ROADEX Network
For better rural roads

Norsk Asfaltforening

Statens vegvesen

Tunge kjøretøyers effekt på vegens levetid

Resultater fra forstudie i regi av Roadex Network

NADim-seminar, Oslo, 4. desember 2014

Per Otto Aursand, Statens vegvesen, Region Nord

Roadex Network

- The fifth collaborative venture by the ROADEX Partners.
- Forum for cooperation and share of best practice
- Identify common needs
- Management of low volume rural roads
  - Implement and test new solutions
  - Arrange workshops and meetings
  - To try to get external funding for research and implementation projects

www.roadex.org

History of ROADEX Network

The ROADEX Pilot Project (1998-2001)

ROADEX began in 1998 as a Pilot project whose aim was "Creating an effective technical exchange & co-operation across the road districts of the European Northern Periphery"

Read more

ROADEX II (2002-2005)

The 3 year ROADEX II – "The research project" expanded on the ROADEX pilot project and brought in new Partners from local industries who relied on heavy road haulage to take their products to market.

Read more

ROADEX III (2006-2007)

ROADEX III – "The Dissemination Project" commenced in January 2006 along with new Partners from Greenland and Iceland.

Read more

ROADEX IV (2008-2012)

ROADEX IV – "Implementing Accessibility" was the fourth, and final, ROADEX project part-funded by the EU Northern Periphery Programme. It aimed to implement the road technologies developed by ROADEX on to the Partner road networks to improve operational efficiency and save money. The Lead Partner for the project was the Northern Region of The Swedish Road Administration and the main project consultant is Roadscanners Oy.

Read more

PARTNERS

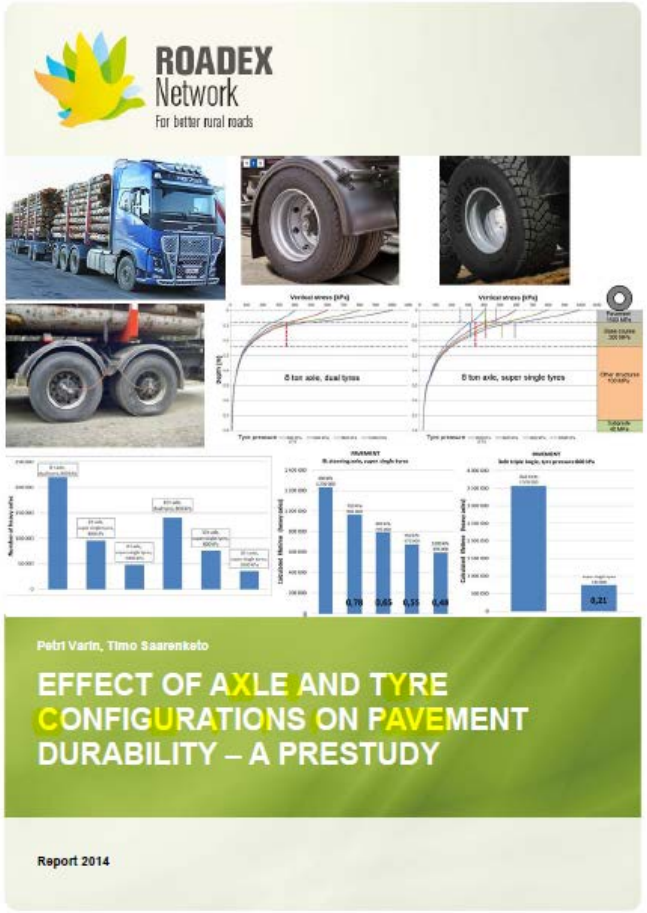
SWEDEN	The Swedish Transport Administration, Northern Region
	Swedish Forest Agency
FINLAND	Centre for Economic Development, Transport and the Environment
	Finnish Transport Agency
ICELAND	The Icelandic Public Roads Administration
NORWAY	Norwegian Public Roads Administration, Northern Region
SCOTLAND	The Highland Council
	The Forestry Commission Scotland
	Transport Scotland
	The Western Isles Council "Comhairle Nan Eilean Siar"
IRELAND	The National Roads Authority
	Department of Transport, Tourism & Sport
PROJECT CONSULTANT	Roadscanners Oy

Statens vegvesen

Roadex Network rapport

Forstudie av effekten av ulike aksel- og dekk-konfigurasjoner på vegens levetid

- Utarbeidet av Roadscanners Oy på oppdrag fra vegadministrasjonene via Roadex Network.
- Generell informasjonspakke på effekten av ulike aksel- og dekk-konfigurasjoner
- Skademekanismer og sportyper
- Faktorer ved kjøretøyet og vegoverbygningen som påvirker bæreevne/levetid.
- Beregningseksempler på typiske veger fra Skottland, Finland, Sverige og Norge



Statens vegvesen

Bakgrunn

- Trend i transportbransjen:
  - lengre og tyngre kjøretøyer
  - flere (og tyngre) aksler.
  - nye dekktyper (Super singel)
  - ringtrykk?

Table 5: Properties of the truck options evaluated in the Swedish calculations

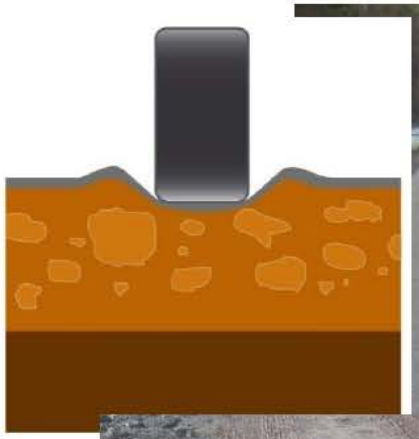
	60 ton Timber	66 ton General Cargo	74 ton Timber	80 ton General Cargo	90 ton Timber
	Timber-Traditional	DUO-CAT	ST-Crane	DUO-Trailer ed 2	ETT
Possible road wear compared to 60 t	1	1.6	1.2	2.2	3.5
					

- Status:
  - Finland: maks tillatt totalvekt økt fra 60 til 76 tonn
  - Sverige: 90 tonn tømmertransporter mellom terminaler. Foreslått å økte maks totalvekt til 74 tonn på vegnettet generellt.
  - Norge: Modulvogntog og 60 tonn tømmertransporter på utvalgte vegstrekninger. Økt andel super singel.

- Mangel på vitenskapelig forankret kunnskap om effekten på nedbryting av vegen.

- Identifisert et stort behov for lett tilgjengelig informasjon.

