Characterisation of the 3D thermomechanical properties of bituminous pavement materials within the LVE domain

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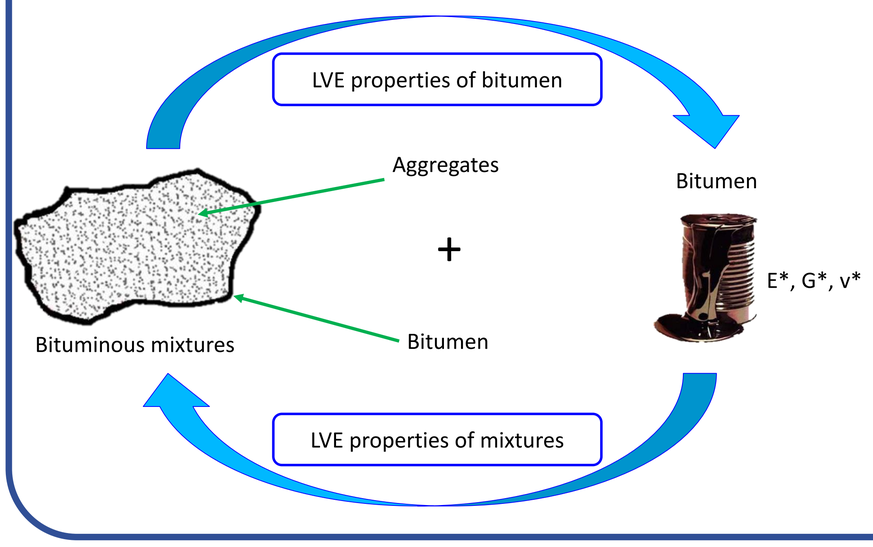
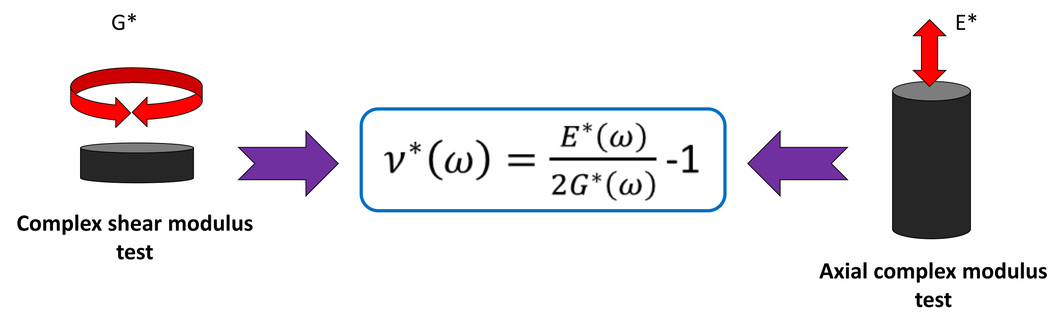
Context and objectives



