Transport Research Arena Europe 2010
3rd edition
Brussels, Belgium
7 - 10, June 2010

Field and Laboratory Quality Control of Asphalt Using Seismic Methods

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Outline

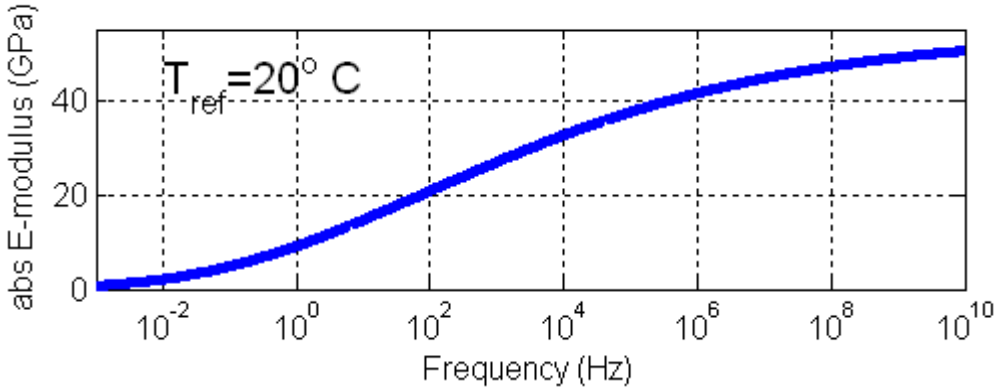
- Background and motivation
- Seismic laboratory testing
- Seismic field testing
- Summary

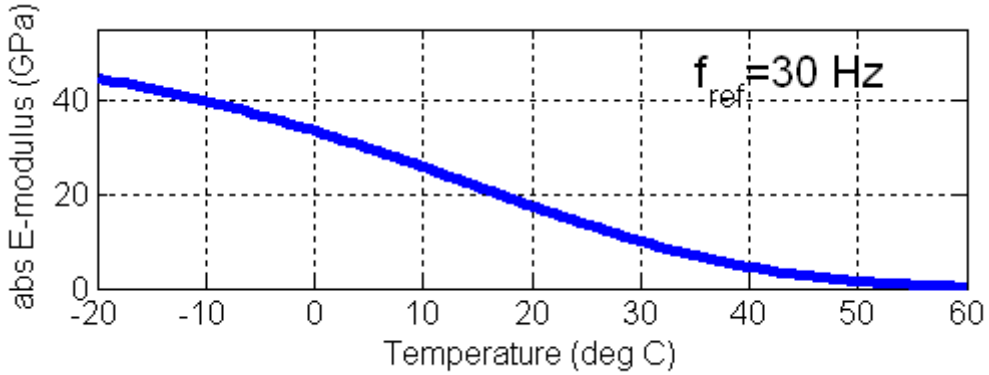
Background - Motivation

- Dynamic E-modulus (*E**) and thickness of pavement layers are the most important parameters against plastic deformations and fatigue cracks.

Background – Asphalt Mastercurve

- A mastercurve is used to describe the dynamic E-modulus (E^*) as a function of frequency (f) and temperature (T).





