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Effect of temperature on asphalt pavement strain responses: APT data and thermo-viscoelastic pavement modelling

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Introduction

The thickness design of asphalt flexible pavements is generally constrained by a fatigue performance criterion of the asphalt base and intermediate layers, which is a function of the material characteristics and the pavement maximum tensile strain developed in the asphalt layers. The calibration of the fatigue performance relationship in a range of temperature conditions requires a good understanding of the effect of climatic conditions on pavement response.

The paper focuses on the simulation of the effect of traffic speed and asphalt temperature on tensile critical strains, including numerical modelling and comparison with APT pavement measured strains.

APR response to load data

IFSTTAR’s accelerated pavement testing (APT) facility simulates traffic loadings on full-scale test pavements. The device applies full truck axle loads in different configurations on the full-scale instrumented pavements. Longitudinal, transverse and vertical strains are monitored in the different pavement layers.

Pavements: Two asphalt pavement structures

Loading: single, tandem and a tridem (triaxle) with 42.5 kN wheel load and speeds between 4 km/h and 50 km/h.

Environment: the average temperature of the base course layer varied between 4°C and 38°C.

Instrumentation: Strain gauges were embedded in the materials at the interface of the layers during the construction of the pavement.

Database: 967 longitudinal and 1054 transverse strain signals.

Pavement modelling conditions

Flexural (complex) modulus measured on specimen extracted from the road bed.

Master curve built from the measured laboratory data

Thermo-viscoelastic model: Huet-Sayegh model used in ViscoRoute 2.0 fitted using ViscoAnalyse (IFSTTAR software).

Conclusion

Thermo-viscoelastic pavement modelling validated against measured pavement strains for wide range of loading and environmental conditions.

Challenges:
• Variability of the response measurements
• Simplification/validation of unbound and subgrade materials models