OBJECTIVE

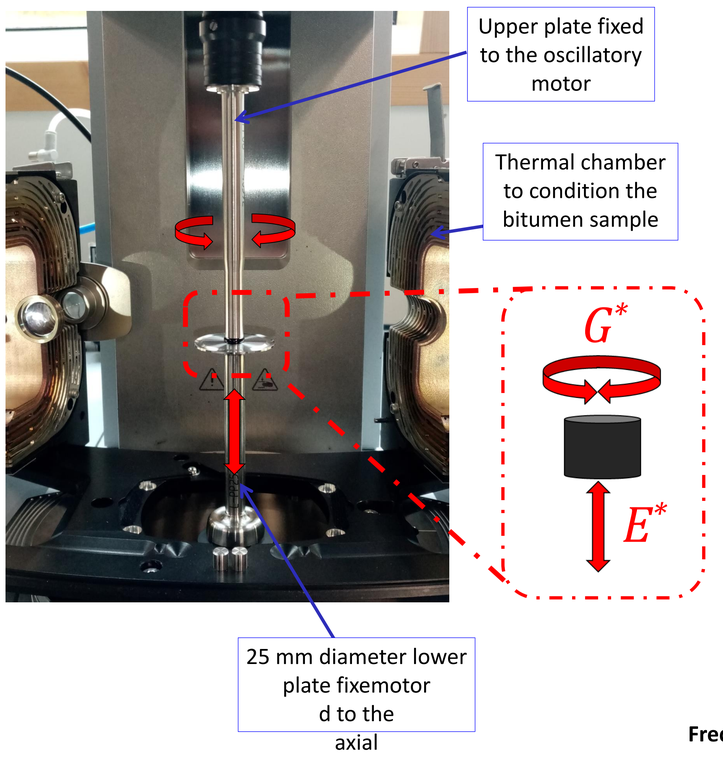
To develope a procedure to **experimentally determine Poisson's ratio (v*)** of bitumen through axial and shear complex modulus tests **using a Dynamic Shear Rheometer** equiped with an axial motor.



A <u>key preliminary step</u> is to study the effect of the aspect ratio of the sample, in order to choose the correct <u>sample geometry (diameter and thickness)</u>.

Experimental campaign

DEVICE

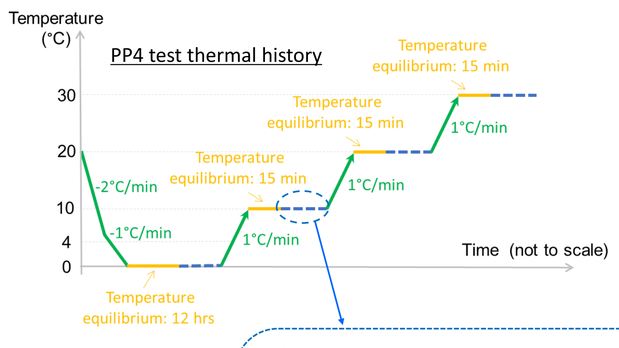


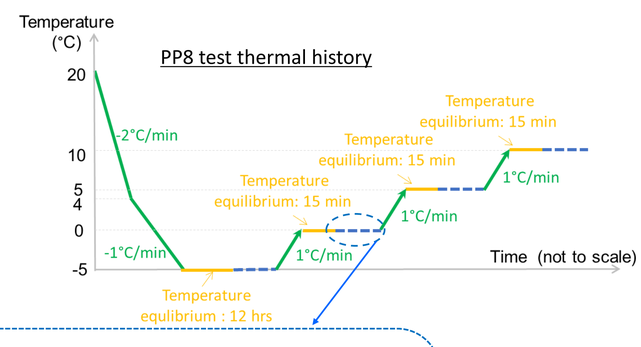
TEST PROCEDURE

DSR geometry type	DSR sample size: Diameter (mm)	Sample height (mm): 1.75	2	3	4	5	
Parallel plate	4	X		X	X	X	PP4
Parallel plate	8		X	X	X	X	PP8

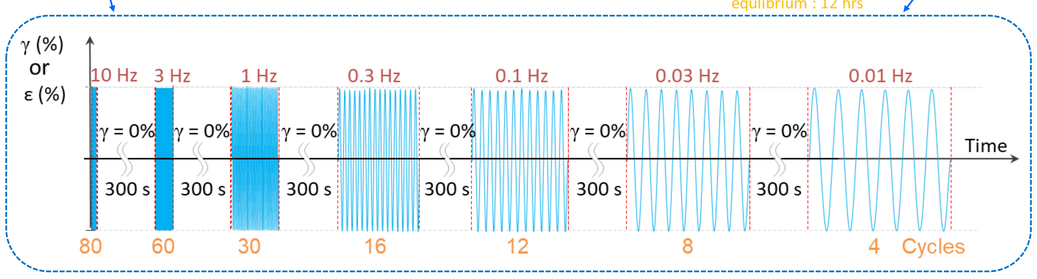
For each sample, complex modulus tests are performed first in shear mode (G*), then in axial mode (E*), at all temperatures.

