Name.....Student I.D.....

Department of Mining and Materials Engineering

Faculty of Engineering

Prince of Songkla University

Mid-term Examination for Semester: 1 Academic Year: 2006

Date: 3 August 2006 Time: 13.30-16.30

Subject: 237-407 Failure Mechanics and Analysis Room: หัวหุ่น

Instructions

1. There are 4 problem sets. Please do all of them. Write your answers on the space provided after each problem sets.
2. Only one (1) piece of A4-size note is allowed. You may write on both sides of the note. Please return it with your answers.
3. Dictionary and calculator are also allowed.
4. Text books and course notes are not allowed.
5. This mid-term exam is accounted for 30% of total grade.

Asst. Prof. Dr. Thawatchai Plookphol

Problem no.	Full score	Student's score
1	20	
2	10	
3	20	
4	20	
Total	70	

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1. A mosquito-killer-spray can with diameter of 60 mm is made of 0.5 mm steel sheet, σ_{ys} = 300 MPa.

(a) For high safety reason, the designer used safety factor, S.F. = 3.0, what is the maximum internal pressure that the can withstands without yielding according to the distortion energy theory, or von Mises' yielding theory? (15 points)

(b) If the can is filled with chemical to the pressure of 0.65 MPa. Estimate the S.F. for this pressure; is it safe or not safe? (5 points)

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2. Explain the followings:

(a) Griffith's fracture theory for brittle materials. (5 points)
(b) Irwin's concept of stress intensity factor (K) (5 points)

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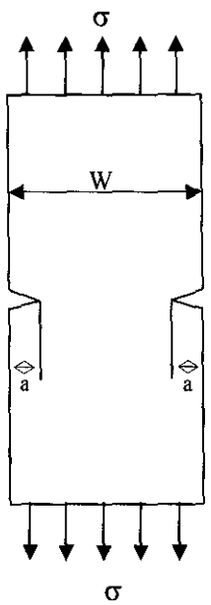
3. A steel plate is 300 mm wide and 6 mm thick. There is a 25 mm-long crack along each edge. If K_{Ic} = 85 MPa·√m,

(a) Calculate the force required to propagate the crack the remaining 250 mm across the width of the plate. (10 points)

(b) Calculate the force require to break the plate in tension if there were no crack. Assume that the fracture strength is 700 MPa. (10 points)

Given: $K_I = 1.12\sigma\sqrt{\pi a}$



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4. A spherical LPG storage tank with radius of 10 m at Singhanakhon, Songkhla was made of steel plate with thickness of 15 mm. The tank was designed to handle maximum pressure of 5 MPa.

(a) What is the yield strength of steel that would be suitable used for fabricating the tank according to Tresca's yielding theory? (10 points)

(b) If weldment of the tank shell contains a small internal penny crack of size, a = 2 mm, would this crack possibly cause failure by sudden explosion? Please show calculation to support your answer. Assuming that K_{Ic} = 30 MPa·√m, σ_{ys} = 1,700 MPa. Given: for internal penny crack,

$$K_I = \frac{2}{\pi} \cdot \sigma \cdot \sqrt{\pi \cdot a}$$ (10 points)

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