Sigmoidal function

$$\log\left|E^*\right| = a_1 + \frac{a_2}{1 + e^{(a_3 - a_4 \log f_{red})}}$$

Reduced frequency

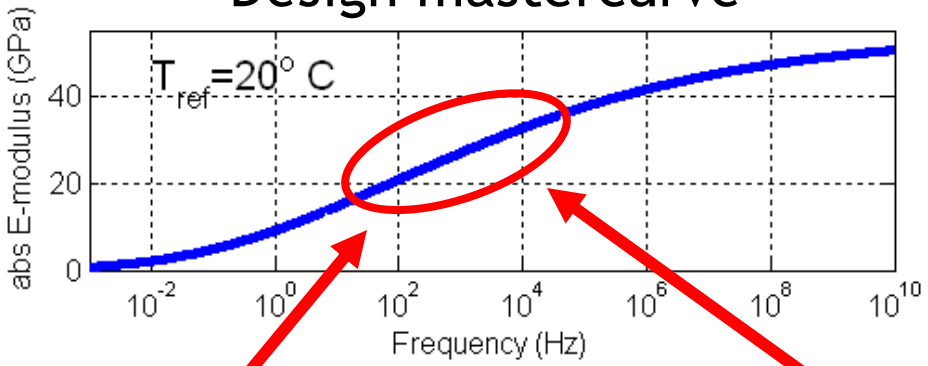
$$f_{red} = a_T f$$

Shift factor

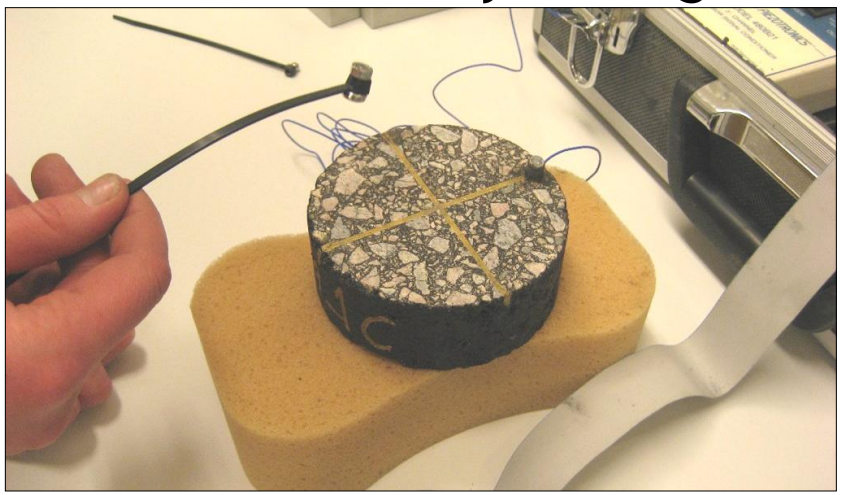
$$\log a_T = -\frac{C_1\left(T - T_{ref}\right)}{C_2 + T - T_{ref}}$$

Seismic Non-destructive quality control

Design mastercurve

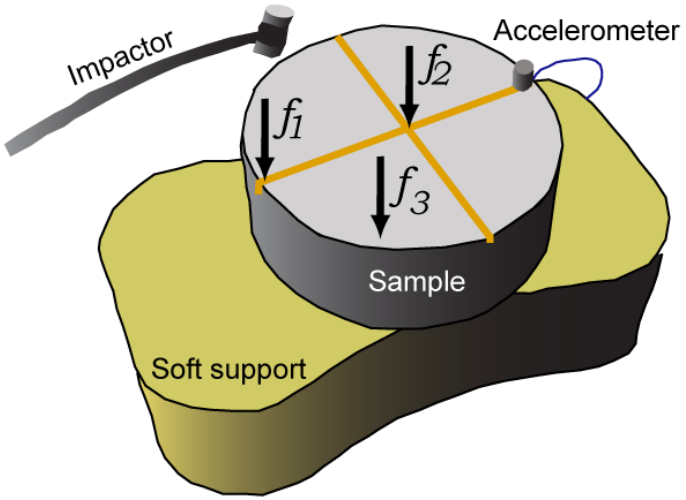


Seismic laboratory testing



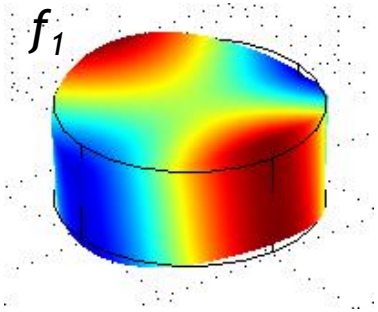
Seismic field testing

Seismic laboratory testing



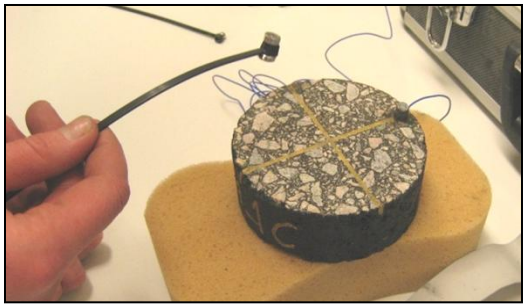
- *Dynamic E-modulus (E*)*
- *Geometry (L,D)*
- *Weight (m)*

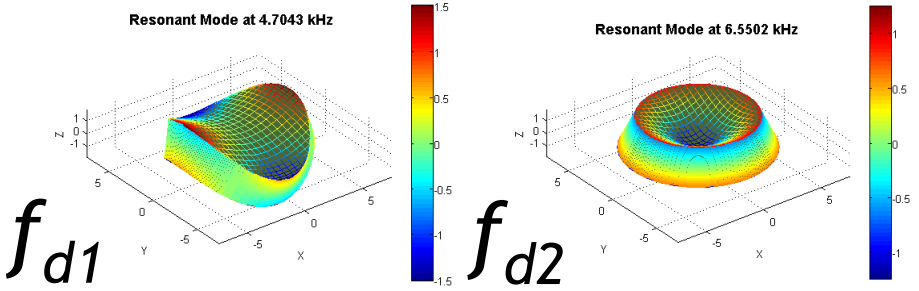
Resonance frequency (f)

