

Advanced Design Methods or Rules of Thumb; does it matter?

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Goals for pavement design (new roads)

- Low life cycle costs
 - For road owner
 - For users
- Tempting: Low investment costs
- Very much to gain with increased pavement life
- Problems in deep layers is very expensive to correct
- Normally new roads are build on the solid side
 - This is good !!

Goals for pavement design (rehabilitation)

- Low life cycle costs
 - For road owner
 - For users
- Tempting: Low investments cost (more km with black surface)
- Very much to gain with increased pavement life
- Problems in deep layer are often not considered
- Normal rehabilitation is not given much consideration
 - Not so good

Norwegian empirical design system

- Catalogue system
- Developed around 1960, only minor changes later
- Simple system
 - Avoid totally wrong design
 - Economical balance between pavement life and construction cost
- Design level two allows to adjust for laboratory determined material behaviour

H/S/A

DIMENSJONERINGSTABELL FOR HOVED-, SAMLE- OG ADKOMSTVEGER (lagtykkelser i cm)

DEKKE ⁸⁾

TRAFIKKGRUPPE
(Antall ekvivalente 10 t aksler pr. felt i dimensjoneringsperioden, N, mill.)

A (< 0,5)	B (0,5 - 1)	C (1 - 2)	D (2 - 3,5)	E (3,5 - 10)	F (> 10)
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Dekketype og tykkelse velges på grunnlag av ÅDT i åpningsåret,
se kap. 512.12 / figur 512.2

BÆRELAG

Typiske materialer:

Ag
Ag over Ap
Ag over Pp
Ag over Fk
Ag over Gja ⁴⁾
Sg, Eg, Gja over Fk ⁴⁾
Fk

Tykkelse (cm), bærelag

9	10	11	12	13	14
5 over 6	5 over 8	5 over 9	5 over 10	6 over 10	7 over 10
4 over 10	5 over 10	6 over 10	7 over 10	8 over 10	9 over 10
5 over 10	6 over 10	7 over 10	7 over 11	-	-
6 over 5	6 over 7	6 over 9	6 over 10	-	-
6 over 12	8 over 12	10 over 12	-	-	-
20	20	-	-	-	-

FORSTERKNINGSLAG PÅ

Materialtype i grunnen:

Bæreevne
gruppe

Tykkelse (cm), forsterkningslag med lastfordelingskoeffisient $a = 1,0$
For stamveger økes tykkelsen med 10 cm i forhold til tabellverdiene ⁷⁾

Fjellskjæring, steinfylling, T1	1	20 ⁹⁾	20 ⁹⁾	20 ⁹⁾	20 ⁹⁾	20 ⁹⁾	20 ⁹⁾
Grus $C_u \geq 15$, T1	2	20 ⁹⁾	20 ⁹⁾	20 ⁹⁾	20 ⁹⁾	20	20
Grus, $C_u < 15$, T1							
Sand $C_u \geq 15$, T1							
Fjellskjæring, steinfylling T2	3	20	20	20	30	40	40
Sand $C_u < 15$, T1 ⁵⁾							
Grus, sand, morene, T2	4	30	30	40	50	60	70
Grus, sand, morene, T3	5	40	50	60	60	70	80
Silt, leire, T4, $s_u \geq 50$ kPa	6	50	60	60	70	80	90
Silt, leire, T4, s_u 37,5-50 kPa	6	50	60	70	70	80	90
Silt, leire, T4, s_u 25-37,5 kPa	6	50+20 ¹⁾	60+10 ¹⁾	70	70	80	90
Silt, leire, T4, $s_u < 25$ kPa ²⁾	6	50+50 ¹⁾	60+40 ¹⁾	70+30 ¹⁾	70+30 ¹⁾	80+20 ¹⁾	90+10 ¹⁾

Total disasters are not common

- And normally not caused by wrong design !!



Advantages

- Easy to perform
- Avoid wrong design
- Based on experience and long term experience

Disadvantages

- Climatic differences
- New materials
- Possibility to adapt to changes
- Special conditions
- Rehabilitation of existing roads

