Week 10: Assignment 10

The due date for submitting this assignment has passed.

As per record you have not submitted this assignment.

1. An infinite stainless steel plate is in the figure below.

\[ \sigma_{xx} = 275 \text{ MPa}, \sigma_{yy} = 210 \text{ MPa}, \quad \epsilon_{xx} = 2 \text{ mm/m}, \quad \epsilon_{yy} = 0 \text{ (both are normal cracks)} \]

\( \sigma_{x} \) and \( \sigma_{y} \) will be ______ (correct up to two decimal).

Accepted Answer: 275, 210

2 points

2. Referring to problem 1, if the crack \( \epsilon_x \) advances under the influence of stress of 250 MPa, then the energy released per unit thickness is ______ J/m².

(Answer in two decimal digits)

Accepted Answer: 250

1 point

3. What is the ratio of stress intensity factor of the central crack to the edge crack? [Correct up to two decimal]

Given: \( \epsilon_{xx} = 2 \text{ mm/m (central crack)} \), \( \sigma_{xx} = 2.5 \text{ mm/m (edge crack)} \), \( \sigma_{xx} = 275 \text{ MPa} \)

Accepted Answer: 0.52

1 point

4. A single-edge slant having a edge crack of length 5 mm is subjected to a stress of 275 MPa. According to fracture mechanics, the length of effective plastic zone in front ahead of crack tip in plane strain condition is ______ mm.

Accepted Answer: 2.6

1 point

5. The stainless-steel slab in the above problem is replaced by a thin stainless-steel plate and was subjected to similar loading condition. The length of total plastic zone ahead of a 1 mm edge crack is 11 mm. Considering the length of the plastic zone in the above problem is 11 mm, the value of \( y \) is ______ mm.

Accepted Answer: 1.4

1 point

6. Flexibility induced crack closure phenomenon involves following which of the following mechanisms

- Residual compressive stress on the previous plasticly deformed material behind the crack front helps in crack closure
- Phase transformation between phase ahead of crack front which help in crack closure
- Displacement due to mode II loading induces crack closure
- Double mode formation at the crack tip helps in crack closure

Accepted Answer: 1

1 point

7. A material in region II of fatigue loading follows Paris relationship given by

\[ \Delta K_{II} = (1.8 \times 10^7) \sigma_{II}^{1.5} \]

(Answer in two decimal digits)

The stress range applied \( \sigma_{II} = 100 \text{ MPa} \). The number of cycles required for a crack to grow from 2mm to 5mm will be

- 1232 cycles
- 1223 cycles
- 1234 cycles
- 1224 cycles

Accepted Answer: 1232

1 point

8. An \( N=7 \) specimen is tested according to ASTM E8/E8M-92 for calculating fatigue toughness. The specimen dimensions are 2.75 inches by 0.35 inches by 0.42 inches. The load variety is 230 MPa. The load displacement curve is obtained with \( P_{max} = 120 \text{ kN} \). Are the conditions valid for a valid \( K_{ult} \) measurement?

- Yes, the conditions are valid
- No, the conditions are not valid

Accepted Answer: Yes

1 point

9. The yield strength of a high-strength sheet is 1.25 kN/mm² and \( K_{ult} \) is 100 MPa. The crack length that can cause sudden failure at half of its yield strength is ______ mm. (Round off to two decimal places)

Accepted Answer: 4.92

1 point