

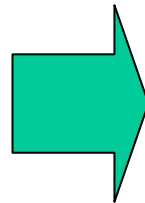


The Danish Pavement Design Guide

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7.10.03 Befæstelser
Kørebane
Vejregler for dimensionering af befæstelser

7.30.01 Befæstelser
Bærelag
Vejregler for prioritering og dimensionering af forstærkningsbelægninger



Input parametre

Materiale	Tykkelse	E-værdi	
Nyt lag	0	0	Gem
35 AB 70/100 GAB II 40/60	143	3230	Start
SG	220	300	Slut
Bundsikring	337	100	Analytisk
Frosttvivlsom		40	Optimer
Navn	Tung Trafik 85%	Længde	Levetid, år
		30	Standard E
Hjul	1		
Antal pr. år	128500		
Vækst, %	0		Total-xls
Min hastighed	60	Max hastighed	60
		Start årstid	5
År i simulering/dimensionering	40	Antal simuleringer	10
			Data-xls
Lag			
			Vis resultater

New Danish design guide

- Modern tool based on sound scientific principles
- Designs for roads at all levels
- Designs in three ways:
 - Pavement catalogue
 - Analytical-empirical method
 - Simulation and optimisation
- Relative importance of road is considered in the design

Pavement design

Design provides:

- Layer thicknesses
- Expected lifetime

Based on:

- Traffic
- Climate
- Natural soils
- Pavement materials
- Failure criteria
- Reliability levels

Design traffic (the easy way)

Class	Trucks/day in both directions	ESALS/day/track	Design traffic ESALS/year
T0*	Only light vehicles	-	-
T1	Less than 1	0.5	75
T2	Up to 75	20	7 300
T3	75 to 150	50	18 300
T4	150 to 600	200	73 000
T5	600 to 1 400	500	180 000
T6	1 400 to 2 000	800	300 000
T7	More than 2 000	1 500	500 000

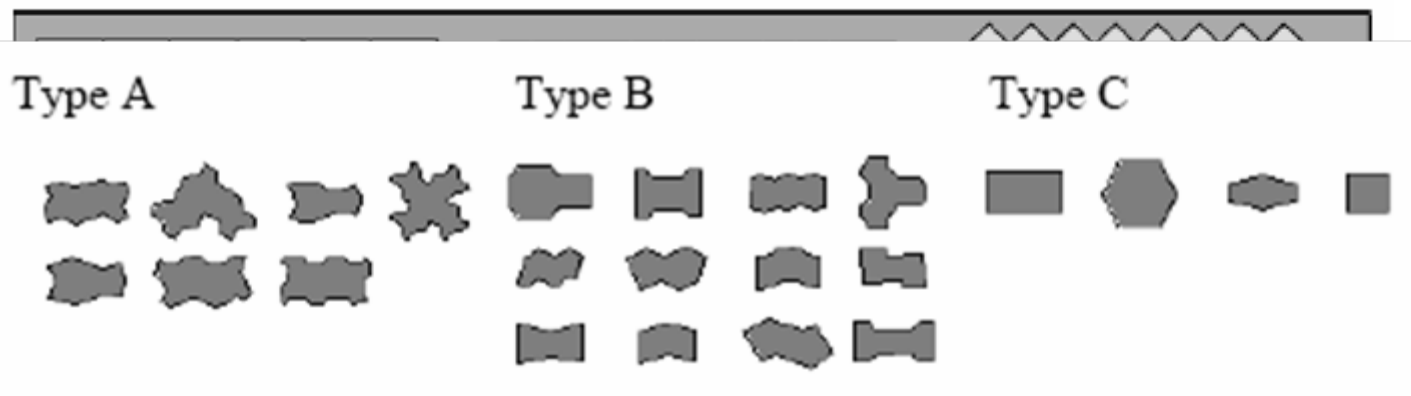
Design traffic (the tough one)

$$ESAL = P \cdot K_F \cdot K_K \cdot K_R \cdot F_{SS} \cdot \Sigma (F_{ESAL} \cdot L)$$

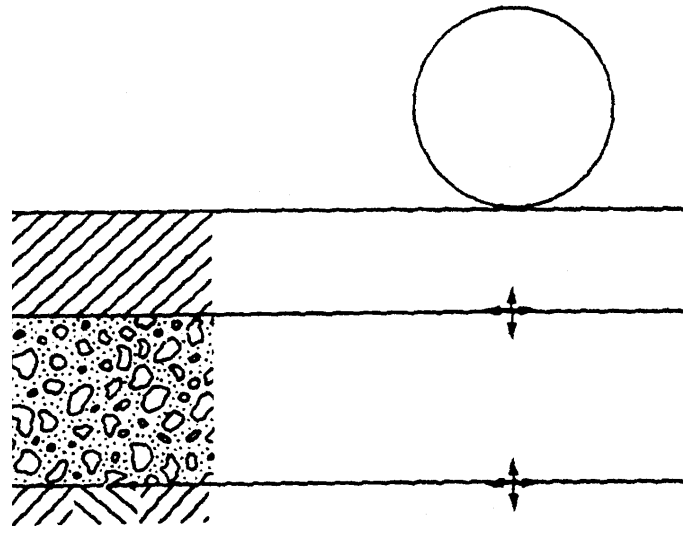
- Increase in traffic volume **P**
- Road width **K_F**
- Channelised traffic **K_K**
- Roundabouts **K_R**
- Road type **F_{SS}**
- Type of vehicle and road location (**F_{ESAL} · L**)

