

***Mechanical Behavior of Materials 5th edition
Dowling Solutions Manual***

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1.5

A plate with a width change as in Fig A.11(c) is subjected to a given force in tension and has given dimensions. It is made of a ductile polycarbonate plastic with a given yield strength. What is the safety factor against large amounts of deformation due to yielding? Does the value seem adequate?

P	w ₂	w ₁	ρ	t	σ _o
N	mm	mm	mm	mm	MPa
2800	24	16	4.0	6.0	62

$$S = \frac{P}{w_1 t}, \quad X_1 = \frac{\sigma_o}{S}$$

S	X ₁
MPa	
29.2	2.13

Units for S: N/mm² = MPa

The safety factor seems reasonable. Note that the quite ductile polycarbonate can deform by a large amount before failing.

1.6

A shaft with a circumferential groove as in Fig A.12(c) is subjected to a given bending moment and has given dimensions. It is made of a ductile titanium alloy with a given yield strength. What is the safety factor against large amounts of deformation due to yielding? Does the value seem adequate?

M	d ₂	d ₁	ρ	σ _o
N·mm	mm	mm	mm	MPa
250,000	22	18	2.0	830

$$S = \frac{32M}{\pi d_1^3}, \quad X_1 = \frac{\sigma_o}{S}$$

S	X ₁
MPa	
436.6	1.90

Units for S: N/mm² = MPa

The safety factor seems adequate. Note that the ductile titanium alloy can deform by a large amount before failing.

Answers for Problems and Questions

INSTRUCTOR'S SUPPLEMENT

The pages that follow give the answers for Problems and Questions where a numerical value or the development of a new equation is requested. Where a series of values needs to be calculated, a typical set of these is given. Approximately half of these answers are the same as those given in the textbook itself.

This supplement is not intended for distribution as a unit to students. Of course, it may be useful to provide students with answers for individual problems from this listing.

CHAPTER 1

1.5 $X_1 = 2.13$

1.6 $X_1 = 1.90$

CHAPTER 3

- 3.4 (a) For $P = 7.22 \text{ kN}$: $\sigma = 111.7 \text{ MPa}$, $\varepsilon = 0.001652$; (b) $\sigma_o = 530 \text{ MPa}$; (c) $P_{o2} = 166.5 \text{ kN}$
- 3.5 (a) $E = 68.8 \text{ GPa}$; (b) $\varepsilon_p = 0.01698$; (c) $L_A = 150.71 \text{ mm}$, $L_0 = 150.00 \text{ mm}$; (d) $L_B = 153.78 \text{ mm}$, $L_0 = 152.55 \text{ mm}$
- 3.6 $E = 206.2 \text{ GPa}$, $\sigma_o = 831 \text{ MPa}$, $\sigma_u = 918 \text{ MPa}$, $100\varepsilon_f = 20.4\%$, $100\varepsilon_{pf} = 20.1\%$, $\%RA = 62.6\%$
- 3.7 $E = 71.5 \text{ GPa}$, $\sigma_o = 301 \text{ MPa}$, $\sigma_u = 323 \text{ MPa}$, $100\varepsilon_f = 14.6\%$, $100\varepsilon_{pf} = 14.3\%$, $\%RA = 56.5\%$
- 3.8 $E = 97.7 \text{ GPa}$, $\sigma_o = 179 \text{ MPa}$, $\sigma_u = 240 \text{ MPa}$, $100\varepsilon_f = 1.17\%$, $100\varepsilon_{pf} = 0.93\%$, $\%RA = 1.86\%$
- 3.9 $E = 201.3 \text{ GPa}$, $\sigma_o = 1400 \text{ MPa}$, $\sigma_u = 1492 \text{ MPa}$, $100\varepsilon_f = 9.40\%$, $100\varepsilon_{pf} = 8.86\%$, $\%RA = 38.0\%$
- 3.10 $E = 68.7 \text{ GPa}$, $\sigma_o = 528 \text{ MPa}$, $\sigma_u = 597 \text{ MPa}$, $100\varepsilon_f = 15.3\%$, $100\varepsilon_{pf} = 14.5\%$, $\%RA = 26.4\%$
- 3.11 $E = 166.1 \text{ GPa}$, $\sigma_o = 418 \text{ MPa}$, $\sigma_u = 490 \text{ MPa}$, $100\varepsilon_f = 1.154\%$, $100\varepsilon_{pf} = 0.859\%$
- 3.12 $E_t = 3530 \text{ MPa}$, $\sigma_{ou} = 55.9 \text{ MPa}$, $\sigma_u = 55.9 \text{ MPa}$, $100\varepsilon_f = 55.9\%$ (estimate), $100\varepsilon_{pf} = 55.0\%$, $\%RA = 60.3\%$