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CHAPTER 3

SOLUTION (3.1)

(a) We obtain
 $\frac{\partial^2 \Phi}{\partial x^2} = -12px$, $\frac{\partial^2 \Phi}{\partial y^2} = 0$, $\frac{\partial^2 \Phi}{\partial z^2} = 6py$
Thus, $\nabla^2 \Phi = -12px + 20py = 0$
and the given stress field represents a possible solution.

(b) $\frac{\partial^2 \Phi}{\partial x^2} = pxy^2 - 2px^2y$
Integrating twice
 $\Phi = \frac{px^3}{6} - \frac{pxy^3}{3} + f_1(x)y + f_2(y)$
The above is substituted into $\nabla^2 \Phi = 0$ to obtain
 $\frac{d^2 f_1}{dx^2} + \frac{d^2 f_2}{dy^2} = 0$
This is possible only if
 $\frac{d^2 f_1}{dx^2} = 0$, $\frac{d^2 f_2}{dy^2} = 0$
We find then
 $f_1 = c_1x^2 + c_2x + c_3$
 $f_2 = c_4y^2 + c_5y + c_6$
Therefore,
 $\Phi = \frac{px^3}{6} - \frac{pxy^3}{3} + (c_1x^2 + c_2x + c_3)y + c_4y^2 + c_5y + c_6$

(c) Edge $y=0$
 $T_x = \int \sigma_{xx} dy = \int \left(\frac{2px}{3} + c_1 \right) dy = \frac{2px}{3} + 2c_1y$
 $T_y = \int \sigma_{xy} dy = \int 0 dy = 0$
Edge $y=h$
 $T_x = \int \left(-\frac{1}{3}pxh^3 + ph^3 + \frac{2px}{3} + c_1 \right) dy$
 $= -pxh^3 - 6px + 2a(h^3 + c_1)h$
 $T_y = \int \left(pxy^2 - 2px^2y \right) dy = 0$

SOLUTION (3.2)

Edge $x = a/2$
 $\tau_{xy} = 0$: $-\frac{1}{3}pa^2y^3 + c_1y^3 + \frac{1}{3}pa^2 + c_1 = 0$
 $\tau_{xz} = 0$: $-\frac{1}{3}pa^2y^3 + c_1y^3 + \frac{1}{3}pa^2 + c_1 = 0$
Adding: $(-\frac{1}{3}pa^2 + 2c_1)y^3 + pa^2 + 2c_1 = 0$

(CONT.)

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