Mode 1 Rutting Problems



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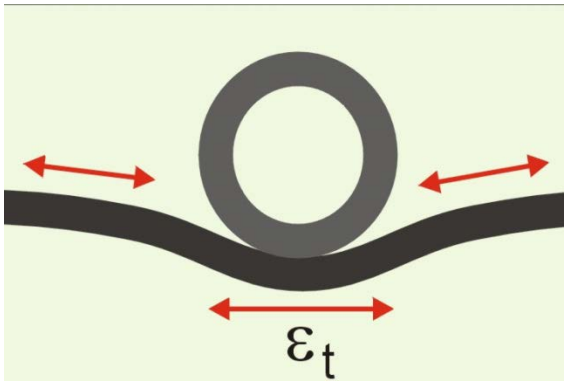
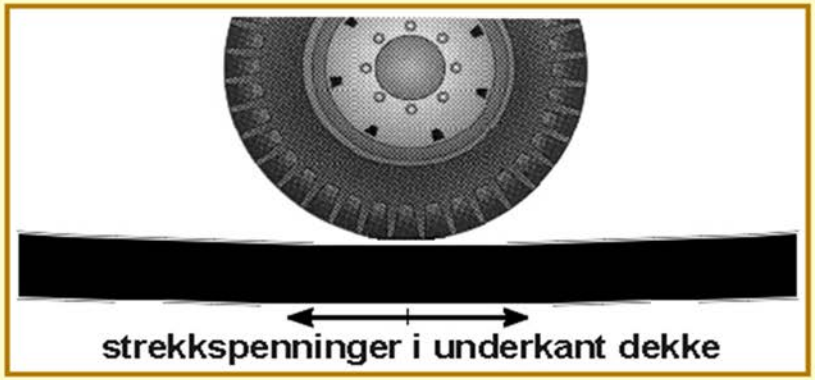
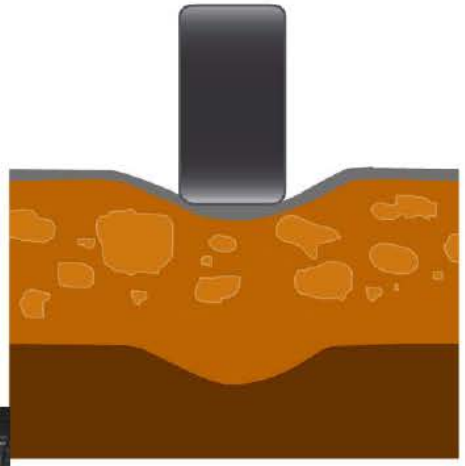
Implementing Accessibility

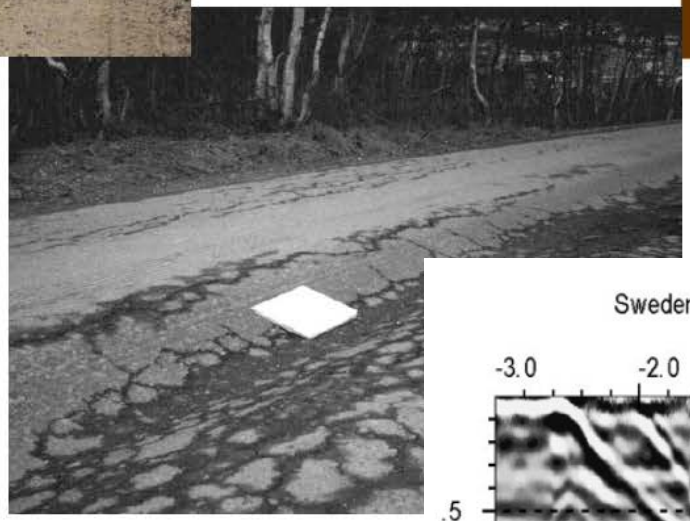
Krakelering
som følge av utmatting

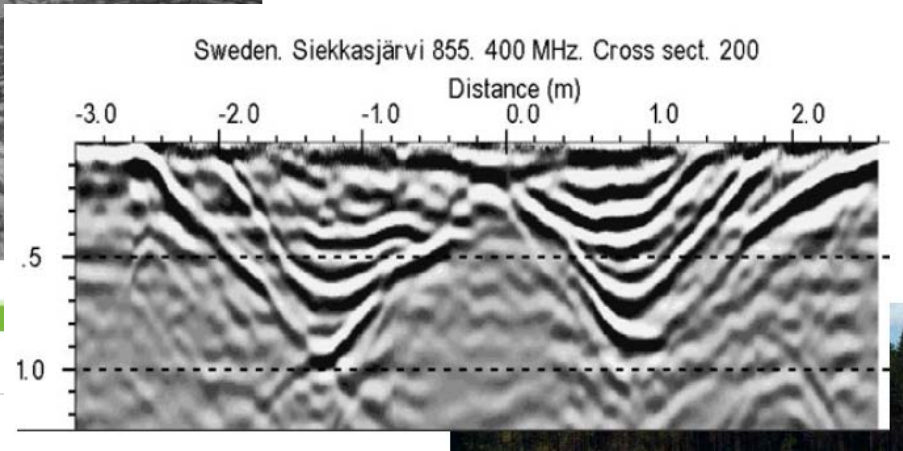




Mode 2 Rutting Problems







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Faktorer som påvirker bæreevnen

