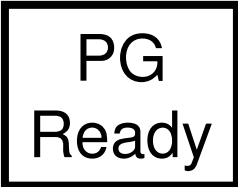


SBUF 11911

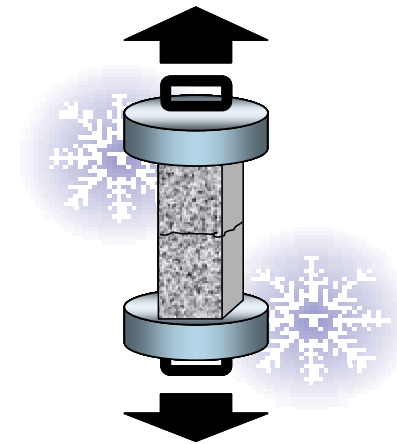
**Kompletterande försök på bindemedel till Etapp 3
– PG-test inkl. lågtemperaturregenskaper**

Niclas Stenberg Krona

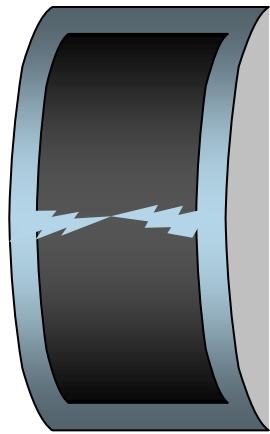
The SKANSKA logo consists of a dark blue square with the word "SKANSKA" written in white, bold, uppercase letters.The PG Ready logo is a black-bordered square containing the text "PG" on the top line and "Ready" on the bottom line, both in a black, sans-serif font.

TSRST – Utfört på VTI

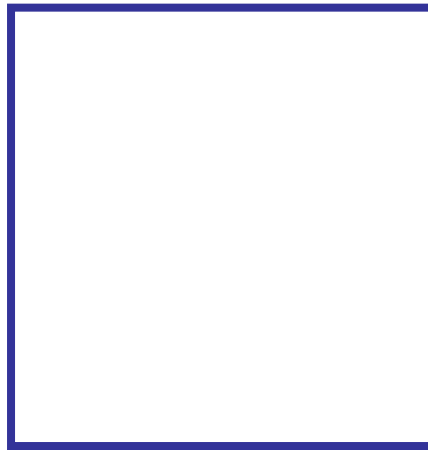
Bindlager	TSRST	
	Brott- temperatur °C	Brott- spänning MPa
Referens	-22,9	3,7
SBS 3% L	-27,4	4,2
SBS 6% L	-	-
PG 64 - 28	-	-
PMB 25	-	-
SBS + EVA	-	-
EVA 6%	-26,7	2,9



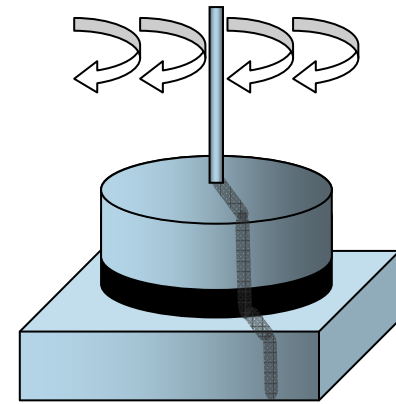
Lågtemperaturtest för bindemedel



Fraass
Brytpunkt



Bending Beam-
Rheometer
&
Direct Tension Test

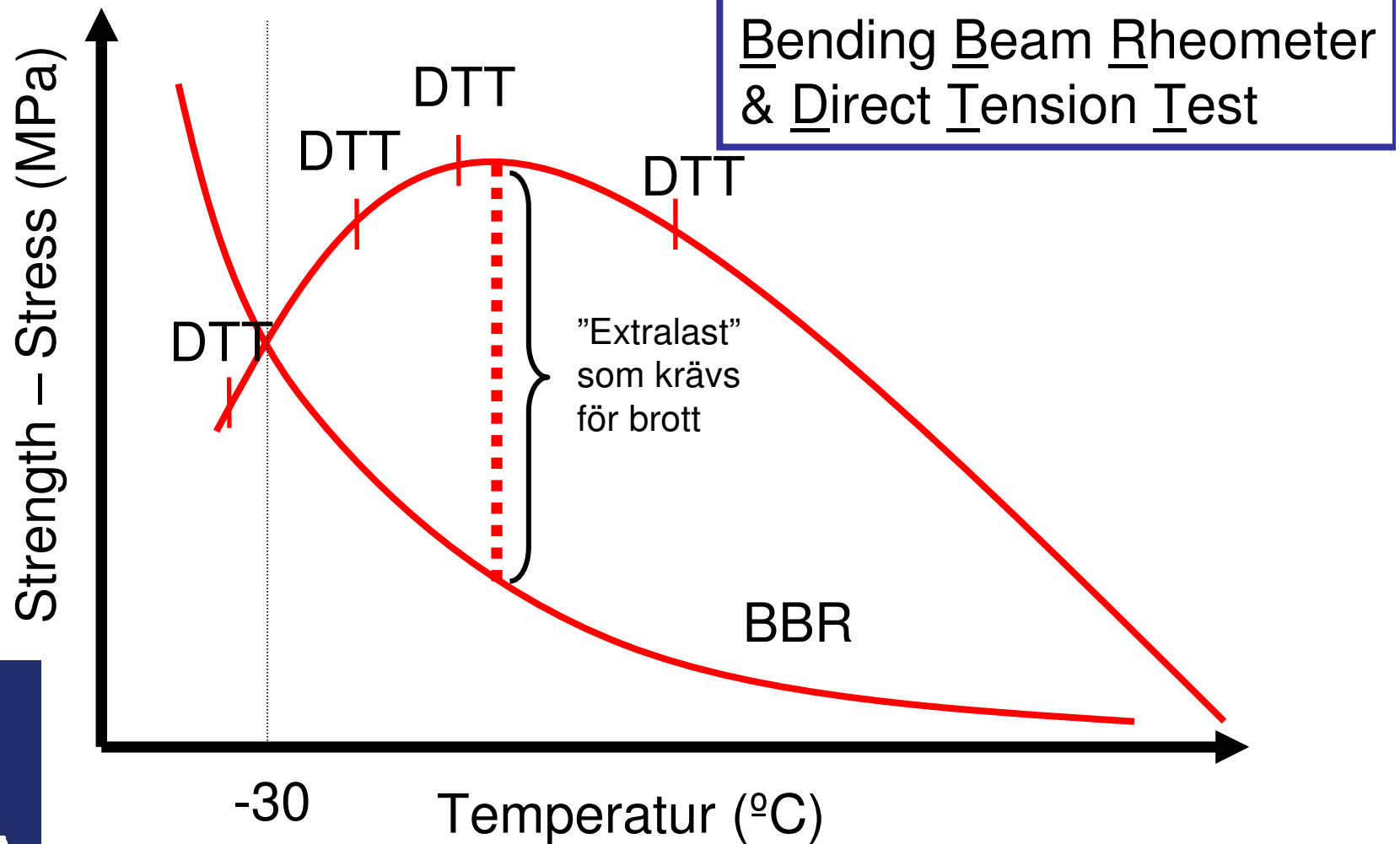


Dynamic Shear
Rheometer

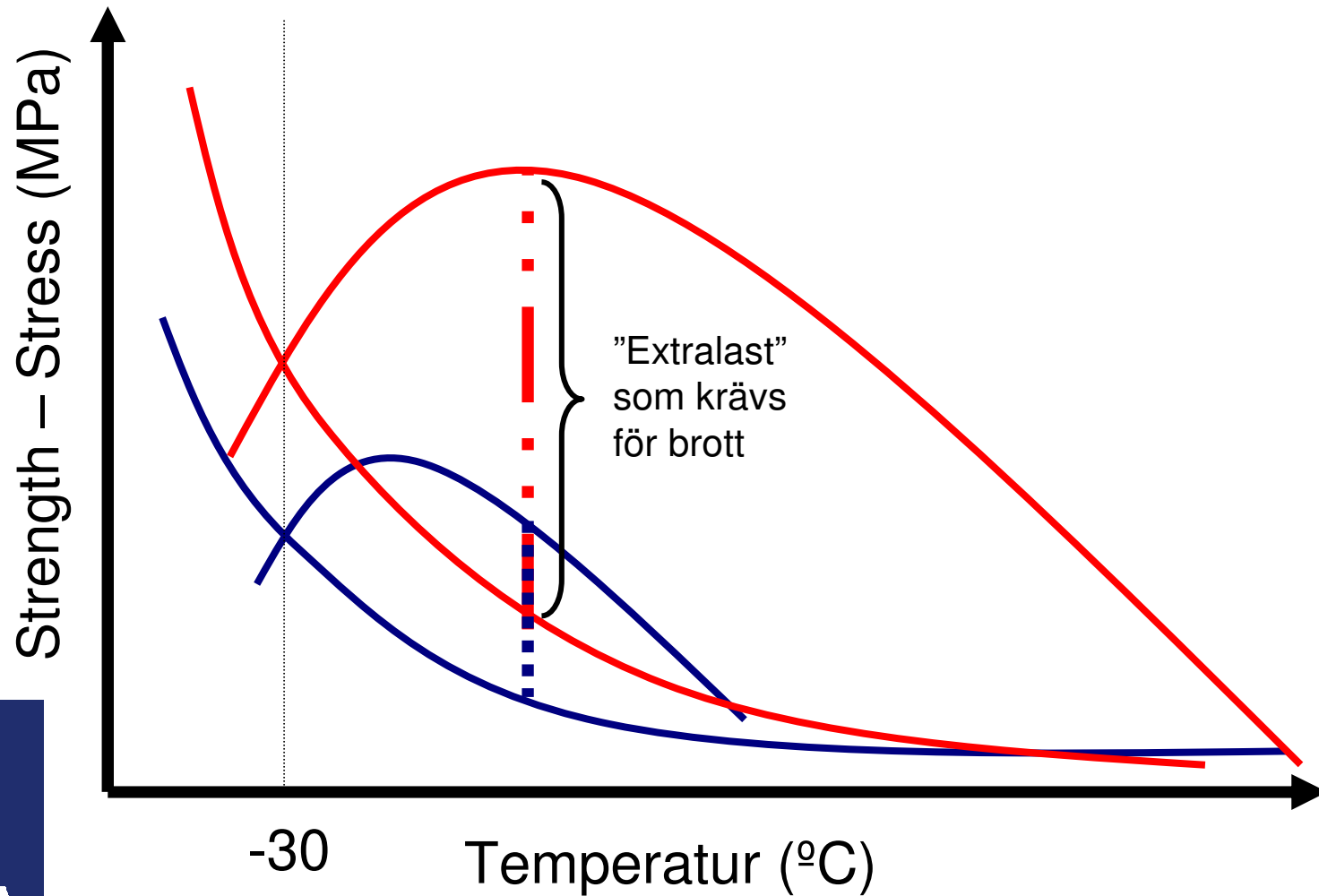
Perormance Grade Lågtemperaturtest BBR och DTT

		Hög Temperatur (°C)				
		52	58	64	70	76
Låg Temperatur (°C)	16	52-16	58-16	64-16	70-16	76-16
	22	52-22	58-22	64-22	70-22	76-22
	28	52-28	58-28	64-28	70-28	76-28
	34	52-34	58-34	64-34	70-34	76-34
	40	52-40	58-40	64-40	70-40	76-40
Bitumen						
Bitumen av hög kvalitet						
PMB						

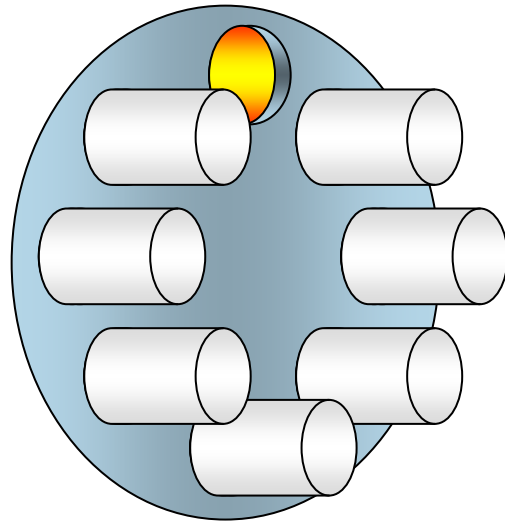
Lågtemperaturbrott Påfrestning vs. Styrka



Samma brottemperatur Olika styrka



Brottemperaturen för PG-klassade bindemedel bestäms efter kort- och långtidsåldring.

