Errors/Typographical Mistakes in Second Edition

Mechanics of Composite Materials, Second Edition
with PROMAL Software

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http://www.autarkaw.com/books/composite/index.html

Many corrections have already been made in the second print of the second edition of the book.

Page 4: Equation 1.3 should read as

$$M = \frac{PL^2}{u}\frac{1}{E/\rho}$$

Page 8: Line 10 from top "minimum deflection of a beam" should read as "minimum deflection of a beam of a rectangular cross-section with fixed width,"

Page 22: Part of last line should read as "of about ~~361~~56 mi/h (25 m/s)."

Page 27. In Figure 1.12, "Polymide" should read as "Polyamide"

Page 72: On Line 2 Replace q_1 by θ_1

Page 72: On Line 6 from below

Replace $\gamma_{xy} = \dfrac{\dfrac{\partial v}{\partial x}}{1+\dfrac{\partial u}{\partial x}} + \dfrac{\dfrac{\partial u}{\partial y}}{1+\dfrac{\partial u}{\partial y}}$ by $\gamma_{xy} = \dfrac{\dfrac{\partial v}{\partial x}}{1+\dfrac{\partial u}{\partial x}} + \dfrac{\dfrac{\partial u}{\partial y}}{1+\dfrac{\partial v}{\partial y}}$

Page 73: 2nd line in Example 2.1: $u=10^{-5}\ (x^2+6y+7xz)$

Page 81. The correct form of Equation (2.32) and (2.33) is given

$$\frac{\partial^2 W}{\partial \varepsilon_i \partial \varepsilon_j} = C_{ij}, \qquad (2.32)$$

$$\frac{\partial^2 W}{\partial \varepsilon_j \partial \varepsilon_i} = C_{ji}. \qquad (2.33)$$

Page 84: Figure 2.12 should have a label of C just like in Figure 2.13.

Page 90: Last line Equation 2.48(d) should read as

$$\tau_{23} = -\tau_{2'3'}$$

Page 91: Equation 2.50(b).

$C_{1'4}$ should read as C_{14}

Page 93: Line after Equation 2.57 should read as

Similarly, as shown in Figure 2.16b, apply $\sigma_1 = 0$, $\sigma_2 \neq 0$, $\sigma_3 = 0$, $\tau_{23}=0$, τ_{31}

Page 96. First line should read as

Inversion of Equation (2.70) would be the (~~compliance~~) stiffness matrix [C] and is

Page 104. Last line should read as

through Equation (~~2.98~~ 2.79) and Equation (2.92) as

Page 96. First line should read as

Inversion of Equation (2.70) would be the (~~compliance~~) stiffness matrix [C] and is

Page 111: Equation 2.99 should have an (=) sign rather than a (–) sign. The equation 2.99 should read as

$$\begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \gamma_{12}/2 \end{bmatrix} = [T] \begin{bmatrix} \varepsilon_x \\ \varepsilon_y \\ \gamma_{xy}/2 \end{bmatrix},$$

Page 112: The last term of $\overline{Q}_{12}$, in Eqn 2.104 (b) should be s^4. The corrected equation is

$$\overline{Q}_{12} = (Q_{11} + Q_{22} - 4\,Q_{66})\, s^2 c^2 + Q_{12}\,(c^4 + s^4),$$

Page 112: In equation (105) , the last column vector should read as

$$\begin{bmatrix} \sigma_x \\ \sigma_y \\ \tau_{xy} \end{bmatrix},$$

the last element of the vector should have a τ .

Page 113: The second word $\overline{S}_{ij}$ on first line of the page should have a bar on top.

Page 113: Line 21: "Transformed compliance matrix" need to read as "Transformed reduced compliance matrix"

Page 118: part (g) of problem: The angle at which the maximum shear stress occurs is 16°

Page 121. $\varepsilon_B = 1.225 \times 10^{-5}$; $\varepsilon_c = -1.855 \times 10^{-4}$

Page 125: The formula for m_x should read as (2 in front of S_{11} is missing)

$$m_x = -\overline{S}_{16} E_1$$

$$= -E_1 [(2S_{11} - 2S_{12} - S_{66}) s c^3 - (2S_{22} - 2S_{12} - S_{66}) s^3 c]$$

Page 137: It should be (-0.1547×10^{-11}) for S_{12} in the formula below.

$$V_3 = \frac{1}{8} [0.5525 \times 10^{-11} + 0.9709 \times 10^{-10} - 2(-0.1547 \times 10^{-11}) - 0.1395 \times 10^{-9}]$$

$$= -0.4220 \times 10^{-11} \frac{1}{Pa},$$

Page 141: $\sigma_2 = -0.866\tau$ (4th line from bottom)

Page 144: Eighth line from top, = sign is missing in

$$\sigma_1 = 0.1714 \times 10^1 R$$

Page 150. The subscript of τ_{13}, although not wrong, should be τ_{31} in equation (2.144) only for reasons of consistency.

