

## HOME ASSIGNMENT #9

*(accompanies Design Problem #4)*

### Warm-Up Exercises

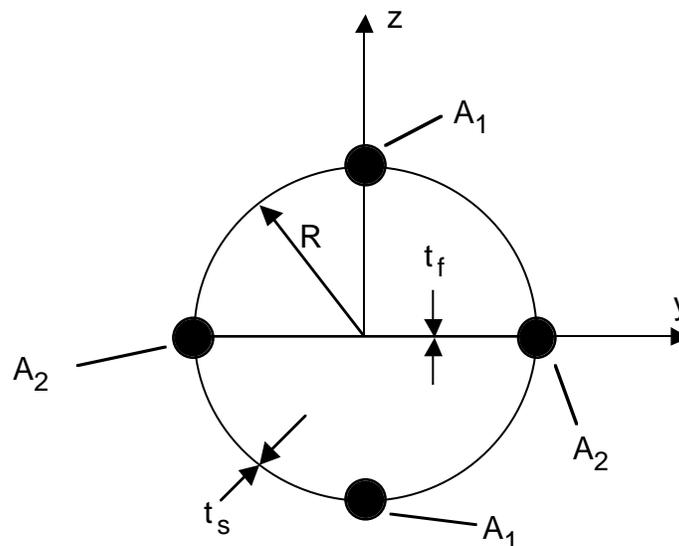
None

### Practice Problems

None

### Application Tasks

Consider the circular shell beam cross-section shown in the accompanying figure. This cross section has four stringers connected by skins. There is also a floor connecting two stringers across the cross-section. The top and bottom stringers have the same area  $A_1$  while the left and right stringers have the same area  $A_2$ . The stringers are all made of the same material with modulus  $E$ . The skins are made of the same material with shear modulus  $G$  and all have the same thickness,  $t_s$ . The floor is made of the same material as the skins but has a different thickness,  $t_f$ . The radius of the cross-section is  $R$ .



This cross-section is a generalization of the cross-section to be considered for the aft fuselage in Design Problem #4. You are to analyze the response of the shell cross-section for five different load cases:

1. A moment of magnitude  $M_y$  about the y-axis.
2. A moment of magnitude  $M_z$  about the z-axis.
3. A shear resultant of magnitude  $S_y$  in the y-direction (negative sense) applied at the shear center.
4. A shear resultant of magnitude  $S_z$  in the z-direction (negative sense) applied at the shear center.
5. A torque of magnitude  $T$  about the x-axis.

For each load case, determine:

- a) The axial stresses in the stringers and the shear stresses in the skins and floor.
- b) The cross-section properties.

Submit this as a **group** piece of work in the same format as a typical home assignment. Be sure to list all the pertinent assumptions that are being made. This shows your analysis technique and your engineering manager will check this and sign off on your approach as you continue in your design task. These solutions can then be used to analyze the specific aft fuselage by superposing the various parts as necessary. (*Solutions for this part of the task will be posted on the 16.20 website on Lecture 43.*)