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

3.2

1. $W_{glass} = 0.5532$ $W_{graphite} = 0.1915$ $W_{epoxy} = 0.2553$
2. $\rho_c = 1880 \cdot \frac{kg}{m^3}$

3.3

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

1.
2. $\rho_{ct} = 1.890 \cdot \frac{gm}{cm^3}$

   $\rho_{ce} = 1.794 \cdot \frac{gm}{cm^3}$
3. $W_f = 0.7019$, $W_m = 0.2981$
4. $V_v = 0.0508$
5.

3.4

1. $V_f = 0.5332$
2. $\rho_c = 1600 \cdot \frac{kg}{m^3}$

3.5

$E_1 = 5.228 \cdot Msi$ $E_2 = 0.8003 \cdot Msi$ $\nu_{12} = 0.2600$
$G_{12} = 0.3086 \cdot Msi$

3.7

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

3.8

$s = 15.06 \cdot \mu m$

3.9

Comparison

	E_1(Msi)	E_2(Msi)	ν_{12}	G_{12}(Msi)
Mechanics of materials	5.228	0.8003	0.2600	0.3086
Halphin-Tsai	5.228	1.309	0.2600	0.4140

3.10

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

3.11

$\nu_f = 0.2269$

3.12

Comparison

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

3.13

0.5, 0.5

3.16

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

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

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

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

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

3.17

1. graphite/epoxy
2. graphite/epoxy

3.18

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

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

3.19

fiber volume fractions less than 20%

3.20

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

3.22

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

3.23

$V_f = 41.74 \cdot \%$

3.24

$\beta_1 = 0.045 m/m/kg/kg$, $\beta_2 = 0.603 m/m/kg/kg$

3.25

1. $m_w = 0.120 \cdot gm$
2. $\Delta v = 0.0875 cm^3$

Intermediate numbers for Problem 3.25: Initial Vol=3.125 cm^3, mass of composite=6.1875 gms; density of composite=1980 kg/m^3