Is Europe in Harmony?

How the Harmonised Asphalt Standards are being implemented across Europe

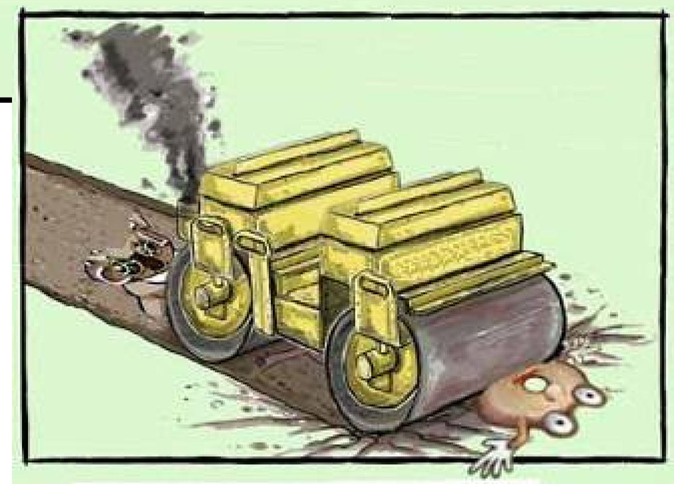
Implications for Test Equipment Manufacturers

Keith Cooper. Cooper Research Technology Limited

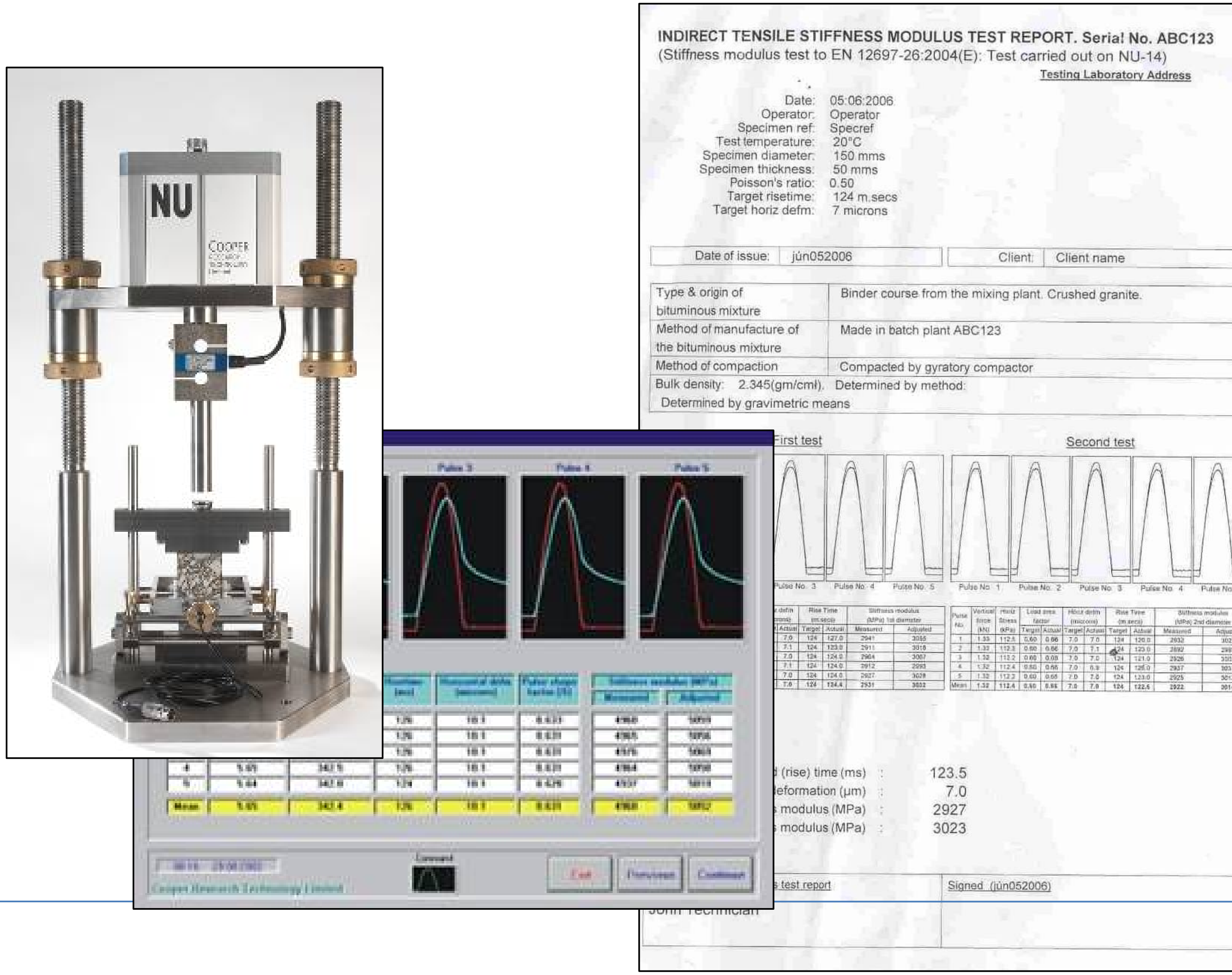
Decisions

