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CHAPTER 3

SOLUTION (1.1)

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

(2) $\frac{\partial^2 \Phi}{\partial x^2} = pxy^2 - 2px^2y$
Integrating w.r.t. y
 $\Phi = \frac{px^2y^3}{6} - \frac{2px^3y^2}{4} + f_1(x) + f_2(y)$
The above is substituted into $\nabla^2 \Phi = 0$ to obtain
 $\frac{\partial^2 \Phi}{\partial x^2} + \frac{\partial^2 \Phi}{\partial y^2} = 0$
This is possible only if
 $\frac{\partial^2 \Phi}{\partial x^2} = 0$, $\frac{\partial^2 \Phi}{\partial y^2} = 0$
We find from
 $f_1 = c_1x^3 + c_2x^2 + c_3x + c_4$
 $f_2 = c_5y^3 + c_6y^2 + c_7y + c_8$
Therefore,
 $\Phi = \frac{px^2y^3}{6} + (c_1x^3 + c_2x^2 + c_3x + c_4) + (c_5y^3 + c_6y^2 + c_7y + c_8)$

(3) Edge $y=0$:
 $F_x = \int \tau_{xy} dy = \int \left(\frac{\partial \Phi}{\partial x} + c_1 \right) dy = \frac{px^2y^2}{2} + 2c_1x$
 $F_x = \int \sigma_{xx} dx = \int (0) dx = 0$

Edge $y=h$:
 $F_x = \int \left(-\frac{1}{2}px^2h^2 + c_1h^2 + \frac{px^2}{2} + c_1 \right) dx$
 $= -\frac{px^3}{6} (h^2 - 4h^2) + 2c_1(h^2 + c_1)h$
 $F_x = \int (px^3 - 2px^2) dx = 0$

SOLUTION (1.2)

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

(CONT.)

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