Barents Case Murmansk

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Murmansk Road Diagnostics Project Goals

• 2008: Demonstrating Murmansk Avtodor personnel with Finnish road survey and diagnostics methods and rehabilitation design and quality control.

• 2012: Analysing further GPR data collected in 2008 to demonstrate how different kinds of road problems can be identified from the GPR and video data (BLVRM project)
Surveys Conducted

Network level project: Video and DGPS based data collection and pavement and drainage condition classification

• Work was done together with Murmansk Avtodor personnel and data collection training was made at the same time

• Test roads were selected by Murmansk Avtodor

• Final analysis done by Roadscanners
Data Collection Using RD CAMLINK - Method

Video camera

Audio comments

DGPS - koordinaatit
Other Roads – network level surveys

<table>
<thead>
<tr>
<th>Road name</th>
<th>Length (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Murmanskina eastern bypass</td>
<td>4.77</td>
</tr>
<tr>
<td>Airport road</td>
<td>17.28</td>
</tr>
<tr>
<td>Kola – Murmashi</td>
<td>15.94</td>
</tr>
<tr>
<td>Kola – Vyhodnoin</td>
<td>5.38</td>
</tr>
<tr>
<td>Kola – Turkis sovhoos</td>
<td>5.61</td>
</tr>
<tr>
<td>Kola – Ylätuloma (Rajajooseppi road)</td>
<td>49.85</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>98.83</strong></td>
</tr>
</tbody>
</table>

Video still-photo from Kola - Vydhoin railway station road
Condition Classification in Murmansk Tests

1. Pavement condition
2. Drainage condition

Condition classification:

<table>
<thead>
<tr>
<th>Class</th>
<th>Color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Green</td>
<td>Good</td>
</tr>
<tr>
<td>1</td>
<td>Yellow</td>
<td>Adequate</td>
</tr>
<tr>
<td>2</td>
<td>Orange</td>
<td>Inadequate</td>
</tr>
<tr>
<td>3</td>
<td>Red</td>
<td>Poor</td>
</tr>
</tbody>
</table>

Theme map: Kola - Turkis sovhos road. Center line describes pavement condition and right and left lines describe drainage condition.
Road Condition Classification - Pavement

Class 0: Good condition

Sound pavement, no distress
Road Condition Classification - Pavement

Class 1: Adequate condition

Pavement mainly ok – small crack may appear
Road Condition Classification - Pavement

Class 2: Inadequate pavement condition

Pavement has distress and settlements

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Road Condition Classification - Pavement

Class 3: Poor pavement condition

Pavement has severe damages
Road Condition Classification - Drainage

Classes 0-1: Good, Adequate

Road shape ok, ditches in good condition
Road Condition Classification - Drainage

Class 2: Inadequate drainage system

Ditches partly filled with soil and vegetation
Road Condition Classification - Drainage

Class 3: Poor drainage system

No side ditches, water is lying on road and shoulders

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## Results – Pavement Condition

<table>
<thead>
<tr>
<th>Pavement condition</th>
<th>Length (m)</th>
<th>good (0)</th>
<th>adequate (1)</th>
<th>inadequate (2)</th>
<th>poor (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road 1 Murmansk itäpuolen ohitustie</td>
<td>4771</td>
<td>971 (20,4 %)</td>
<td>2525 (52,9 %)</td>
<td>1243 (26,1 %)</td>
<td>32 (0,7 %)</td>
</tr>
<tr>
<td>Road 2 Lentokentäntie</td>
<td>17281</td>
<td>9534 (55,2 %)</td>
<td>4502 (26,1 %)</td>
<td>2759 (16,0 %)</td>
<td>486 (2,8 %)</td>
</tr>
<tr>
<td>Road 3 Kola-Murmashin tie</td>
<td>15937</td>
<td>7763 (48,7 %)</td>
<td>4833 (30,3 %)</td>
<td>3099 (19,4 %)</td>
<td>242 (1,5 %)</td>
</tr>
<tr>
<td>Road 4 Kola - Vydhodnoin Asema</td>
<td>5376</td>
<td>3077 (57,2 %)</td>
<td>2062 (38,4 %)</td>
<td>237 (4,4 %)</td>
<td>0 (0,0 %)</td>
</tr>
<tr>
<td>Road 5 Kola - Turkiisovohoosi</td>
<td>5612</td>
<td>381 (6,8 %)</td>
<td>2377 (42,4 %)</td>
<td>2510 (44,7 %)</td>
<td>344 (6,1 %)</td>
</tr>
<tr>
<td>Road 6 Kola - Ylätuloma</td>
<td>49851</td>
<td>3557 (7,1 %)</td>
<td>30624 (42,4 %)</td>
<td>11484 (44,7 %)</td>
<td>4186 (6,1 %)</td>
</tr>
<tr>
<td>Road 7 Lotan tie 149-164 km</td>
<td>15001</td>
<td>13043 (86,9 %)</td>
<td>1289 (8,6 %)</td>
<td>575 (3,8 %)</td>
<td>94 (0,6 %)</td>
</tr>
<tr>
<td>Lotan tie 174-180 km</td>
<td>6301</td>
<td>4825 (76,6 %)</td>
<td>1216 (19,3 %)</td>
<td>185 (2,9 %)</td>
<td>75 (1,2 %)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>120130</td>
<td>43151 (35,9 %)</td>
<td>49428 (41,1 %)</td>
<td>22092 (18,4 %)</td>
<td>5459 (4,5 %)</td>
</tr>
</tbody>
</table>

