4.2 Stress-strain and elastic behaviour

Name: _____ Class: _____ Date: _____ **Total: 14 marks**

KEY WORDS engineering stress • true stress • Young's modulus

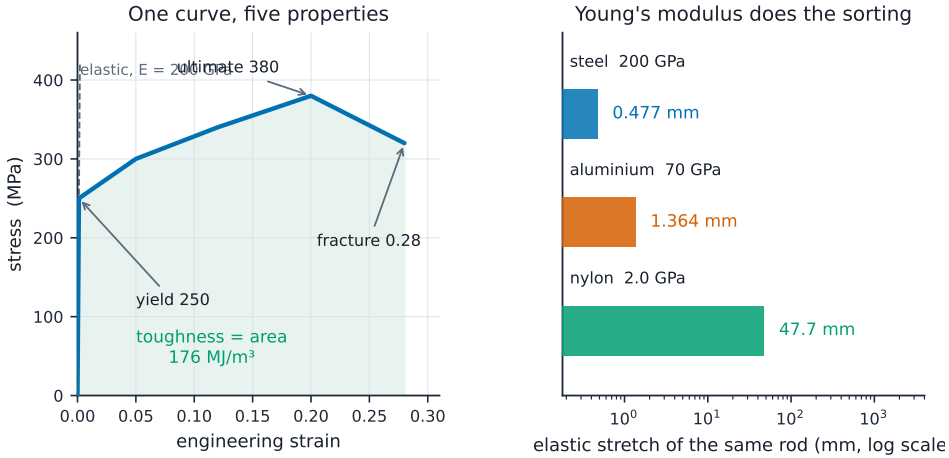
Objective

Read stiffness and strength off a tensile test: stress, elastic deflection by Hooke's law, and the true/engineering conversion.

1 Key knowledge and worked examples

■ The certificate

$\sigma = F/A_0$; elastic $\varepsilon = \sigma/E$, $\delta = \varepsilon L$; true: $\varepsilon_t = \ln(1+e)$, $\sigma_t = \sigma(1+e)$. E: 200 / 70 / 2.0 GPa.



*Young's modulus does the sorting

■ Worked example. The rod test

10.0 mm rod at 15.0 kN: $\sigma = 191.0$ MPa; steel stretches 0.477 mm, aluminium 1.364 mm - deflections scale as $1/E$ ✓.

2 Practice

A 12.0 mm steel rod, 1.20 m long, carries 20.0 kN in tension.

2.1 The cross-sectional area (four significant figures, mm^2) and the engineering stress (one decimal, MPa). [4]

2.2 The elastic extension in steel and in aluminium (three decimals, mm), with the modulus ratio stated. [4]

2.3 At an engineering strain of 0.15: the true strain (four decimals) and true stress as a multiple of engineering stress. [3]

2.4 One sentence each: what does the 0.2% offset convention fix, and why must ductility percentages quote a gauge length? [3]

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