Effekt av økt antall aksler

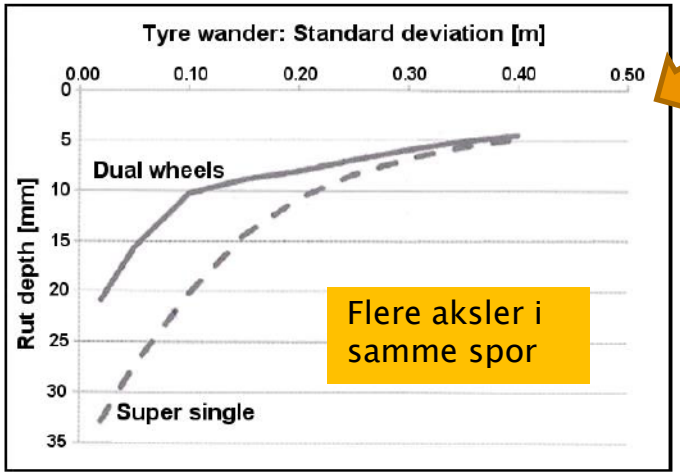
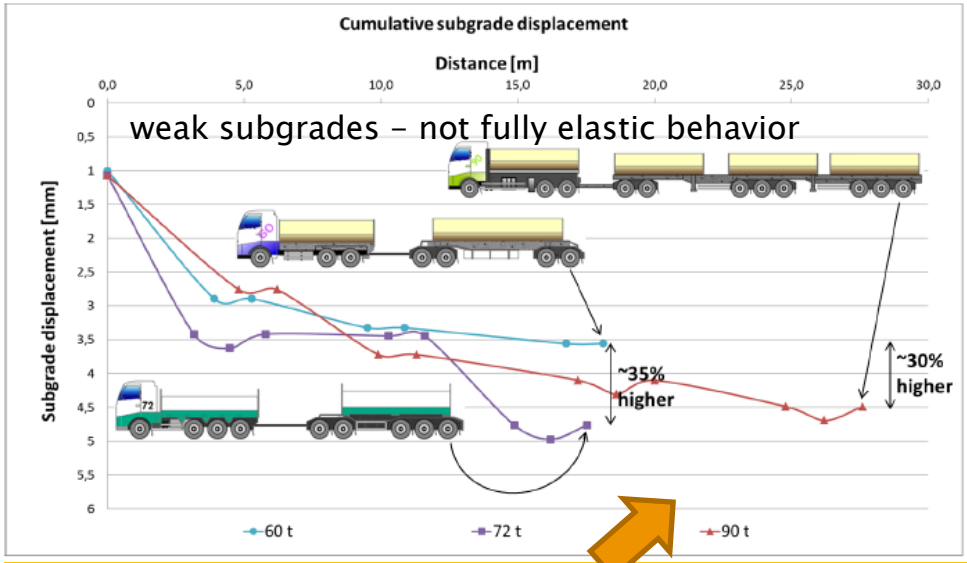


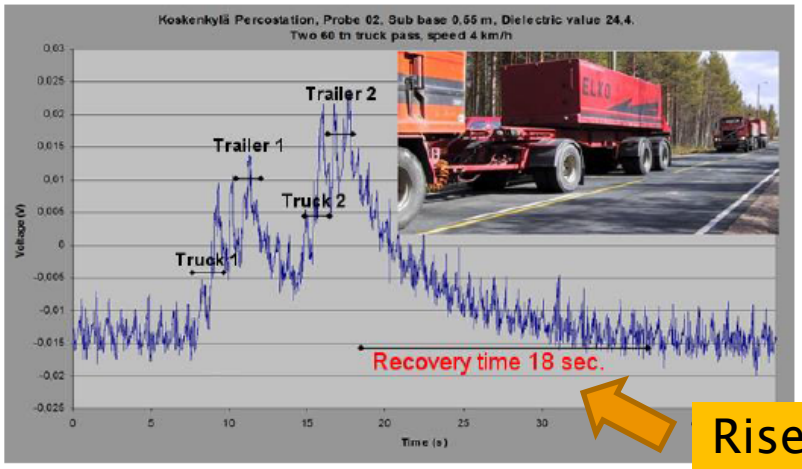
Figure 3: Effect of tyre wander on pavement rutting (Said, 2013)

Potential for up to 6 times higher rutting

~~Økt totaltvekt har ingen betydning så lenge lasten fordeles over flere aksler?~~



72/90 t – cumulative displacement 30 – 35 % higher than 60 t – rise in porewater pressure in the subgrade



Rise in the subbase layer porewater pressure

Figure 7: An example from Koskenkylä Percostation from Finland, where two trucks are driving close to each other. Due to the several consecutive axles, the structure does not have a sufficiently long enough time to recover and this leads the pore water pressure to rise higher and higher.

Effekt av aksellast, dekktype og ringtrykk (Eksempel fra Road 659 Finland)

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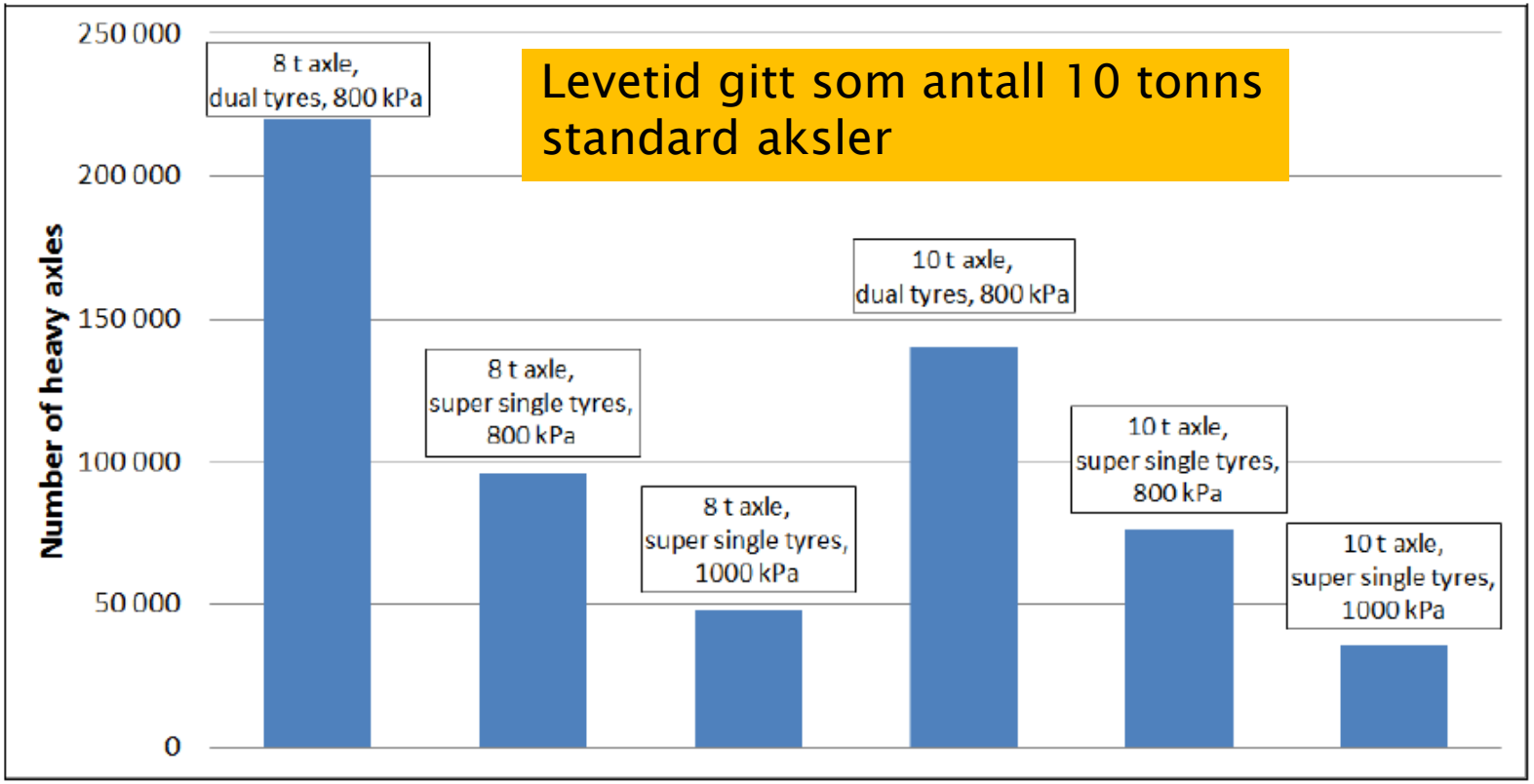

