AE 670 Aerospace Structural Analysis-I
Assignment No. 7

7.1 Prove that the stress function

$$\psi = -G\theta\left[\frac{1}{2}\left(y^2 + z^2\right) - \frac{1}{2a}\left(y^3 - 3yz^2\right) - \frac{2a^2}{27}\right]$$

is the solution for the equilateral triangle shown. At what points will the maximum shear stress occur? Determine its value in terms of θ.

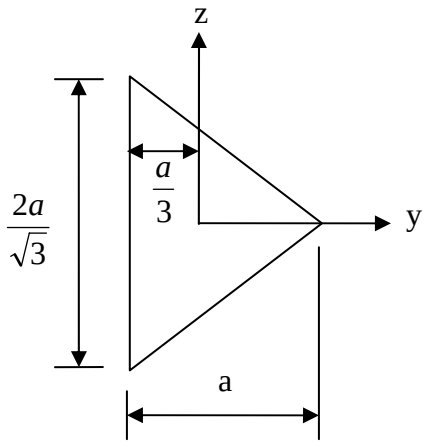

Figure 1

7.2 Obtain approximate equations for *J* and the maximum shear stress due to M_t for the thin modified double-wedge cross section shown by using equations developed in the section of thin walled open sections.

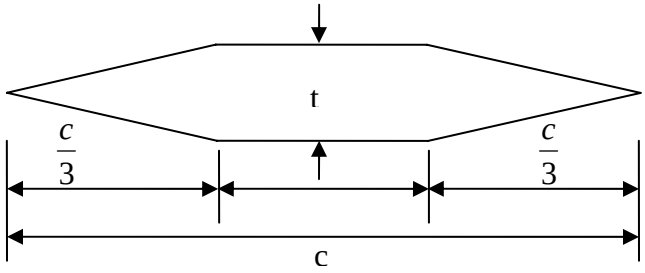

Figure 2

7.3 Determine the torsion constant for the T section shown.

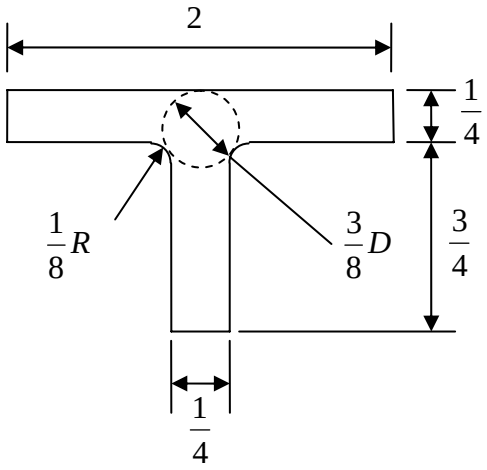

Figure 3

7.4 Prove that $f = 0$ is the solution for a hollow circular cross section of inside radius a and outside radius b. Show that $J = I_P$ and $\sigma_{xs} = \frac{M_t r}{I_P}$, where I_P is the polar moment of inertia of the hollow section.

7.5 The slit and unslit tubes shown have the same radii and wall thickness and a subjected to the same torques. Determine the ratio of the angles of twist and the ratio of the shear stresses of the two sections. What does this indicate about the relative merits of open and closed sections?

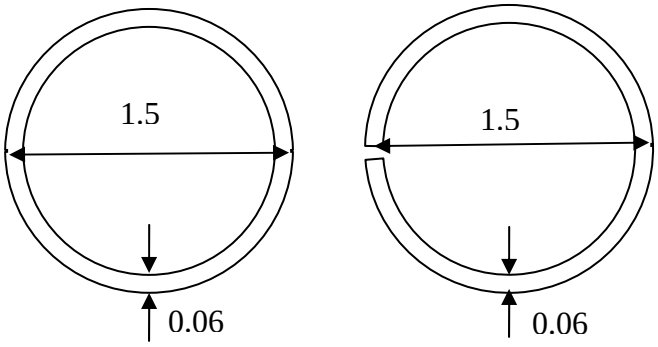

Figure 4

7.6 The nonhomogeneous box beam shown is subjected to a torque of 10000 in.-lb. Find the shear stress in each wall and the angle of twist per unit length. The cover skins are Inconel *X* ($G = 11.9 \times 10^6$ psi) and the spar webs are 6Al-4V titanium ($G = 6.2 \times 10^6$ psi).

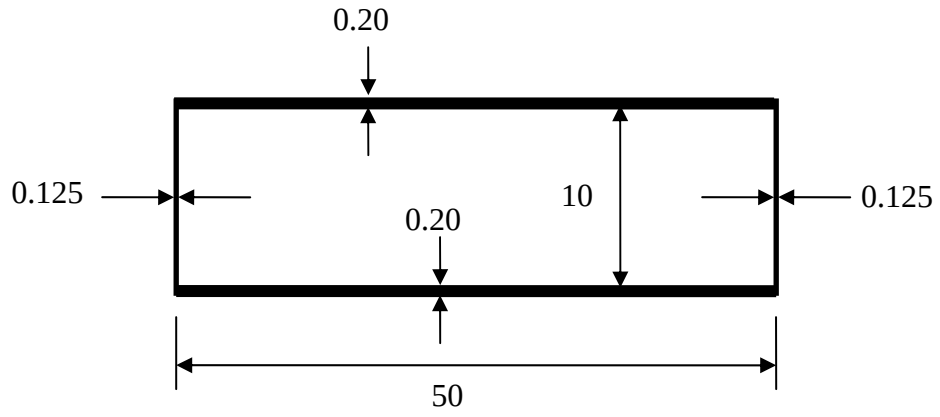

Figure 5

7.7 The two-cell box beam shown is subjected to a torque of 10000 in.-lb. Determine the shear flow in the center spar and the angle of twist per unit length if the material is 2024-T3 clad aluminum ($G = 4.0 \times 10^6$ psi).

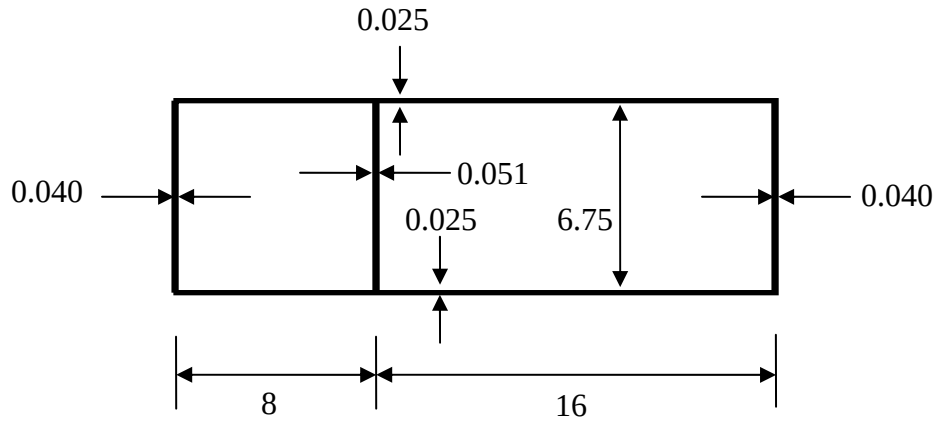

Figure 6