

RAP Binder Properties

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Binder properties from RAP mixes

- How do we estimate binder properties and effectiveness of binder mixing in RAP materials

G* estimation from E* data

- Back-calculation using Hirsch model

$$E^*_m = P_c \left[4,200,000 \left(1 - \frac{VMA}{100} \right) + 3G^*_b \left(\frac{VFA \times VMA}{10,000} \right) \right] + (1 - P_c) \left[\frac{1 - \frac{VMA}{100}}{4,200,000} + \frac{VMA}{3 \times VFA \times G^*_b} \right]^{-1}$$

$$P_c = \frac{\left(20 + \frac{VFA \times 3G^*_b}{VMA} \right)^{0.58}}{650 + \left(\frac{VFA \times 3G^*_b}{VMA} \right)^{0.58}}$$

- This provides G* as a function of frequency

G* model then fitted to model

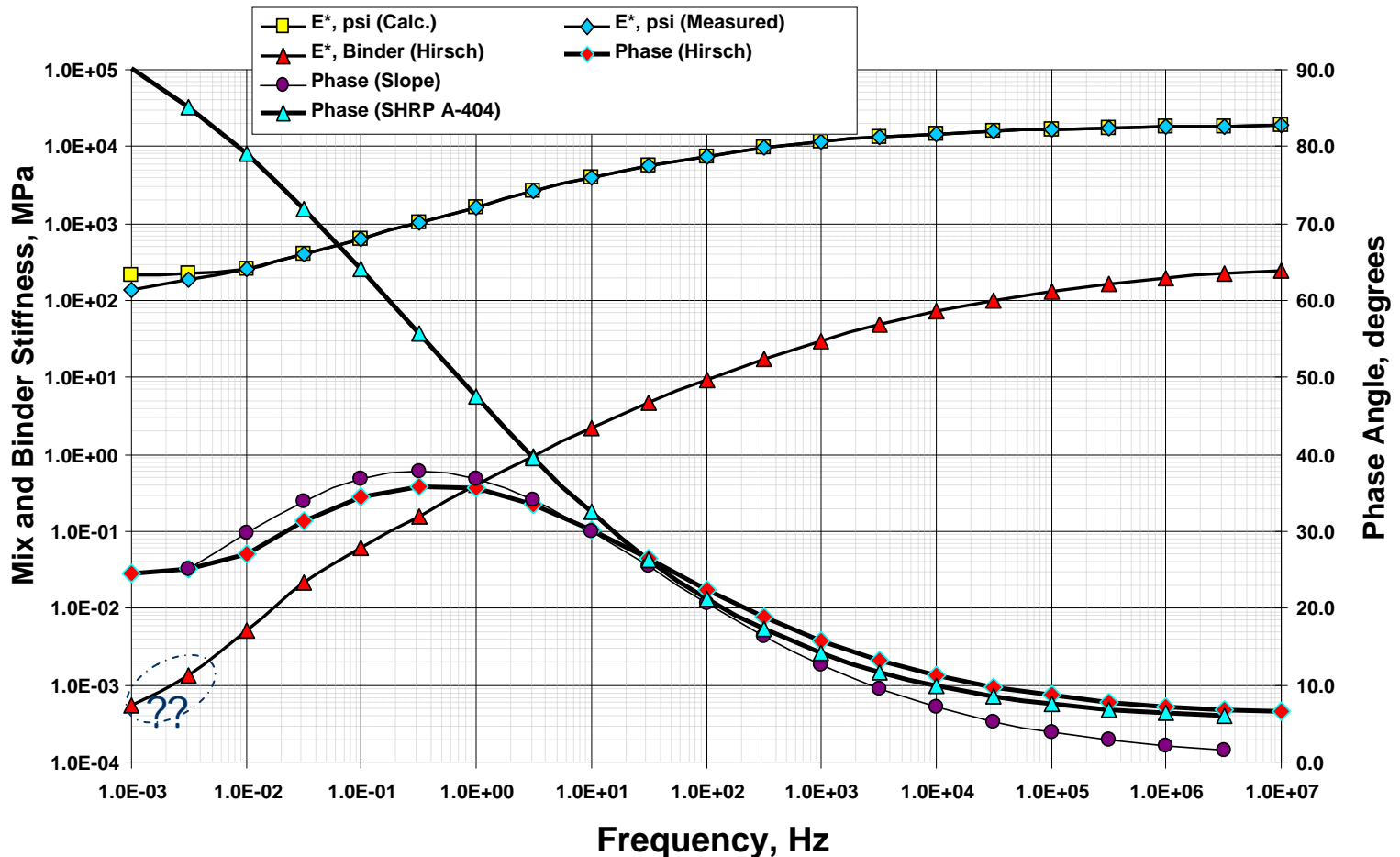
- Fit back-calculated G* to Christensen-Anderson model