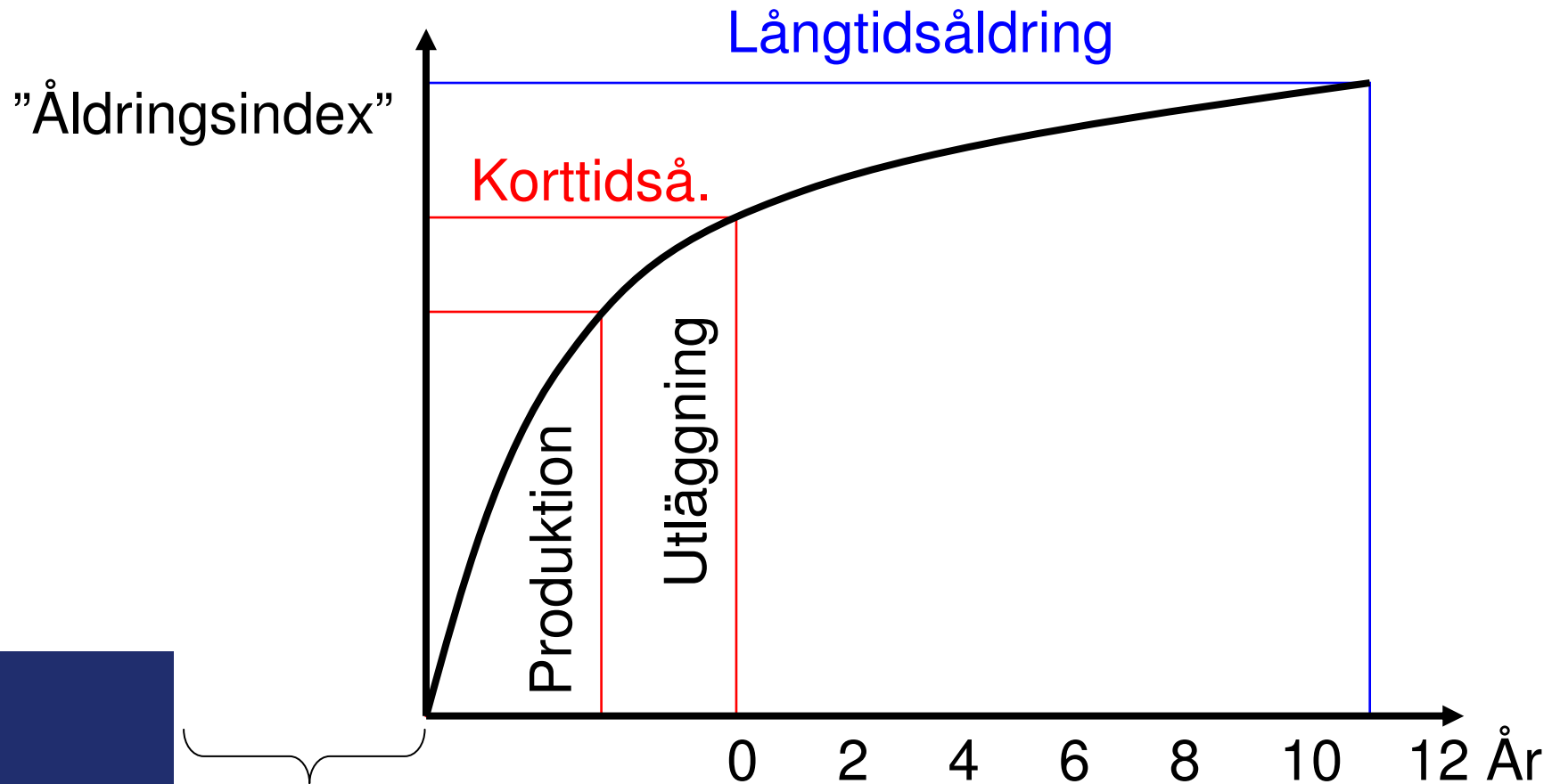


Korttidsåldring:
Rolling Thin Film
Oven Test



Långtidsåldring:
Preassure
Aging Vessel

Bindemedlet åldras före efter och under utförandet.



SKANSKA

?

PG-klassning bindemedlen till Etapp 2 m a p Lågtemperaturregenskaper

- Referens 70/100 : -28°C
- SBS-Linjär 6% (50/100-75): -28°C
- SBS-Radiell 4% (50/100-75): -28°C
- EVA 6% (50/70-53): -24°C

TSRST är mer utslagsgivande?

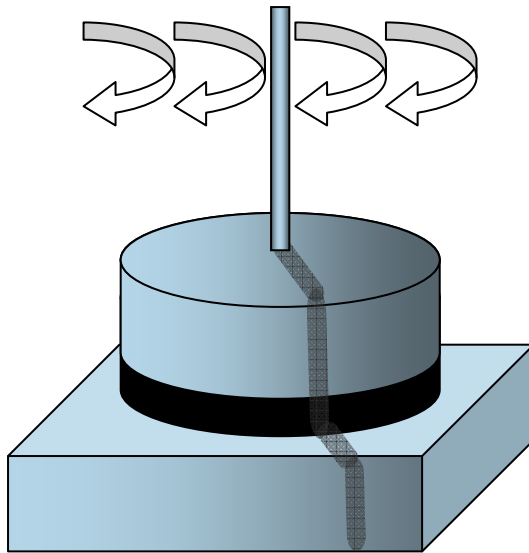
Perormance Grade , Maxtemperaturtest DSR

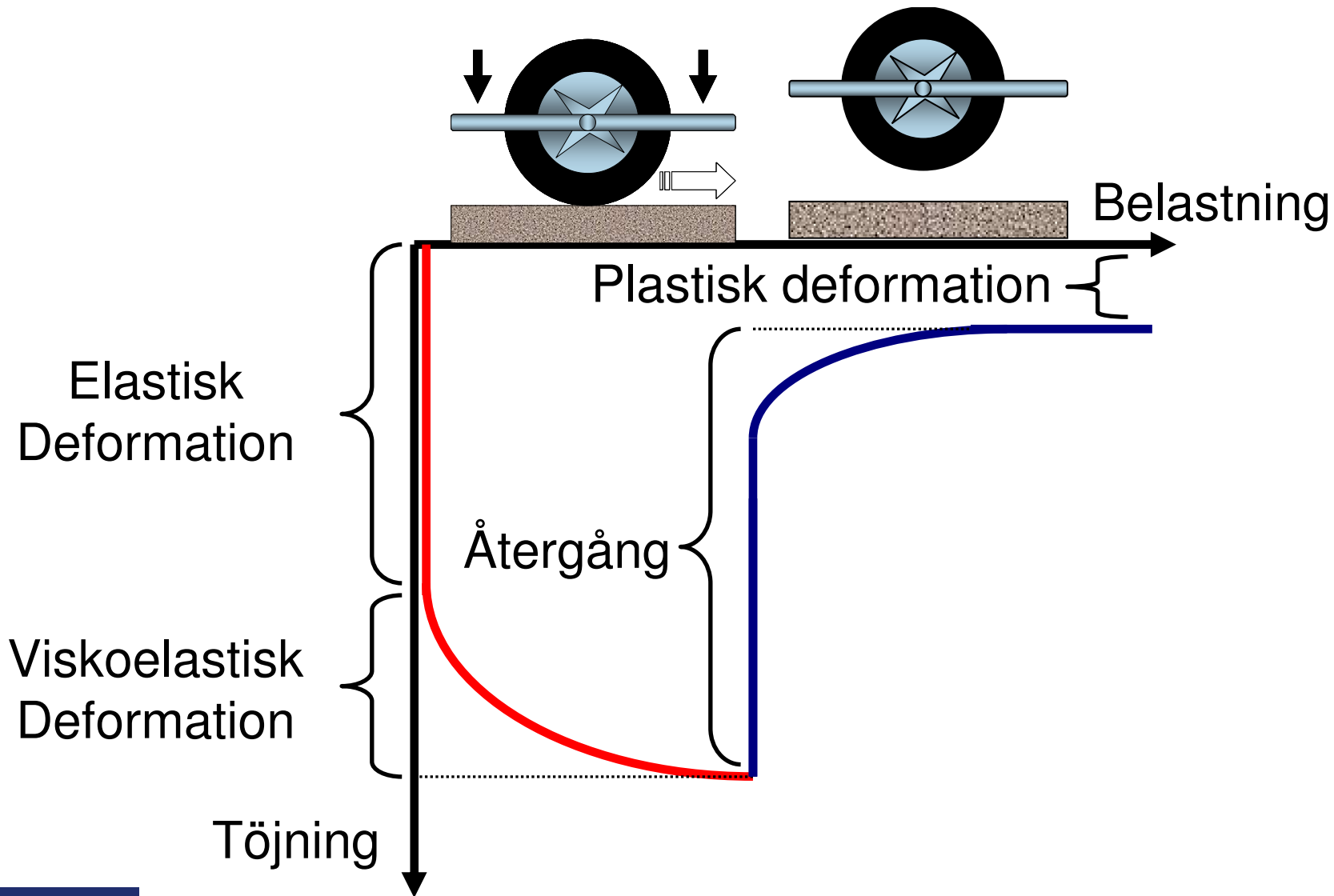
		Hög Temperatur (°C)				
		52	58	64	70	76
Låg Temperatur (°C)	16	52-16	58-16	64-16	70-16	76-16
	22	52-22	58-22	64-22	70-22	76-22
	28	52-28	58-28	64-28	70-28	76-28
	34	52-34	58-34	64-34	70-34	76-34
	40	52-40	58-40	64-40	70-40	76-40

