King Fahd University of Petroleum & Minerals
جامعة الملك فهد للبترول و المعادن

Department of Aerospace Engineering

AE530 Aerospace Structures I – Final Exam

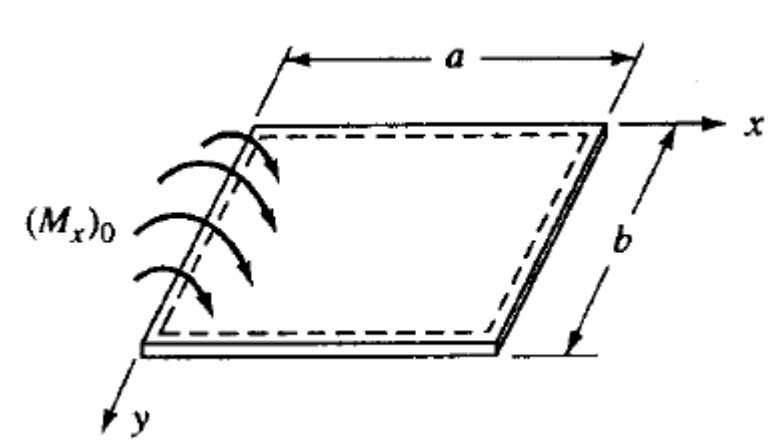
Jan. 24th, 2007 — Total Mark 100
Time Allowed: 150 minutes — Open Book Exam

Name:_____ **ID No.:**_____

Question ONE (20 Marks)

An aircraft skin panel can be modeled as a simply supported rectangular plate subjected to an edge moment $(M_x)_0$ as shown. Determine the deflection shape of this panel.

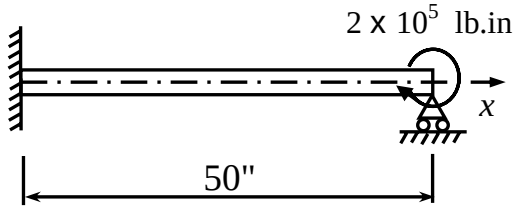
Solution:



Question TWO (20 Marks)

An aircraft component can be modeled as a statically indeterminate beam with $EI=3x10^8$ lb.in^2. Determine the distribution of the bending displacement $w(x)$. Find also the values of all support reactions.

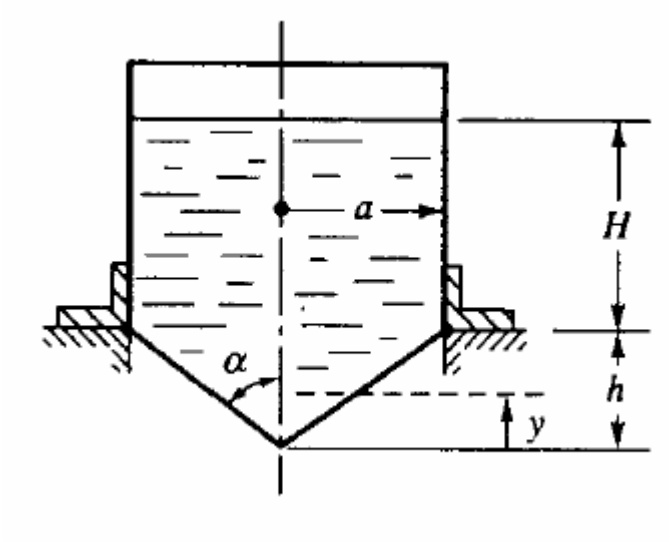
Solution:



Question THREE (20 Marks)

A cylindrical tank has a suspended conical bottom. The tank is supported along its peripheral as shown and is filled with a liquid of specific density γ. Derive expressions for the membrane forces in both parts as functions of y.

Solution:



Question FOUR (30 Marks)

Consider a $[0/90]_s$ laminate of total thickness 0.08 inch. All layers are of equal thickness and are made of S-2 glass/epoxy with the following stiffness coefficients:
$Q_{11} = 7.953 \times 10^6$, $Q_{12} = 0.4444 \times 10^6$, $Q_{22} = 1.576 \times 10^6$, $Q_{66} = 0.5743 \times 10^6$ (psi)

a. Calculate the elements of the *D* matrix for this laminate.

b. If the laminate is subjected to the moment resultants: $M_x = M_y = M$. Determine the maximum allowable value of M, using Tsai-Hill's criterion. Allowable stresses of S-2 glass/epoxy layers are: $X = 150$ ksi, $Y = 4$ ksi, $S = 6$ ksi.

Solution:

Question FIVE (10 Marks)

Consider the following displacement field:

$$u = (y - 2z) \quad , \qquad v = -(y+1)^3 \quad , \qquad w = z$$

Determine the principal strains at the point (1,1,1). Is there any question of displacement compatibility here?

Solution:

Good Luck *Dr. Wael Abdelrahman*

$$N_\theta = \gamma(H + h - y)t\frac{\tan\alpha}{\cos\alpha}$$

$$N_s = \frac{\gamma}{2}\left(H + h - \tfrac{2}{3}y\right)y\frac{\tan\alpha}{\cos\alpha}$$