

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: 2007

Date: August 2, 2007 Time: 13.30-16.30

Subject: 237-407 Failure Mechanics and Analysis Room: A205

Instructions

1. There are 3 problem sets. Please do all of them. Write your answers in the space provided after each problem sets.
2. Dictionary and calculator are allowed.
3. Text books and course notes are not allowed.
4. This mid-term exam is accounted for 25 % of total grade.

Asst. Prof. Dr. Thawatchai Plookphol

Problem no.	Full score	Student's score
1	20	
2	20	
3	10	
Total	50	

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Problem 1

A large thick plate of steel is examined by X-ray method, and found to contain no detectable cracks. The equipment can detect a single edge-crack of depth $a = 1$ mm or greater. The steel has fracture toughness K_{IC} of $53 \text{ MPa}\sqrt{\text{m}}$ and yield strength of 950 MPa. Assuming that the plate contains cracks on the limit of detection, determine whether the plate will undergo general yield or will fail by fast fracture before general yielding occurs. What is the stress at which fast fracture would occur? (20 points)

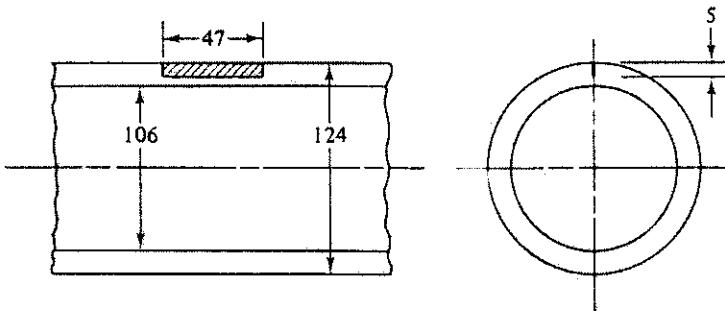
Given:

$$K_J = 1.12\sigma\sqrt{\pi a}$$

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Problem 2

A portion of a gas valve made of gray cast iron is in the shape of a tube of 124 mm OD and 106 mm ID. If a radial crack 47 mm in the axial direction and 5 mm deep in the radial direction extends inward from the outer surface, estimate the K_{Ic} of this cast iron if it fractured under an internal pressure of 2 MPa. All dimensions are in mm, see Figure shown below. (20 points)



See additional data in the next page.

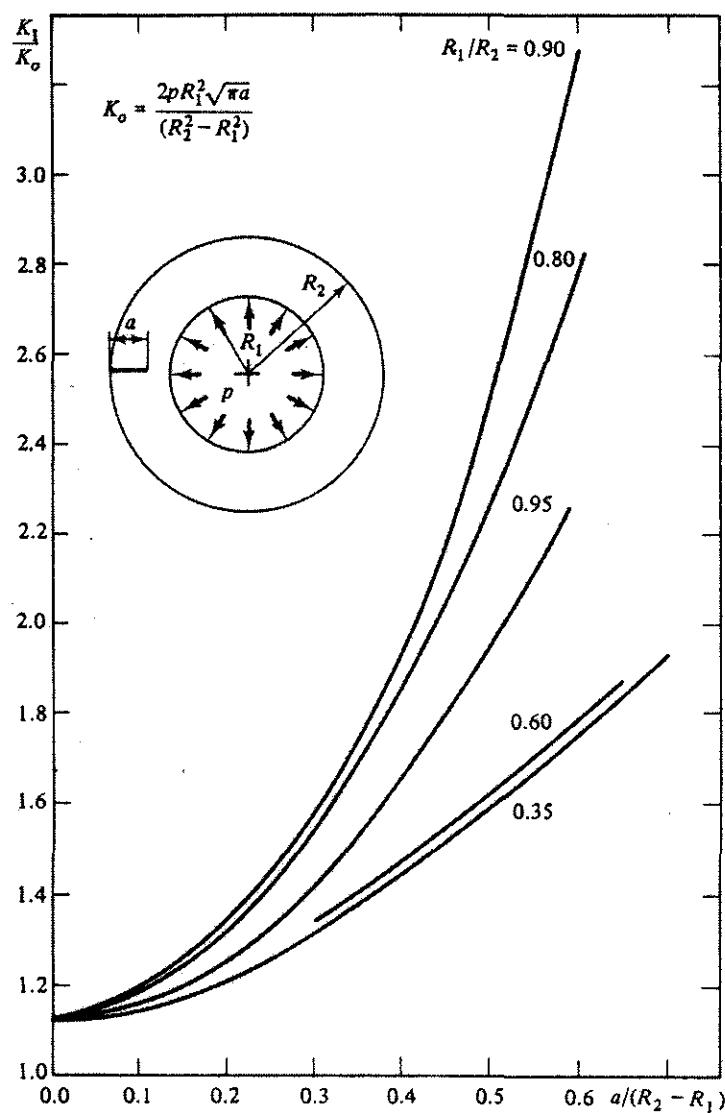
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An external radial edge crack in a tube subjected to a uniform internal pressure:

$$K_I = CK_0$$

where, $K_0 = \frac{2pR_1^2\sqrt{\pi a}}{(R_2^2 - R_1^2)}$.

The value of C or $\frac{K_I}{K_0}$ can be estimated from chart below.



K_I for an external radial edge crack in a tube subjected to a uniform internal pressure.

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Problem 3

3.1 What is plastic zone in Fracture Mechanics? (5 points)

3.2 The size and shape of plastic zone is influenced by what factors? (5 points)