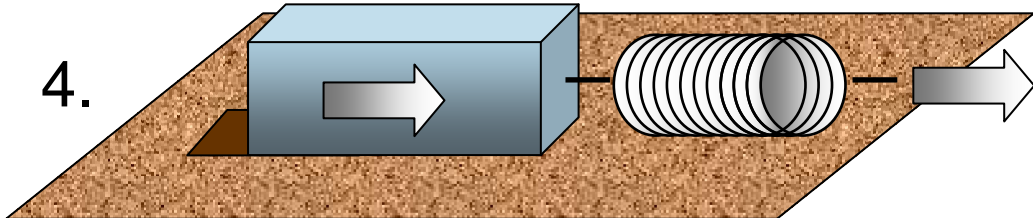
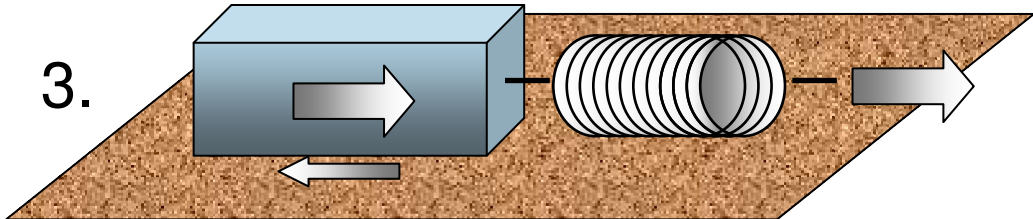
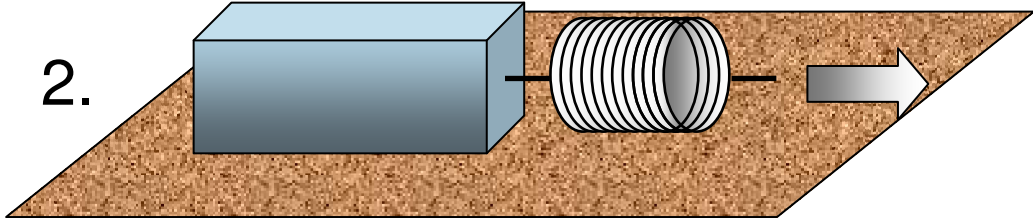
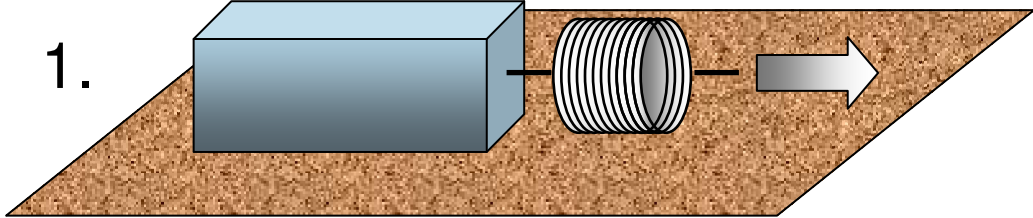
Bitumen
Bitumen av hög kvalitet
PMB

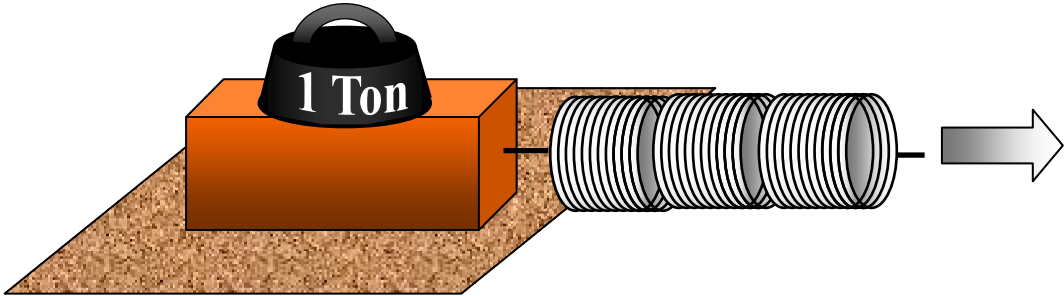


Dynamic Shear Rheometer

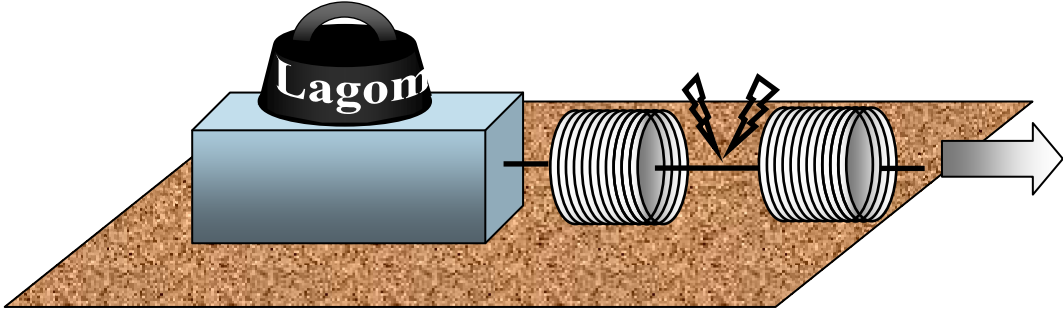




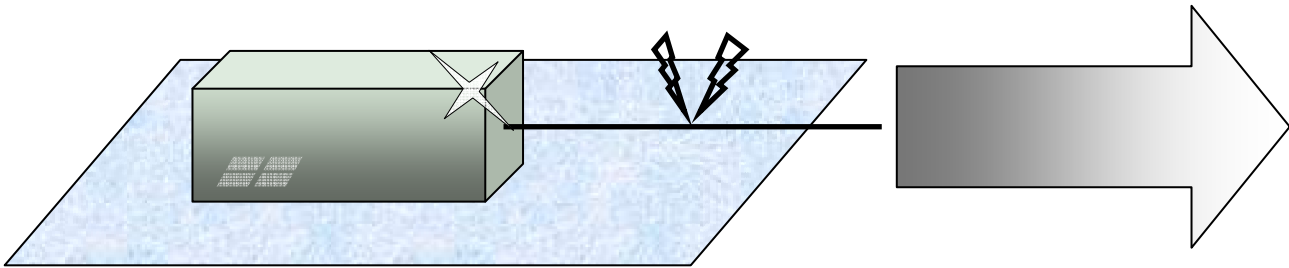




Höga Temperaturer (Deformation)



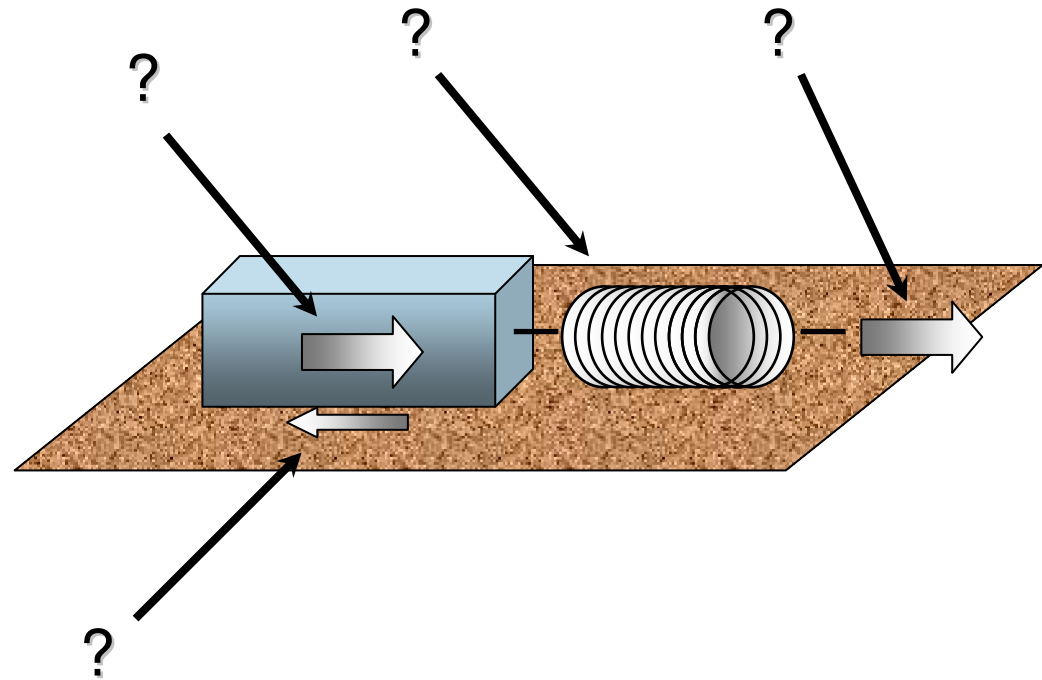
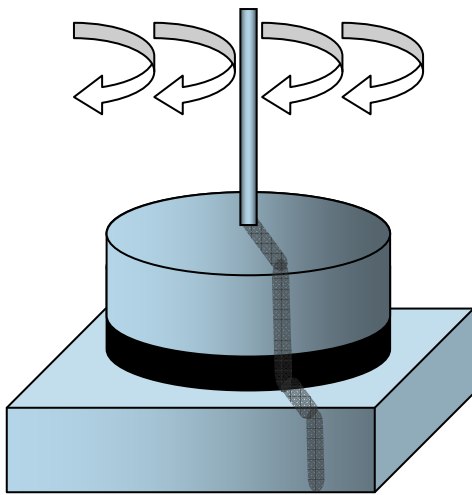
Normala Temperaturer (Utmattning)



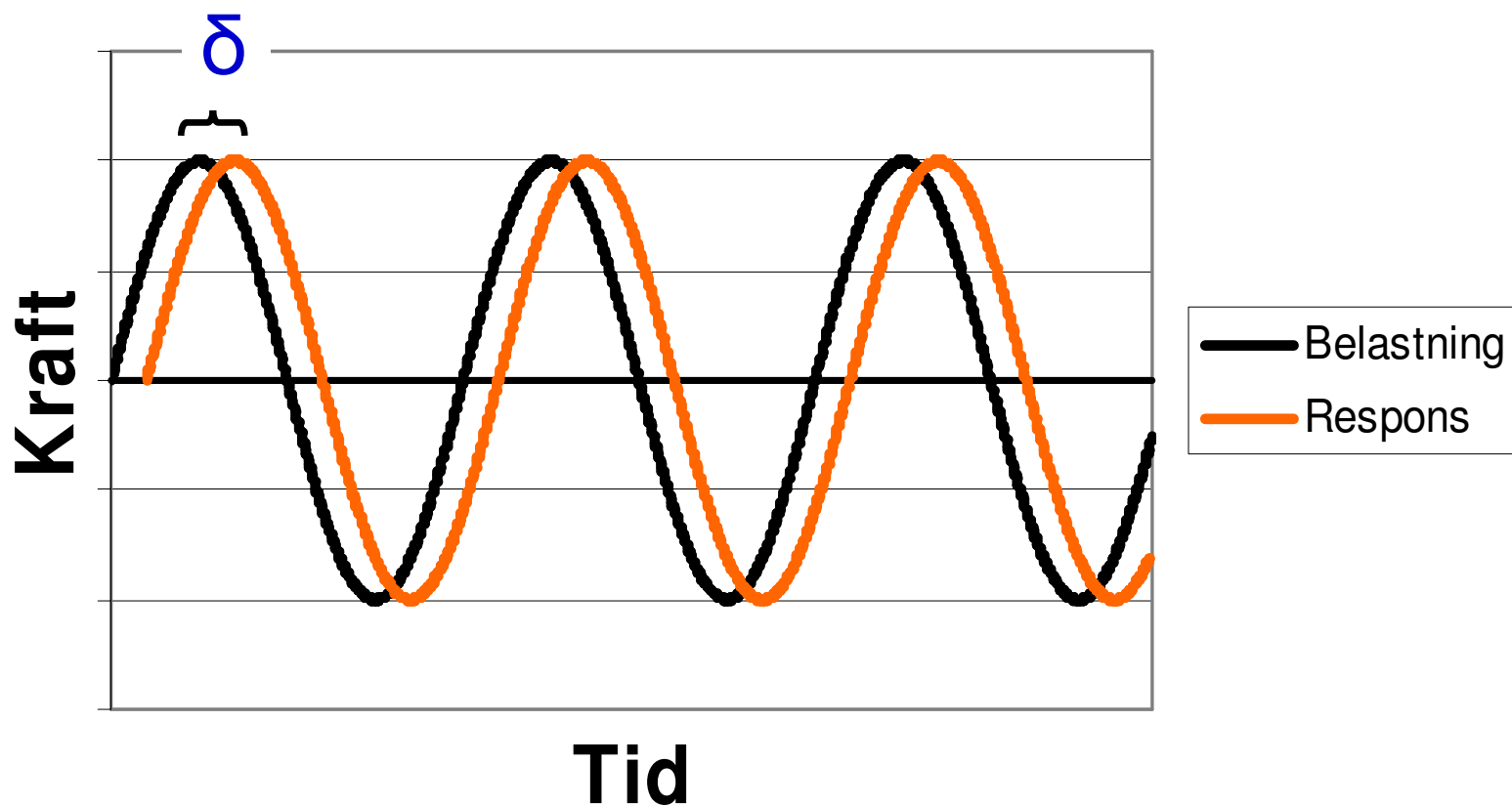
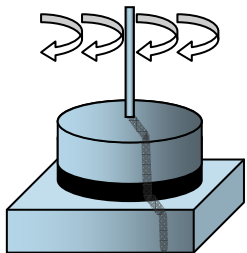
Mycket låga temperaturer (Brott)



