

$$\Rightarrow W = \frac{48 E I \delta}{L^3}$$

Get modulus, E , from
isochronal $\approx 910 \text{ MPa}$

\Rightarrow

$$W = 76.4 \text{ N}$$

KELVIN MODEL

$$\sigma = k\varepsilon + \mu \dot{\varepsilon}$$

CREEP: constant stress σ_0

$$\sigma_0 = k\varepsilon + \mu \dot{\varepsilon} \quad \leftarrow \text{Differential Eqn}$$

$$\text{Solution } \varepsilon = \frac{\sigma_0}{k} \left[1 - e^{-\left(\frac{k}{\mu}t\right)} \right]$$

$$t=0 \quad e^{-\frac{k \cdot 0}{\mu}} = 1 \Rightarrow \varepsilon = 0$$

$$t \rightarrow \infty \quad e^{-\frac{k \cdot t}{\mu}} \rightarrow 0 \quad \varepsilon \Rightarrow \frac{\sigma_0}{k} \quad \text{strain you'd get with spring alone}$$

ε goes from 0 to $\frac{\sigma_0}{k}$ asymptotically

RELAXATION: constant STRAIN $\Rightarrow \dot{\varepsilon} = 0$
 $\varepsilon = \varepsilon'$

$$\dot{\varepsilon} = \frac{d\varepsilon}{dt}$$

$$\sigma = k\varepsilon' + \cancel{\mu(0)} \Rightarrow \sigma = k\varepsilon'$$

σ is constant too.

RECOVERY REMOVE STRESS WHILE @ strain level ε' $\sigma = 0$

$$0 = k\varepsilon + \mu \dot{\varepsilon}$$

$$\varepsilon = \varepsilon' e^{-\left[\frac{k}{\mu}t\right]} \quad \text{i.e. another asymptote.}$$

$$[t=0, \varepsilon = \varepsilon'] \quad [t \rightarrow \infty, \varepsilon \rightarrow 0]$$

MAXWELL MODEL:

$$\sigma_1 = k \epsilon_1 \quad \text{spring}$$

$$\sigma_2 = \mu \dot{\epsilon}_2 \quad \text{DAMPER}$$
$$= \mu \frac{d\epsilon_2}{dt}$$

IN SERIES

$$\sigma = \sigma_1 = \sigma_2$$

$$\epsilon = \epsilon_1 + \epsilon_2$$

$$\Rightarrow \dot{\epsilon} = \dot{\epsilon}_1 + \dot{\epsilon}_2$$

$$\dot{\epsilon}_2 = \frac{\sigma_2}{\mu}$$

$$\epsilon_1 = \frac{\sigma_1}{k} \Rightarrow \dot{\epsilon}_1 = \frac{\dot{\sigma}_1}{k}$$

$$\dot{\epsilon} = \frac{\sigma_2}{\mu} + \frac{\dot{\sigma}_1}{k} = \frac{\sigma}{\mu} + \frac{\dot{\sigma}}{k}$$

CREEP const stress = σ_0
 $\Rightarrow \dot{\sigma} = 0$

$$\dot{\epsilon} = \frac{\sigma_0}{\mu} + 0 = \text{constant.}$$

ϵ increasing in a straight line FOREVER with no limit

THERE WILL BE AN INITIAL ELASTIC STRETCH EQUAL TO $\epsilon = \frac{\sigma_0}{k}$ i.e. EQUAL TO final limit of KELVIN ~~model~~ ^{MODEL}

STRESS RELAXATION

LD CONST STRAIN $\Rightarrow \dot{\epsilon} = 0$

$$0 = \frac{\sigma}{\mu} + \frac{\dot{\sigma}}{k} \Rightarrow \text{DIFFERENTIAL EQUATION}$$

$$\sigma = \sigma_0 e^{-\left(\frac{k t}{\mu}\right)} \quad \sigma = \sigma_0 @ t = 0$$

RECOVERY

LD REMOVE STRESS

ELASTIC STRAIN RECOVERS INSTANTLY

$$\Rightarrow \epsilon_e \rightarrow 0$$

NO further recovery.

$$\sigma = 0 \quad \dot{\sigma} = 0$$

$$\dot{\epsilon} = 0$$

ELASTIC RECOVERY =

$\frac{\sigma'}{k}$ \swarrow STRESS in SYSTEM at MOMENT of ~~RELAXATION~~ LOAD REMOVAL