- **Do we make EN equipment?**

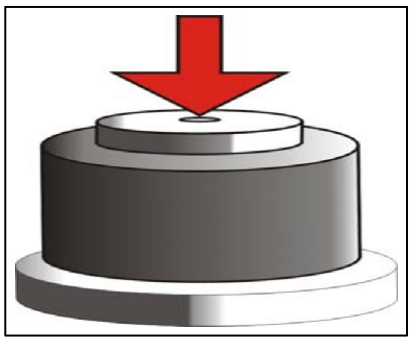
Once a new technology rolls over you, if you’re not part of the steamroller, you’re part of the road

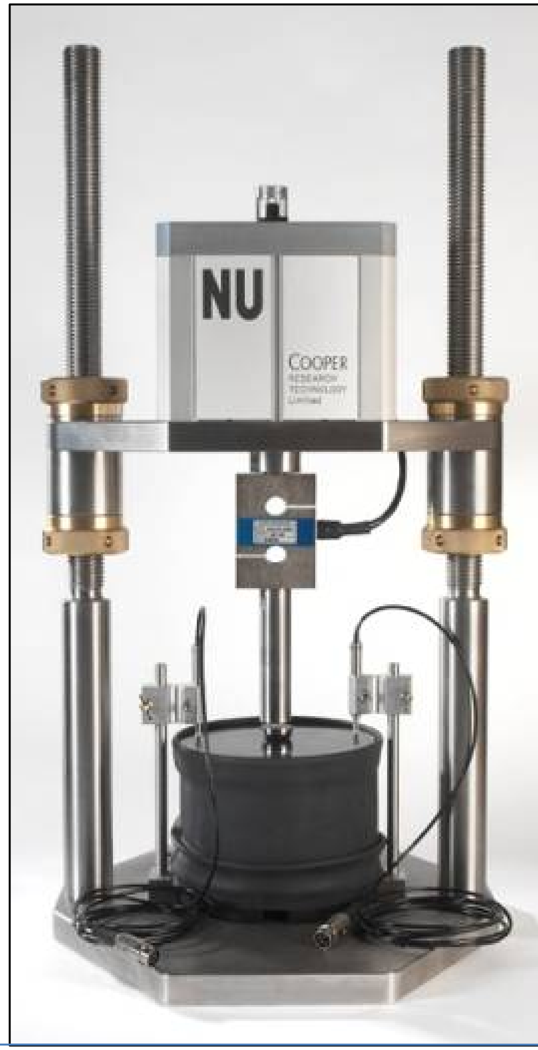


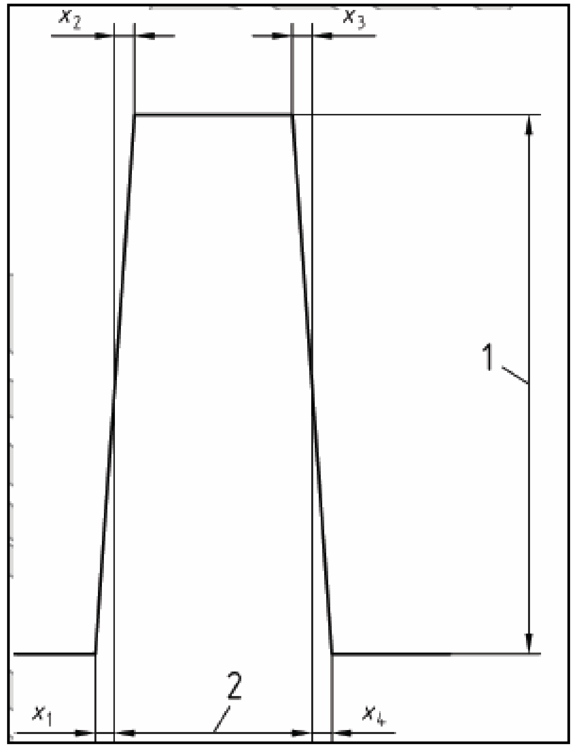
EN 12697-25 Stiffness (IT-CY)