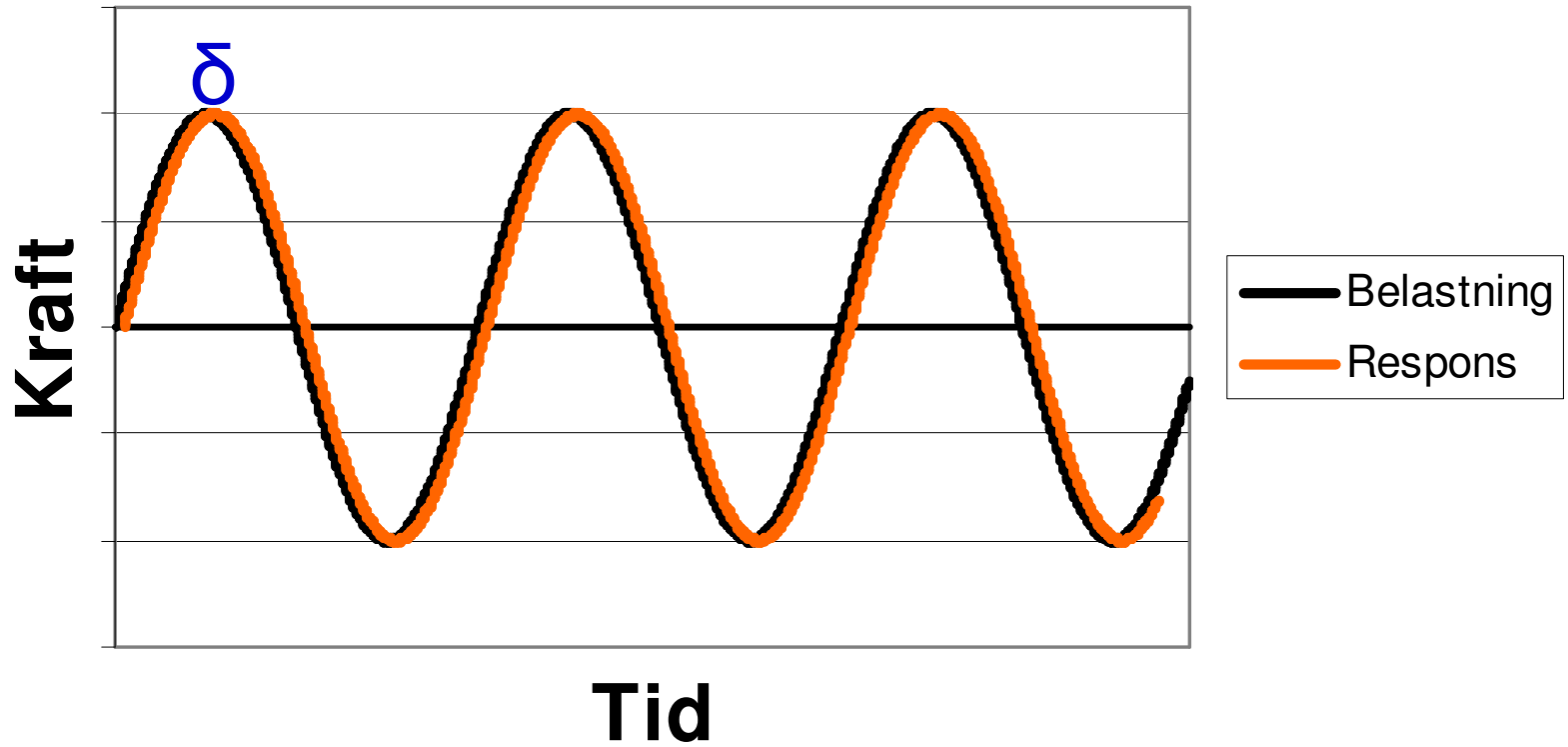
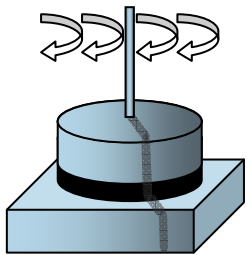
Dynamic Shear Rheometer



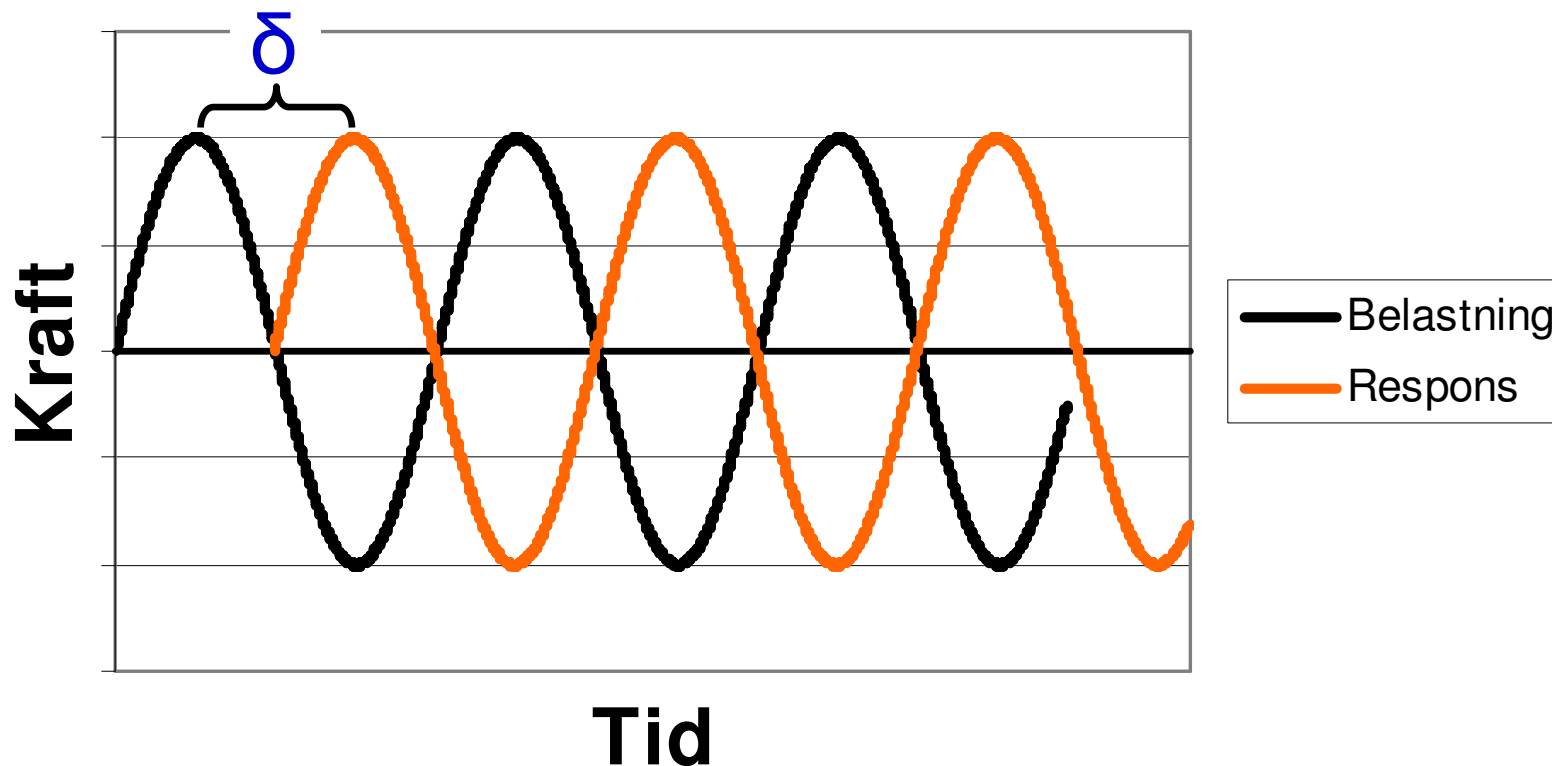
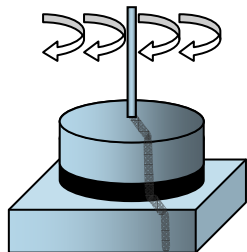
Fasvinkeln – Tiden mellan pålagd kraft och motsvarande "svar" i bindemedlet



Helt Elastisk, Fasvinkel = 0°



Helt Viskoelastisk, Fasvinkel = 90°



(Tid blir till avstånd blir till vinkel)

Figur 1. Dynamisk skjuvmodul och fasvinkel vid 10 rad/s för samtliga bindemedel.