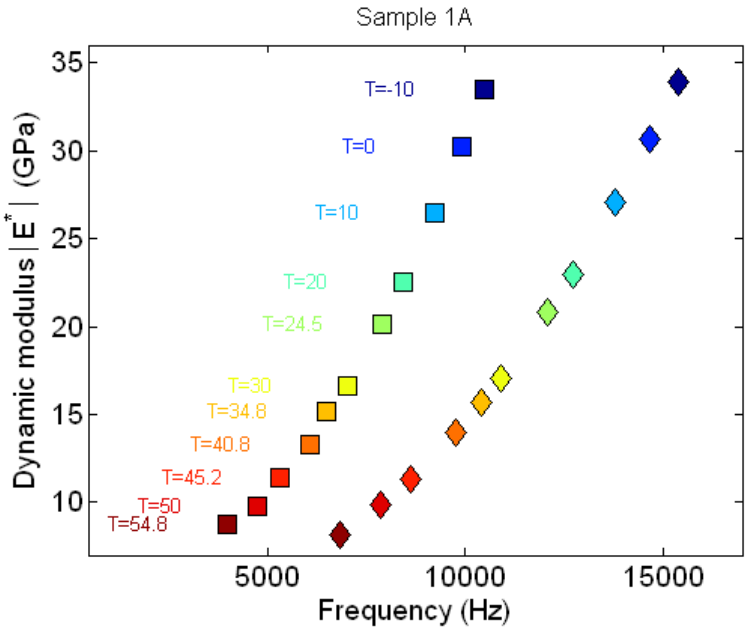


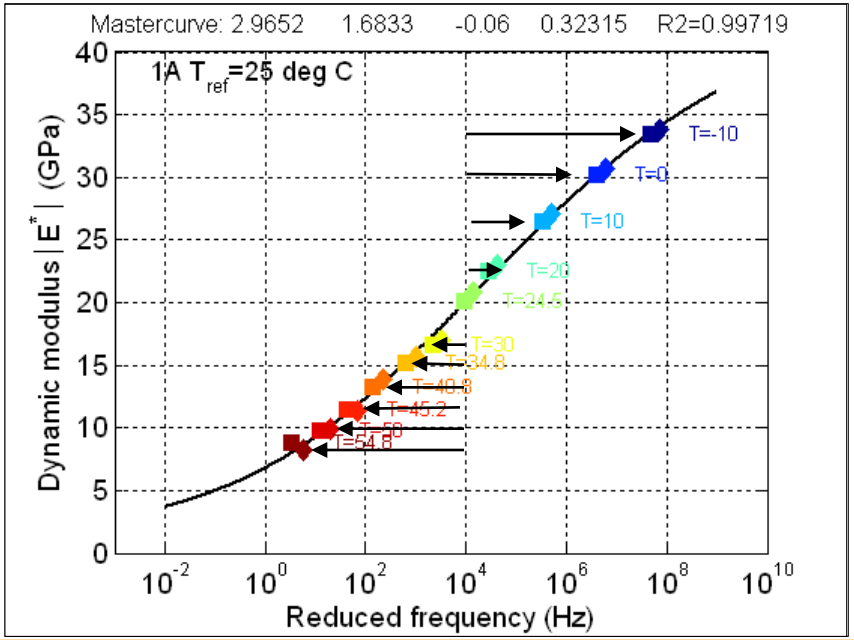
Seismic laboratory testing

Results from 3 polymer modified samples: 1A, 1B, 1C



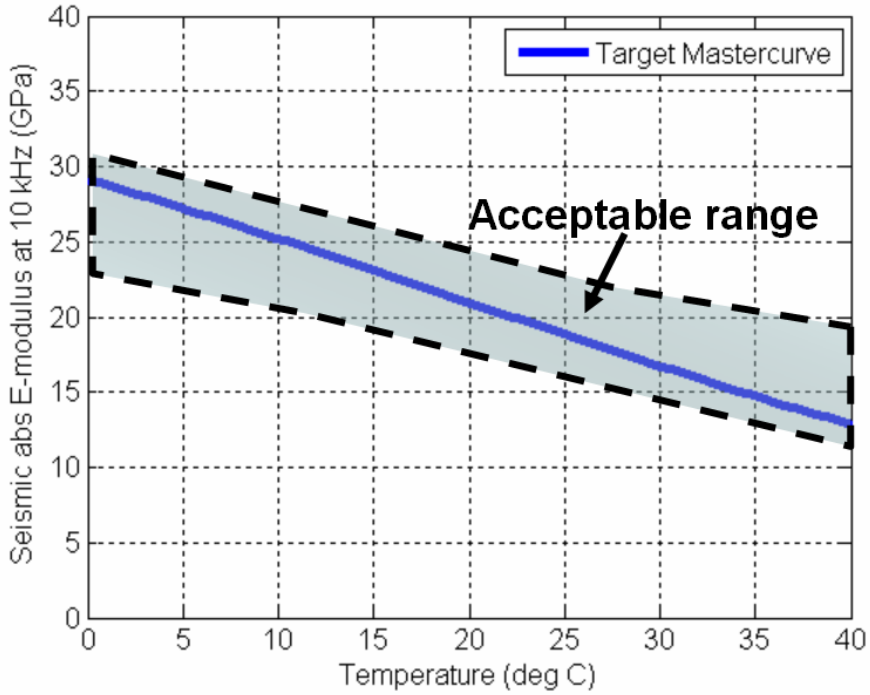






Seismic field testing

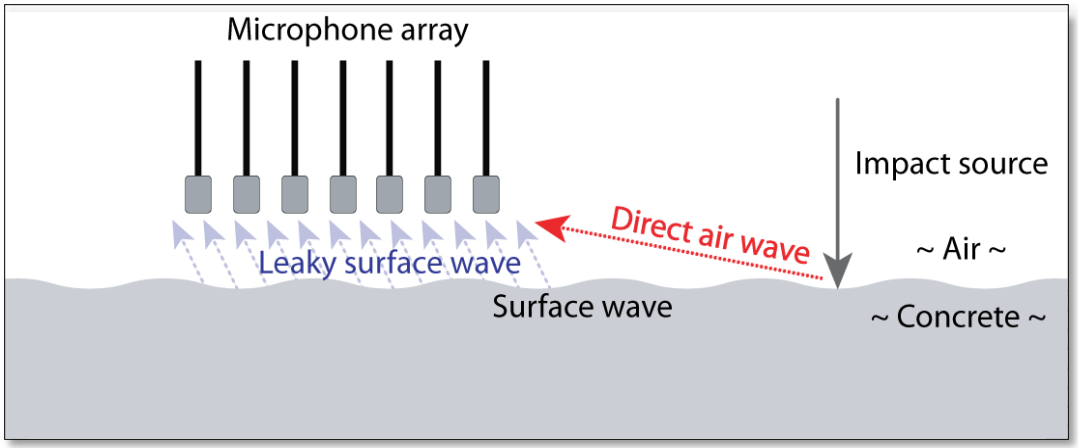
