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CHAPTER 3

SOLUTION (3.1)

(a) We obtain

$\frac{\partial^4\Phi}{\partial x^4} = -12pxy \quad \frac{\partial^4\Phi}{\partial y^4} = 0 \quad \frac{\partial^4\Phi}{\partial x^2\partial y^2} = 6pxy$

Thus, $\nabla^4\Phi = -12pxy + 2(6pxy) = 0$

and the given stress field represents a possible solution. ◄

(b) $\frac{\partial^2\Phi}{\partial x^2} = pxy^3 - 2px^3y$

Integrating twice

$\Phi = \frac{px^3y^3}{6} - \frac{px^5y}{10} + f_1(y)x + f_2(y)$

The above is substituted into $\nabla^4\Phi = 0$ to obtain

$\frac{d^4 f_1(y)}{dy^4}x + \frac{d^4 f_2(y)}{dy^4} = 0$

This is possible only if

$\frac{d^4 f_1(y)}{dy^4} = 0 \quad \frac{d^4 f_2(y)}{dy^4} = 0$

We find then

$f_1 = c_4y^3 + c_5y^2 + c_6y + c_7$

$f_2 = c_8y^3 + c_9y^2 + c_{10}y + c_{11}$

Therefore,

$\Phi = \frac{px^3y^3}{6} - \frac{px^5y}{10} + (c_4y^3 + c_5y^2 + c_6y + c_7)x + c_8y^3 + c_9y^2 + c_{10}y + c_{11}$ ◄

(c) Edge y=0:

$V_x = \int_{-a}^{a} \tau_{xy} t dx = \int_{-a}^{a} (\frac{px^4}{2} + c_3) t dx = \frac{pa^5 t}{5} + 2c_3 at$ ◄

$P_y = \int_{-a}^{a} \sigma_y t dx = \int_{-a}^{a} (0) t dx = 0$ ◄

Edge y=b:

$V_x = \int_{-a}^{a} (-\frac{3}{2}px^2b^2 + c_1b^2 + \frac{px^4}{2} + c_3) t dx$

$= -pa^3(b^2 - \frac{a^2}{5})t + 2a(c_1b^2 + c_3)t$ ◄

$P_y = \int_{-a}^{a} (pxb^3 - 2px^3b) t dx = 0$ ◄

SOLUTION (3.2)

Edge $x = \pm a$:

$\tau_{xy} = 0: \quad -\frac{3}{2}pa^2y^2 + c_1y^2 + \frac{1}{2}pa^4 + c_3 = 0$

$\tau_{xy} = 0: \quad -\frac{3}{2}pa^2y^2 + c_1y^2 + \frac{1}{2}pa^4 + c_3 = 0$

Adding, $(-3pa^2 + 2c_1)y^2 + pa^4 + 2c_3 = 0$

(CONT.)

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