

Mechanics of Composite Materials
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Answers to Selected Problems

Chapter 3

3.1

1. $V_f = 0.6575$, $V_m = 0.3425$

2. $\rho_c = 2055 \cdot \frac{\text{kg}}{\text{m}^3}$

3.2

1. $W_{\text{glass}} = 0.5532$ $W_{\text{graphite}} = 0.1915$ $W_{\text{epoxy}} = 0.2553$

2. $\rho_c = 1880 \cdot \frac{\text{kg}}{\text{m}^3}$

3.3

$V'_f = 0.5306$ $V'_m = 0.4694$

1.

2. $\rho_{\text{ct}} = 1.890 \cdot \frac{\text{gm}}{\text{cm}^3}$

3. $\rho_{\text{ce}} = 1.794 \cdot \frac{\text{gm}}{\text{cm}^3}$

4. $W_f = 0.7019$, $W_m = 0.2981$

5.

$V_v = 0.0508$

6.

3.4

1. $V_f = 0.5332$

2. $\rho_c = 1600 \cdot \frac{\text{kg}}{\text{m}^3}$

3.5

$E_1 = 5.228 \cdot \text{Msi}$ $E_2 = 0.8003 \cdot \text{Msi}$ $\nu_{12} = 0.2600$

$G_{12} = 0.3086 \cdot \text{Msi}$

3.7

$$\frac{d}{s} = 2 \cdot \sqrt{\frac{V_f}{\pi}}$$

3.8

$$s = 15.06 \cdot \mu\text{m}$$

3.9

Comparison	$E_1(\text{Msi})$	$E_2(\text{Msi})$	ν_{12}	$G_{12}(\text{Msi})$
Mechanics of materials	5.228	0.8003	0.2600	0.3086
Halpin-Tsai	5.228	1.309	0.2600	0.4140

3.10

$$V_{\text{graphite}} = 25.21 \cdot \%$$

3.11

$$\nu_f = 0.2269$$

3.12

Comparison	$E_1(\text{Msi})$	$E_2(\text{Msi})$	ν_{12}	$G_{12}(\text{Msi})$
Mechanics of materials	5.228	0.8003	0.2600	0.3086
Halpin-Tsai	5.228	1.309	0.2600	0.4140
Elasticity	5.235	-----	0.2163	0.6672

3.13

0.5, 0.5

3.16

$$\sigma_{1Tult} = 95.31 \cdot \text{ksi}$$

$$\sigma_{1Cult} = 7.576 \cdot \text{ksi}$$

$$\sigma_{2Tult} = 4.461 \cdot \text{ksi}$$

$$\sigma_{2Cult} = 7.560 \cdot \text{ksi}$$

$$\tau_{12ult} = 2.508 \cdot \text{ksi}$$

3.17

1. graphite/epoxy
2. steel

3.18

$$\alpha_1 = 3.615 \frac{\frac{\mu\text{in}}{\text{in}}}{\text{in}}$$

$$\alpha_2 = 19.33 \frac{\frac{\mu\text{in}}{\text{in}}}{\text{in}}$$

3.19

fiber volume fractions less than 20%

3.20

$$V_f := 5.894\%, \alpha_2(5.894\%) = 69.31 \cdot \frac{\frac{\mu\text{m}}{\text{m}}}{\text{°C}}$$

3.22

$$\alpha_1 = 4.71 \cdot \frac{\frac{\mu\text{in}}{\text{in}}}{\text{°F}}$$

3.23

$$V_f = 41.74\%$$

3.24

$$\beta_1 = 0.045 \text{ m/m/kg/kg}, \beta_2 = 0.603 \text{ m/m/kg/kg}$$

3.25

1. $m_w = 0.120 \cdot \text{gm}$

2. $\Delta v = 0.1554 \text{ cm}^3$