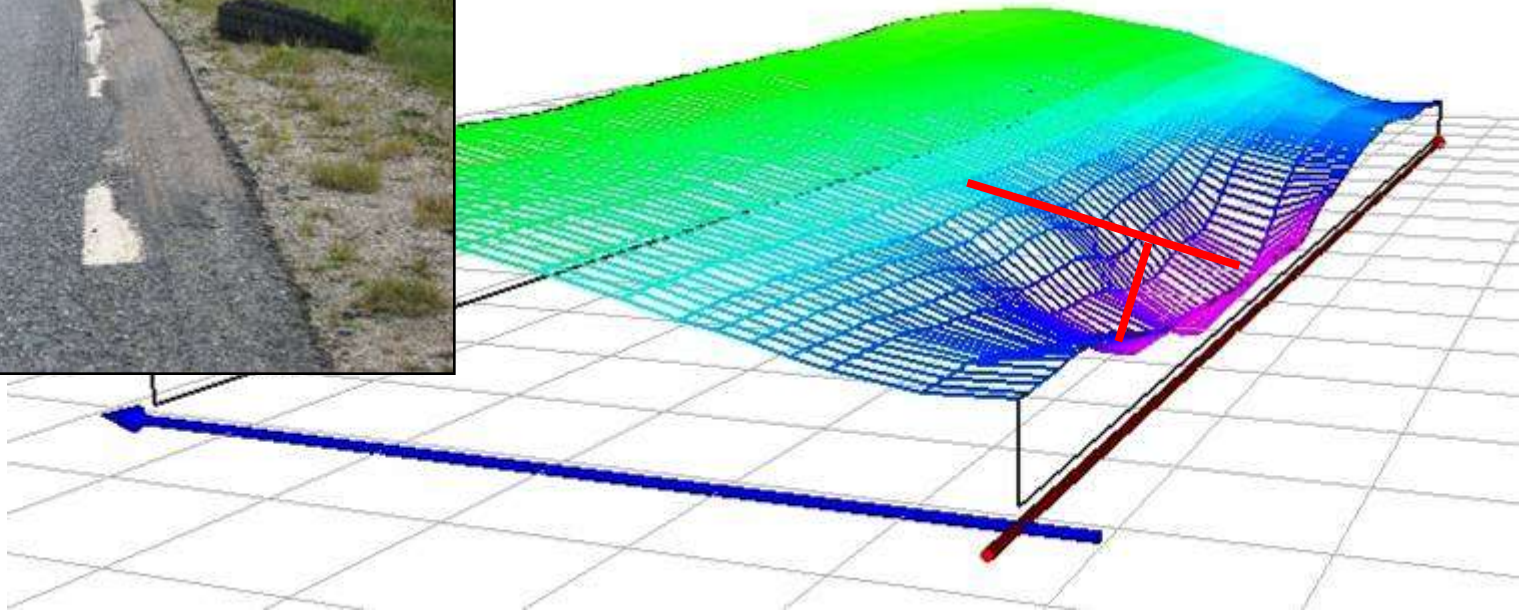
Very high lateral acc at the driver seat: 3.5m/s² (+ 75 %)



Typical 3D laserscan of edge deformation at Åkerö:

Note: Exploded truck tire

The 1.18 % RBCS variance was caused by a 69 mm deep deformation



RBCS = Rut bottom cross slope

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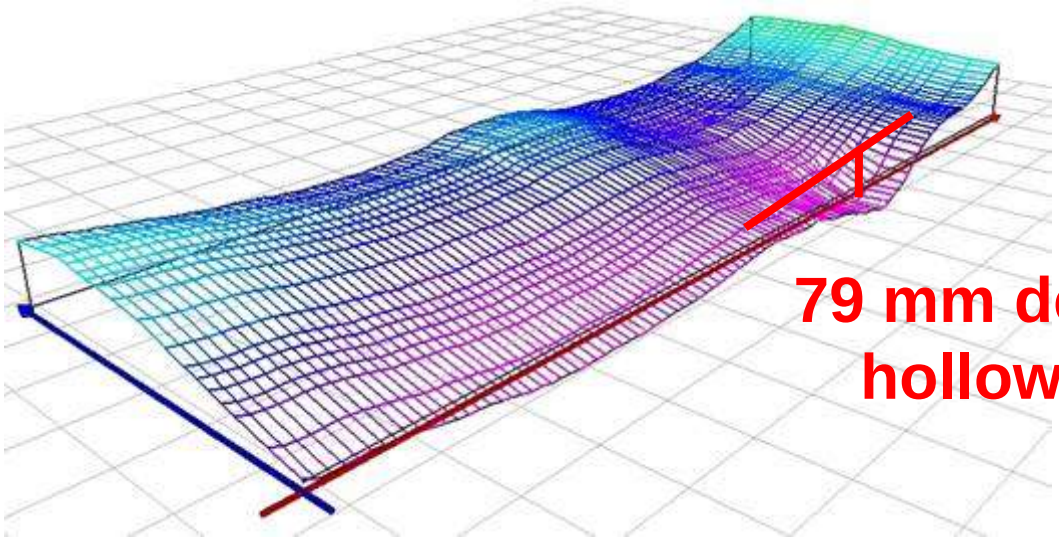
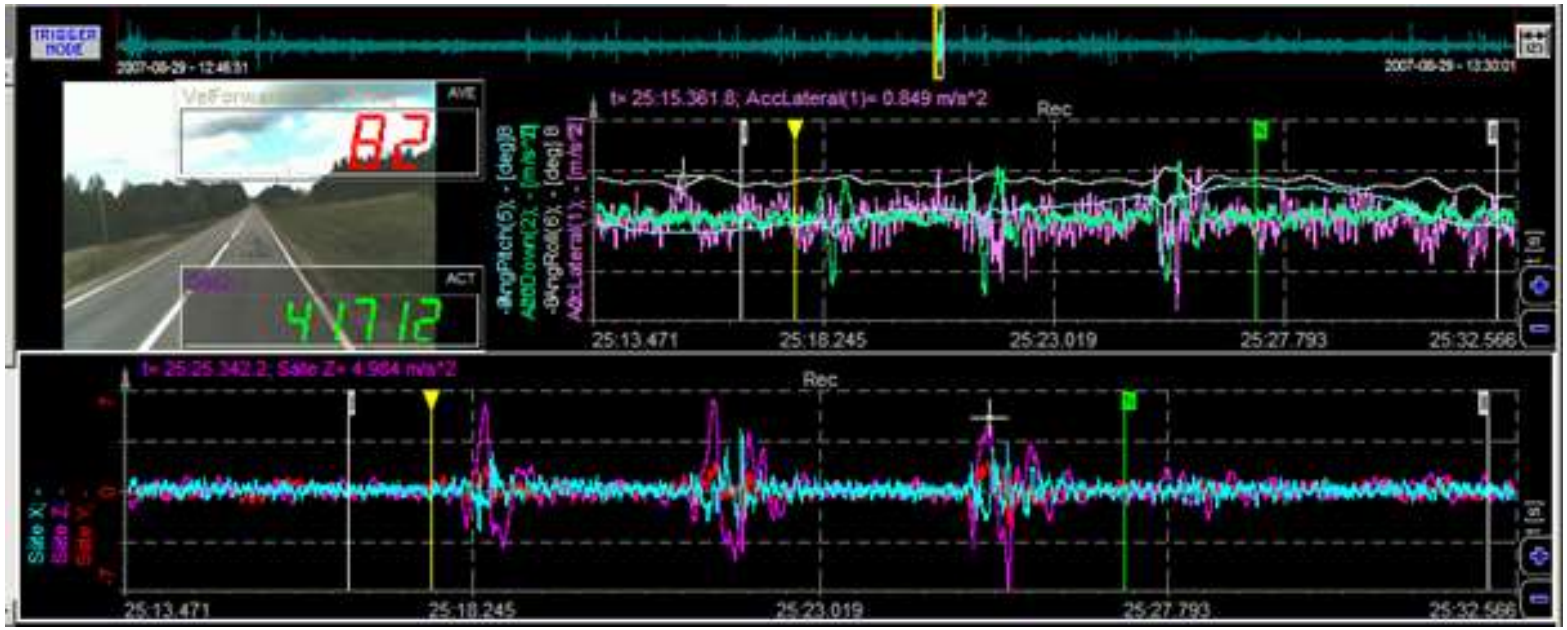
Bumps at culverts:

3D laserscan of settlement at a culvert repair



Special health risk at bumps



Transient vibration can cause high compression stresses in the spine; a special health risk.