Design by catalogue

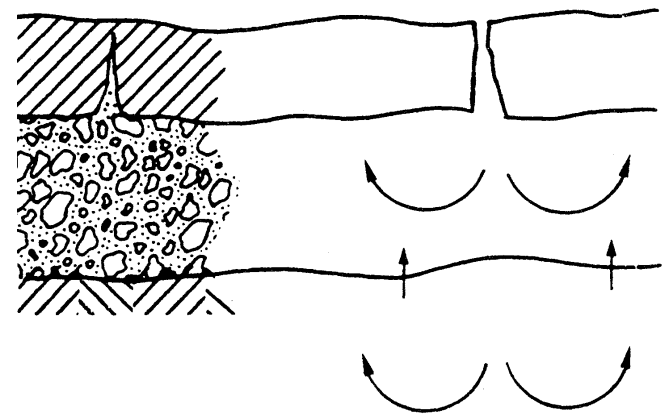
- Simple, empirical design for minor roads
- Often expensive solution
- Flexible pavements
- Concrete paving blocks



Analytical-empirical model



Response model:
analytical



Failure models:
empirical

Failure criteria

- Asphalt: permissible tensile strain at bottom of asphalt layer

$$\varepsilon_h = -0,000250 \cdot \left(N_{\text{Æ}10} / 10^6 \right)^{-0,191}$$

- Cement stabilized gravel: permissible tensile strain at bottom of layer

$$\varepsilon_h = A \cdot \left(N_{\text{Æ}10} / 10^6 \right)^{-0,125}$$

- Unbound materials: permissible compressive stress at top of layer

$$\sigma_z = 0,086 \text{ MPa} \cdot (E/160 \text{ MPa})^{1,06} \cdot \left(N_{\text{Æ}10} / 10^6 \right)^{-0,25}$$

Failure criteria functions

The failure criteria limit

- Cracking in the asphalt layer
- Deterioration of cement stabilized gravel
- Unacceptable rutting/roughness

Material library

Material	E-value (MPa)	Min. thickness (mm)
Cement concrete, non-reinforced	35.000	150
Cement stabilized gravel, intact layer (factory)	7.000-15.000	150
Gravel macadam (SKM)	1.000	70
Singels macadam (SIM)	600	70
Granular base (SG)	300	150
Recycled cement concrete A (KGBA)	400	150
Recycled cement concrete B (KGBB)	300	150
Recycled cement concrete C (KGBC)	200	150
Recycled asphalt (KGA)	300	150
Recycled tile	250	150
Blast furnace slag	70	150
Sandy sub-base (BL)	100	200




Subgrade type determines total pavement thickness

Frost sensitivity	Safe	Questionnable	Sensitive
Material type	Sand and gravel without significant amounts of silt/silty soils.	Moraine clay and clay.	Silt and very silty soils with possible access to water, Slags and fly ash.
Traffic class			
T0, T1	As determined by the M-E analysis	400 mm	500 mm
T2		500 mm	700 mm
T3		600 mm	800 mm
T4, T5, T6, T7		700 mm	900 mm

Special features

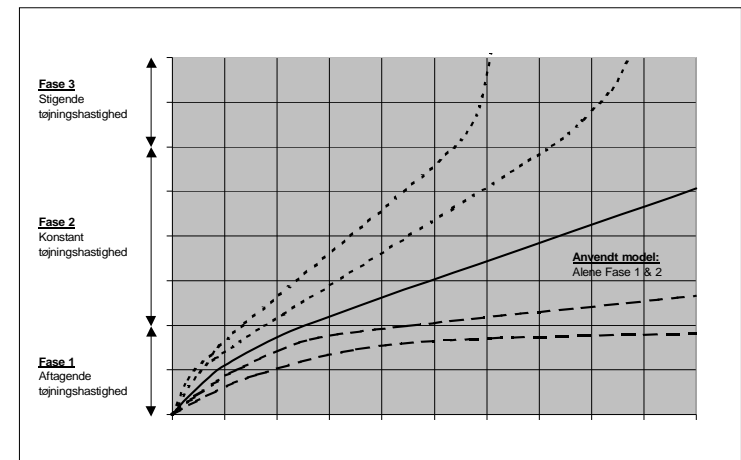
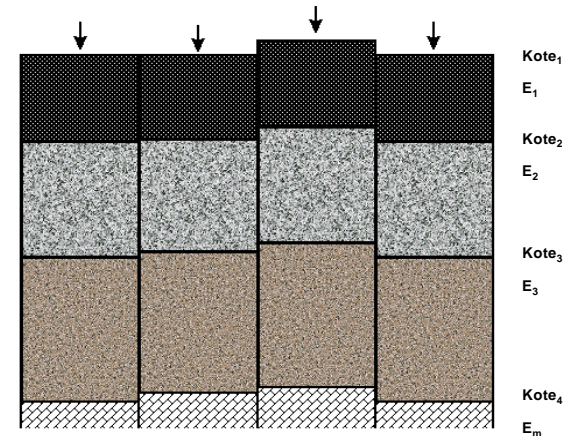
- Adjustment of E-values for asphalt based on driving speed:

$$\frac{E_v}{E_{60}} = \left(\frac{v}{60} \right)^{0.37}$$

	Material	Straight section ($v > 60$ km/h)	Turning lane ($v = 10$ km/h)
	Asphalt surface course	35 mm	35 mm
	Asphalt bound base	108 mm	149 mm
	Granular base	220 mm	190 mm