$$G^*(\omega) = G_0 \left[1 + (\lambda/\omega)^\beta \right]^{-1/\beta}$$

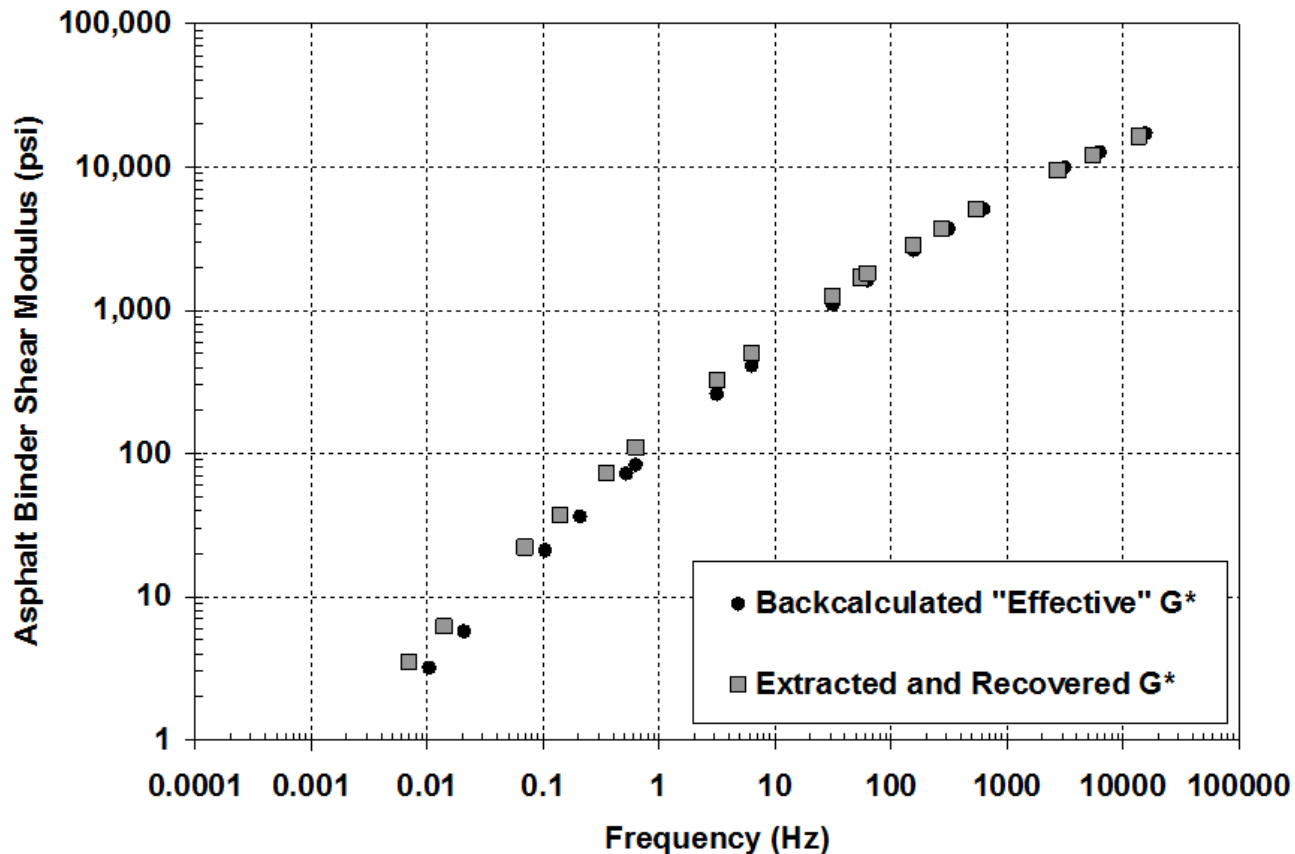
$$\delta(\omega) = 90 \left[1 + (\omega/\lambda)^\beta \right]^{-1}$$

- Enables complete description of G* and δ curve

Example RAP – mix to binder



Example – back-calculated vs. recovered



Usefulness of method

1. Data is needed for binder (G^* , d) as input for MEPDG
2. Can use this to assess the effectiveness of the RAP binder re-mixing with the virgin additional added binder