EN 12697-25 Cyclic compression







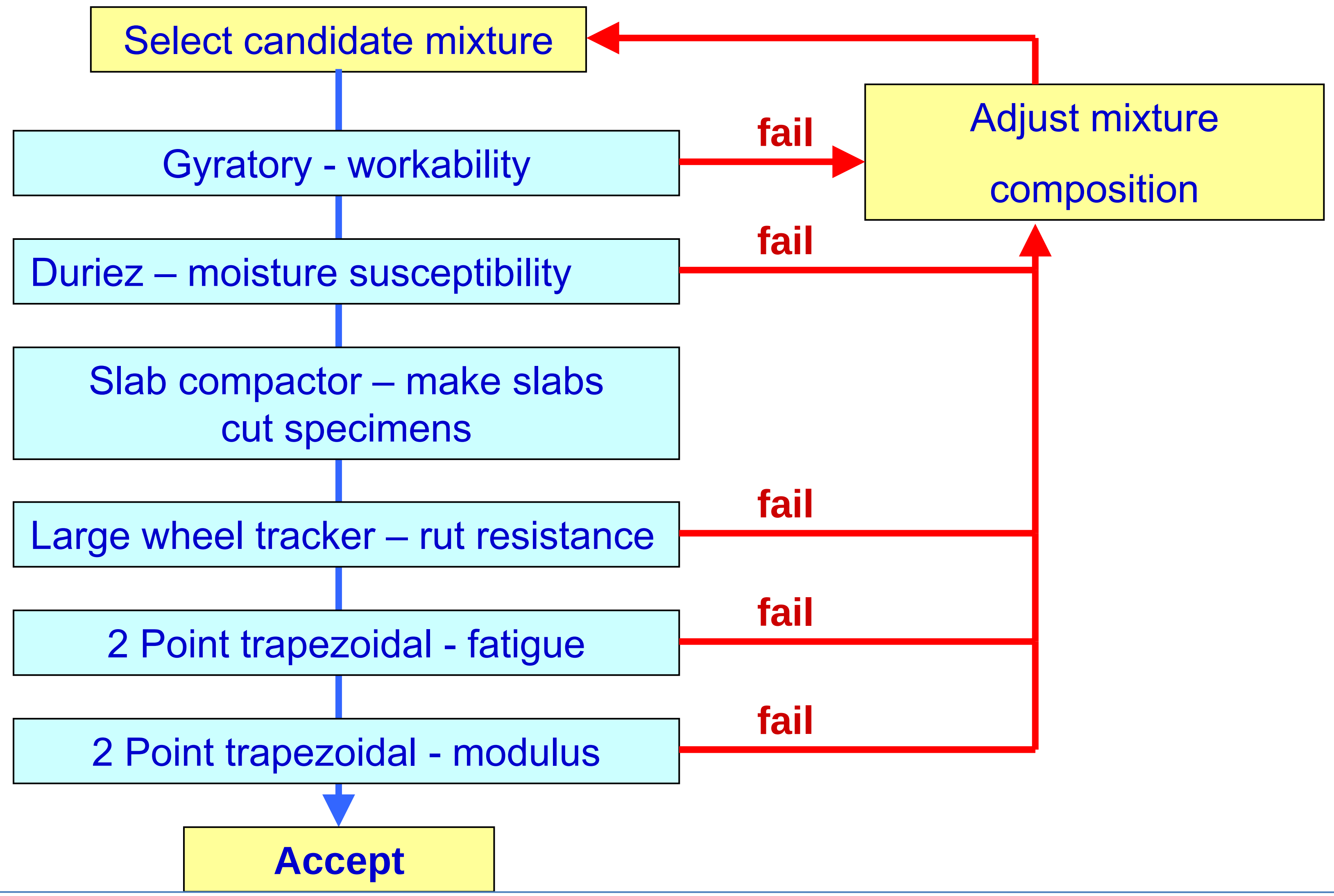
EN 12697

32 Wheeltracking
Small size device – Procedure B

22 Slab compaction
Smooth steel roller


Make ready
our test methods
Oui
LE MACADAM

French mixture design procedure



EN 12697-22 Wheeltracking

Large size device

6.1.1.4 *The rolling load* applied to the test specimen shall be (5000 ± 50) N at the centre of the test specimen, measured **<u>at least</u>** when the device is static.

EN12697-33 Slab compaction

Pneumatic tyred slab compactor

Which equipment do we make?

