Evaluating the Necessity of Standard Frequencies and Temperatures of RAP Mixture

By Michelle Kelly

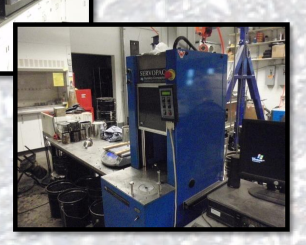
Overview:

- AASHTO TP62 currently states four temperatures at six frequencies need to be tested
- Standard temperatures (°C): 4.4, 21.1, 37.8, 54.4
- Standard frequencies (Hz): 25, 10, 5, 1, 0.5, 0.1
- Pilot to see the effect different frequencies, different temperatures, or both has on the master curve
- Potential to save time and money on testing

Methods:

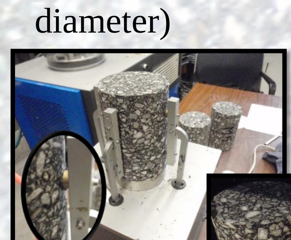
Specimen creation

- Specimens created according to ASSHTO T312
- 50 Gyration mix, 12.5 nmas, PG64-28, 30% RAP mix, produced in Portsmouth, NH at Pike Industries



- Asphalt Temperature 335°F discharge, 315°F compaction
- Material placed inside cylindrical molds and molded by gyratory compactor

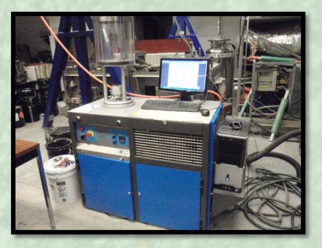
- Determined air voids before and after cutting and coring, Air void 6 +/- 0.5 SSD method AASHTO T166
- Coring with core drill and cut with industrial saw (150 mm tall, 100 mm diameter)

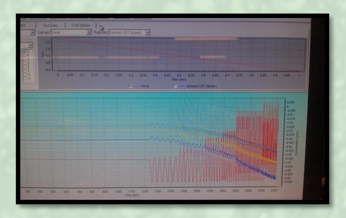


- 8 brackets were applied using bonding epoxy for sensor application
- Six specimen were created, but only 5 were used for experimentation

Testing

- UTS019 program used
- Sinusoidal load applied using AMPT (Asphalt Mixture Performance Tester)





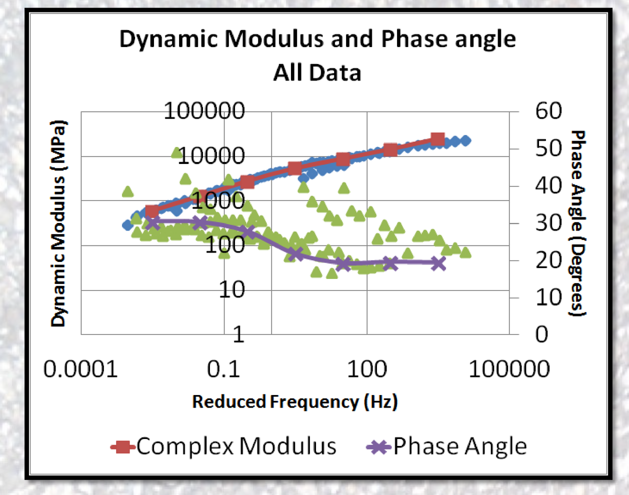
- Environmental chamber used to ensure accurate temperatures
- Loose core LVDTs measured deformation of asphalt
- Tested 5 specimen at 21 frequencies (Hz) and 5 temperatures (°C):

