Analysis and Prediction of Large Composite Structures: Three Case Studies

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Airbus A 380 Section 19 Frame

Analysis and Prediction of Large Composite Structures: Three Case Studies

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- material behavior = response to load & deformation
  - instantaneous
  - time dependent
- creep in different materials
- master curves
- examples

Material Behavior / Models

mechanical models

elastic = spring (Hookeian)

viscous = dashpot (Newtonian)

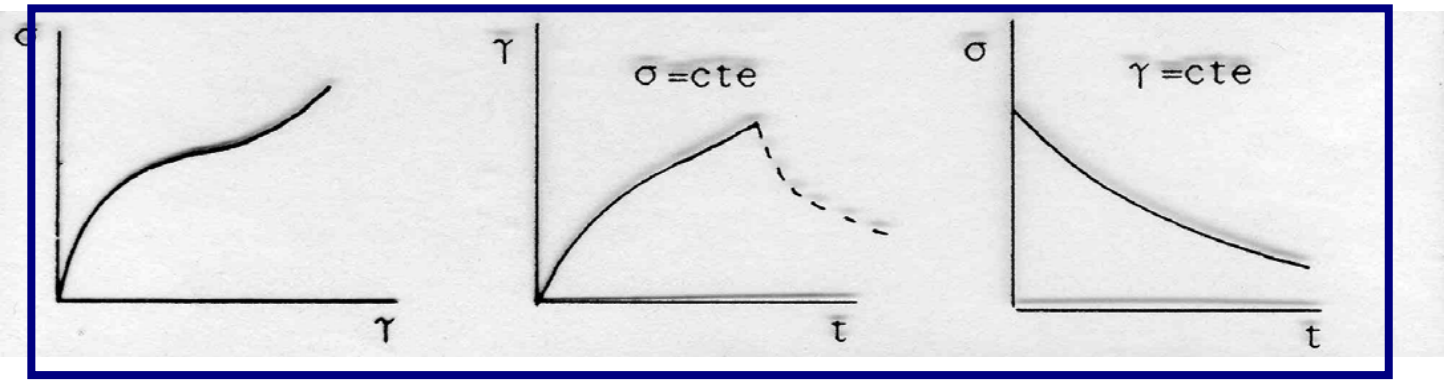
viscoelastic = combination

creep test

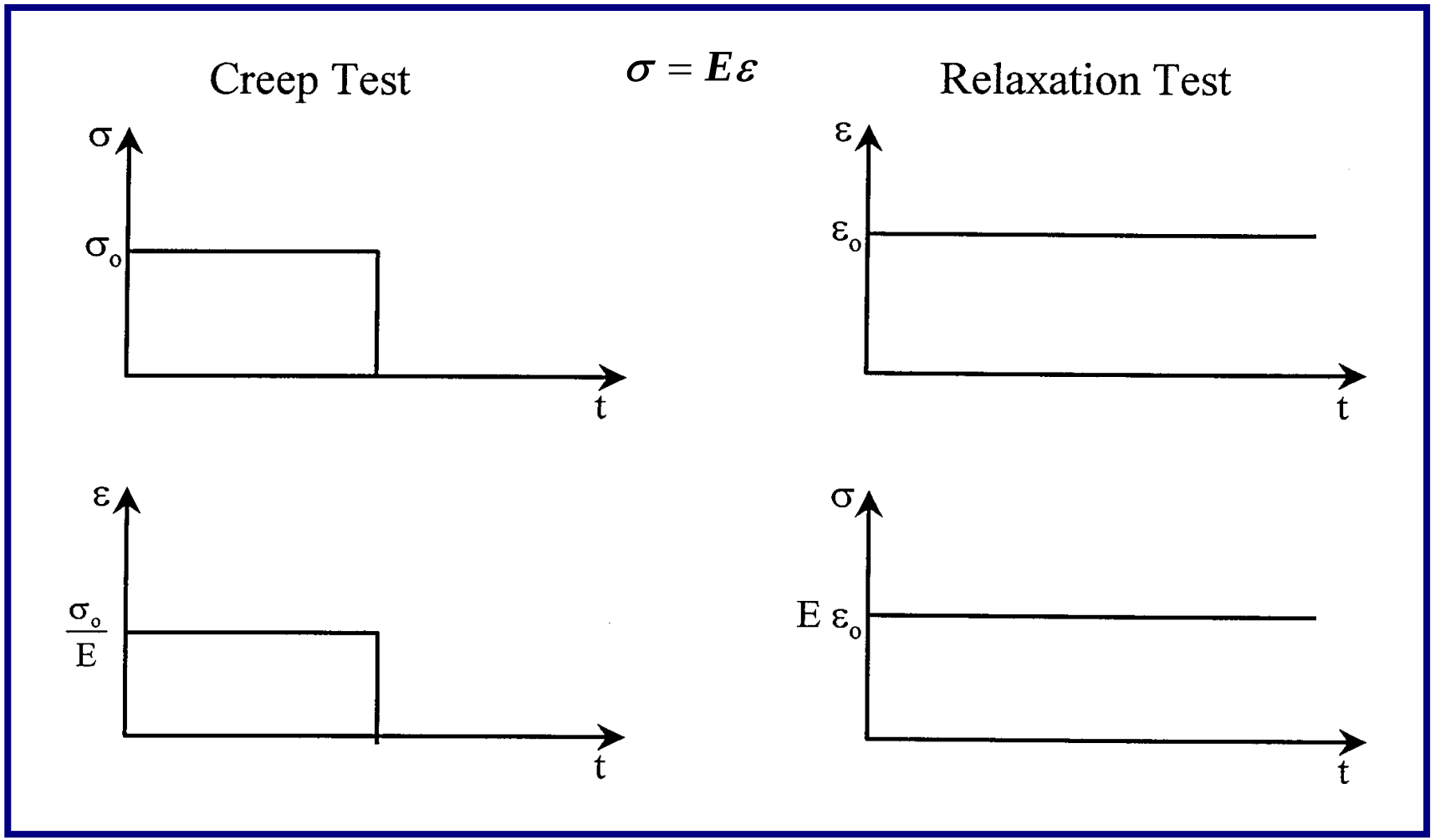
response to constant load

relaxation test

response to constant deformation

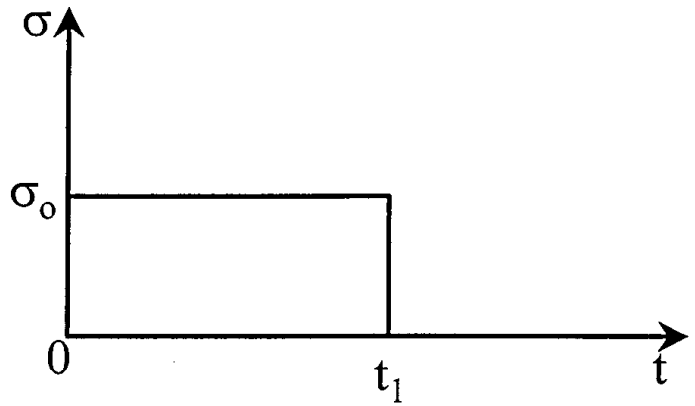


Material Behavior / Models (ELASTIC)



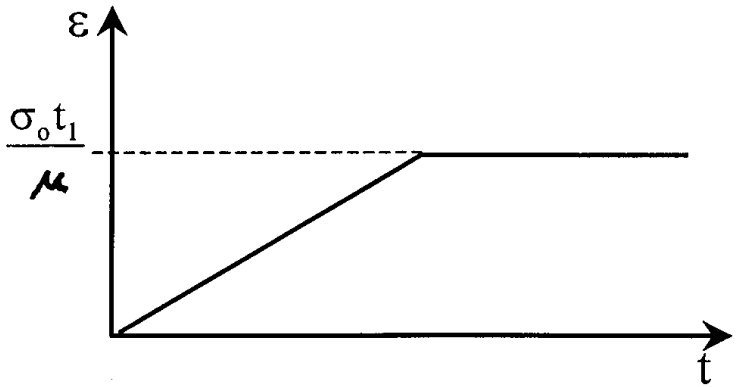
Material Behavior / Models (VISCOUS)