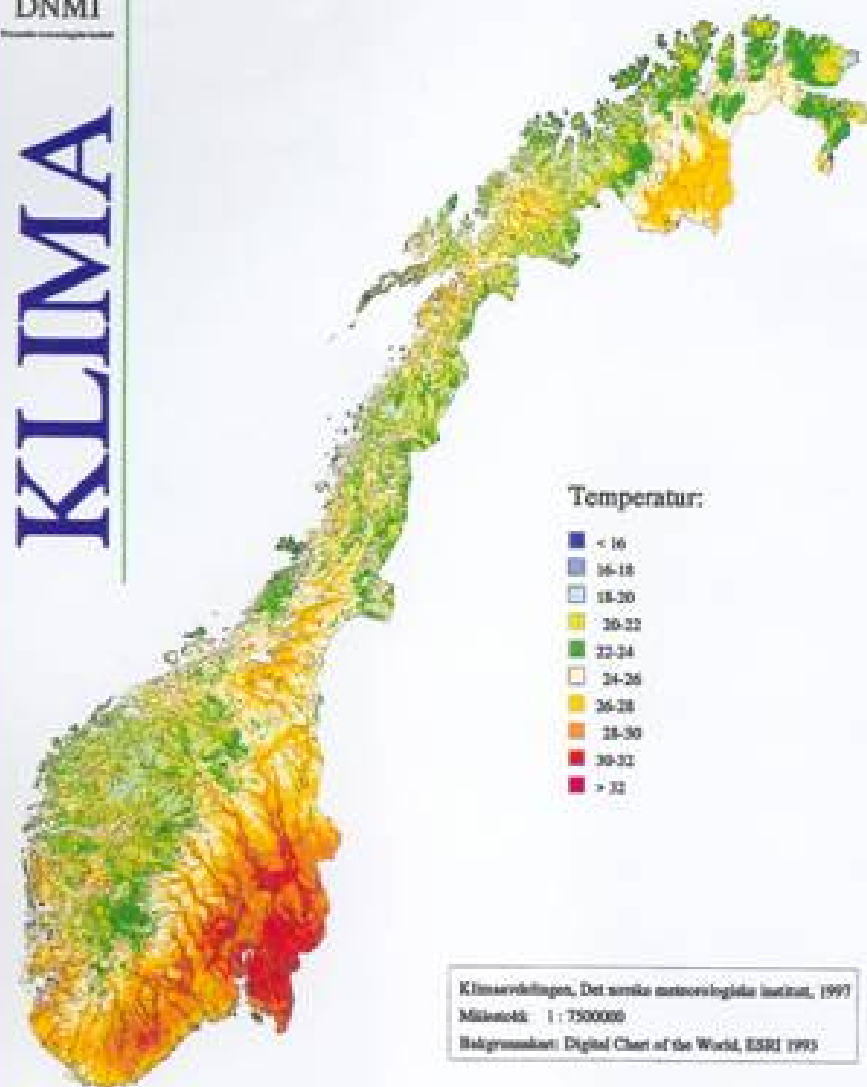


DNMI

KLIMA

TEMPERATURKART

Høyeste lufttemperatur (7 døgn, $T_{max,98\%}$)

