# 4.6 Failure and material selection

Name: _____ Class: _____ Date: _____ **Total: 15 marks**

**KEY WORDS** fatigue • material index

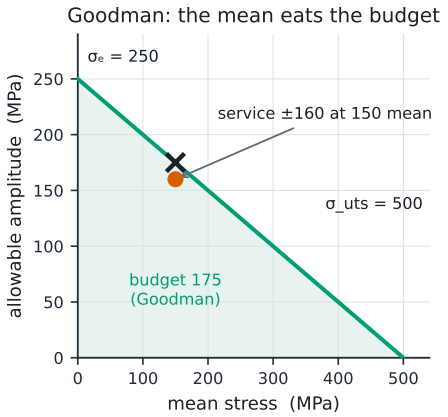
## Objective

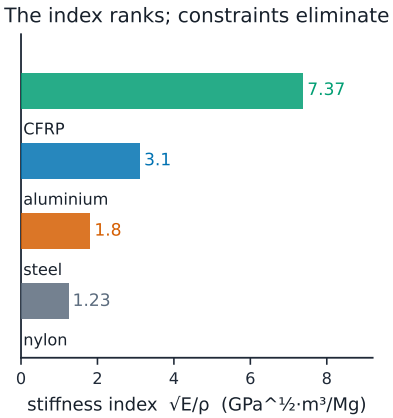
Close the failure file: Basquin amplitudes, the Goodman cut for mean stress, the corrosion budget, and one material index.

## 1 Key knowledge and worked examples

### ■ The three ledgers

Basquin $\sigma_a = \sigma'_f(2N)^b$; Goodman $\sigma_a/\sigma_e + \sigma_m/\sigma_{uts} = 1$; corrosion mm/yr; index $\sqrt{E}/\rho$.




*Fatigue prices the cycles; the index ranks

### ■ Worked example. The bracket

$\sigma'_f = 900$, $b = -0.10$: 226.1 MPa at $10^6$, 142.6 at $10^8$; Goodman cuts 250 to 175.0 at 150 mean ✓; 0.12 mm/yr × 25 = 3.0 mm ✓.

## 2 Practice

An aluminium part has $\sigma'_f = 800$ MPa, $b = -0.12$.

**2.1** The fatigue amplitude at $10^5$ and $10^7$ reversals (one decimal each). [4]

**2.2** With $\sigma_e = 200$ MPa and $\sigma_{uts} = 400$ MPa: the allowable amplitude at a mean stress of 120 MPa (one decimal). [3]

**2.3** A corrosion rate of 0.08 mm/yr for a 20-season design life: the wall loss (one decimal, mm). [2]

**2.4** The stiffness index $\sqrt{E}/\rho$ of titanium ($E = 110$ GPa, $\rho = 4.5$ Mg/m$^3$) against steel's 1.80 (two decimals), and one sentence on what the comparison does and does not decide. [4]

**2.5** True or false with one line of reason: a component loaded well below yield cannot fail by fatigue. [2]