BS EN12697-26 Stiffness - Test methods

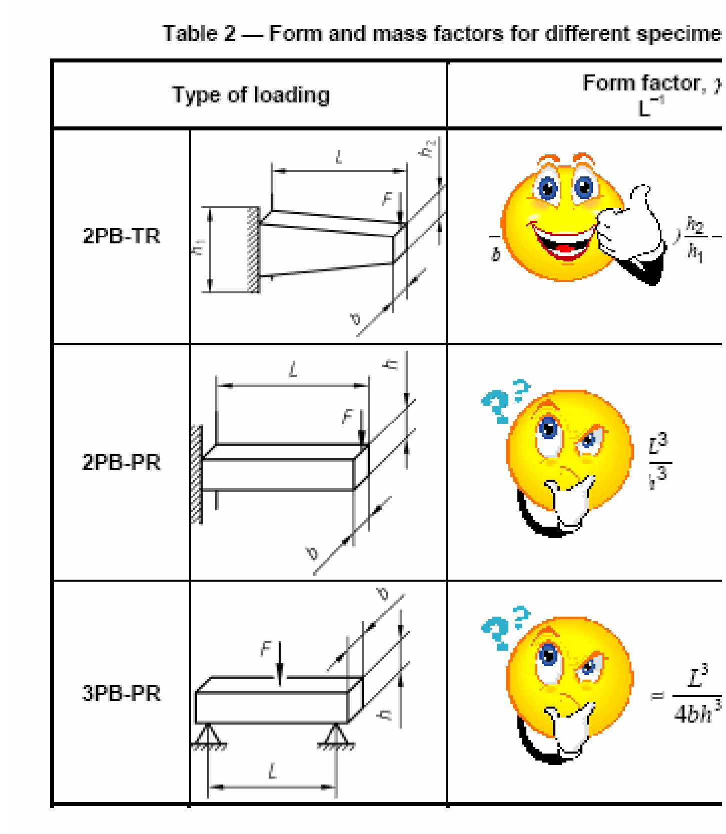
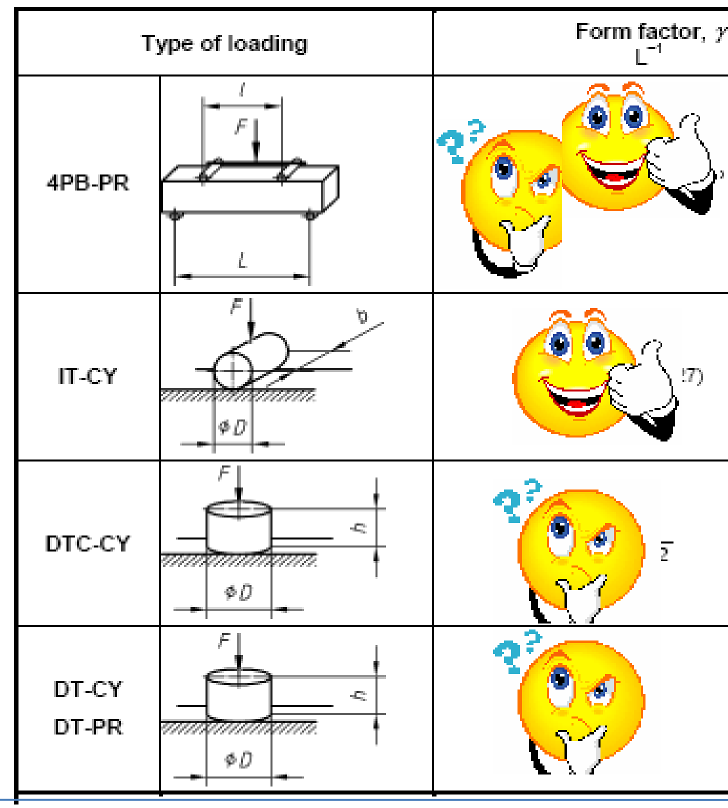


Table 2 — Form and mass factors for different specime

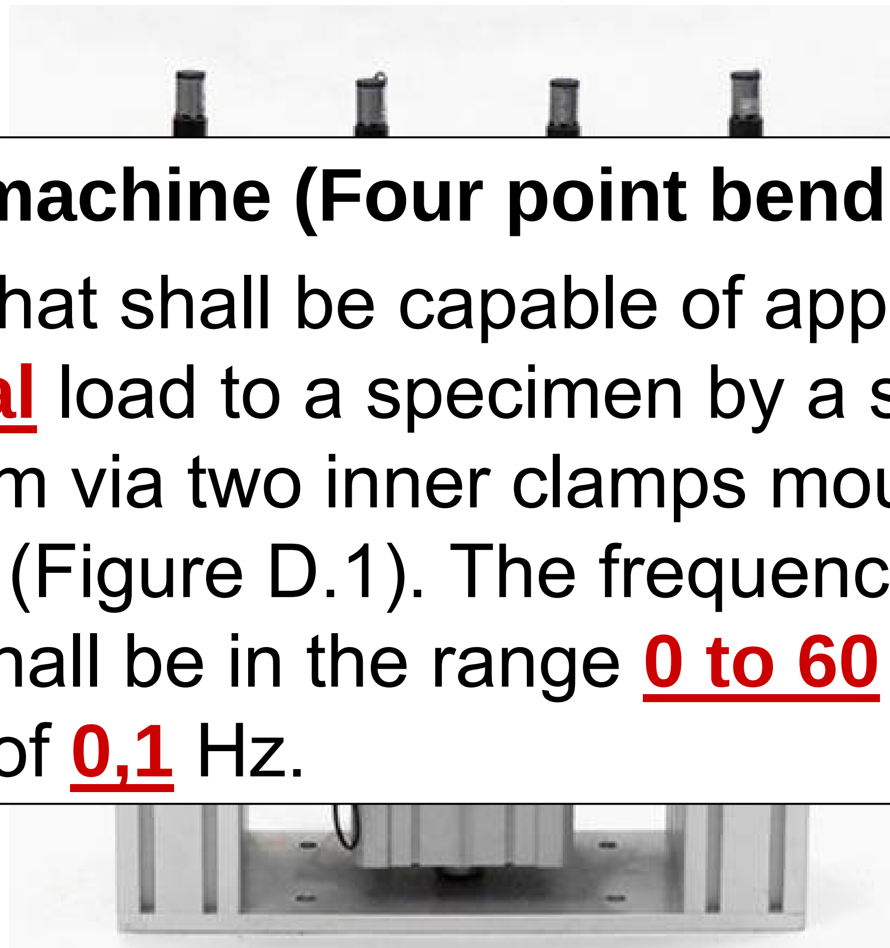
Type of loading		Form factor, γ L^{-1}
2PB-TR		$\frac{h_2}{h_1}$
2PB-PR		$\frac{L^3}{h^3}$
3PB-PR		$= \frac{L^3}{4bh^3}$