Pavement thickness is 84 mm and pavement modulus 1850 MPa, base course 110 mm / 260 MPa, other structures 860 mm / 100 MPa and subgrade modulus 25 MPa.
Kritisk faktor: Tøyning i underkant asfalt

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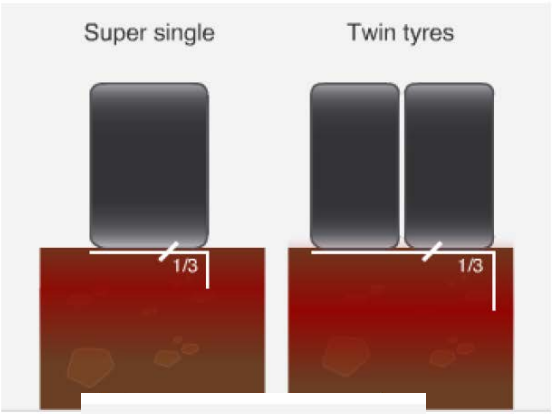
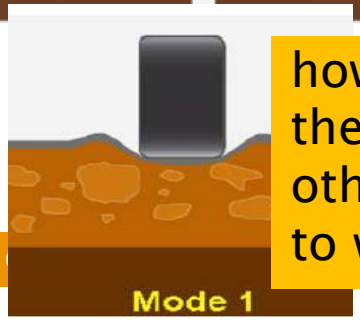
Faktorer som påvirker bæreevnen

Effekt av dekktype

- Bredden på dekket har størst betydning og påvirker type 1 spor mest
- Vertikal spenning fra super singel signifikant større enn fra tvillinghjul.
- Med tynne asfaltlag (<10 cm) kan årlig sporutviklijng være 8-18 ganger høyere med super singel med tvillinghjul. (EU's COST 334)

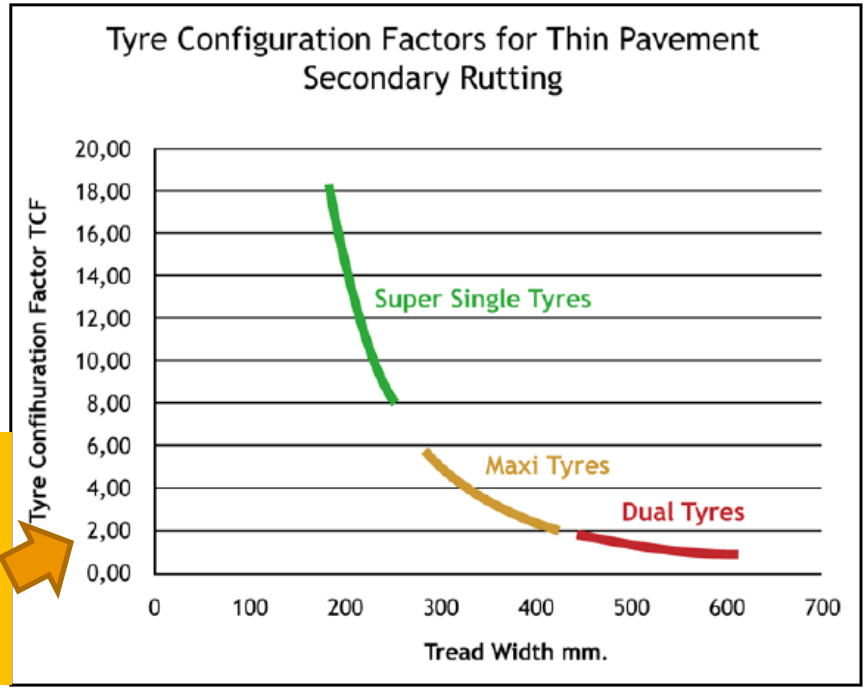




how many times higher the rutting speed is with other tyre types compared to wide dual tyres

Dual

Maxi



Faktorer som påvirker bæreevnen

Verified by field measurements performed in two locations in Finland (Saarenketo et al. 2014)