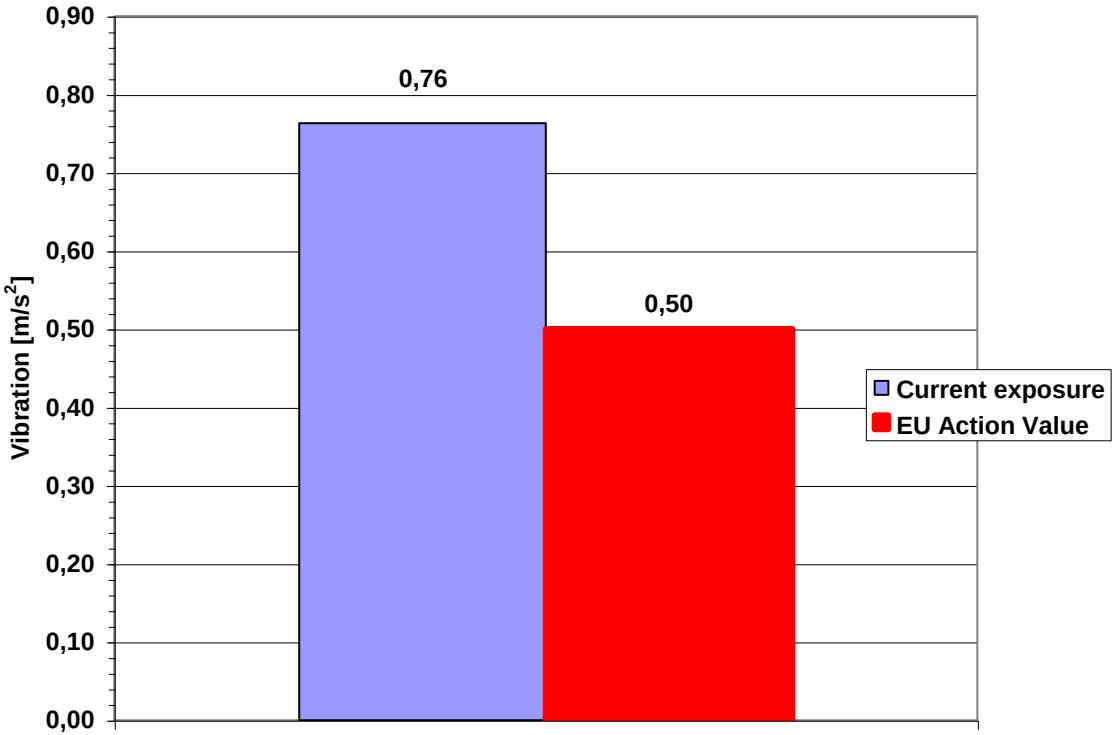
The worst bumps gave S_{ed} > 0.5 MPa. Exceeding this stress level corresponds to health risk, as per ISO 2631-5 (2004).

S_{ed} = "Equivalent daily static compression dose"

Average daily vibration exposure A(8) (EU Directive 2002/44/EC)

Results for normal driving shifts, taking roundtrips from the forests to the coast:

A(8) = 0.76 m/s², over EU Action Value 0.5 m/s².



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Tests in Finland, Norway & Scotland

Reproducing the case study from the Beaver Road

1. Measuring truck drivers daily vibration exposure, A(8).
2. Measuring spine compression, S_{ed}, caused by jolts at severe bumps.
3. Relating truck roll & lateral buffeting to road edge deformation.

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!!Advance notice – Free seminar!!

FCE/ROADEX seminar on ”Low Impact Vehicles and TPC”

Stirling, Wednesday 23 June 2010

Subject	Speaker
TPCS	Al Bradley, FPInnovations, Canada
Tyre management	Dan Lamb, Michelin UK
ROADEX research	Pauli Kolisoja, Tampere University of Technology
Vehicle & driver vibration	Johan Granlund, Vectura
Tireboss	Brian Spreen, Tire Pressure Control International
Bigfoot	Neil Wylie, Innovative Transport Equipment Ltd
Case Study	David Leslie, James Jones & Sons Ltd
Case Study	John Scott, JST Services

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THANK YOU

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