Type of loading		Form factor, γ L^{-1}
4PB-PR		
IT-CY		!7)
DTC-CY		2
DT-CY DT-PR		

EN12697-24 Fatigue

Four point bending

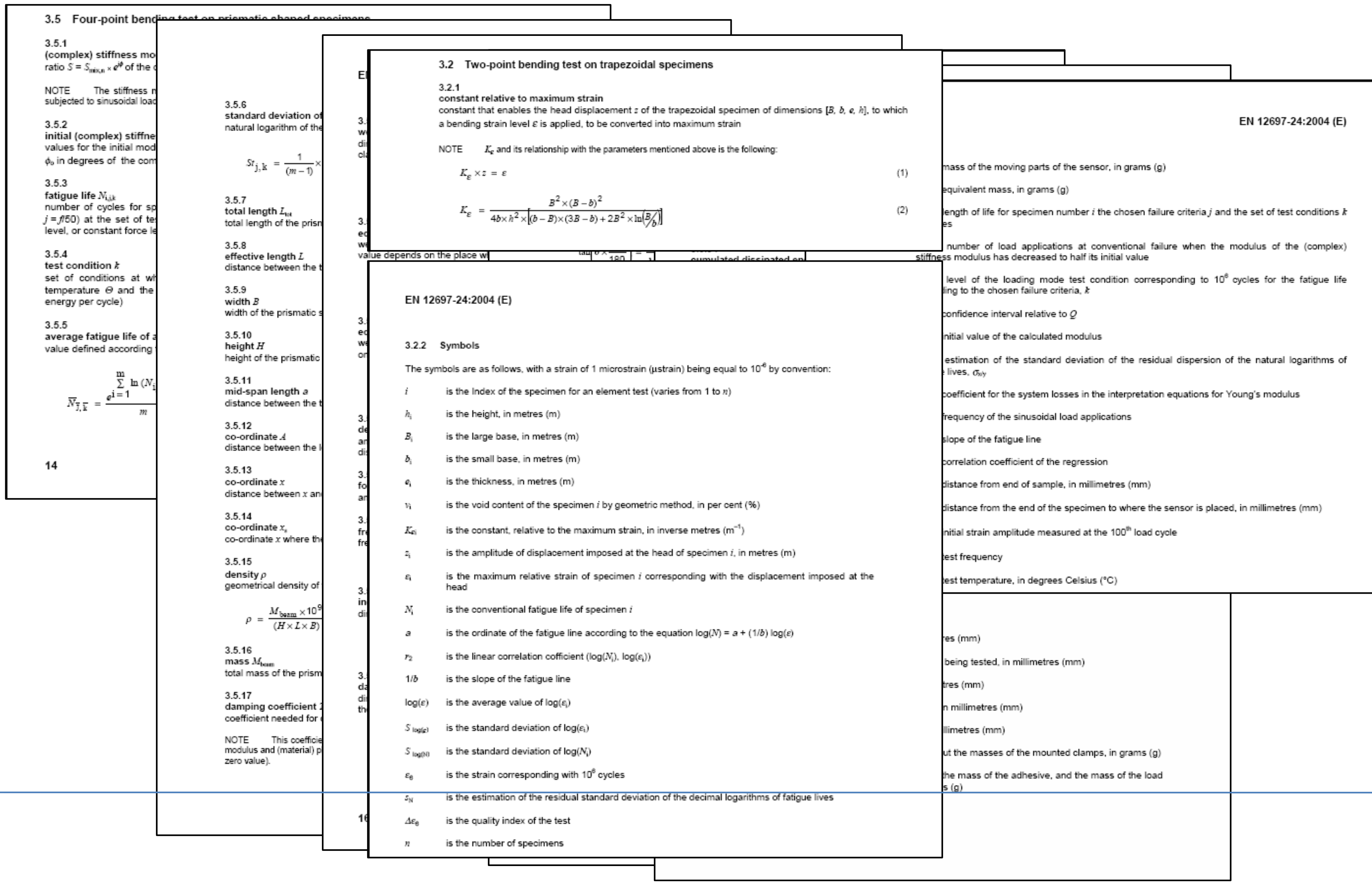


D.2.1 Test machine (Four point bending fatigue)

Equipment that shall be capable of applying a **sinusoidal** load to a specimen by a suitable mechanism via two inner clamps mounted on the specimen (Figure D.1). The frequency of the load, f_0, shall be in the range **0 to 60** Hz with an accuracy of **0,1** Hz.