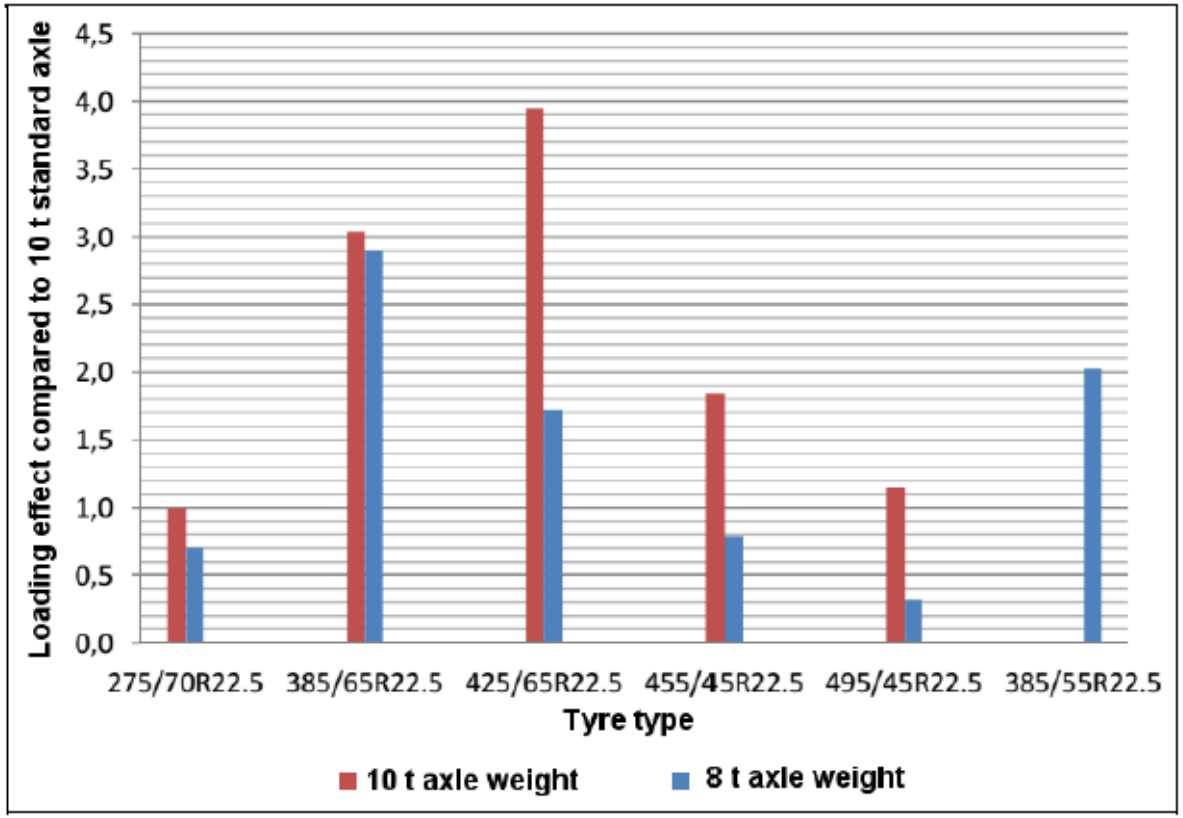


Figure 12: The loading effect of different tyre type and axle weight configurations compared to standard axle (dual tyres 275/70R22.5, axle weight 10 tonnes). The bar on the right represents the front tyre of the truck with a 7.4 tonnes axle weight. (Haakana 2014)

Faktorer som påvirker bæreevnen

Effekt av ringtrykk

- Har størst effekt på krakelering (utmatting) og type 1 spor

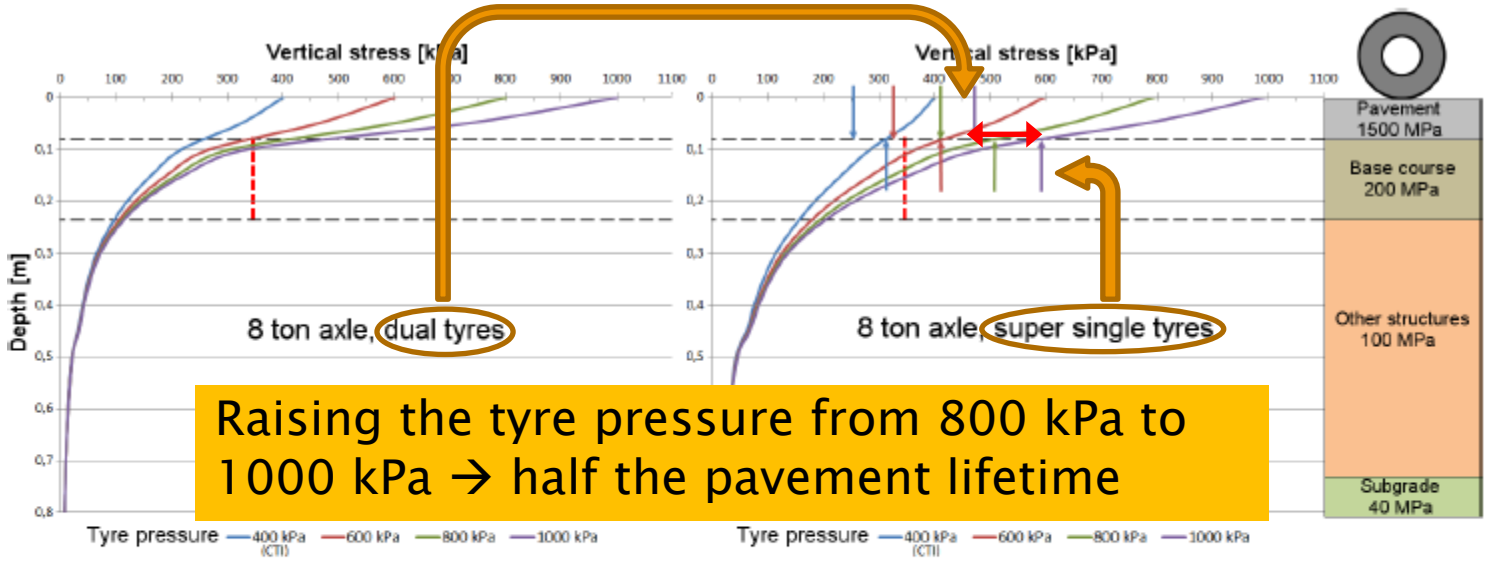


Figure 13: An example of the effect of tyre type and tyre pressure on the vertical stresses induced by an 8 tonnes single axle load on a typical low volume road. The pavement thickness is 80 mm. On the left a case with dual tyres is presented, and on the right with super single tyres. On the right the upper arrows present the stress at the bottom of pavement with different tyre pressures and with dual tyres, and the lower arrows present the corresponding values with super single tyres. The red vertical dashed line shows the stress value 350 kPa, which is often considered as critical stress limit.

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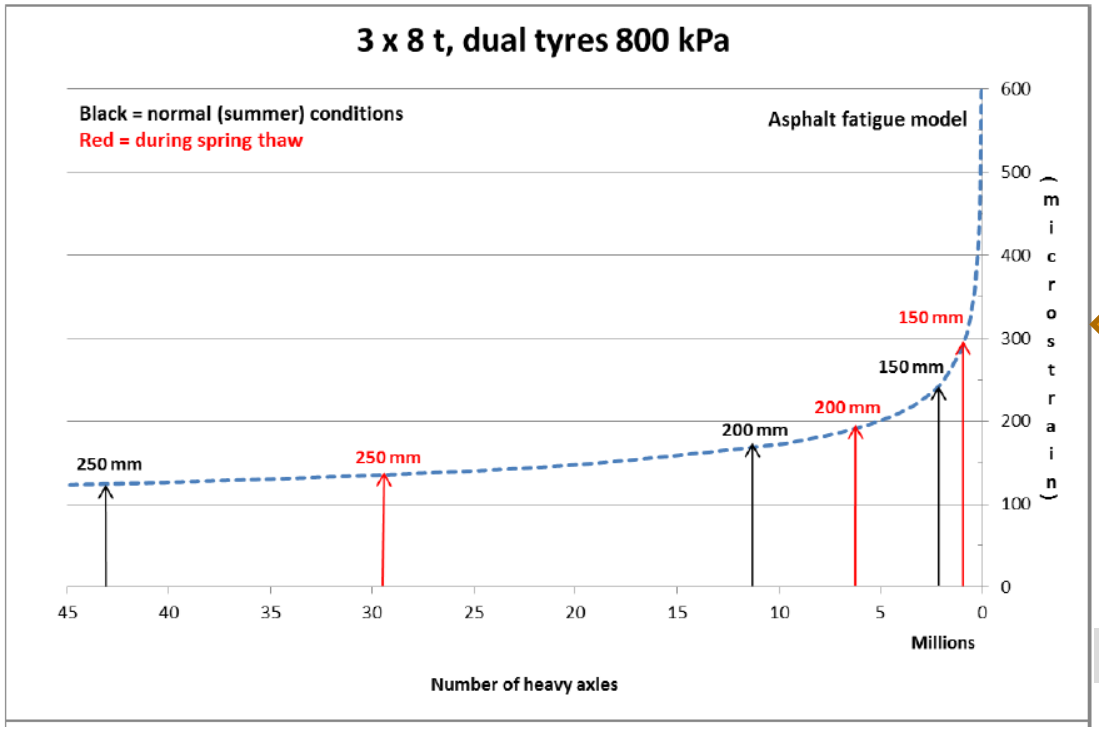
Faktorer som påvirker bæreevnen

