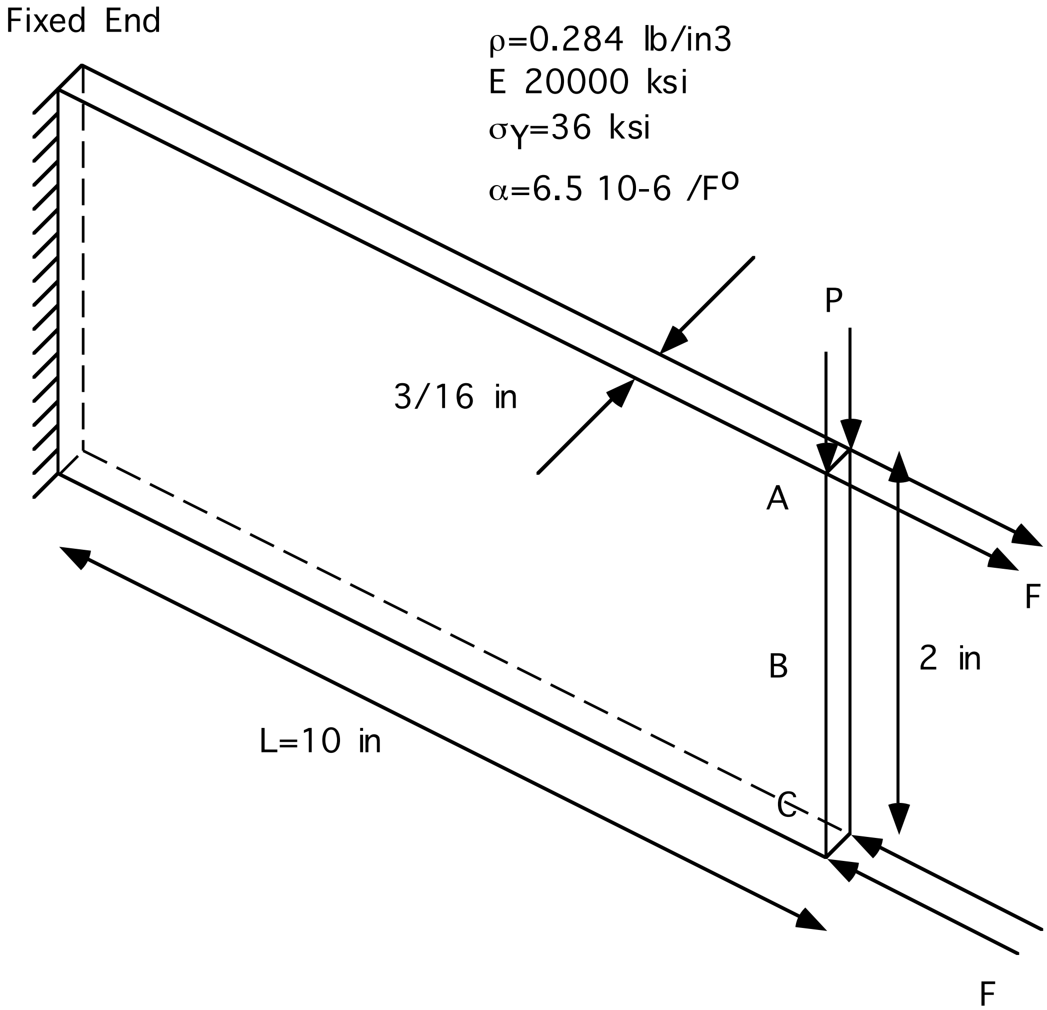
Homework #1 (2/10/97)
MEAM 305   Introduction to Finite Element Methods

97W

Consider a structural steel (ASTM-A36) made cantilever shown in the following figure :



(1) Develop a finite element model by using 8 node hexagonal elements (HEXA element in MSC/NASTRAN) with 5 elements in the longitudinal direction, 2 elements in the height and width directions of the cross section, that is, by the total equal size 5 x 2 x 2 = 20 elements.

Material is a standard structural steel whose constants are given in the figure, and assume that the left end cross section is rigidly fixed, and forces P and F are applied at the other free end section.

It is noted that force F is applied at the top and bottom edges, but their directions are opposite each other so that they generate bending moment.

When a finite element model is developed, forces P and F are carried by the edges equally, that is, they would be distributed equally to every element edges.

Assume for this first problem, P=5 lb and F=0 lb.

Verify your result with the elementary beam theory you have leaned in MEAM211 and 311.

(2) Using the finite element model in (1), find the value of F that provides the same maximum normal stress in the longitudinal direction with the case of P=5 lb. In this case, P=0 lb. Compare with the longitudinal stress distribution of this case with the one in (1).

(3) Find the maximum P or F we can apply to this cantilever, when the allowable stress is one third of the yield stress.

If you are interested in working more (that means, you need not submit the result, but it can be a good exercise),

(4) Develop a finite element model by using 4 node quadrilateral plate elements (QUAD4 elements in MSC/NASTRAN), and solve the first problem, and make comparison with the result by three-dimensional solid elements.

(6) Develop a finite element model by using 2 node beam elements (CBAR elements in MSC/NASTRAN), and solve the first problem.