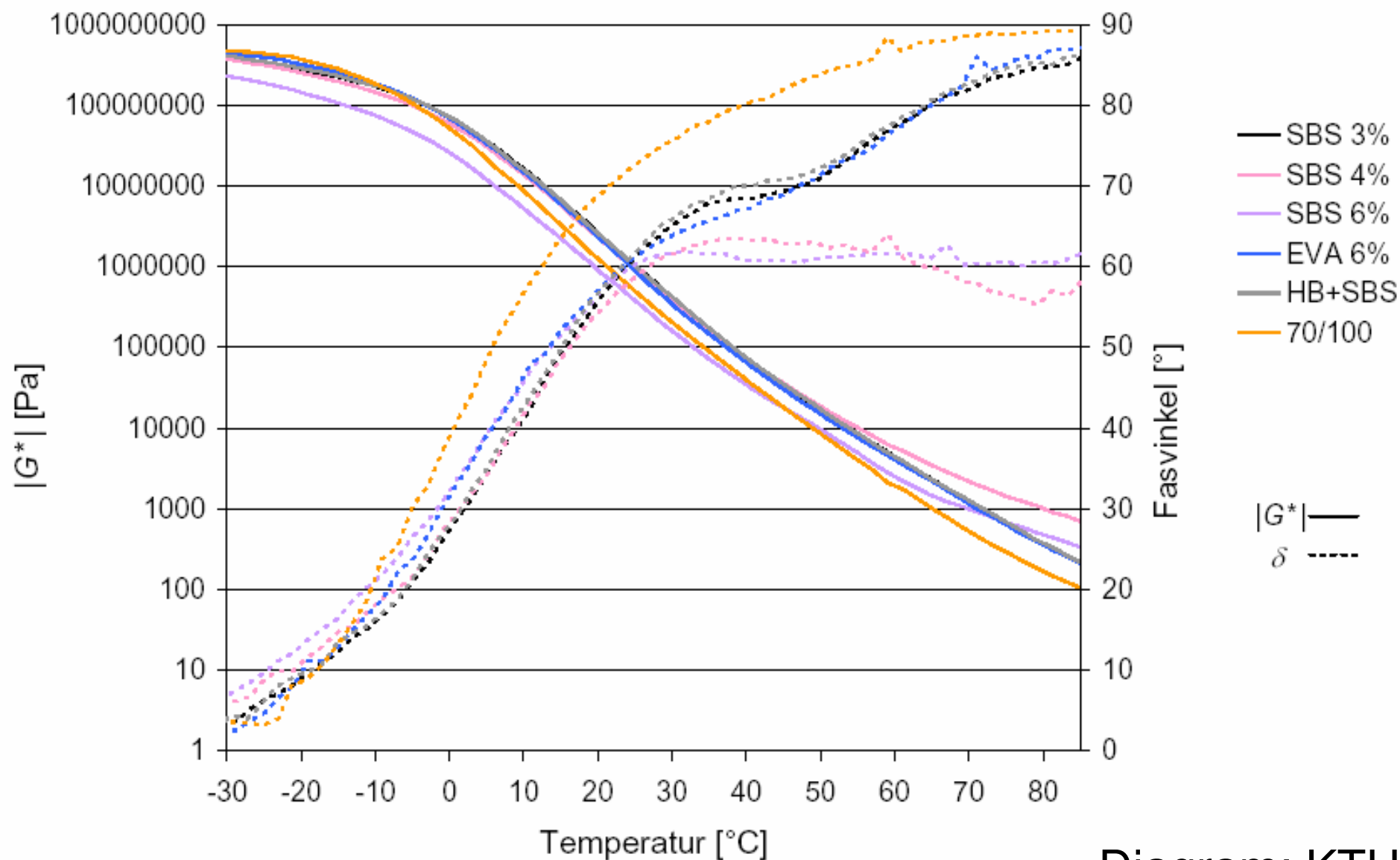
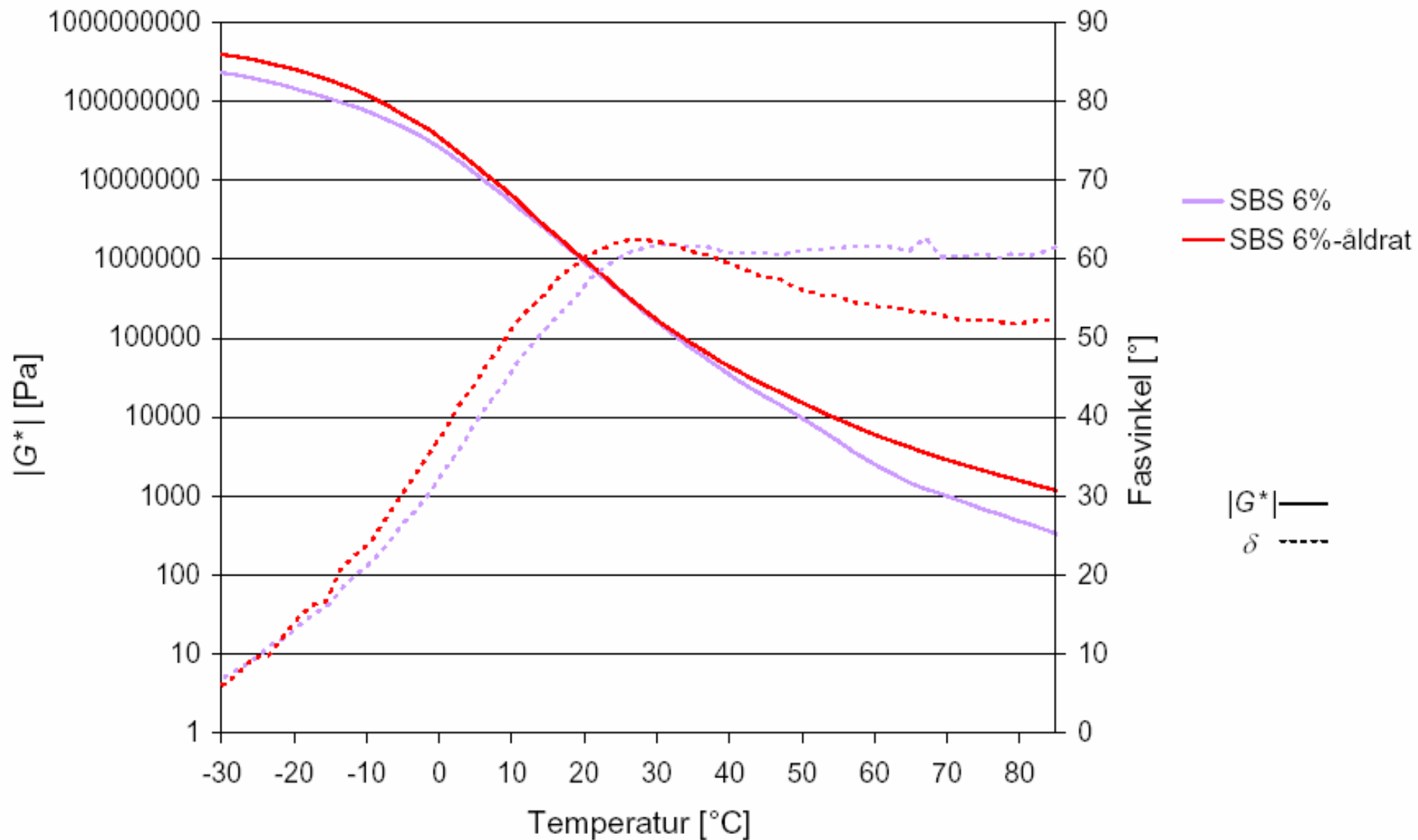
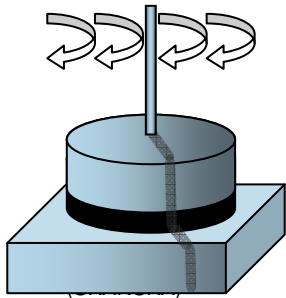


Diagram: KTH

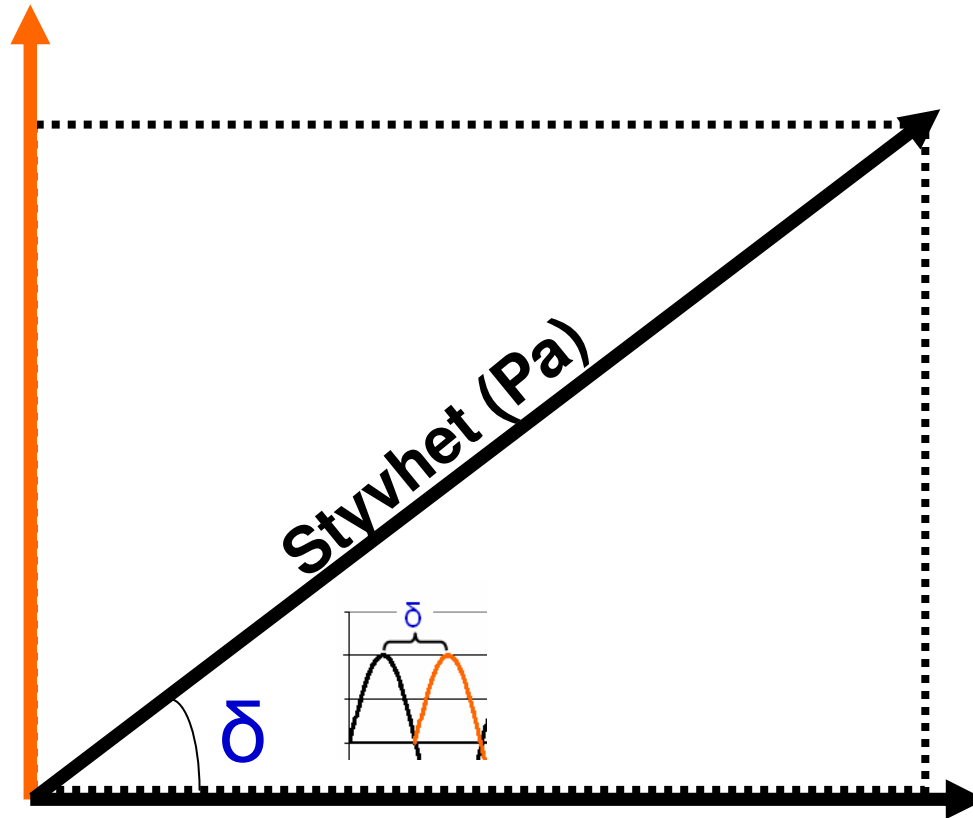


Figur 5. SBS 6%, original resp. åldrat prov.