Vegkonstruksjonen

- Kritiske faktorer for utmatting og type 1 spor:
  - Asfalttykkelse
  - Kvaliteten på eventuelle grusbærelag
- Kritiske faktorer for type 2 spor:
  - Total tykkelse og stivhet på hele konstruksjonen



Example of the effect of pavement thickness on ASPHALT PAVEMENT fatigue and lifetime (number of heavy axles) during summer conditions and during spring thaw period based on BISAR calculations.

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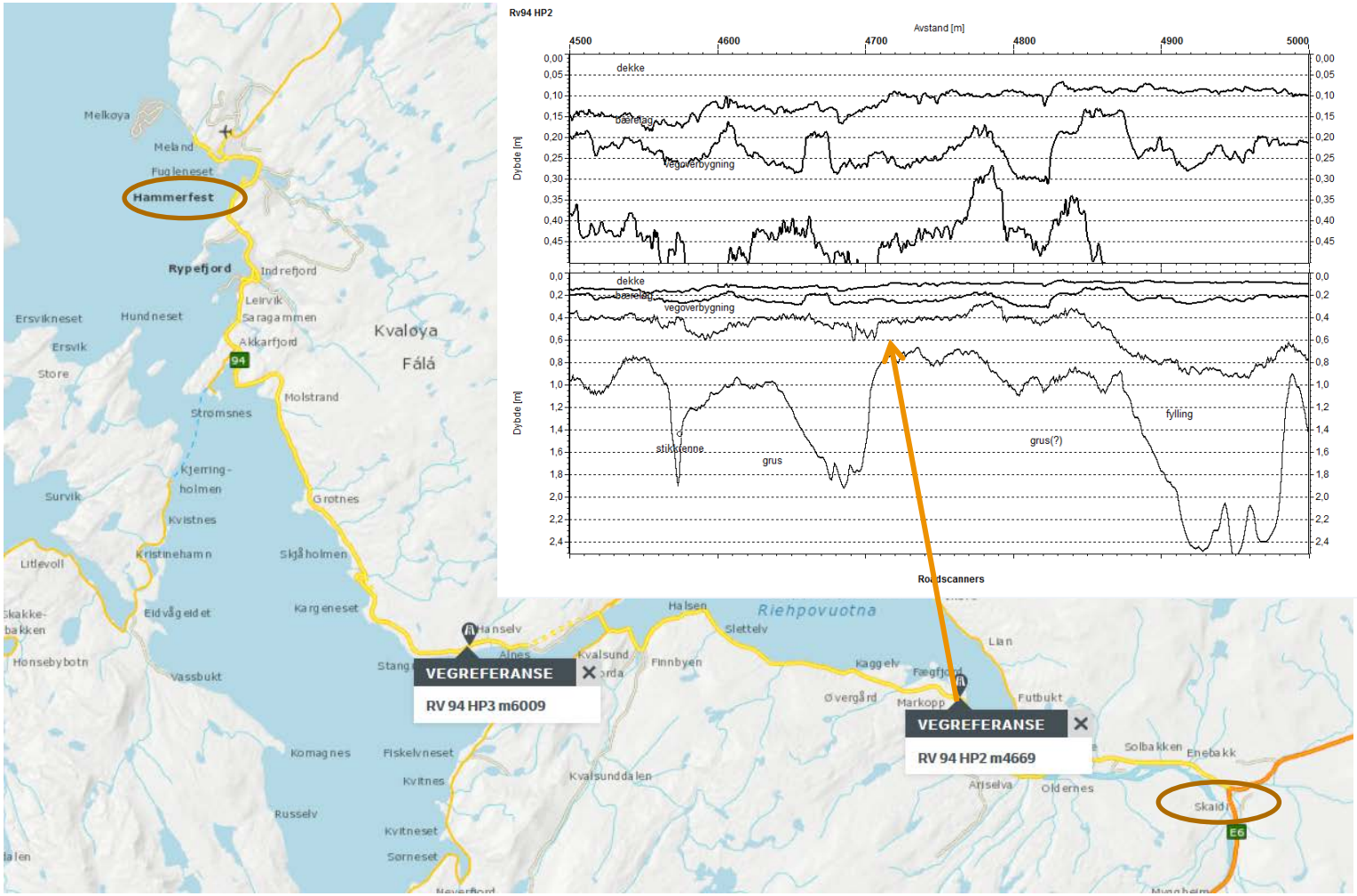
Beregningseksempel