Design and laboratory testing gives an acceptable range for non-destructive quality control in the field at any temperature.



Seismic field testing

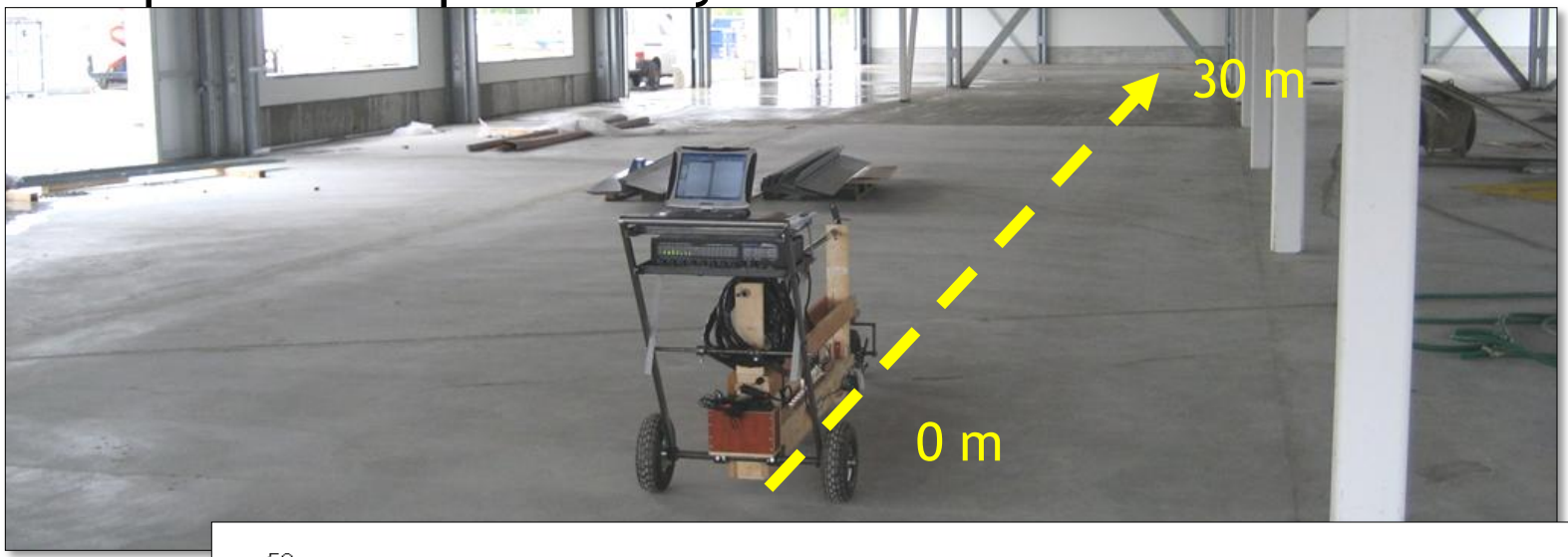
Non-contact surface wave testing in the field