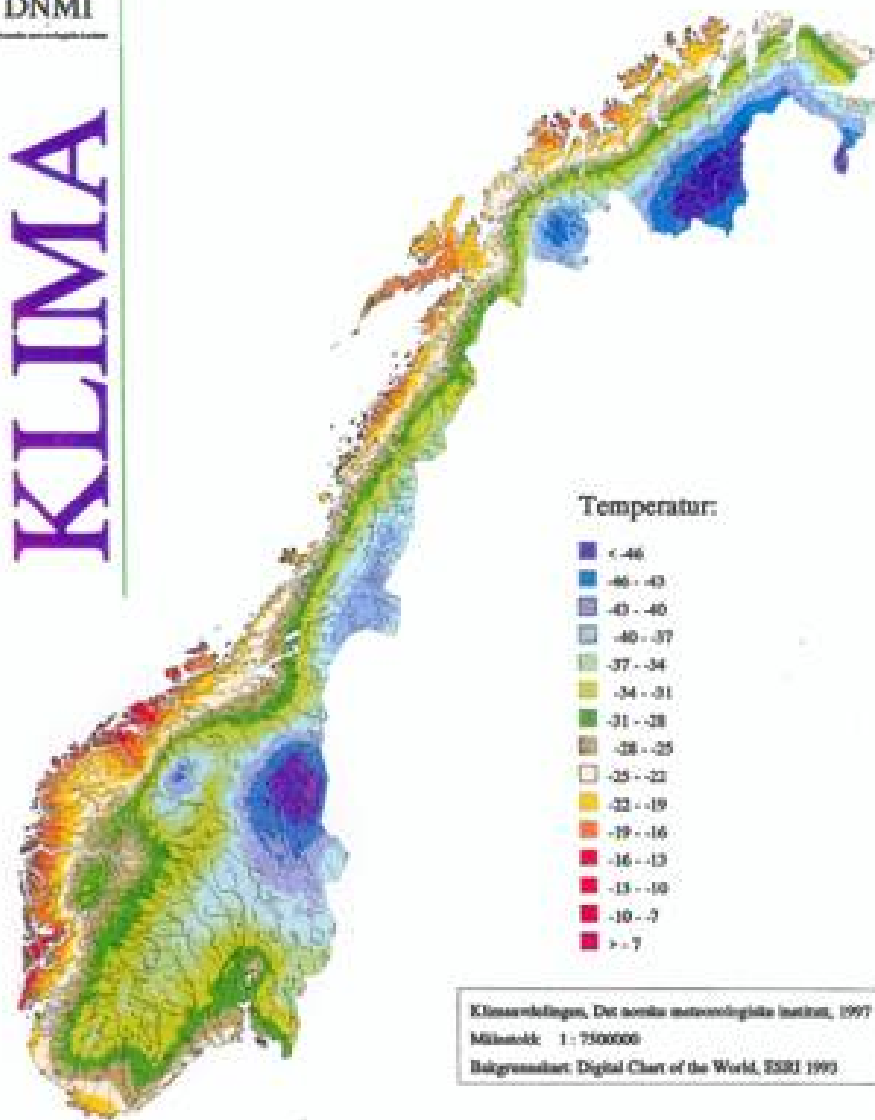


DNMI

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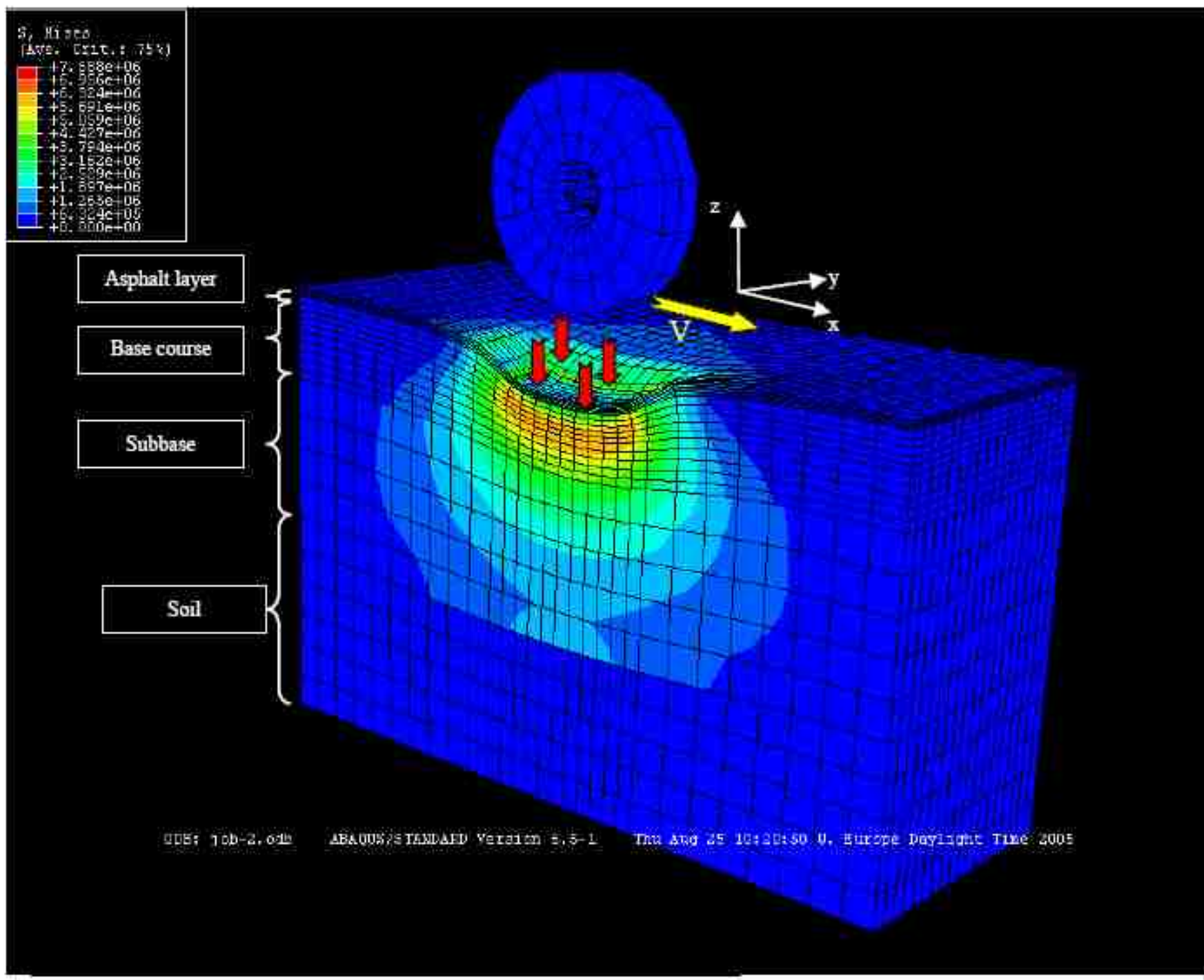
TEMPERATURKART

Laveste lufttemperatur ($T_{min,98\%}$)



Advanced methods

- Performance prediction models
- Requirments
- Life Cycle Cost Analyses
- Pavement design system



Requirements to system

- Reliable
- Fast/easy to use and understand
- Use available data for input (no extra tests)
- Take everything into account
 - Traffic (including future)
 - Materials (relative to other parameters)
 - Climatic differences (including future change)
 - etc
- Cost near to nothing to develop
- And be ready tomorrow (or yesterday)

Reality (State of the art)

- Uncertainties in every part
- Will be complicated (Finite Element Method)
- Will require extra data
 - We do not know the traffic (good enough)
 - Material parameters must be determined in laboratory
 - Climate change is not easy to predict
- Will be expensive to develop
- Will take some time to develop

Why should we consider this anyway

- Recruitment of clever young people
- For rehabilitation better results should be possible
- Climate and traffic changes might make it necessary
- Small improvement in pavement lifetime means huge savings

Conclusion

- Yes ! We should develop an advanced pavement design system
- However, I could not be considered impartial in the question.

Thank you !