Rv94 – Finnmark



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Beregningseksempel

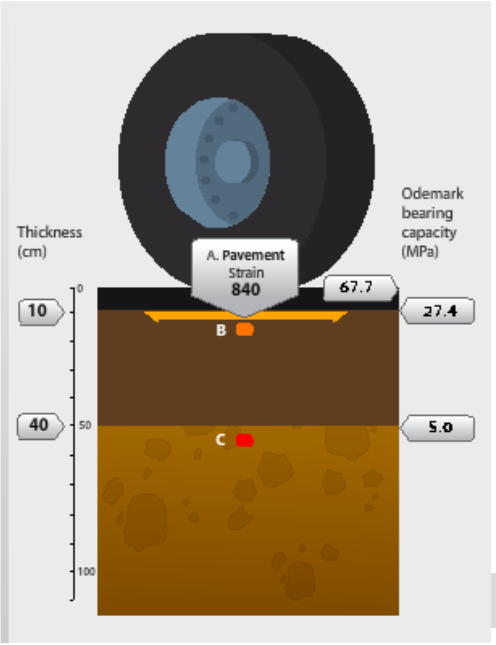
Rv94 – Finnmark

Basert på georadar og fallodd

Table 3: Properties of the Norwegian example structures

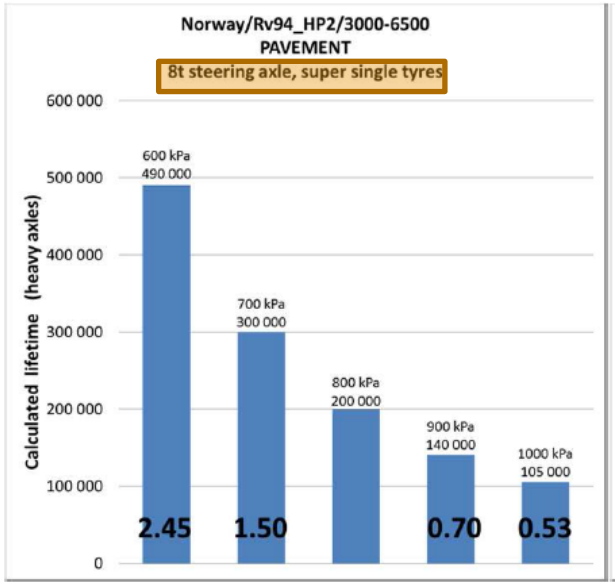
Road / distance interval	Pavement		Base course		Other structures		Subgrade
	thickness [mm]	modulus [MPa]	thickness [mm]	modulus [MPa]	thickness [mm]	modulus [MPa]	modulus [MPa]
Rv94_HP2 / 3000 – 6500	106	1690	110	278	511	146	50
Rv94_HP3 / 4100 – 5800	117	1840	107	177	589	94	33
Rv94_HP3 / 8800 – 9450	118	1920	71	222	604	114	25

- Effekten av ringtrykk og dekktype evaluert separat for bundne lag (tøyning), ubundne lag (deformasjon) og undergrunn (deformasjon).
- Resilientmodul og bruddgrensekriterier er hentet fra finsk design standard.
- Forskjellen mellom punkter mer interresant enn absoluttverdier.

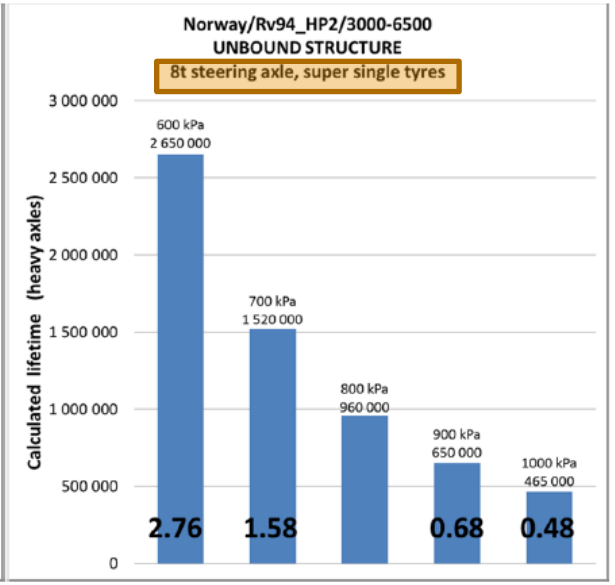


Norway: Effect of Tyre Pressure to Pavement Structure Lifetime Rv 94

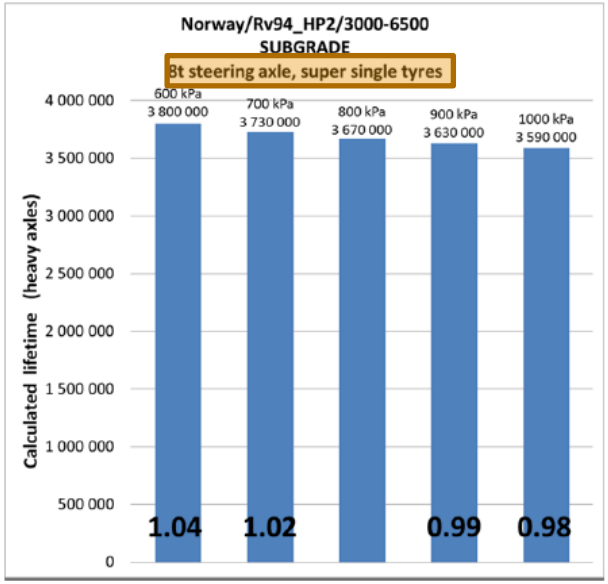
Pavement



Unbound Base



Subgrade

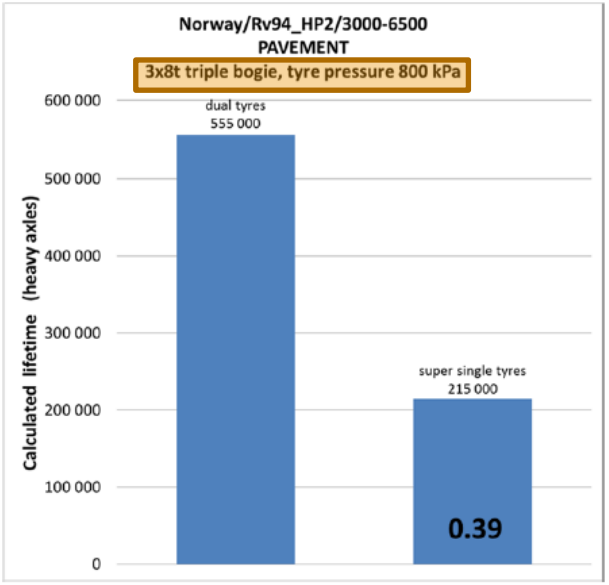


Ringtrykk har stor påvirkning på dekke og bærelag

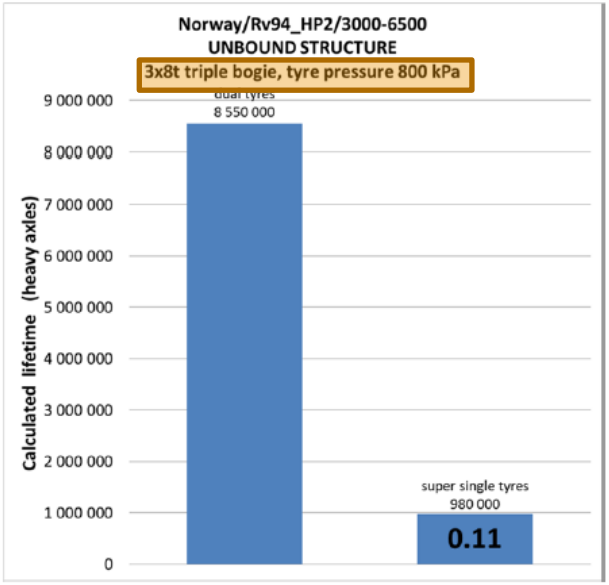
Pavement	106 mm	1700 MPa
Base	110 mm	280 MPa
Other structures	510 mm	150 Mpa
Subgrade		50 MPa