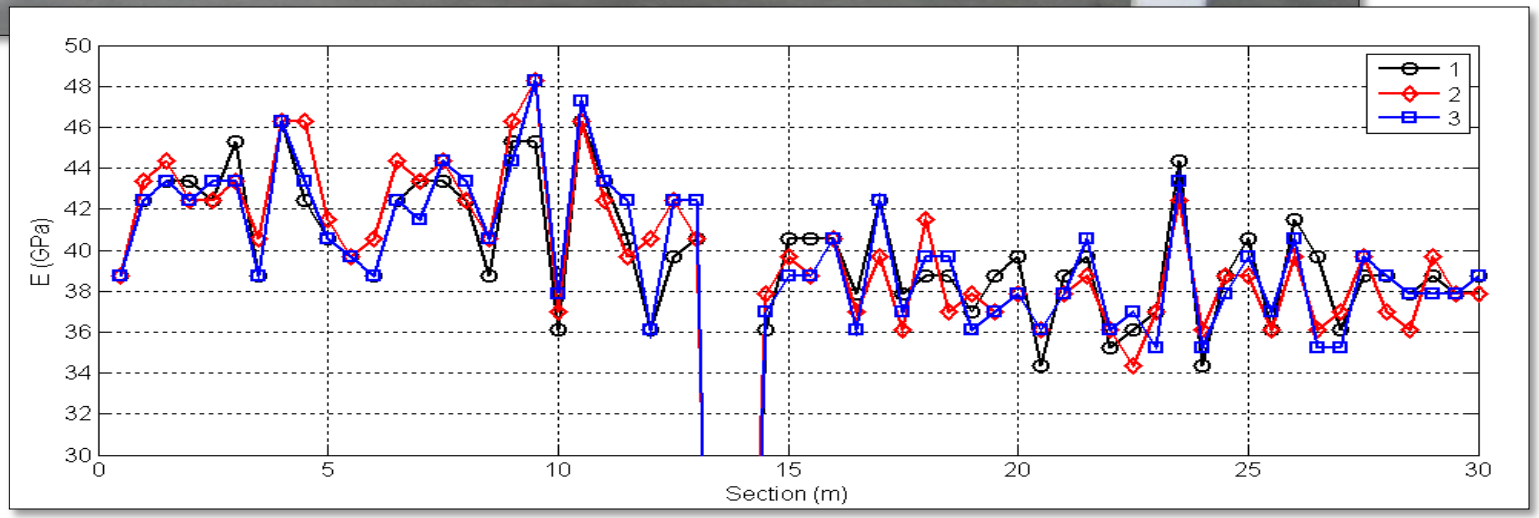
Prototype rolling array with automatic impact source



Seismic field testing

Example from repeatability test on concrete slab





Summary

- Future quality control of asphalt layers needs to be directly linked to the dynamic modulus (*E**) mastercurve used in design.

- Laboratory resonance frequency testing is a simple and cost effective method to measure *E** on arbitrary sized asphalt samples (high frequency mastercurve).

- Non-destructive seismic field testing can measure *E** on-the-fly using a rolling non-contact microphone array.