
Aircraft Structures (202000157)

Homework Assignment #1

Due date: May 1st, 2021 at 17:00

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Question 1 The two dimensional stress state at a particular point in a structure equals $\sigma_x = 350$ MPa, $\sigma_y = 225$ MPa and $\tau_{xy} = 100$ MPa.

1. Calculate the principal stresses and the orientation of the corresponding principal planes.

Answer

The principal stresses are: $\sigma_I = 405$ MPa and $\sigma_{II} = 170$ MPa, while the principal planes are oriented at $\theta = 0.51 \pm \pi/2$ or $\theta = 29^\circ \pm 90^\circ$.

As a reminder, the equations for the principal stresses are:

$$\sigma_{I,II} = \frac{\sigma_x + \sigma_y}{2} \pm \frac{1}{2} \sqrt{(\sigma_x - \sigma_y)^2 + 4\tau_{xy}^2},$$

while the principal planes can be found using:

$$\tan 2\theta = \frac{2\tau_{xy}}{\sigma_x - \sigma_y}.$$

2. What is the magnitude of the shear stress acting on the principal planes?

Answer

The shear stress on the principal planes equals 0 MPa.

Question 2 The turbine blades in modern jet engines are subjected to intense heat and extreme loads...