Creep Test



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

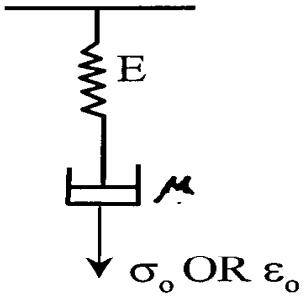
$$\tau = \dot{\gamma}\eta$$



$$E = 2(1+\upsilon)G$$

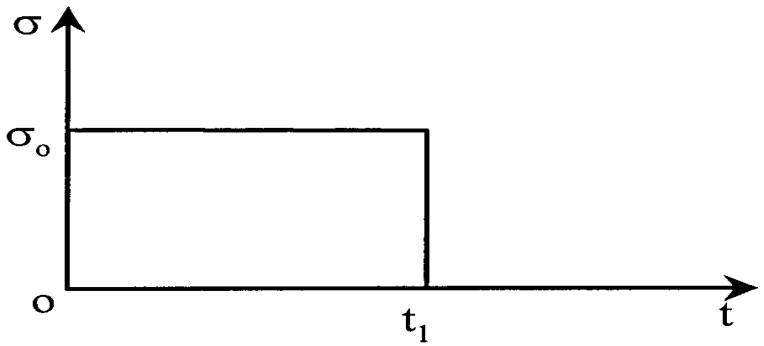
for $\upsilon = 0.5;\ \mu = 3\eta$

Viscoelastic solids (MAXWELL Model)

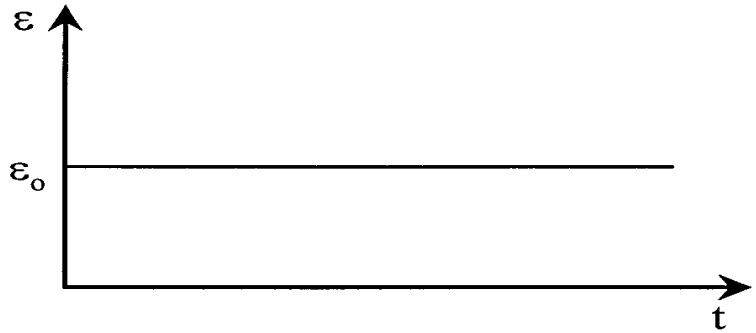


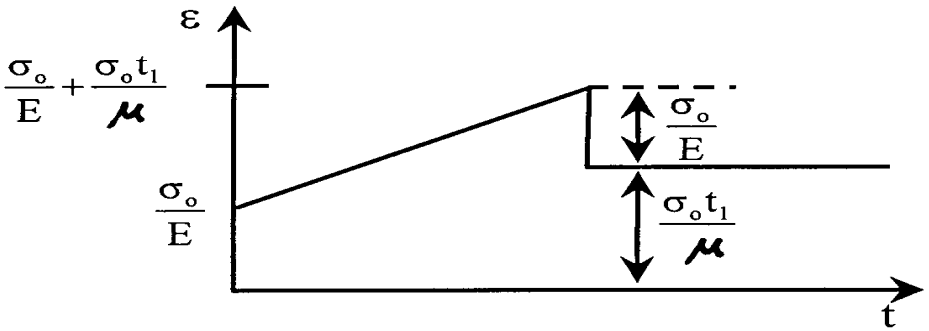
Elements in Series
Same Stress Acts on Both Elements

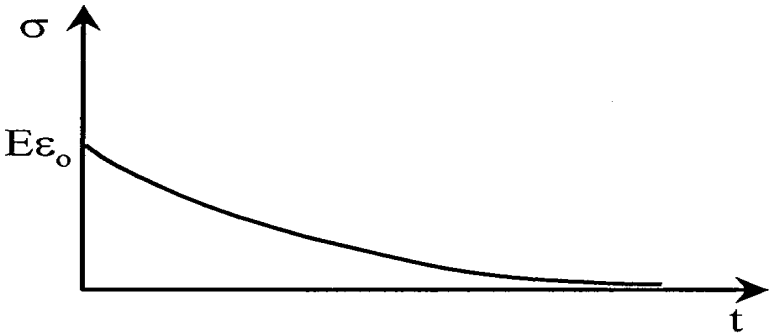
Creep Test



Relaxation Test







Viscoelastic solids (MAXWELL Model)

spring + dashpot in series
creep test

$$\varepsilon(t) = \sigma_0 \left(\frac{1}{E} + \frac{t}{\mu}\right)$$

relaxation test

$$\sigma(t) = E\varepsilon_0 e^{-\frac{E}{\mu}t}$$

$$\frac{\mu}{E} = \text{relaxation time} = \tau \text{ or } \theta$$

$\sigma = \sigma_0 e^{-t/\theta_1}$ $\theta_1 = \eta_1 / E_1$ $\gamma = (\sigma_0/E_1) + (\sigma_0/\eta_1)t$ $\sigma = 0.37\sigma_0$ per $t = \theta_1$

Material Behavior / Models

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