EN 12697 – 24 Resistance to fatigue

3 Terms, definitions, symbols and abbreviations



3.2 Two-point bending test on trapezoidal specimens

3.2.1
constant relative to maximum strain
constant that enables the head displacement z of the trapezoidal specimen of dimensions [B, b, e, h], to which a bending strain level ε is applied, to be converted into maximum strain

NOTE K_ε and its relationship with the parameters mentioned above is the following:

$$K_\varepsilon \times z = \varepsilon \quad (1)$$

$$K_\varepsilon = \frac{B^2 \times (B-b)^2}{4b \times h^2 \times \left[(b-B)\times(3B-b) + 2B^2 \times \ln\left(B/b\right)\right]} \quad (2)$$

EN 12697-24:2004 (E)

3.2.2 Symbols

The symbols are as follows, with a strain of 1 microstrain (µstrain) being equal to 10^{-6} by convention:

i	is the Index of the specimen for an element test (varies from 1 to n)
h_i	is the height, in metres (m)
B_i	is the large base, in metres (m)
b_i	is the small base, in metres (m)
e_i	is the thickness, in metres (m)
v_i	is the void content of the specimen i by geometric method, in per cent (%)
$K_{\varepsilon i}$	is the constant, relative to the maximum strain, in inverse metres (m^{-1})
z_i	is the amplitude of displacement imposed at the head of specimen i, in metres (m)
ε_i	is the maximum relative strain of specimen i corresponding with the displacement imposed at the head
N_i	is the conventional fatigue life of specimen i
a	is the ordinate of the fatigue line according to the equation $\log(N) = a + (1/b) \log(\varepsilon)$
r_2	is the linear correlation coefficient ($\log(N_i)$, $\log(\varepsilon_i)$)
$1/b$	is the slope of the fatigue line
$\log(\varepsilon)$	is the average value of $\log(\varepsilon_i)$
$S_{\log(\varepsilon)}$	is the standard deviation of $\log(\varepsilon_i)$
$S_{\log(N)}$	is the standard deviation of $\log(N_i)$
ε_6	is the strain corresponding with 10^6 cycles
s_N	is the estimation of the residual standard deviation of the decimal logarithms of fatigue lives
$\Delta\varepsilon_6$	is the quality index of the test
n	is the number of specimens

Two point bending test equipment

BS EN 12697-26 Stiffness

3 Terms, definitions and symbols

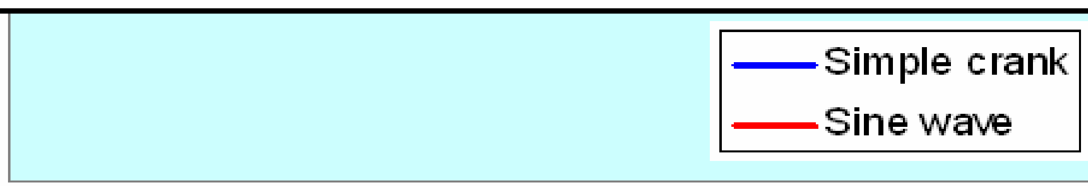
3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