Page 149: G_{12} substitution should have 10^9.

$$(\gamma_{12})_{ult} = \frac{(\tau_{12})_{ult}}{G_{12}} = \frac{68\times10^{6}}{7.17\times10^{9}} = 9.483\times10^{-3}$$

Page 157: Second line from the bottom. "Equation 2.165c" should read as "Equation 2.171 c".

Page 159: Eight line from bottom

~~per Equation (2.99)~~ per Equations (2.77) and (2.92)

Page 168. Replace problem#2 by the problem at end of this errata document (see page 12 of 13) because the engineering constants in the problem are not valid.

Page 168. Replace problem#3 by the problem at the end of this errata document (see page 12 of 13) as the [C] matrix is not valid.

Page 169: Problem 2.15. "matrix [Q] ~~is given~~"

Page 197. Second line from bottom, the = sign is missing after σ_1

$$\sigma_1 = \tau_{xy}\,\mathrm{Sin}\,\theta\,\mathrm{Cos}\,\theta + \sigma_y\,\mathrm{Sin}^2\theta + \tau_{xy}\,\mathrm{Cos}\,\theta\,\mathrm{Sin}\,\theta + \sigma_x\,\mathrm{Cos}^2\theta$$

Page 206: Equation 3.3a-c should have ρ instead of *r*. It should read as

$$w_c = \rho_c\, \mathrm{v_c},$$
$$w_f = \rho_f\, \mathrm{v_f}, \text{and}$$
$$w_m = \rho_m\, \mathrm{v_m}.$$

Page 210: The first line

$$W_f = \frac{2500}{2110}\times \text{~~0.3~~ } 0.7$$

Page 210: The last line

$$=(0.3)\ (\text{~~0.1896~~ } 1.896\times10^{-3})$$

Page 212: Line 10 from top: "For composites with a certain volume of voids ~~V~~ v_v"

Pg. 217: In the third diagram of Figure 3.3, the thickness of the fiber should be noted as "t_f" instead of "t_r"

Pg. 227: In Figure 3.11(b), the bottom dimension line for t_f should be in line with the bold line of the original shape instead of the dotted line of the deformed shape. In the top figure, the thickness of the fiber should be t_f

Page 239: Top of page ~~G~~ G_{12}=8.130 *GPa*

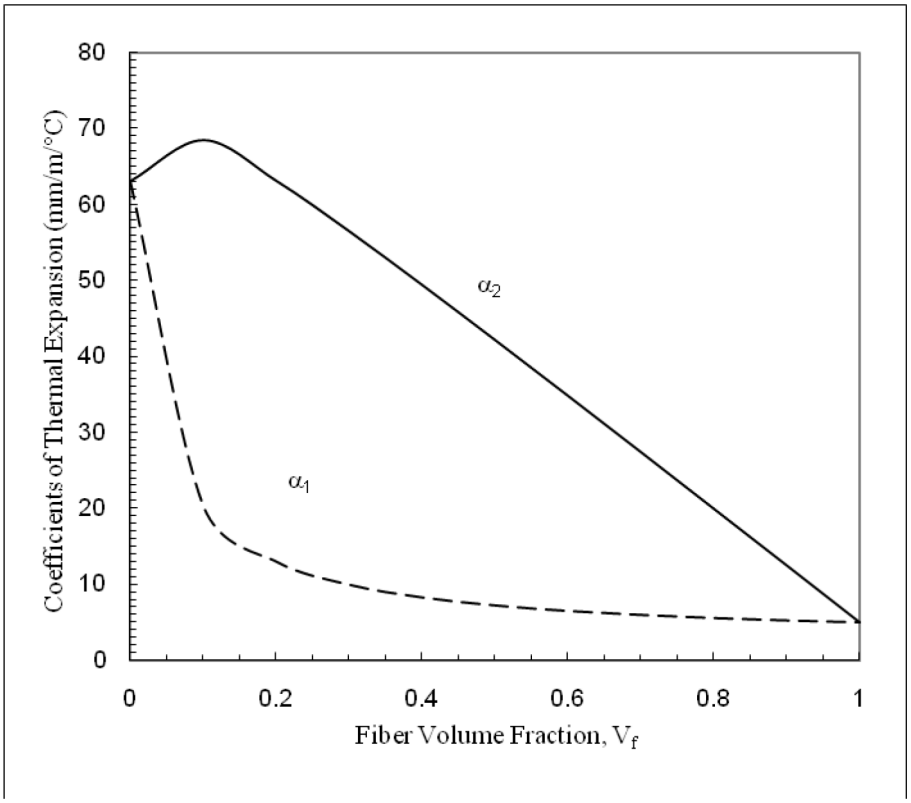
Page 280. Table 3.6, the equations referred to are 3.173(a) and 3.173(b).

