

## Exercise 12: Yield and fracture

Jan. 31, 2022 - Feb. 04, 2022

**Question 1** .....

*Reference:* Rösler, Harders, Bäker, Mechanisches Verhalten der Werkstoffe, 2nd ed, Teubner, p. 412

A component made from a polycrystalline Aluminum alloy has the yield strength of 200 MPa and is subjected to plane stress with

$$\sigma_{xx} = \sigma_{yy} = 155 \text{ MPa}, \quad \tau_{xy} = 55 \text{ MPa}.$$

- (a) Write the deviatoric stress!
- (b) Calculate the principal stresses!
- (c) Evaluate both Tresca's and von Mises' criterion to determine whether the material will yield!

**Question 2** .....

*Reference:* Sun, Fracture Mechanics, 1st ed, Academic Press (p. 72)

Consider the following Airy stress function,

$$\phi = Ay^2,$$

where  $A$  is a constant. Compute the stress components and the displacements, assuming zero rigid body rotation.

**Question 3** .....

A Si plate has a thickness of 775  $\mu\text{m}$  and a width of 240 mm. It has a rectangular cross-section and contains a 100  $\mu\text{m}$  deep notch. The plate is subjected to pure bending with a moment of  $M = 0.03 \text{ Nm}$ . Will it break?  $K_I$  for this load case is given in the figure. The material has fracture toughness  $K_{Ic} = 0.9 \text{ MPa}\sqrt{\text{m}}$  and a Young's modulus of  $E = 165 \text{ GPa}$ .