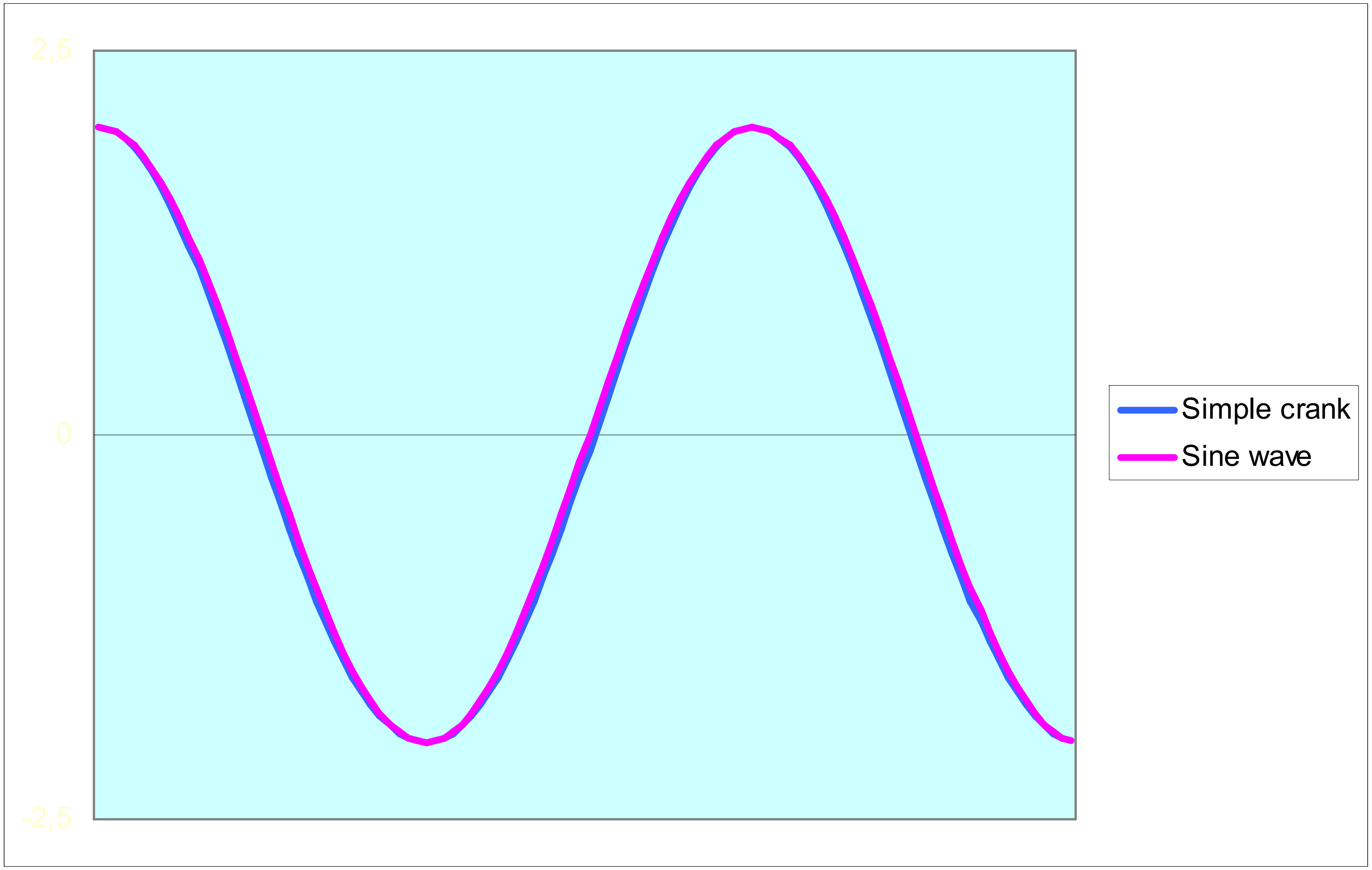
3.1.1

complex modulus

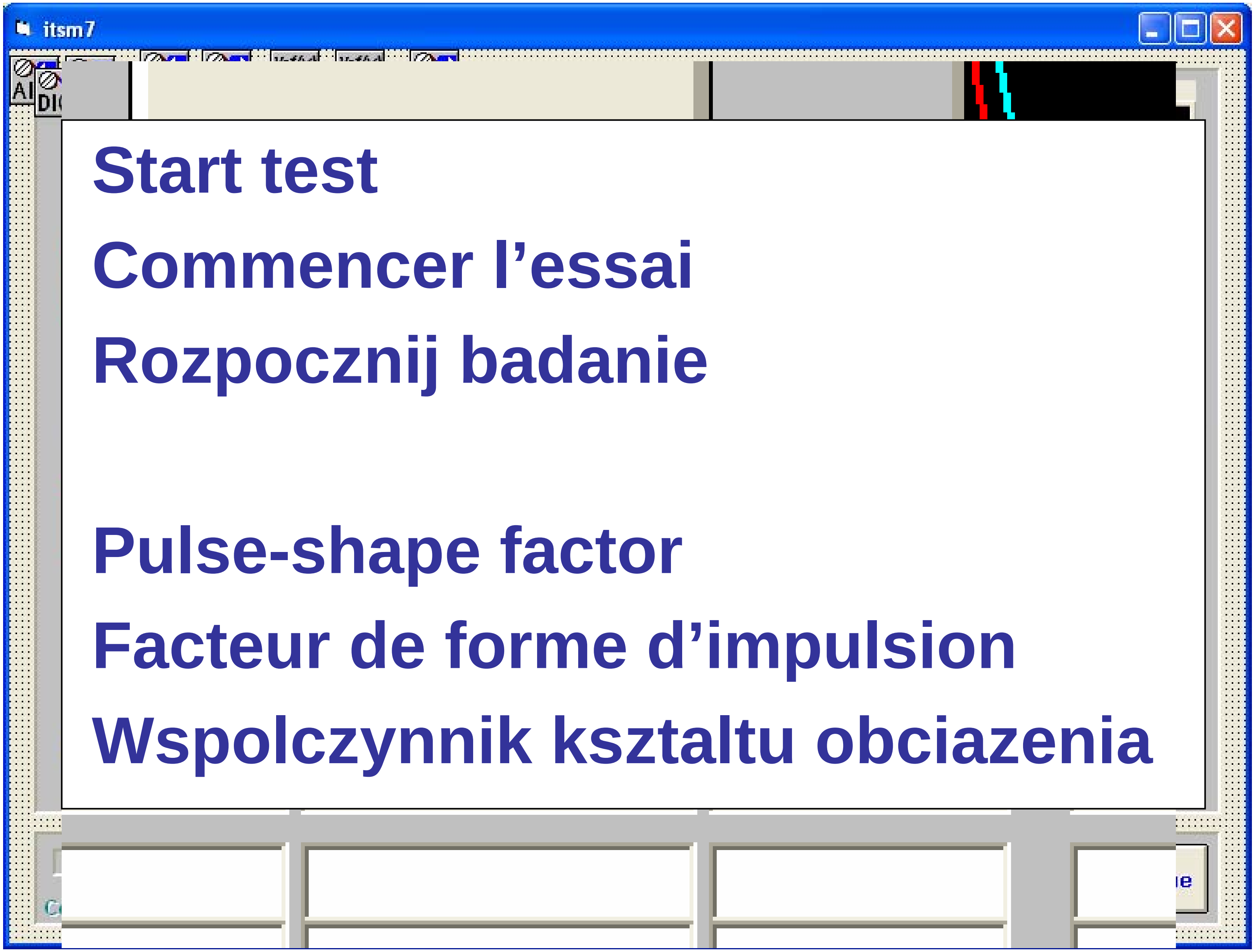
relationship between stress and strain for a linear visco-elastic material submitted to a **sinusoidal** load waveform at time, *t*, where applying a stress σ x sin(ωt) results in a strain ϵ x sin(ω x (t - ϕ)) that has a phase angle, ϕ, with respect to the stress.