**Pavement condition**

- Hyvää: 36%
- Kohtalainen: 41%
- Välttävä: 18%
- Huono: 5%

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# Results – Drainage analysis

<table>
<thead>
<tr>
<th>Road</th>
<th>Drainage condition</th>
<th>Length (oja-m)</th>
<th>Good (0)</th>
<th>Adequate (1)</th>
<th>Inadequate (2)</th>
<th>Poor (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road 1</td>
<td>Murmansk in itäpuolen ohiutie</td>
<td>9542</td>
<td>1692 (17.7%)</td>
<td>4323 (45.3%)</td>
<td>3147 (33.0%)</td>
<td>380 (4.0%)</td>
</tr>
<tr>
<td>Road 2</td>
<td>Lentokentäntie</td>
<td>34562</td>
<td>9296 (26.9%)</td>
<td>15620 (45.2%)</td>
<td>9291 (26.9%)</td>
<td>355 (1.0%)</td>
</tr>
<tr>
<td>Road 3</td>
<td>Kola-Murmashin tie</td>
<td>31874</td>
<td>1164 (3.7%)</td>
<td>10608 (33.3%)</td>
<td>18831 (59.1%)</td>
<td>1271 (4.0%)</td>
</tr>
<tr>
<td>Road 4</td>
<td>Kola - Vydhodnoin Asema</td>
<td>10752</td>
<td>33 (0.3%)</td>
<td>5210 (48.5%)</td>
<td>5060 (47.1%)</td>
<td>449 (4.2%)</td>
</tr>
<tr>
<td>Road 5</td>
<td>Kola - Turkkissovoosi</td>
<td>11224</td>
<td>188 (1.7%)</td>
<td>2455 (21.9%)</td>
<td>7473 (66.6%)</td>
<td>1108 (9.9%)</td>
</tr>
<tr>
<td>Road 6</td>
<td>Kola - Ylatuloma</td>
<td>81908</td>
<td>170 (0.2%)</td>
<td>16735 (20.4%)</td>
<td>36740 (44.9%)</td>
<td>28263 (34.5%)</td>
</tr>
<tr>
<td>Road 7</td>
<td>Lotan tie 149-164 km</td>
<td>29975</td>
<td>4515 (15.1%)</td>
<td>3572 (11.9%)</td>
<td>18828 (62.8%)</td>
<td>3060 (10.2%)</td>
</tr>
<tr>
<td>Lotan tie 174-180 km</td>
<td>12602</td>
<td>7673 (60.9%)</td>
<td>4830 (38.3%)</td>
<td>99 (0.8%)</td>
<td>0 (0.0%)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>222439</td>
<td>24731 (11.1%)</td>
<td>63353 (28.5%)</td>
<td>99469 (44.7%)</td>
<td>34886 (15.7%)</td>
<td></td>
</tr>
</tbody>
</table>

![Drainage condition chart](chart.png)
Results

Average drainage condition

- Good: 1.34
- Poor: 2.40

Pavement condition classes:

- Ei vaurioita (0)
- Pieniä vaurioita (1)
- Huomattavia vaurioita (2)
- Erittäin paljon vaurioita (3)
Projec Level Surveys with GPR

Road: Murmansk – Lotta - Rajajooseppi

149+000 – 163+600 (14,6 km)
174+000 – 180+200 (6,2 km)

Total: 20,8 km
(41,6 lane km)
Example of GPR Output (1)
GPR Output example (2)

- Thickness: pavem/base
- Antenna bouncing
- Pavement Er
- Er deviation
- Drainage
- Condition class

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GPR Survey Statistics

<table>
<thead>
<tr>
<th>Section</th>
<th>149+000 – 163+000</th>
<th>174+000 – 180+000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>Left</td>
<td>Right</td>
</tr>
<tr>
<td>Pavement thickness (cm)</td>
<td>12,8</td>
<td>11,3</td>
</tr>
<tr>
<td>Pavement dielectric value</td>
<td>5,62</td>
<td>6,00</td>
</tr>
<tr>
<td>Pavement dielectric value deviation</td>
<td>0,37</td>
<td>0,42</td>
</tr>
<tr>
<td>Base course thickness (cm)</td>
<td>21,6</td>
<td>20,4</td>
</tr>
</tbody>
</table>

Pavement and base course were clear and easy to identify - but sub base was partly mixed and partly same material than base. Road structure and embankment was easy to be interpreted. => GPR works well in Murmansk area!!
2012 – BLVRM Project: Detailed Diagnostics

Lotta - km 149.755 Frost bump and longitudinal crack
Lotta - km 150.050 Bedrock

Differential frost heave when coming and leaving to bedrock
Lotta - km 151.150 Peat

Uneven road over peat indicating differential settlements and frost problems
Lotta - km 151.720 Culvert with no transition wedges

No transition wedge built to culvert, big bump on the top of culvert.
Lotta - km 151.945 Culvert with good transition wedge

Well built culvert transition wedge, no bumps
Lotta - km 152.300 Forgotten culvert

No culvert marking no culvert heads visible, big bump on the top of culvert, transition wedge to depth of 60 cm.
Lotta - km 153.000 Settlements

Uneven road, big bumps, bended structures on GPR data

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Lotta - km 153.000 Sandy base/subbase

Bumps due to shear problems in base and sub base, too much sand, compaction problems?
Lotta - km 155.620 Old Timber Grillage

Bad settlements over peat bog, old timber grillage beneath the old road
Lotta - km 153.500 Good section

Even road, no major bumps, thick asphalt (200 mm), low dielectric value of base course
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Thank You