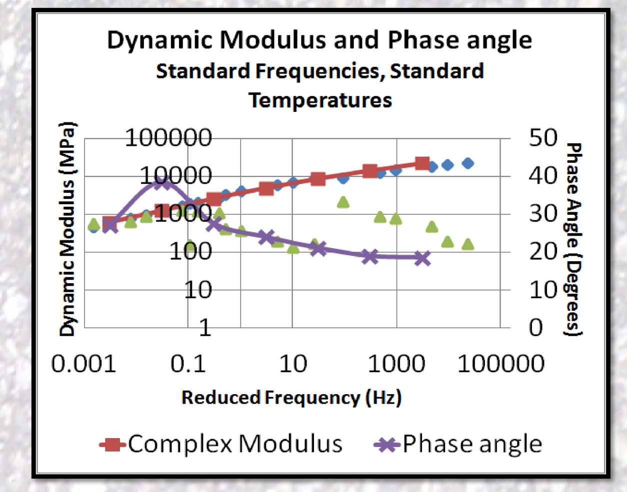
4.4°C(40°F)	12.8°C(55°F)	21.1°C(70°F)	29.4°C(85°F)	37.8°C(100°F)
0.01 Hz	0.01 Hz	0.01 Hz	0.01 Hz	0.1 Hz
0.015 Hz	0.015 Hz	0.015 Hz	0.015 Hz	0.15 Hz
0.025 Hz	0.025 Hz	0.025 Hz	0.025 Hz	0.25 Hz
0.035 Hz	0.035 Hz	0.035 Hz	0.035 Hz	0.35 Hz
0.05 Hz	0.05 Hz	0.05 Hz	0.05 Hz	0.5 Hz
0.07 Hz	0.07 Hz	0.07 Hz	0.07 Hz	0.7 Hz
0.1 Hz	0.1 Hz	0.1 Hz	0.1 Hz	1 Hz
0.15 Hz	0.15 Hz	0.15 Hz	0.15 Hz	1.5 Hz
0.25 Hz	0.25 Hz	0.25 Hz	0.25 Hz	2.5 Hz
0.35 Hz	0.35 Hz	0.35 Hz	0.35 Hz	3.5 Hz
0.5 Hz	0.5 Hz	0.5 Hz	0.5 Hz	5 Hz
0.7 Hz	0.7 Hz	0.7 Hz	0.7 Hz	7 Hz
1 Hz	1 Hz	1 Hz	1 Hz	10 Hz
1.5 Hz	1.5 Hz	1.5 Hz	1.5 Hz	15 Hz
2.5 Hz	2.5 Hz	2.5 Hz	2.5 Hz	25 Hz
3.5 Hz	3.5 Hz	3.5 Hz	3.5 Hz	
5 Hz	5 Hz	5 Hz	5 Hz	
7 Hz	7 Hz	7 Hz	7 Hz	
10 Hz	10 Hz	10 Hz	10 Hz	
15 Hz	15 Hz	15 Hz	15 Hz	
25 Hz	25 Hz	25 Hz	25 Hz	

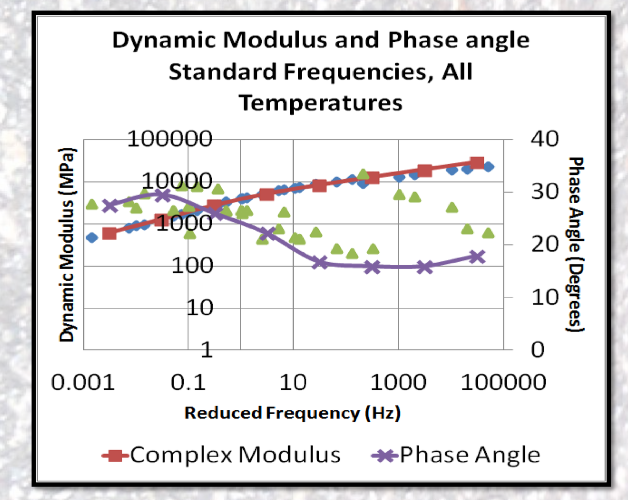
Data Analysis

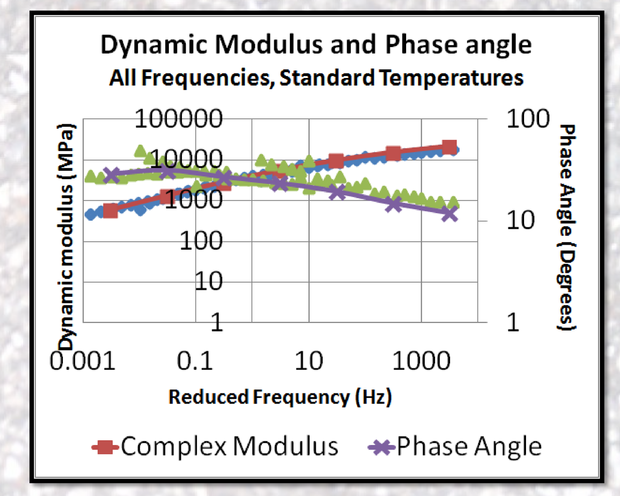
- MATLAB used to filter data, intended to capture 100 samples per cycle
- Excel formulas used to find dynamic modulus and phase angles
- Rhea used to shift data to the Master curve