Page 282: Eighth line from top should read as: Using the transverse ultimate strain failure mode formula (~~3.76~~ 3.171)

Page 285: The table in Figure 3.31, $L_2 = 127 \pm 1.5$

Page 287: Eighth line from top**.** Substituting the expressions in Equation (~~3.82~~3.177) in Equation (~~3.81~~3.176), we get

Figure 3.38: Replace by



Page 310: Problem 3.18**:** ~~60%~~ unidirectional

Page 311: Problem 3.22: Replace units in 2nd line by USCS system of units.

Page 313: *28. Shepery* should read as *28. Shapery*

Page 318: Fifth line from top, "A notation of ∓45° would indicate the -45° angle ply …."

Page 321: The deformed shape should be a rectangle.

Page 324. The units of the curvatures in the example are 1/in, that is,

$$\begin{Bmatrix} \kappa_x \\ \kappa_y \\ \kappa_{xy} \end{Bmatrix} = \begin{Bmatrix} 1.965 \\ 0.2385 \\ -1.773 \end{Bmatrix} \frac{1}{in}$$

Page 335: The B matrix is

$$[B] = \begin{bmatrix} -3.129\times10^{6} & 9.855\times10^{5} & -1.072\times10^{6} \\ 9.855\times10^{5} & 1.158\times10^{6} & -1.072\times10^{6} \\ -1.072\times10^{6} & -1.072\times10^{6} & 9.855\times10^{5} \end{bmatrix} Pa-m^2$$

Page 350: Replace Equation (4.57) by

$$\begin{bmatrix} \varepsilon_x^M \\ \varepsilon_y^M \\ \gamma_{xy}^M \end{bmatrix} = \begin{bmatrix} \varepsilon_x \\ \varepsilon_y \\ \gamma_{xy} \end{bmatrix} - \begin{bmatrix} \varepsilon_x^T \\ \varepsilon_y^T \\ \gamma_{xy}^T \end{bmatrix} - \begin{bmatrix} \varepsilon_x^C \\ \varepsilon_y^C \\ \gamma_{xy}^C \end{bmatrix}$$

Page 354: Sixth line from top "Equation (2.175)" should read as "Equation (~~2.175~~2.181)"

Page 358: Table 4.6. The third column item is $\sigma_{~~yx}$

Page 364: Problem 4.2: Part 5 should be $[45/\mp 30]_2$

Page 367: Last line in problem 4.19: "The thickness of each lamina is 0.005 m" should read as "The thickness of each lamina is 0.005 ~~m~~ inches"

Page 378: Line before Equation (5.9) should read as "From Equation (~~2.131a~~ 2.137a)"

Page 379: The equation 5.15 is good for N≥2.

Page 383: The last column is for γ_{12}

Page 387: Table 5.5: Strain ε_1 in 0^o ply on top is 5.525×10^{-10}

Page 389: First line, replace ~~play~~ by "ply" in the formula.

Page 400: Line 8 should read as

$$E_b = 10.3 \times 10^6 \frac{1}{12}(4)(1)^3$$

Page 400: Line 17 should read as

$$3.433 \times 10^6 = 26.25 \times 10^6 \frac{1}{12} 4\ h^3$$

Page 402: Footnote: The number ~~*0.0004921 in*~~. should read as 0.004921 in.

Page 414: Line 10: "-5.162×10^{-7}" should be "$=5.162 \times 10^{-7}$"

Page 437: Figure 6.5. The shear values in the shear diagram should be 10 and -10 instead of 20 and -20.

Page 456: Item 2 of Problem 6.1: "Find the local stresses at" should read as "Find the ~~local~~ global stresses at"

Page 456: Item 2 of Problem 6.2: "Find the local stresses at" should read as "Find the ~~local~~ global stresses at"

Page 527: Problem 5.14; use SI system for change in temperature, $-150\ ^oC$.

