The influence of asphalt workmanship on pavement service life

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The goal of the R & D program Durable Roads is to achieve increased pavement service life and reduced annual cost for the pavement structure on Norwegian road network.
Organisation of NPRA (Norwegian Public Roads Administration)

- The Directorate of Public Roads
- Five regions
- 72 Driver and vehicle licensing offices
- 7,500 employees

Norwegian public road network: 93,800 km
- 10,500 km national roads, highways
- 44,300 km county roads
- 39,000 km municipal roads
Norway; a country of tunnels

1100 tunnels in NPRA service
Total tunnel length 1200 km
Including the world’s longest road tunnel Lærdal tunnel
Norway; a country of bridges

20700 bridges in NPRA service

Total bridge length 850 km

140–160 new bridges every year

Hardanger bridge; 1380 m
The Atlantic Ocean Road in Norway
“Construction of the Century”

Weather exposed conditions
Durability challenges on constructions
Norway; a country of tunnels and bridges

1 100 tunnels
20 700 bridges

“a premise for freedom of movement and accessibility”

But; maintenance and operation costs are high!
The Nordic countries have climate challenges

- up-west corner of Europe
- facing the Atlantic ocean
- Mexico Gulf-stream waters (warm)
- Arctic winds and waters (cold)

- southern vs. northern conditions
- coastal vs. inland conditions
- precipitation; rain and snow
- rapidly changing temperatures
- high and low temperatures
Nordic countries use **studded winter tires**
Studded tires

• increased maintenance costs
• reduced traffic safety
• dust and health problems in cities
Present situation – many premature failures

- Premature pavement failures/distresses occur too often
- Focus on cost and completion time
- Less focus on quality of work and proper use of materials/techniques
- Inadequate control procedures
Present situation – many premature failures

- Interlayer bonding, joints, bleeding etc. are typical problems
- Often related to asphalt works, not mix design
The asphalt mix itself is most often OK

- Material testing, mix design
- Asphalt production
- Quality assurance, FPC
But something happens from plant to final pavement

Pictures from “Best practice guide”: 
Then, who decides the final outcome of the job?

Key words:
- Competence
- Motivation

Skilled workers are more motivated workers
NPRA actions to prolong pavement service life

- Technical improvements, including clearer and more precise requirements
- Competence improvements, involving both road owners and contractors
Many distresses because of lack of bonding
Actions regarding bonding:

- Improved contract descriptions
  - Area to be covered by tack coat, minimum amount of bitumen pr m²
- Improved control procedures
- Introduced new laboratory methods/procedures

«shear bond test»
Many distresses because of non-homogeneous asphalt
ViaPPS - NPRA’s laser based road monitoring system

- 360 degree rotating laser scanning
- Resolution:
  - 1300 measuring points in each cross profile
  - Cross profile gap 8 cm (at 60 km/h)
- Detailed surface detection (rutting, texture, cracking etc.)
- New application; tunnel profiles
New module in ViaPPS: Homogeneity

Statistical texture analysis from laser data

Image of asphalt surface homogeneity

Extreme slippery and/or open textured areas can be detected instantly

Start new paved section  Bleeding areas  End new paved section
Many distresses because of open joints
Execution of longitudinal and transverse joints

Tried out special measures in some contracts, e.g. edge restraining devises.

And; intensified control and increased focus on these problems in all regions.
30% of Norwegian asphalt is boat transported; create problems due to long distances, reloadings etc.
Promising experiences from IR scanning

IR cameras have shown to be a very useful tool to detect inhomogeneities, especially in connection to boat transport contracts.

Typical temperature profile on the road after reloading from boat to truck and further on to paver. Cold materials in almost every truck load can be seen.
Boat contracts in 2016: Introduced extra loading/mixing equipment on the road (feeder or Shuttle Buggy)

Positive results; the effects can be read directly from the IR pictures (see next slides)
Boat transport without feeder/Shuttle Buggy

Risk area 10,6 %
Boat transport with feeder/Shuttle Buggy

Risk area 1.4%
Risk area vs. transport distance (on truck)

Risk area from IR scanning (%) vs. Truck transport distance (km)
**Actions for pavement improvement (summary)**

- Improved bonding/tack coat requirements
- Improved execution of joints
- Improved surface control

**Shear bond test**
- extra tack coating
- edge compaction
- revised void requirements

**IR scanning**
«homogeneity mapping» from laser scanning data (detecting bleeding and open textured areas)
Actions for pavement improvement (summary)

- Best practice guide
- example; truck loading

- Boat transport guidelines
- loading/unloading procedures
- temperature control/considerations

- Asphalt control instructions
- IR scanning
- priority list of parameters to check
Actions for pavement improvement (summary)

Training courses and competence building

- Know–how transfer from experienced to young professionals
- Review/update of control procedures
- Training on use of instruments and measurement procedures
- Calibration
- Etc.
Main objective – increase pavement service life

- Avoiding early distresses and failures will give substantial savings
What if we succeed?

- Considerable savings over time, in both maintenance and repair costs

- Reduced pavement maintenance costs
- Reduced patching/repair costs
Conclusion

We are convinced that we can obtain a very good payback when investing in good workmanship and improved competence/expertise.
Thank you!
The North Cape in midnight sun