Sinusoidal or not sinusoidal?



Two point trapezoidal bending



Start test

Commencer l’essai

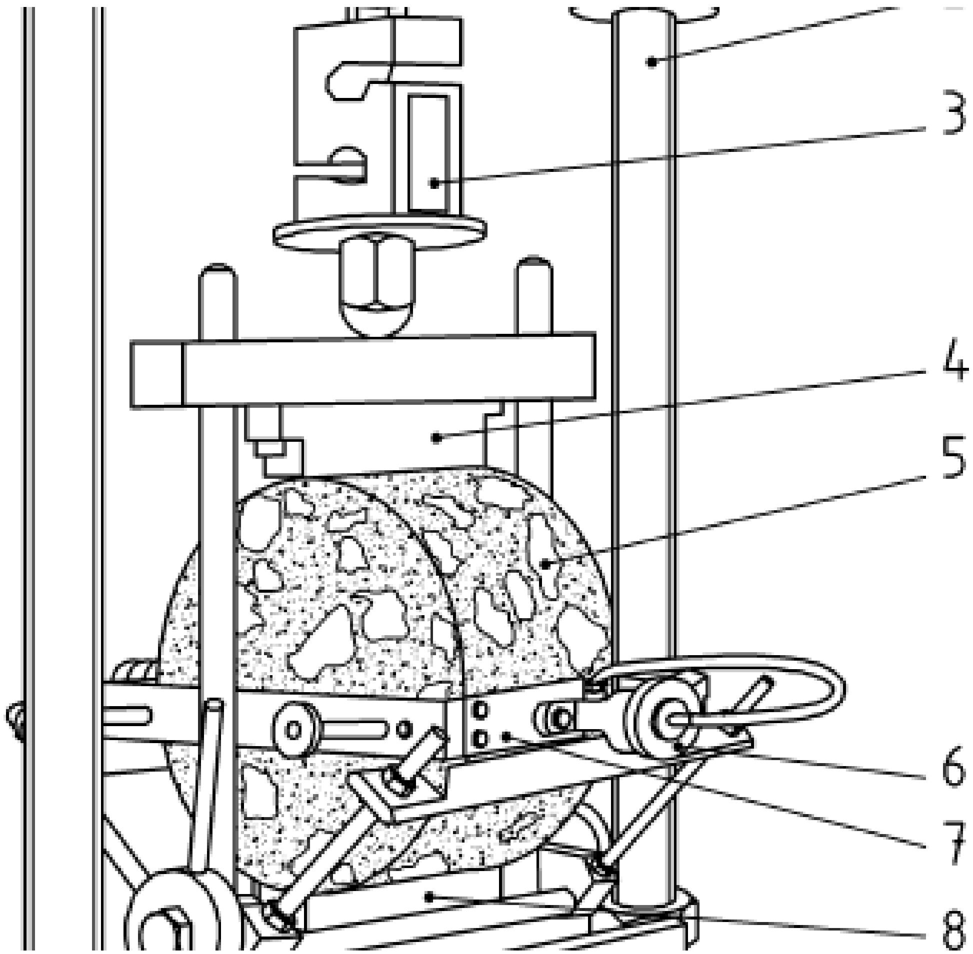
Rozpocznij badanie

Pulse-shape factor

Facteur de forme d’impulsion

Wspolczynnik ksztaltu obciazenia

Loading strips



The three Rs

- Reliability
- Repeatability
- Reproduceability

= Round robin te