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Page 62: Eqn 2.8. should read as

$$\varepsilon_x = \frac{\partial u}{\partial x},$$

Page 71: "*stiffness matrix (Equation 2.36)*" should read as "*compliance matrix (equation (2.36))*"

Page 73: "*stiffness matrix (Equation 2.36)*" should read as "*compliance matrix (equation (2.39))*"

Page 74: 5th line from top - spelling mistake "*monoclic*" should read as "*monoclinic*"

Page 93: The second last matrix should read as

$$\left[\overline{Q}\right] = \begin{bmatrix} 0.8053\times10^{-10} & -0.7878\times10^{-11} & -0.3234\times10^{-10} \\ -0.7878\times10^{-11} & 0.3475\times10^{-10} & -0.4696\times10^{-10} \\ -0.3234\times10^{-10} & -0.4696\times10^{-10} & 0.1141\times10^{-9} \end{bmatrix}^{-1}$$

Page 105: Equation (2.132b) should have "Q_{22}" instead of "Q_{12}". It should read as

$$U_2 = \frac{1}{2}(Q_{11} - Q_{22}),$$

Page 119: Units of S are MPa
Page 121: Units of S are MPa
Page 124: Eqn 2.159 - Put "2" in front of H_{12}

$$(H_1 + H_2)\sigma + (H_{11} + H_{22} + 2H_{12})\sigma^2 = 1.$$

Page 124: In eqn 2.160, put "-" instead of "+" in front of $(H_{11} + H_{22})\sigma^2$. The eqn should read as

$$H_{12} = \frac{1}{2\sigma^2}[1 - (H_1 + H_2)\sigma - (H_{11} + H_{22})\sigma^2].$$

Page 138: Problem 2.38 - Line 1, Add "$\sigma>0$" after "$\sigma_x = -\sigma, \sigma_y = -\sigma.$"

Page 141: Matrix C should be

$$[C] = \begin{bmatrix} 9 & 33 & 38 & 54 \\ 12 & 45 & 48 & 69 \\ 23 & 90 & 82 & 121 \end{bmatrix}.$$

Page 183: An = sign is missing after τ_{yz}

Footnote should read as

…….. Hydrostatic stress is defined as

$$\sigma_{xx} = \sigma_{yy} = \sigma_{zz} = p,\ \tau_{xy} = 0, \tau_{yz} = 0, \tau_{zx} = 0$$

Page 213: Equation 3.108 should read as

$$\beta_2 = \frac{V_f(1+\nu_f)\Delta C_f \beta_f + V_m(1+\nu_m)\Delta C_m \beta_m}{(V_m \rho_m \Delta C_m + V_f \rho_f \Delta C_f)} \rho_c - \beta_1 \nu_{12},$$

The change is in the first symbol of the numerator on the right hand side

Page 256: The units for fictitious thermal moments are *Pa-m^2*

Page 260: α instead of σ in last matrix equation. It should read as

$$\begin{bmatrix} \alpha_x \\ \alpha_y \\ \alpha_{xy} \end{bmatrix} = \begin{bmatrix} 5.353\times10^{-10} & -2.297\times10^{-11} & 0 \\ -2.297\times10^{-11} & 9.886\times10^{-10} & 0 \\ 0 & 0 & 9.298\times10^{-9} \end{bmatrix} \begin{bmatrix} 1.852\times10^{3} \\ 2.673\times10^{3} \\ 0 \end{bmatrix}$$

Page 265: Problem 4.12: put '*transformed*' in front of '*reduced stiffness matrix*'

Page 265: Problem 4.14: Line 3 from top Replace "*glass/epoxy*" by "*graphite/epoxy*"

Page 272: Examples of quasi-isotropic laminates include [0/36/72/-36/-72]. The last two angles in book are wrong!