Norway: Effect of Tyre Type to Pavement Structure Lifetime Rv 94

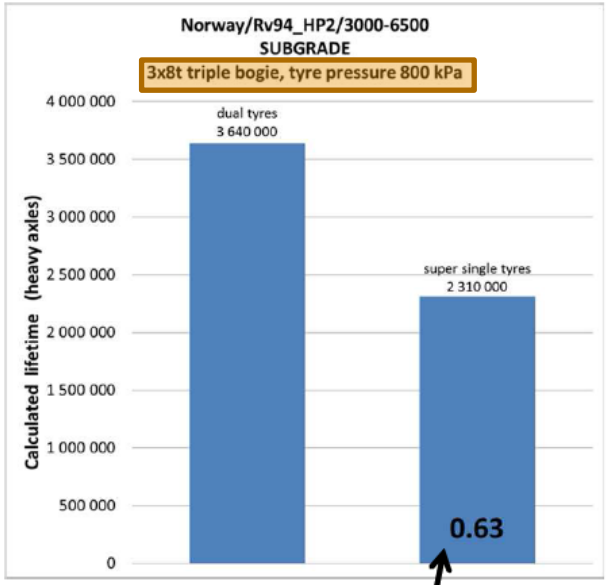
Pavement



Unbound Base



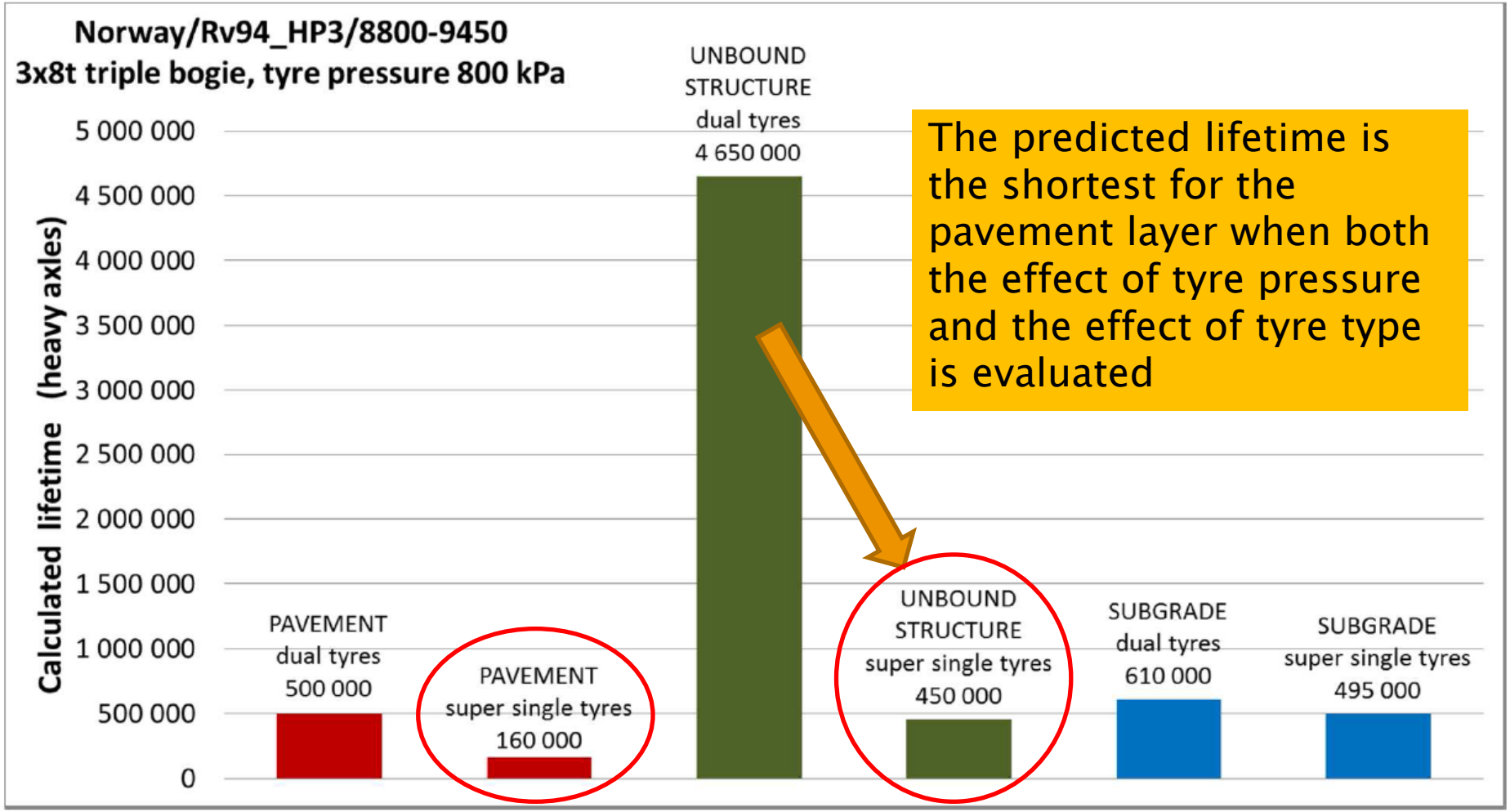
Subgrade



Pavement	106 mm	1700 MPa
Base	110 mm	280 MPa
Other structures	510 mm	150 Mpa
Subgrade		50 MPa

This ratio is most likely even smaller (Finnish field tests)

”Weakest link” Calculations, Norway



Statens vegvesen

Kort oppsummert

*"…the most **critical issue** for Norway in the future will be…*

the increased pavement rutting (fatigue) due to the use of super single tyres…

…even though truck weights and axle weights will remain unchanged"

Statens vegvesen

Anbefalinger

- *"This report shows that **increasing total weights on the trucks that are forced to use dual tyres** can be beneficial for countries with thin pavements on their road networks."*

- *"One of the best methods to **improve the load bearing** capacity of a pavement structure is to use a **thicker pavement**. However, before adding any new pavement layers, **the road drainage should be improved**. "*

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Takk for oppmerksomheten!

- Rapporten kan lastes ned herfra:

http://www.roadex.org/services/knowledge-center/publications/69-2/