AOE 3024, Thin Walled Structures

Homework # 6, Due October 19, 2001

1.a. A rectangular element in a linearly elastic isotropic material is subjected to a tensile stress of $83N/mm^2$ and $65N/mm^2$ on mutually perpendicular planes (say x and y directions).

(i) Determine the strain in the direction of each stress and in the direction normal to both these directions (*i.e.* ϵ_{zz}). Assume $E = 200000N/mm^2$, and Poisson's ratio $\nu = 0.3$. (4 points)

(ii) Also determine the principal strains, the maximum shear strain, and their respective directions at the point. (4 points).

(iii) Determine the value of the maximum shear stress. (2 points)

2. One of the advanced airplanes that NASA is considering for carrying a large number of passengers is the Inboard-Wing Airplane. As shown in the figure, the concept calls for the airplane to have two fuselages at the wing tips and the engine in the middle. Assuming the aerodynamic lift acting on the wing, per unit length, to be given by

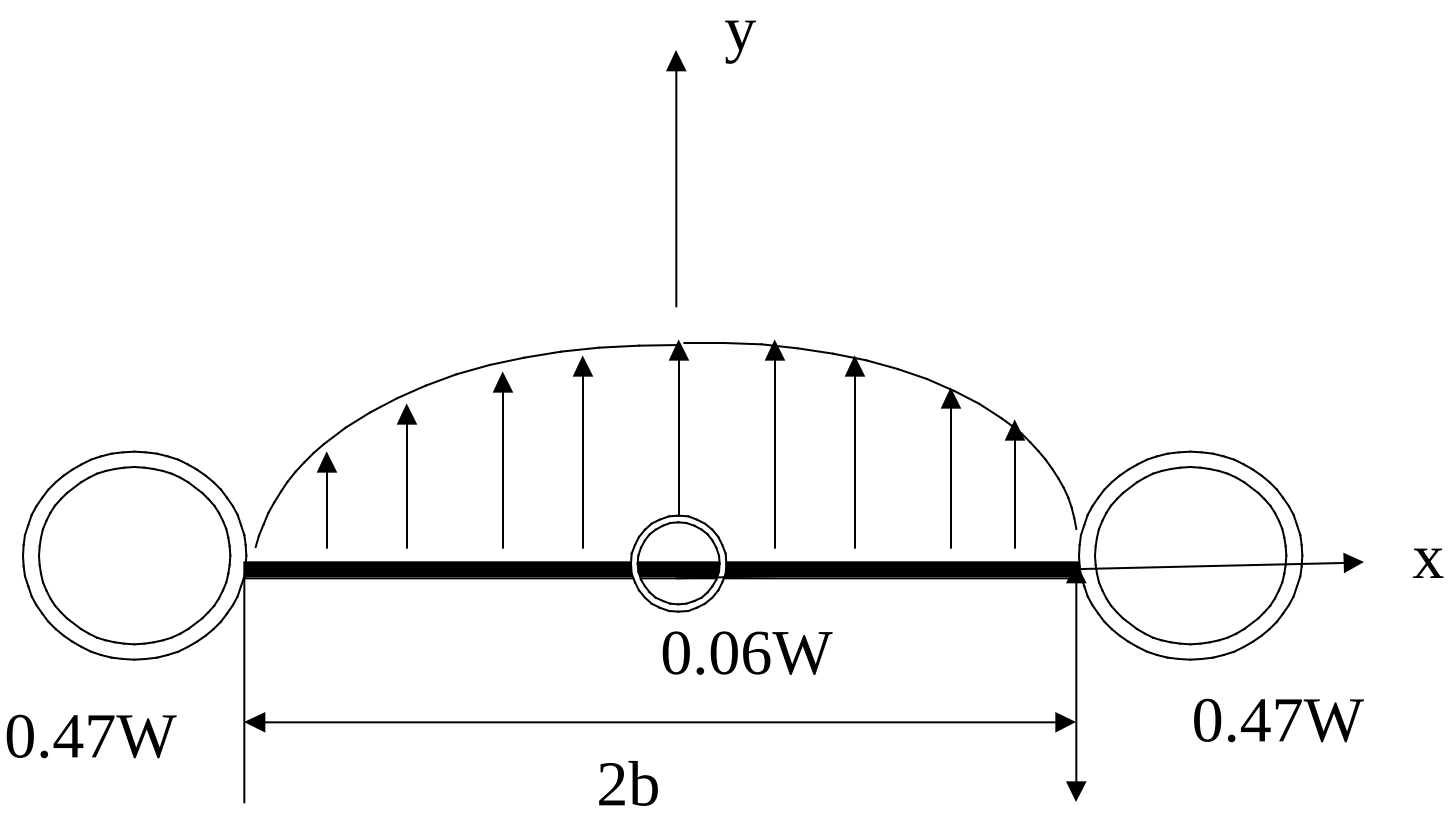
$$w(x) = p_0 \left(1 - \left(\frac{x}{b}\right)^2\right)$$

Here x is measured from the middle of the wing. The wing span is $2b$. Assume, the weight of the engine is $0.06W$ and the weight of each of the fuselages to be $0.47W$; W being the total weight of the aircraft.

a) Determine the value of p_0 such that the total lift generated by the wing is W (3 points)

b) Draw the nondimensionalized shear force (V/W) and bending moment (M/Wb) diagrams for the wing against non-dimensionalized distance x/b. Clearly show your sign convention. (6 points)

c) In the above calculations, we have assumed the weight of the wing to be negligible. How would your results change if that assumption is not made. Assume that the weight of the wing is $0.20W$, distributed uniformly, and the weight of each of the fuselages is $0.37W$. (6 points)


y
x
0.06W
0.47W
0.47W
2b