Fatigue & Fracture

Worked Example 1 – Fatigue

Department of Mechanical, Materials & Manufacturing Engineering

MMME2053 – Mechanics of Solids

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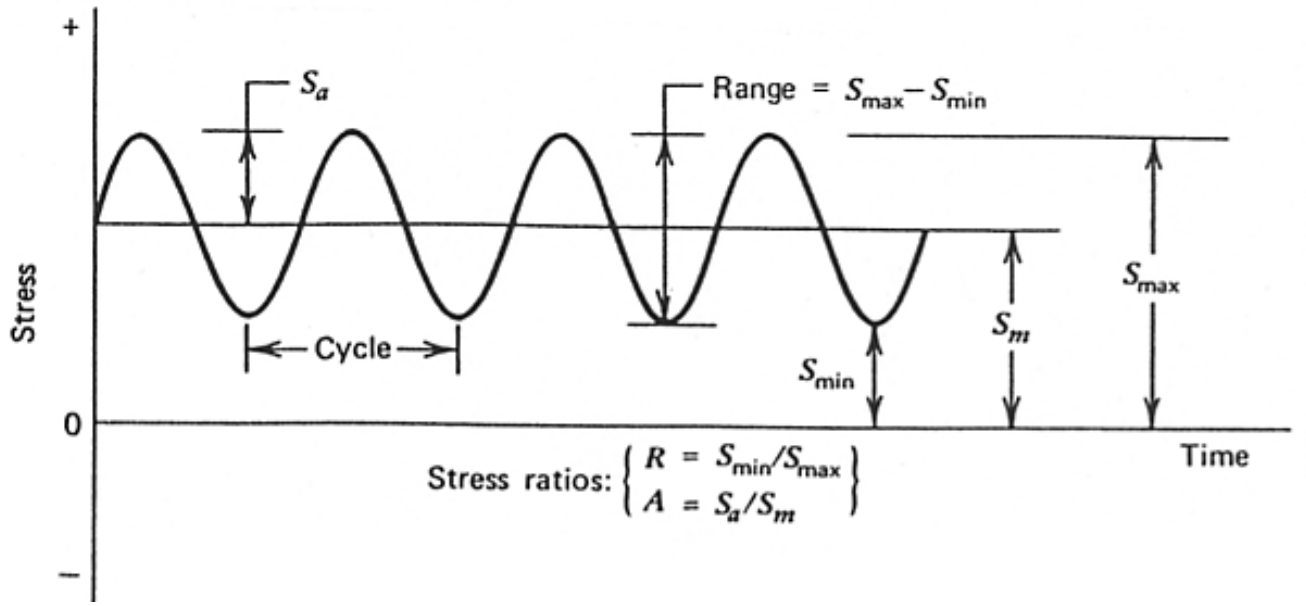
Worked Example 1

Fatigue of a Component

A component is made from a material with an ultimate tensile strength of 300 MPa. The component will be cyclically loaded such that the mean stress is 65 MPa. Using a modified Goodman line, determine the maximum allowable stress amplitude if a safety factor of 1.1 is required. Assume an endurance limit for the material of 100 MPa and a fatigue notch strength reduction factor of 1.75 for the component.

Solution



$\sigma_m = 65$ MPa

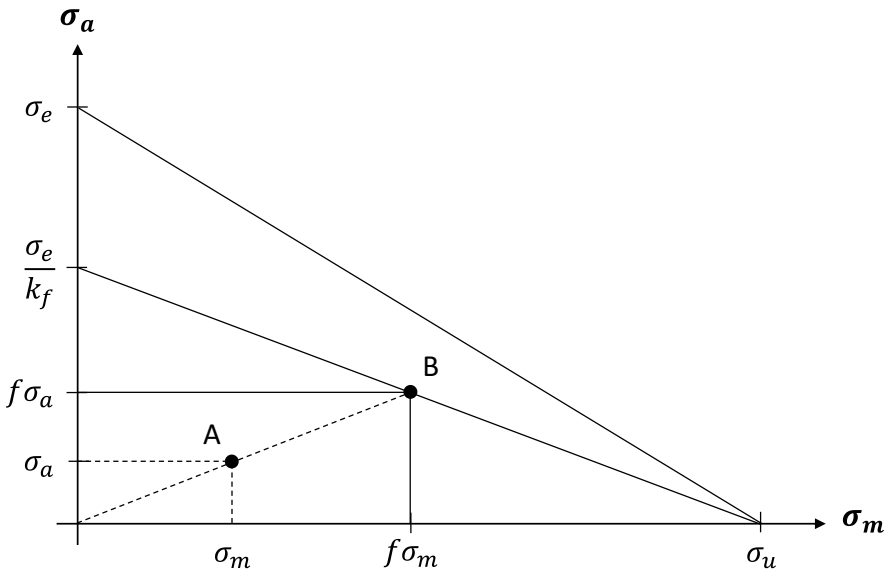
$\sigma_u = 300$ MPa

$\sigma_e = 100$ MPa

$f = 1.1$

$k_f = 1.75$

$\sigma_a = ???$



From similar triangles:

$$\frac{\sigma_e}{k_f \sigma_u} = \frac{f\sigma_a}{\sigma_u - f\sigma_m}$$

$$\therefore \sigma_a = \frac{\sigma_e(\sigma_u - f\sigma_m)}{f k_f \sigma_u} = \frac{100(300 - 1.1\times 65)}{1.1\times 1.75\times 300} = 39.57 \text{ MPa}$$