Page 276: Equation (5.18) should read as

$$[A^*] = \frac{1}{h}\begin{bmatrix} \frac{U_1}{U_1^2 - U_4^2} & -\frac{U_4}{U_1^2 - U_4^2} & 0 \\ -\frac{U_4}{U_1^2 - U_4^2} & \frac{U_1}{U_1^2 - U_4^2} & 0 \\ 0 & 0 & \frac{2}{U_1 - U_4} \end{bmatrix}$$

Page 278-282:

First ply failure

$$\frac{N_x}{h} = \frac{7.277\times10^{6}}{0.015}$$
$$= 0.4851\times10^{9}\ Pa$$

The normal strain in the *x*-direction at this load is

$$(\varepsilon_x^0)_{\text{first ply failiure}} = (5.353\times10^{-10})(7.277\times10^{6})$$

$$= 3.895\times10^{-3}$$

Last ply failure

$$\frac{N_x}{h} = \frac{1.5 \times 10^7}{0.015}$$
$$= 0.1 \times 10^{10}\ Pa$$

$$(\varepsilon_x^0)_{\text{last ply failiure}} = (5.525 \times 10^{-10})(1.5 \times 10^7)$$

$$= 8.288 \times 10^{-3}$$

Page 284. Figure 5.1 does not show the strains correctly.

Page 288: Example 5.5. Properties of aluminum are given in Table 3.4.

Page 289: Missing *"t="* in

$$t = \sqrt{\frac{6(13000)2}{4(40.02)\ 10^3}}$$
$$= 0.9872\ in.$$

Page 299: Problem 5.10. Both parts of the problem are about the given laminate

Page 300: Problem 5.18. Change 'stiffness' by 'modulus'

REVISED PROBLEM 2.2 AND 2.3

2.2 The engineering constants for an orthotropic material are found to be

$$E_1 = 21.7\ Msi,\ E_2 = 1.74\ Msi,\ E_3 = 1.74\ Msi,$$
$$v_{12} = 0.25,\ v_{13} = 0.25,\ v_{23} = 0.43,$$
$$G_{12} = 0.61\ Msi,\ G_{23} = 0.45\ Msi,\ G_{31} = 0.61\ Msi$$

Find the stiffness matrix [C] and the compliance matrix [S] for the above orthotropic material.

Answers

$$[S] = \begin{bmatrix} 0.046083 & -0.011521 & -0.01152 & 0 & 0 & 0 \\ -0.011521 & 0.57471 & -0.24713 & 0 & 0 & 0 \\ -0.011521 & -0.24713 & 0.57471 & 0 & 0 & 0 \\ 0 & 0 & 0 & 2.2222 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1.6393 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1.6393 \end{bmatrix} Msi^{-1}$$

$$[C] = \begin{bmatrix} 22.088 & 0.77682 & 0.77682 & 0 & 0 & 0 \\ 0.77682 & 2.162 & 0.94524 & 0 & 0 & 0 \\ 0.77682 & 0.94524 & 2.162 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.45 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.61 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.61 \end{bmatrix} Msi$$

2.3 Consider an orthotropic material with the stiffness matrix given by

$$[C] = \begin{bmatrix} 152.68 & 5.3571 & 5.3571 & 0 & 0 & 0 \\ 5.3571 & 14.91 & 6.5185 & 0 & 0 & 0 \\ 5.3571 & 6.5185 & 14.91 & 0 & 0 & 0 \\ 0 & 0 & 0 & 3.1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 4.2 & 0 \\ 0 & 0 & 0 & 0 & 0 & 4.2 \end{bmatrix} GPa$$

Find

a) the stresses in the principal directions of symmetry if the strains in the principal directions of symmetry at a point in the material are

$\varepsilon_1 = 1$ μm/m, $\varepsilon_2 = 3$ μm/m, $\varepsilon_3 = 2$ μm/m,

$\gamma_{23} = 0$, $\gamma_{31} = 5$ μm/m, $\gamma_{12} = 6$ μm/m,

b) the compliance matrix [S]

c) the engineering constants $E_1, E_2, E_3, \nu_{12}, \nu_{23}, \nu_{31}, G_{12}, G_{23}, G_{31}$.

d) the strain energy per unit volume at the point where strains are given in part (a)

Answers

(a) [179460 63124 54733 0 21000 25200] Pa

(b) $[S] = \begin{bmatrix} 0.0066667 & -0.0016667 & -0.0016667 & 0 & 0 & 0 \\ -0.0016667 & 0.083333 & -0.035833 & 0 & 0 & 0 \\ -0.0016667 & -0.035833 & 0.083333 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.32258 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.2381 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.2381 \end{bmatrix} GPa^{-1}$

(c) $E_1=150GPa$, $E_2=12GPa$, $E_3=12GPA$, $\nu_{12}=0.25$, $\nu_{23}=0.43$, $\nu_{31}=0.02$, $G_{12}=4.2$ GPa, $G_{23}=3.1GPa$, $G_{31}=4.2$ GPa.

(d) 0.36725 N-m/m^3