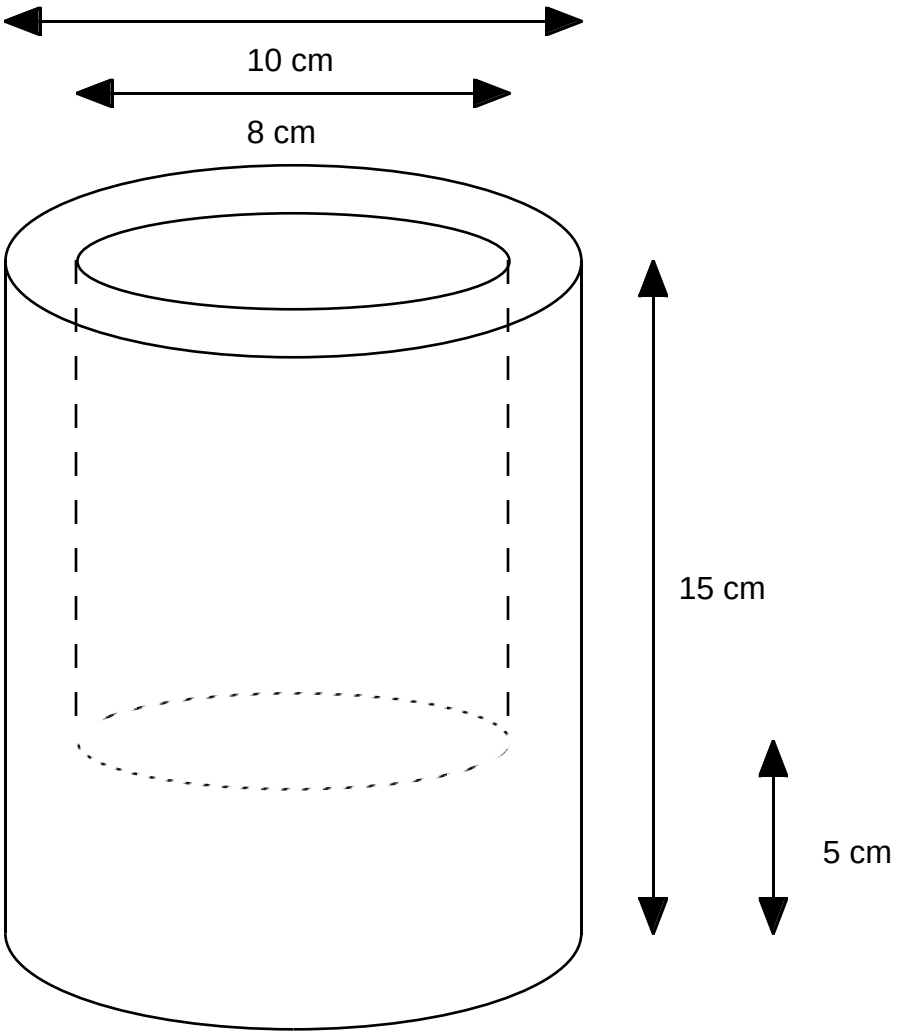
Homework #3
MEAM 305 Introduction to the Finite Element Method

Due Date April 18, 1997

Consider a three dimensional a half way hollow solid cylinder like structure shown in the following figure :



Suppose that the material is structural steel (ASTM-A36) such that

density	$\rho = 7860\ kg/m^3$
Elasticity Modulus	$E = 200\ GPa$
Shear Modulus	$G = 79\ GPa$
Coefficient of Thermal Expansion	$\alpha = 11.7 \times 10^{-6}\ /^o C$

Yield Strength in Tension	$\sigma_Y = 200\ MPa$
Yield Strength in Shear	$\tau_Y = 145\ MPa$
Ultimate Strength in Tension	$s_T = 400\ MPa$

(1) Find the displacement and stress produced by cooling of this structure by 100 ^oC by modeling this structure by HEXA elements using HYPERMESH and MSC/NASTRAN.

To the hollow portion, phosphor bronze is pored to make a two material made solid cylinder, where bronze is characterized by

density	$\rho = 8860\ kg/m^3$
Elasticity Modulus	$E = 110\ GPa$
Shear Modulus	$G = 41\ GPa$
Coefficient of Thermal Expansion	$\alpha = 17.8 \times 10^{-6}\ /^o C$

(2) Find the displacement and stress when it is cooling down by 300 ^oC. Especially examine the stress and strain in the vicinity of the interface of two materials.

Additional Problem for the students who would like to study more. You need not do this, but you have time and mind to make additional work, then try.

(3) Make up a finite element model of a solid cylinder made of steel and bronze by using two superelements (one superelement is for the portion only steel, and the other is for the portion of bronze covered by steel), and generate stiffness, mass, and damping matrices of the superelements by using SEMGENERATE in MSC/NASTRAN.