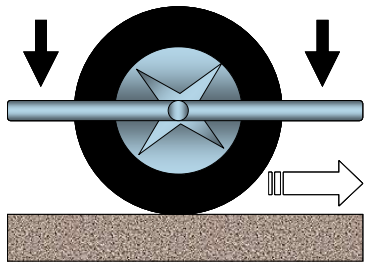
DSR

Viskoelastisk deformation



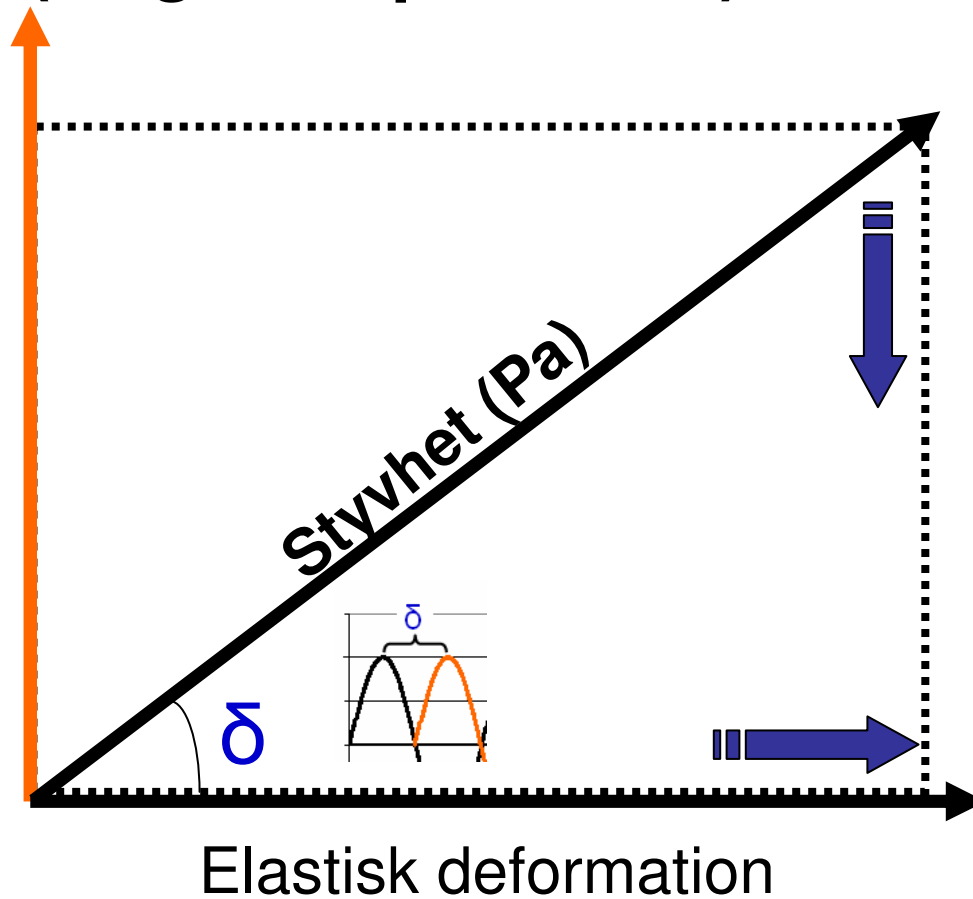
Elastisk deformation





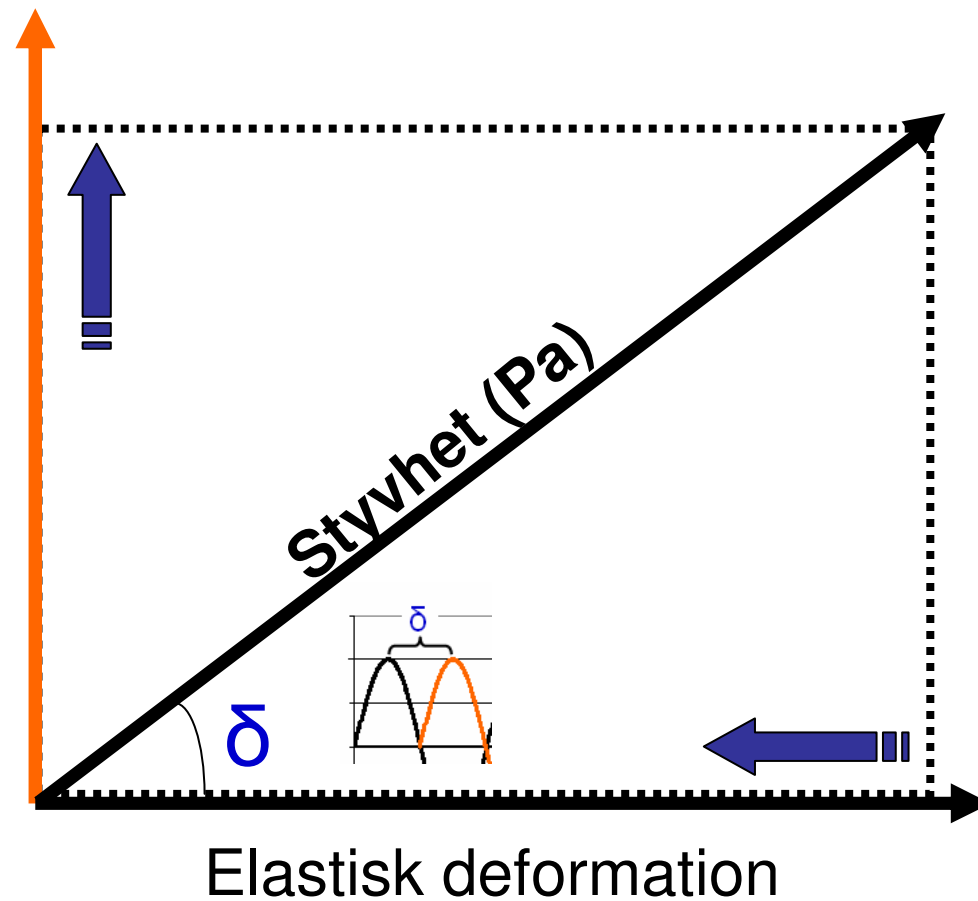
DSR och spårbildning (Höga temperaturer)

