LECTURE 3, EXAMPLE 2 DETERMINE WHETHER THE FOLLOWING TWO DIMENSIONAL STATE OF STRESS IS POSSIBLE WITHIN AN ELASTIC STRUCTURAL MEMBER. ASSUME THAT THE BODY FORCES ARE NEGLIGIBLE.

GIVEN:

1. $\sigma_x = -\frac{3}{2} \cdot x^2 \cdot y^2$, $\tau_{xy} = x \cdot y^3$, $\sigma_y = -\frac{1}{4} \cdot y^4$

ASSUMPTIONS:

1. SMALL DEFORMATIONS
2. BODY IN EQUILIBRIUM
3. SOLID BODY
4. BODY FORCES ARE NEGLECTED.

FIND:

1. DETERMINE IF THIS STATE OF STRESS IS POSSIBLE.

SOLUTION:

STARTING WITH TWO DIMENSIONAL EQUILIBRIUM

$$\frac{\partial \sigma_x}{\partial x} + \frac{\partial \tau_{xy}}{\partial y} + \bar{F}_x = 0 \qquad (1)$$

$$\frac{\partial \sigma_y}{\partial y} + \frac{\partial \tau_{xy}}{\partial x} + \bar{F}_y = 0 \qquad (2)$$

STARTING WITH (1)

$$\frac{\partial}{\partial x}\left(-\frac{3}{2} \cdot x^2 \cdot y^2\right) + \frac{\partial}{\partial y}\left(x \cdot y^3\right) + 0 = 0$$

$$-\frac{3}{2} \cdot 2 \cdot x \cdot y^2 + 3 \cdot x y^2 + 0 = 0$$

$$0 = 0 \checkmark$$

EQUATION (1) IS SATISFIED

NOW (2)

$$\frac{\partial}{\partial x}\left(-\frac{1}{4} \cdot y^4\right) + \frac{\partial}{\partial x}\left(x \cdot y^3\right) + 0 = 0$$

$$-y^3 + y^3 + 0 = 0$$

$$0 = 0 \checkmark$$

EQUATION (2) IS SATISFIED

SUMMARY: THIS PROBLEM DEMONSTRATES THAT THE GIVEN STATE OF STRESS MEETS THE EQUILIBRIUM CONDITION NECESSARY FOR THE STATE OF STRESS TO BE PRESENT.

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