Design by simulation

- For 300 mm pavement sections:
 - permanent deformation
 - reduction in E-value for asphalt
- Models for:
 - Pavement: longitudinal profile, thicknesses, E-values
 - Load: reaction between wheel and pavement
 - Climate: temperature and E-value
 - Pavement response: stress, strain, deflection
 - Asphalt deterioration
 - Permanent deformation



Failure criteria - simulation

Lifetimes based on four failure criteria:

- Roughness, IRI: 4 m/km
- Rutting, RD: 10 mm
- Average E-value: 67% of E (new asphalt)
- Minimum E-value: 33% of E (new asphalt)

Reliability of design

	Low safety 50% reliability		Standard MMOPP 85% reliability		High safety 95% reliability	
	Thickness of asphalt and granular base layers					
Asphalt	128 mm		143 mm		158 mm	
Gravel	210 mm		220 mm		230 mm	
	Life (year)					
	Average	Std. dev.	Average	Std. dev.	Average	Std. dev.
IRI	15.5	2.5	16.8	2.3	20.9	3.3
Rutting	16.9	1.6	19.0	2.3	22.9	3.1
Cracking	28.6	10.3	32.5	9.8	38.1	4.1
Potholes	21.2	10.2	27.6	10.9	34.7	7.3

Optimization

Determination by simulation of the pavement, which exactly satisfies the specified reliability level

Optimer

	Fra	Til	Trin	Pris/m ³
30 SMA 40/60	<input type="text" value="130"/>	<input type="text" value="145"/>	<input type="text" value="3"/>	<input type="text" value="2000"/>
SG	<input type="text" value="210"/>	<input type="text" value="230"/>	<input type="text" value="4"/>	<input type="text" value="300"/>
Bundsikring	<input type="text" value="300"/>	<input type="text" value="300"/>	<input type="text" value="0"/>	<input type="text" value="200"/>
	IRI	Sporkøring	Gennemsnits E-værdi	Mindste E-værdi
Levetid, år	<input type="text" value="15"/>	<input type="text" value="15"/>	<input type="text" value="15"/>	<input type="text" value="15"/>
Pålidelighed%	<input type="text" value="85"/>	<input type="text" value="85"/>	<input type="text" value="85"/>	<input type="text" value="85"/>
Minimums tykkelse	<input type="text" value="700"/>	<input type="button" value="Reset"/>	<input type="button" value="Start"/>	<input type="button" value="Slut"/>

The new design guide

- Easy accessible software obtainable at at no cost
- Easy to evaluate a high number of alternative design solutions
- Easy to see how pavement material characteristics, layer thicknesses and traffic influence the design
- Complete integration between design of new pavements and overlays
- Varying safety factors makes it possible to design with a view to the relative importance of road sections

The design guide at the web

3. Veje - Microsoft Internet Explorer leveret af Vejdirektoratet

Rediger Vis Foretrukne Funktioner Hjælp

Tilbage Søg Foretrukne

Adresse Gå Hyperlinks

Vejdirektoratet.dk Trafikken.dk om vejsektoren | min vejsektor | sitemap

Vejsektoren.dk

| | | |

[> udskriv](#)

Vejregler

[Forside](#)

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[Vejregler](#)

[0. Generelt](#)

[1. Trafikarealer, land](#)

[2. Trafikarealer, by](#)

[3. Veje](#)

[4. Broer](#)

[5. Færdselsregulering](#)

[6. Udstyr](#)

[7. Auditering](#)

[Udbudsforskrifter](#)

[Om vejregelarbejdet](#)

[Tegn og forkortelser](#)

[Find og bestil](#)

[Nyhedsarkiv](#)

Vejregler

3. Veje

Vejkonstruktioner

(E) 2 Konstruktion og vedligehold af veje og stier, Afvandingskonstruktioner ([PDF](#))
Dimensionering af befæstelser og forstærkningsbelægninger ([PDF](#))
Brugervejledning til MMOPP4 ([PDF](#))
Installationspakken til dimensioneringsprogrammet [MMOPP4](#) (6 Mb)

Vejvedligehold

4 Vedligehold af færdselsarealet ([PDF](#) 4,5 Mb)

5 Vedligehold af det færdselsfrie areal ([PDF](#))

6 Håndbog for drift af veje og stier ([PDF](#) 1,9 Mb)

Søg i Vejregler

[Hjælp til søgning](#)