

Viscoelasticity – Lecture 4

2 Viscoelastic Behaviour

2.1 Boltzmann Superposition Principle

- For a Linear Viscoelastic material, this proposes that
 - Strain response due to complex loading is the sum of the strains due to each step

$$\text{Modulus} = E(t) = \frac{\sigma}{\epsilon(t)}$$

If stress σ_0 applied at zero time...

$$\Rightarrow \text{creep strain} = \epsilon(t) = \frac{\sigma_0}{E(t)}$$

If stress σ_1 applied at time u ...

$$\Rightarrow \text{creep strain} = \epsilon(t) = \frac{\sigma_1}{E(t-u)}$$

3 Viscoelastic Behaviour

3.1 Boltzmann Superposition Principle

Suppose there is a series of stress increments, starting at $t = 0$

$$\epsilon(t) = \sum_{i=0}^N \frac{\sigma_i}{E(t-u_i)}$$

In limit, this becomes an integration

$$\Rightarrow \epsilon(t) = \int_0^t \frac{1}{E(t-u)} \left(\frac{d\sigma(u)}{du} \right) du$$

and...

$$\Rightarrow \sigma(t) = \int_0^t E(t-u) \left(\frac{d\epsilon(u)}{du} \right) du$$

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4.1 Boltzmann Superposition Principle

