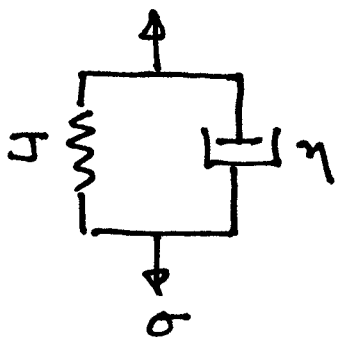
4.8 (a) Kelvin (Voigt) model



parallel: $\gamma_s = \gamma_d = \gamma$

$$\sigma = \sigma_s + \sigma_d = \frac{1}{J}\gamma + \eta\dot{\gamma}$$

$$J\sigma = \gamma + \underbrace{J\eta}_{\tau \to \tau_r}\dot{\gamma} = \gamma + \tau_r\dot{\gamma}$$

Laplace:

$$J\bar{\sigma} = \bar{\gamma} + \tau_r \cdot s\bar{\gamma} = (1+\tau_r s)\bar{\gamma}$$

$$= \tau_r\left(s + \frac{1}{\tau_r}\right)\bar{\gamma}$$

Creep: $\sigma = \sigma_0 u(t) \rightarrow \bar{\sigma} = \sigma_0/s$

$$\frac{\bar{\gamma}}{\sigma_0} \equiv \bar{J}_{cep} = \frac{J}{\tau_r \cdot s\left(s+\frac{1}{\tau_r}\right)}$$

$$J_{cep} = J\left(1 - e^{-t/\tau_{cep}}\right)$$

$\gamma: \frac{1}{s(s+a)} = \frac{1}{a}(1-e^{-at})$