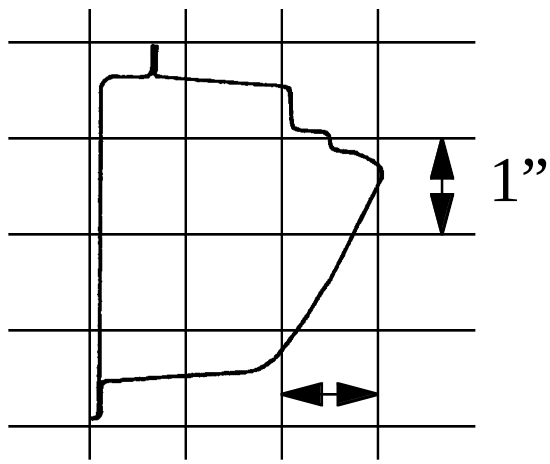
Homework #2
MEAM 599-02 Automotive Body Structures

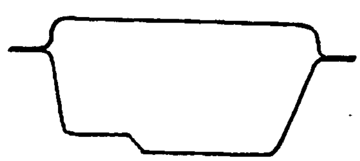
1998 Winter

1. Using AISI/CARS'96_GAS or equivalent software such as UNIGRAPHICS if you are familer with, find the geometric property of the following four cross sections. To do this, the thickness of the sheet metal to form the frames is assumed to be 1 mm. If a specific material characterization is required, you may pick up it from the database in AISI/CARS'96 for structural steel commonly used in automotive body. Since the geometry is given in approximately, you will determine the input to AISI/CARS'96 based on your judgement for details.

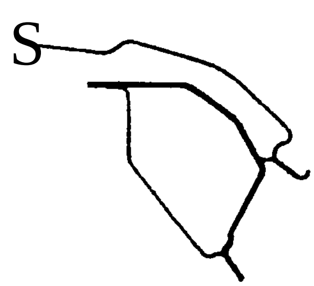
(a)



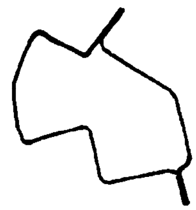
(b)



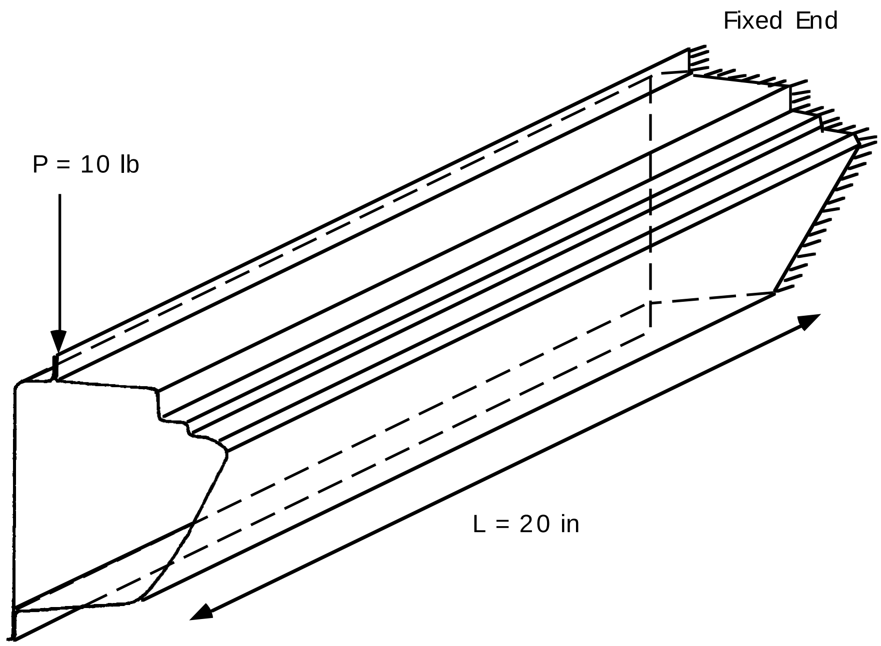
(c)



(d)



2. Assuming the cross section given in 1-(a), we consider a cantilever beam shown in the following figure.



Although this cantilever should be regrded as a short beam, assuming that this is modeled as a beam we have studied so far,

(a) Find the axial stress distribution on the cross section at the fixed end of the cantilever, and

(b) Find the horizontal and vertical deflections as well as the angle of twist of the beam at the free end.

To do so, you may model this cantilever by a beam element. Since the one end is fixed, you will end up a 6 x 6 matrix equation that can be solved by MATLAB. Unkowns are the two transverse deflections of the shear center, the average axial displacement, three rotations about the x, y, and z axes, respectively, where x and y are the principal axes of the cross section. For your analysis, you should specify what material constants are applied for structural steel. Here, we expect that Young's modulus is about 200 Gpa (30 M psi), and Poisson's ratio is about 0.29.

It is also noted that the vertical load P is applied not on the shear center, it generates twist moment about the shear center. Thus, you will have three input, say, V_x, V_y, and M_z.