Preface

This manual contains solutions for the Problems and Questions sections at the end of each chapter. Numerical problems primarily occur beginning in Chapter 3 and virtually all of solutions of this type are included. However, solutions are not included for discussion questions. Additionally, solutions are only included for the more difficult problems that request derivation of an equation.

It is requested that solutions from this manual not be distributed to students or posted on bulletin boards and/or websites. Refraining from these practices will prolong the useful life of the problems at all institutions using the textbook. Transparencies or digital projections made from this manual may of course be used in the classroom without seriously compromising the future usefulness of the problem.

The initial posting of solutions in May 2006 includes most problem solutions through Chapter 10. Others through Chapter 15 will be added in approximately August 2006. A small number of additional solutions and corrections will then be posted as they become available.

Although great care has been taken to avoid errors in this manual, some no doubt remain. The author would be most grateful to be informed of any significant errors found in this manual or in the text itself. The address is N. E. Dowling, ESM Dept., Mailcode 0219, Virginia Tech, Blacksburg, VA 24061.

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1.7 Plate with width change, Fig. A.11(c).

$P = 3600\ N$, $w_2 = 24$, $w_1 = 16$, $t = 5\ mm$

Polycarbonate, $\sigma_o = 62\ MPa$, $\varepsilon_f = 110$ to 150%

$X_1 = ?$ adequate?

$$S = \frac{P}{w_1 t} = \frac{3600\ N}{16(5)\ mm^2} = 45\ MPa$$

$$X_1 = \frac{\sigma_o}{S} = \frac{62\ MPa}{45\ MPa} = 1.38$$

The value is a bit low but may be suitable under ideal circumstances. Note that the material is quite ductile.

1.8 Shaft with circumferential groove, Fig. A.12 (c). $d_2 = 25$, $d_1 = 20$, $\rho = 2.5$ mm
Aluminum alloy, $\sigma_o = 303$ MPa, $\varepsilon_f = 20\%$
$M = 120$ N·m. $X_1 = ?$ adequate?

$$S = \frac{32M}{\pi d_1^3} = \frac{32\,(120{,}000 \text{ N·mm})}{\pi\,(20 \text{ mm})^3} = 152.8 \text{ MPa}$$

$$X_1 = \frac{\sigma_o}{S} = \frac{303 \text{ MPa}}{152.8 \text{ MPa}} = 1.98 \quad ◀$$

The value is quite adequate in view of the ductile material behavior. ◀