Viskoelastisk deformation



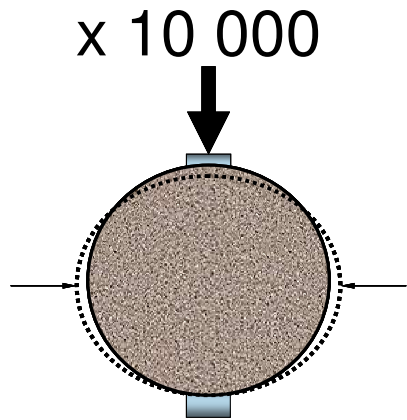
DSR och lågtemperaturbrott

Viskoelastisk deformation



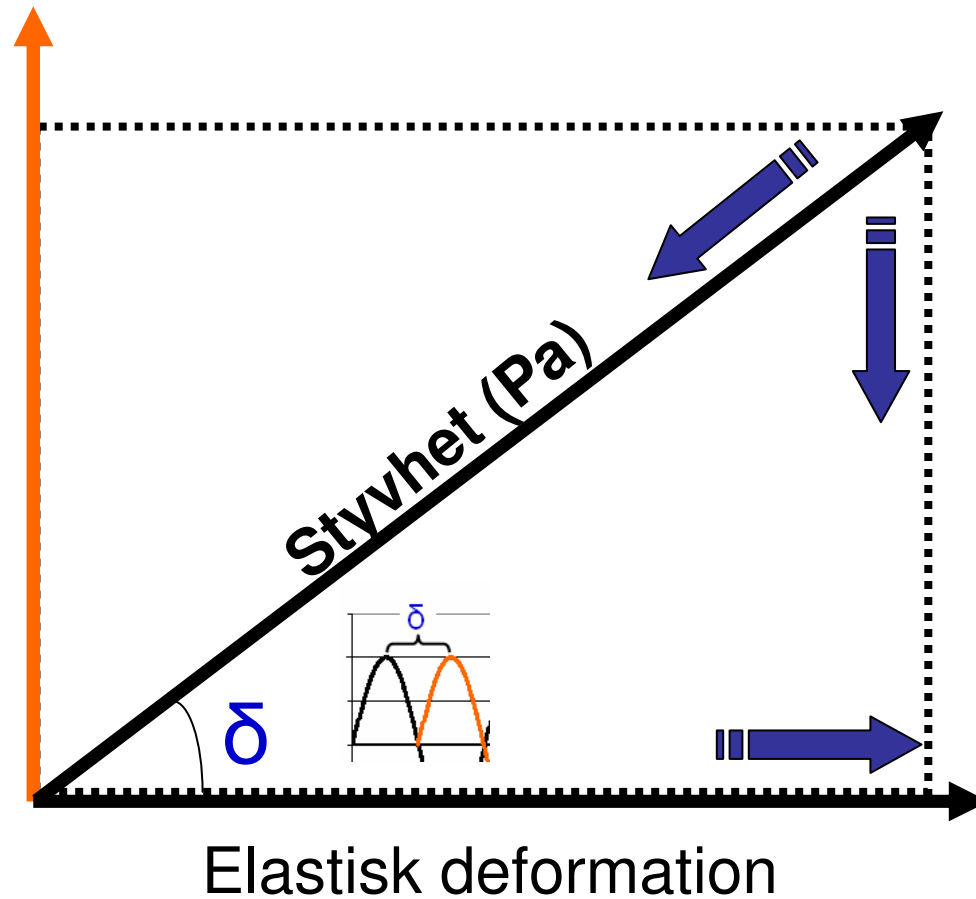
Elastisk deformation



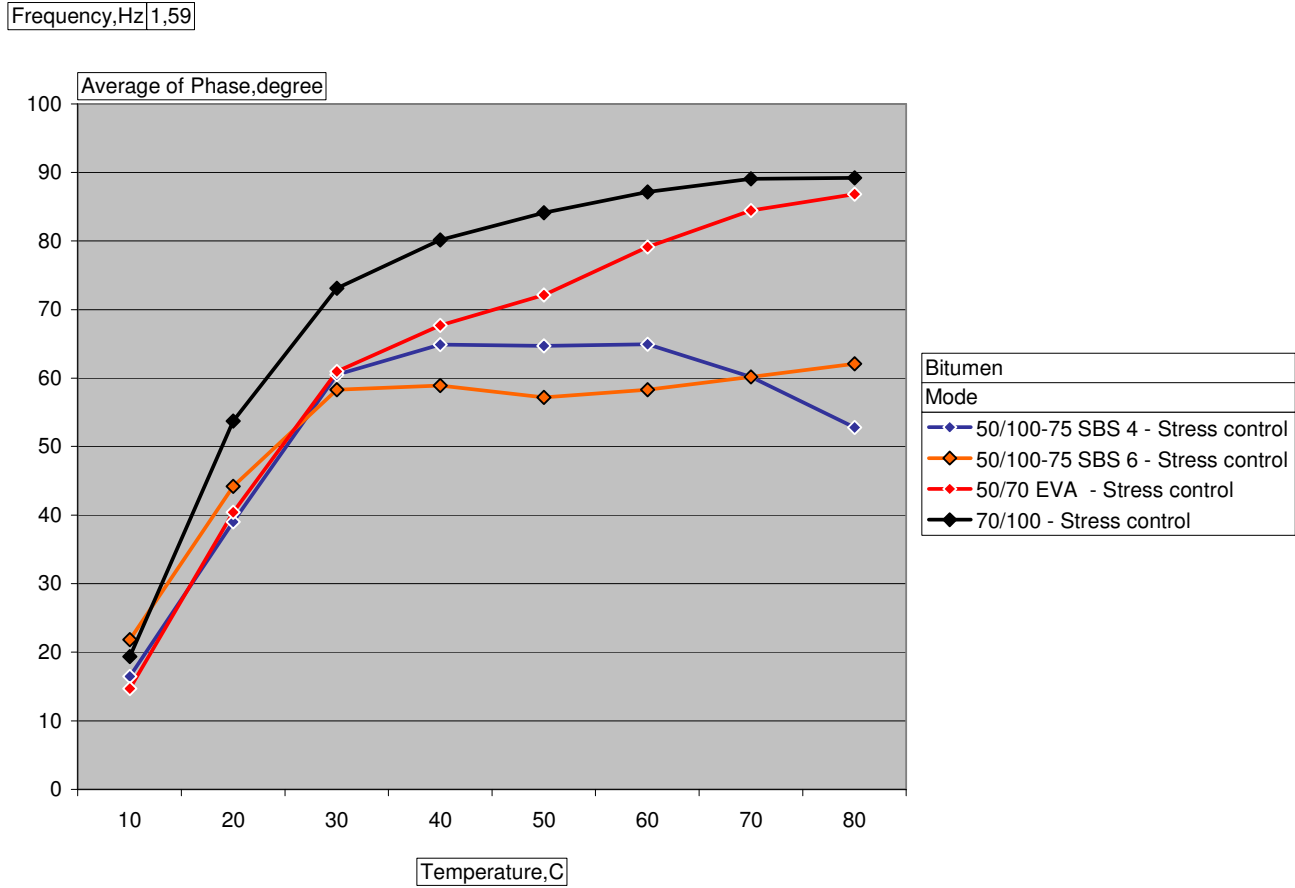


Viskoelastisk deformation

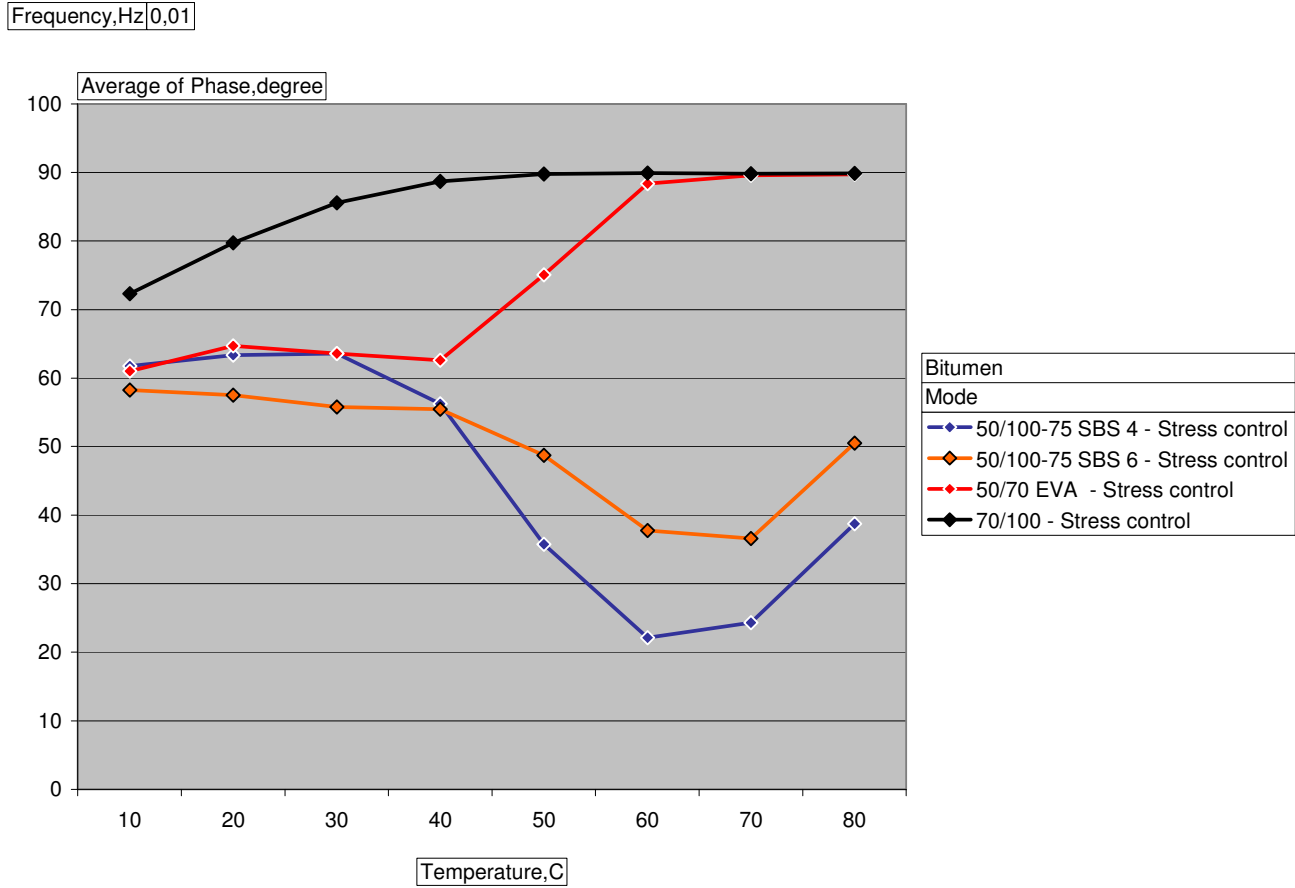
DSR och utmattning (vid samma temperatur som stabilitetstest enligt SHRP)



Fasvinkel vid 1,6Hz

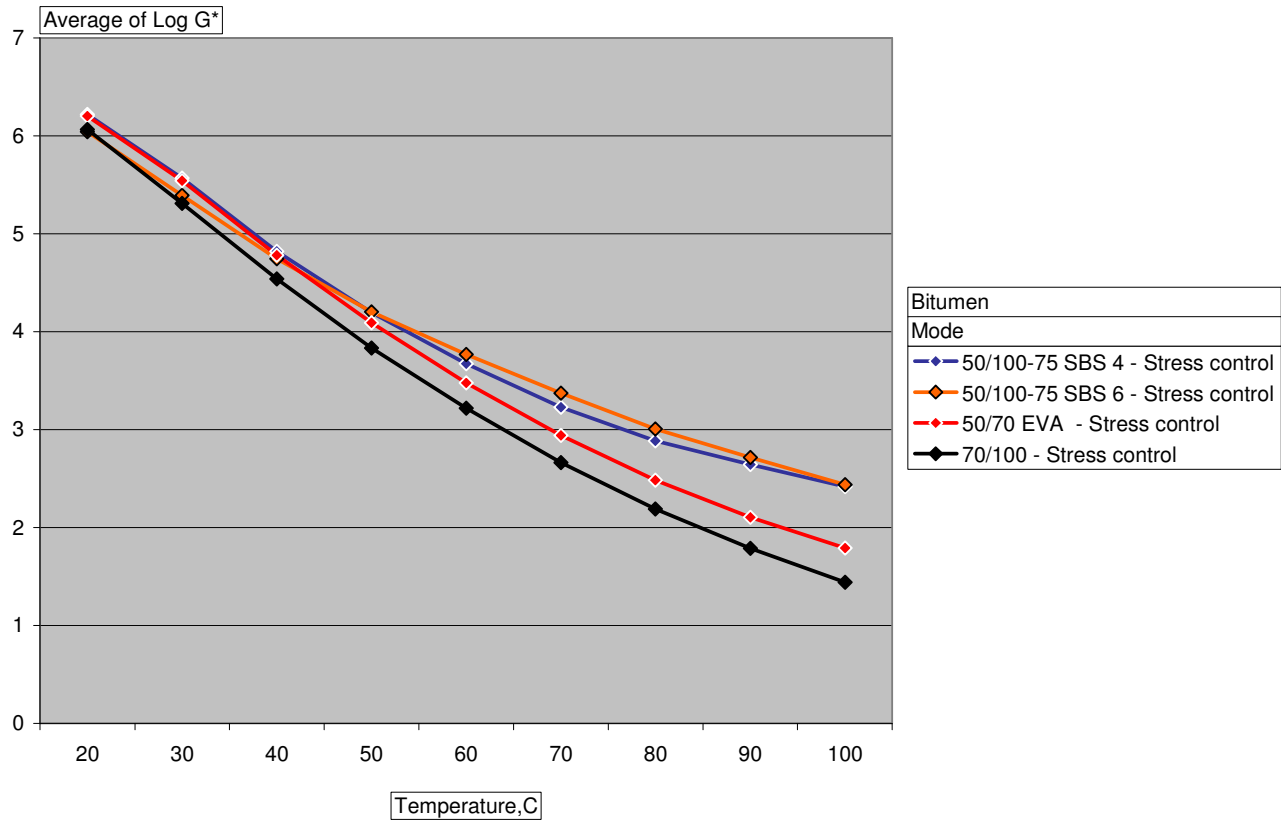


Fasvinkel vid 0,01Hz



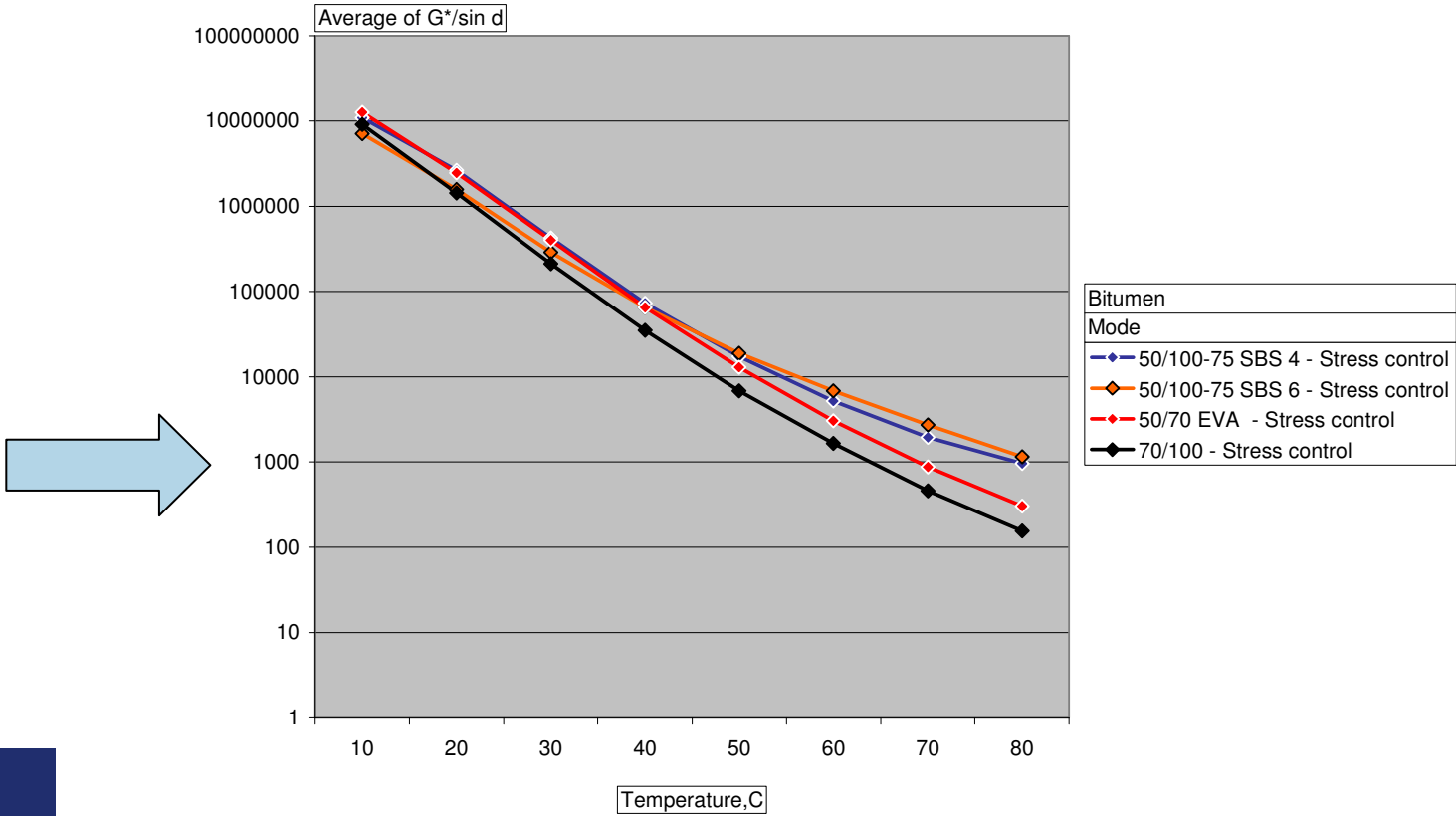
Styvhet vid 1,6Hz

Frequency,Hz|1,59



Rutting Parameter – Styvhet / Sin δ Minst 1 kPa vid PG-klassen

Frequency, Hz 1,59



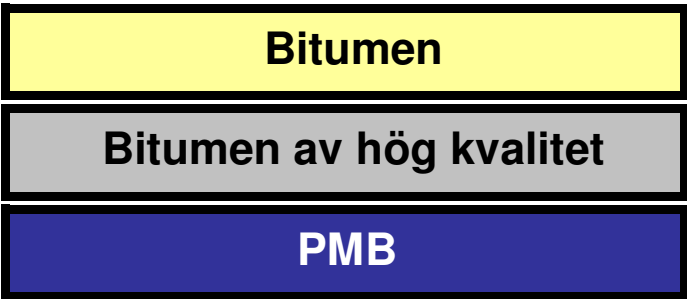
Måste även vara max 2,2 kPa efter RTFOT (ej testat)

PG-klassning av bindemedel till Etapp 3

EVA 6%

		Hög Temperatur (°C)				
		52	58	64	70	76
Låg Temperatur (°C)	16	52-16	58-16	64-16	70-16	76-16
	22	52-22	58-22	64-22	70-22	76-22
	28	52-28	58-28	64-28	70-28	76-28
	34	52-34	58-34	64-34	70-34	76-34
	40	52-40	58-40	64-40	70-40	76-40