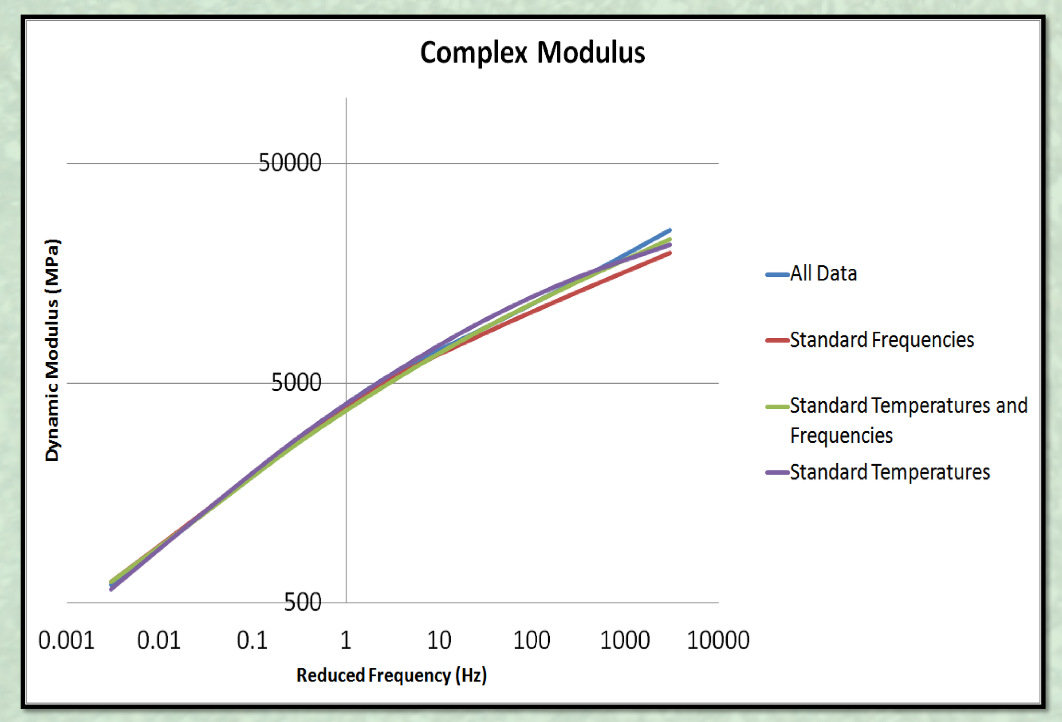
Results:

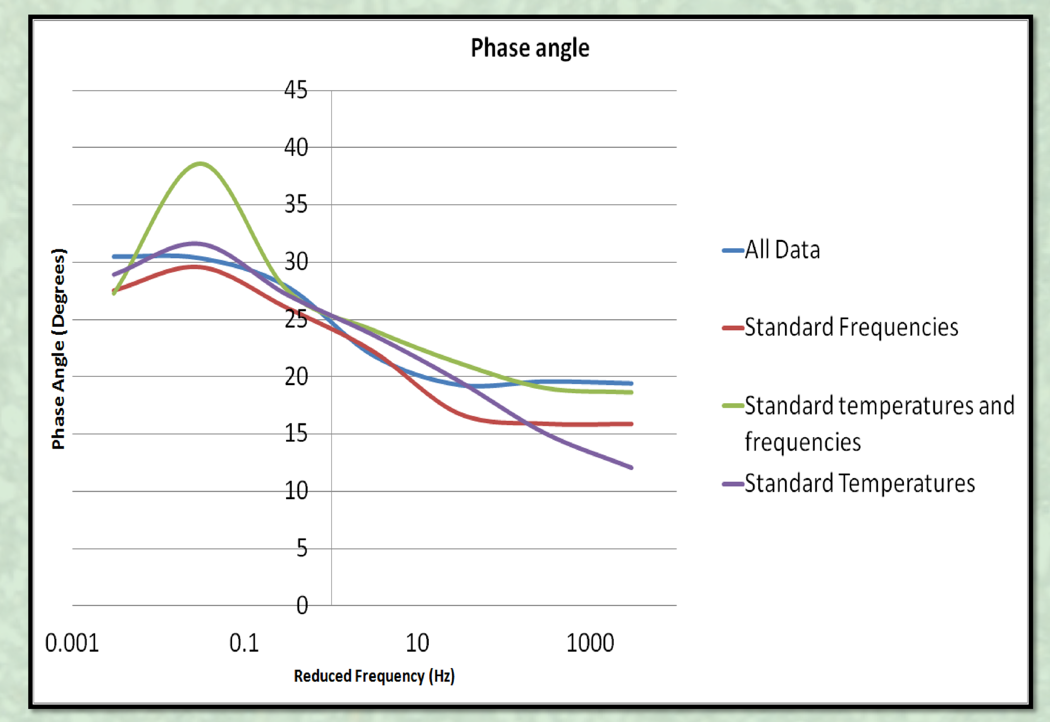












Summary:

- All of the data (with nothing taken out) appears to be more stiff at the coldest temperature
- The standard temperatures and frequencies appear to be less stiff then the standard frequencies, all temperatures in the middle temperatures and then switch at low temperatures
- Standard Temperatures appears to be most elastic at low temperatures (high reduced frequency)

Acknowledgements:

Dr. Jo Daniel, David Mensching, Sonja Pape, Christopher Jaques, UNH Civil Engineering Department
Dr. Steve Hale and Dr. Erin Bell, UNH RETE principal investigators
Research was funded through NSF #1132648

Future work:

- Complete testing on 46.1°C (115°F) and 54.4°C (130°F) at all frequencies
- Find dynamic modulus and phase angle of all five specimen tested
- Take out small pieces of the data to see the effect