Test conditions	
Temperatures	Frequencies (Hz)
-5°C, 0°C, 5°C, 10°C	0.01, 0.03, 0.1, 0.3, 1, 3, 10
0°C, 10°C, 20°C, 30°C	0.01, 0.03, 0.1, 0.3, 1, 3, 10



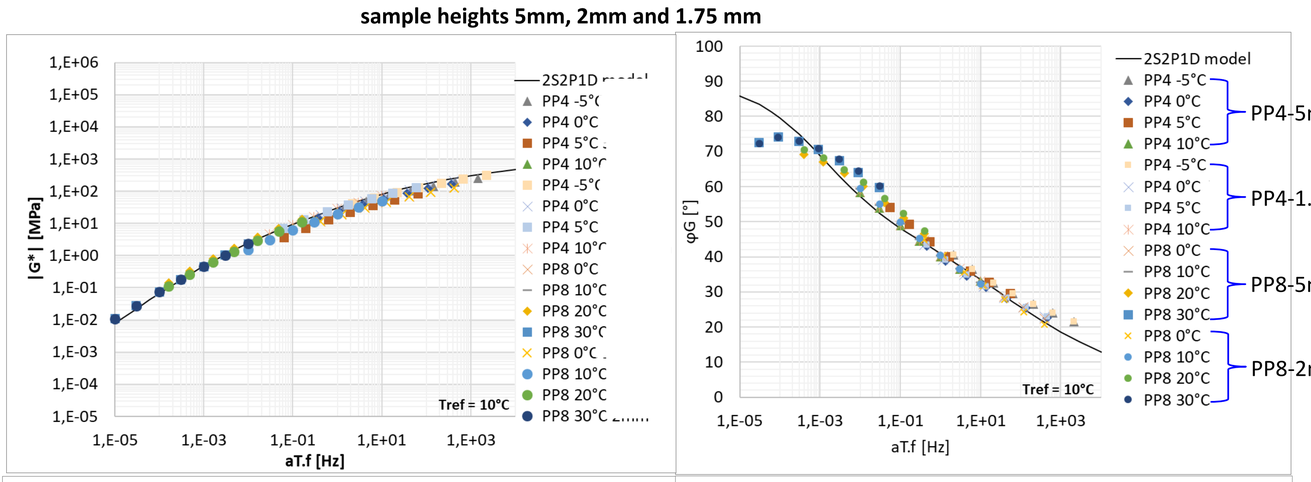


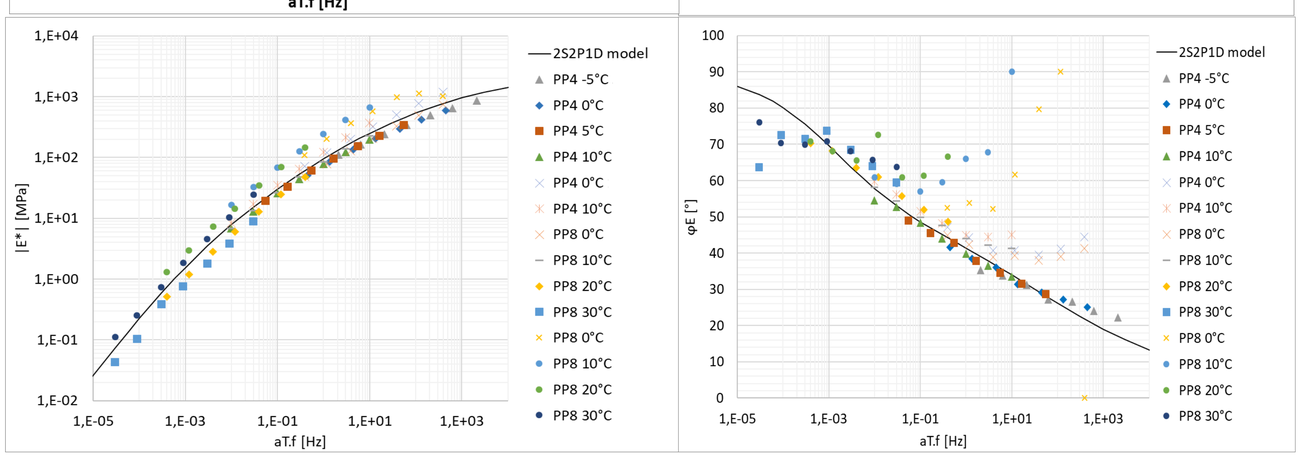
Frequency sweep test sequence



Example of Results

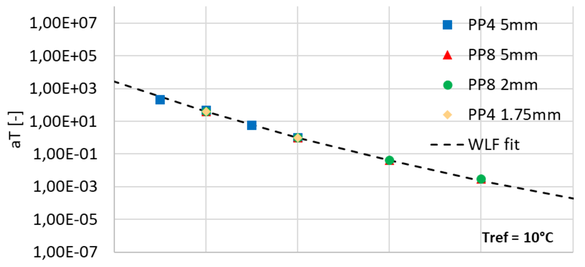
Master curves of shear complex and axial complex moduli at different sample heights 5mm, 2mm and 1.75 mm



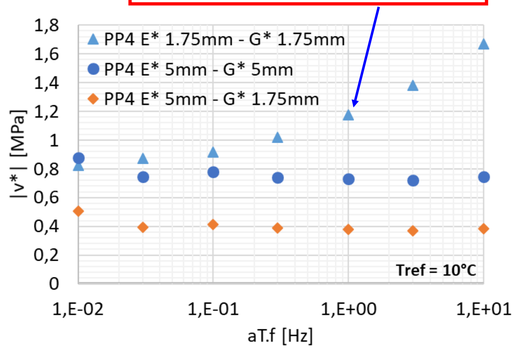


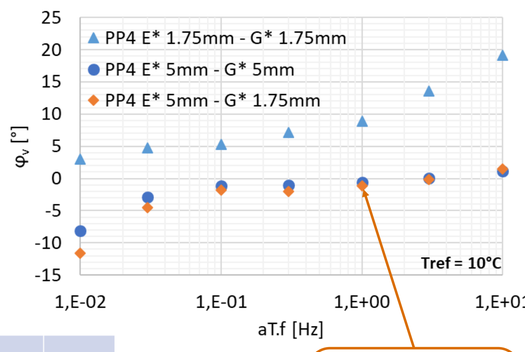
WLF fit of |E*| and |G*|

A unique WLF curve is fitted with the same shift factors aT of both shear and axial complex modulus



Oedometric condition approached, E* measured is not accurate. Oedometric condition is independent from temperature, it depends on the aspect ratio





Results from 5mm height |E*| and 1.75mm |G*| within expected limits

2S2P1D model and WLF constants

Sample heights	G_{00} (MPa)	G_0 (MPa)	k	h	δ	τ_E (10°C)	β	C_1	C_2
5, 2, 1.75	0	990	0.24	0.55	2.45	7.0E-04	300	38.88	244.33
	E_{00} (MPa)	E_0 (MPa)	k	h	δ	τ_E (10°C)	β	C_1	C_2
5, 2, 1.75	0	3000	0.24	0.55	2.45	6.0E-04	250	36.69	245.98

Conclusions

- The same set of shift factors can be used to generate master curves of shear and axial complex modulus at any sample height.
- Poisson's ratio results from combinations of 5mm |E*| and 1.75mm |G*| are coherent with values found in literature. FEM modelling of the results on-going to take into account oedometric condition.