Referens
70/100



SBS 4%R &
SBS 6%L

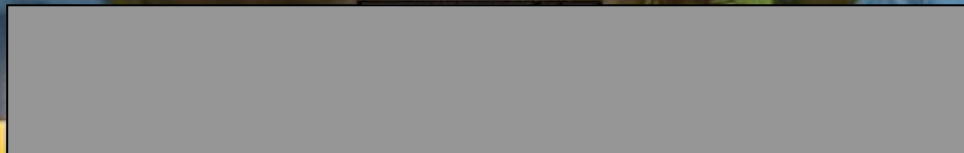
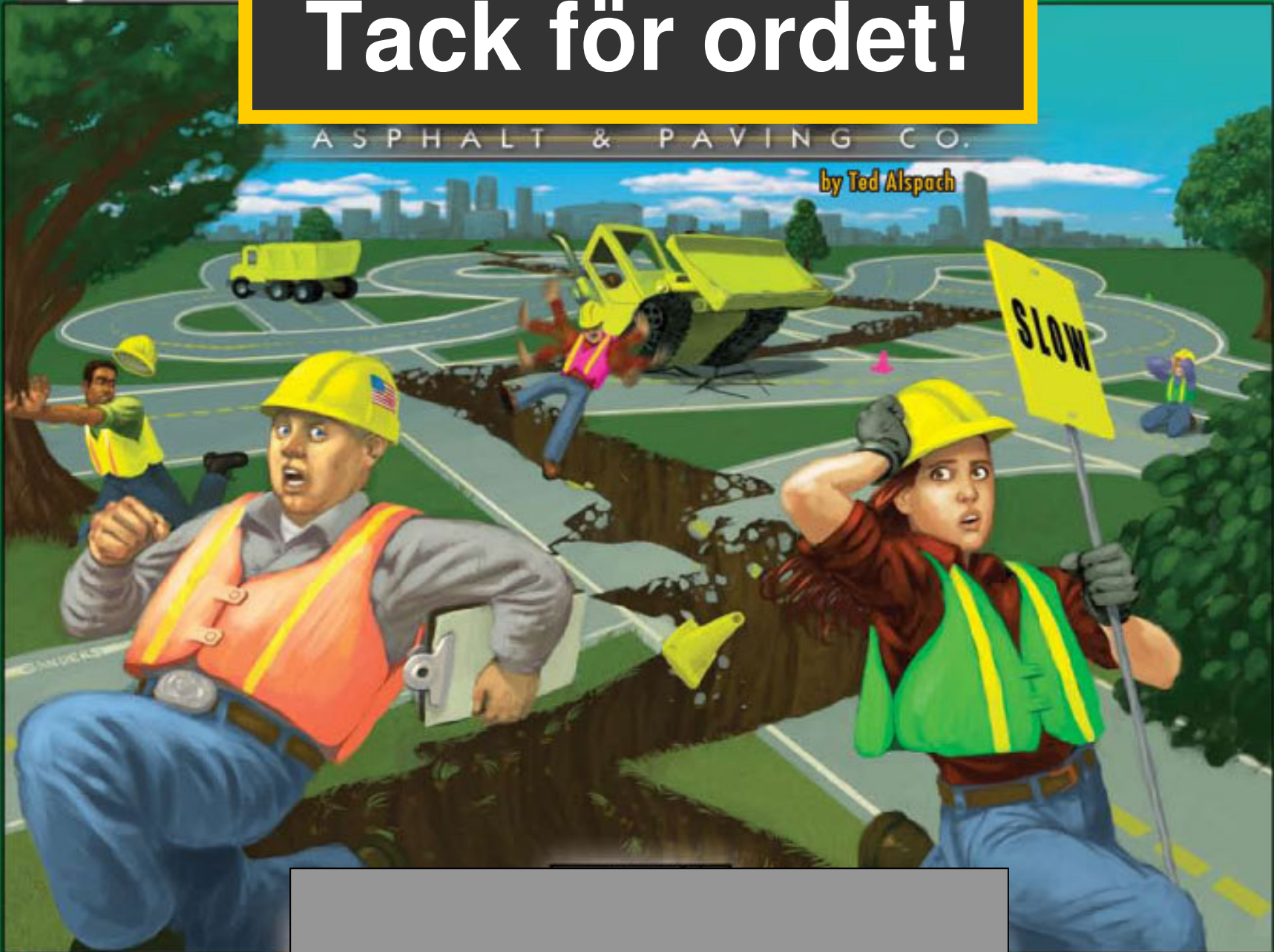


PG
Ready

Tack för ordet!

ASPHALT & PAVING CO.

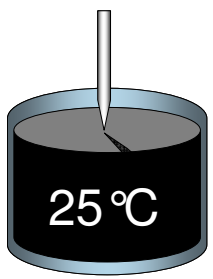
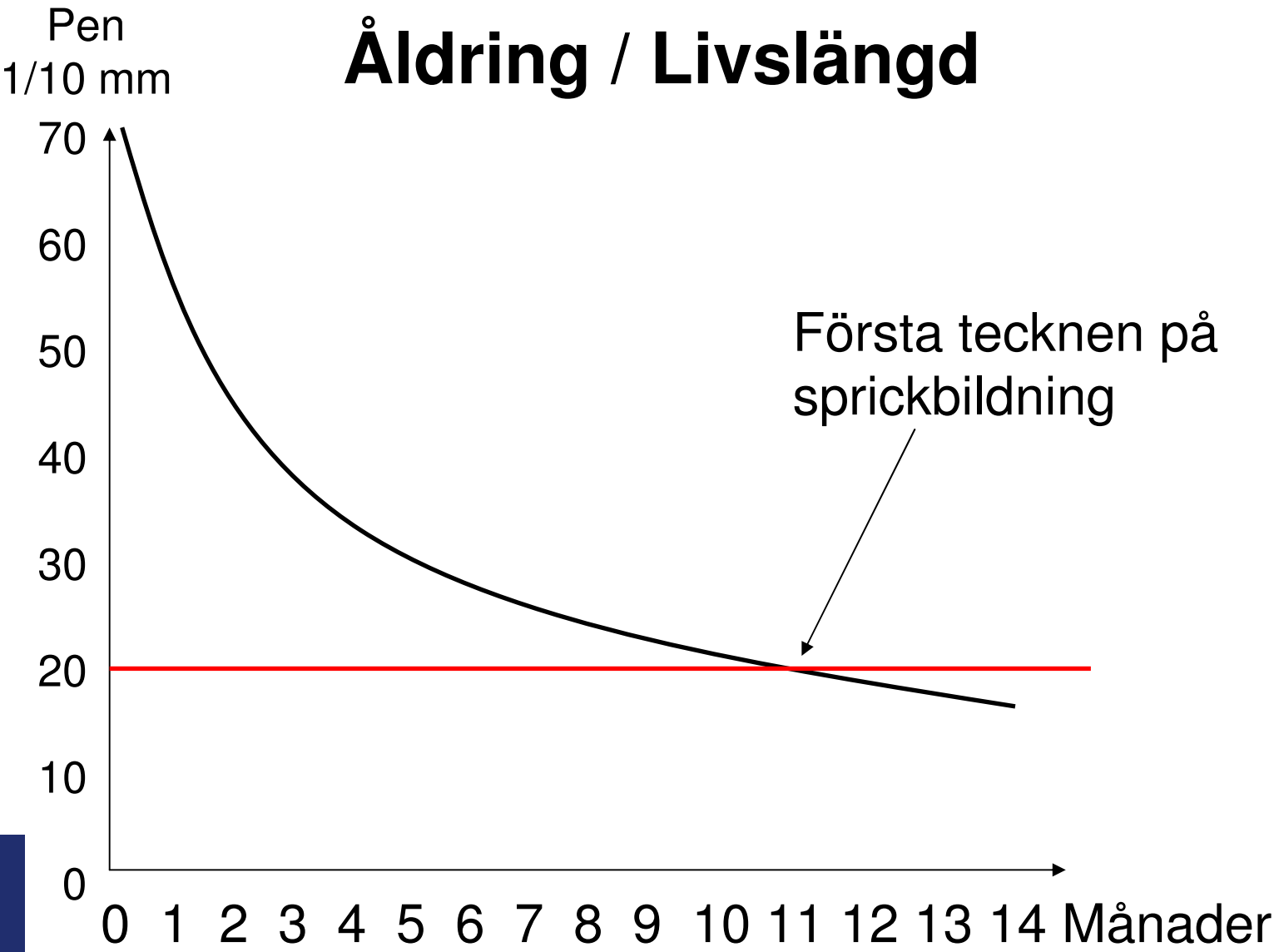
by Ted Alspach



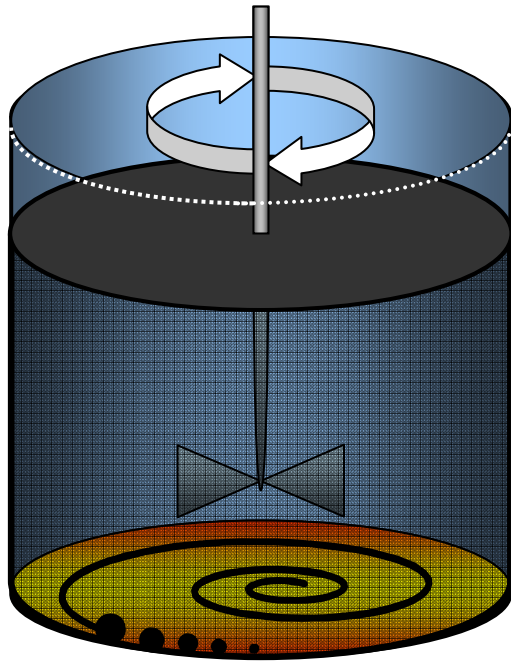




Åldring / Livslängd

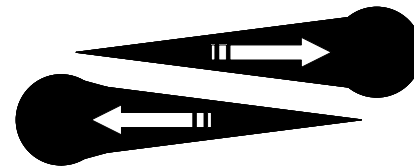
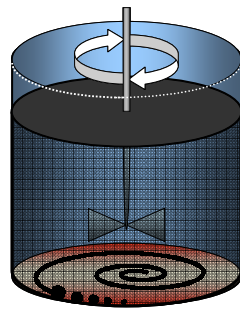


Åldringsegenskaper hos polymermodifierade bindemedel – SBUF Projekt 11607



Elastisk återgång

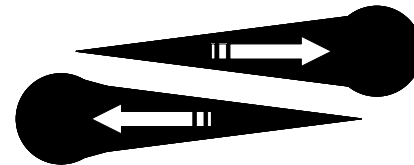
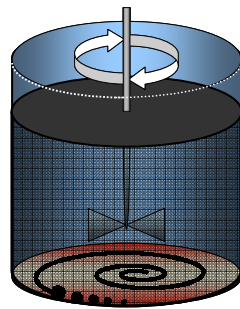
Bindemedel	Före Åldring	Efter Åldring
70 / 100	15%	Brott! 0cm
SBS 3 %	71%	Brott! 17cm
SBS 6 %	89%	86%
EVA 5%	45%	50%



Sex dagar
180°C

Elastisk återgång

Bindemedel	Före Åldring	Efter Åldring
70 / 100	15%	Brott! 0cm
SBS 3 %	71%	Brott! 17cm
SBS 6 %	89%	86%
EVA 5%	45%	50%



Sex dagar
180°C