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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, $\nabla^2 \Phi = -12px + 2(6py) = 0$
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 $y=0$
 $T_x = \int_0^t \sigma_{xx} dy = \int_0^t (2px^2 + c_1) dy = 2pxt + c_1t$
 $T_y = \int_0^t \sigma_{xy} dy = \int_0^t 0 dy = 0$
Edge $y=h$
 $T_x = \int_0^t (-\frac{1}{3}px^3 + px^2 + \frac{2}{3}px + c_1) dy$
 $= -pxt(\frac{1}{3}h^3 - \frac{1}{2}h^2 + \frac{1}{2}h) + c_1ht$
 $T_y = \int_0^t (pxh^2 - 2px^2) dy = 0$

SOLUTION (3.2)

Edge $x = at$
 $\tau_{xz} = 0$: $-\frac{1}{3}pa^3y^3 + c_1y^3 + \frac{1}{2}pa^2y^2 + c_2y = 0$
 $\tau_{yz} = 0$: $-\frac{1}{3}pa^3y^3 + c_1y^3 + \frac{1}{2}pa^2y^2 + c_2y = 0$
Adding, $(-\frac{1}{3}pa^3 + 2c_1)y^3 + pa^2y^2 + 2c_2y = 0$

(CONT.)

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