MAE 404/503 Finite Elements in Engineering
Programming assignment #4

Write a MATLAB function for the analysis of a 3D truss system shown in Figure 1. The truss system has a length *L*, width *w*, and is composed of *N* sections. The truss is supported by fixing all components of displacement at the three nodes located at ($x = 0$). A force couple is applied at the nodes located at ($x = L$) as shown in the figure. The forces in the force couple act parallel to the *z*-axis and have a magnitude of *p* at the top of the truss and *p*/2 at the bottom of the truss, specified in Newton.

Each truss element is made from PVC (polyvinyl chloride) (ρ = 1380 kg/m^3, E = 3.0 GPa) and has a hollow circular cross section with an outer diameter of 33 mm and an inner diameter of 26 mm. Assume that the acceleration due to gravity is g = 9.81 m/s^2 along the negative y-axis.

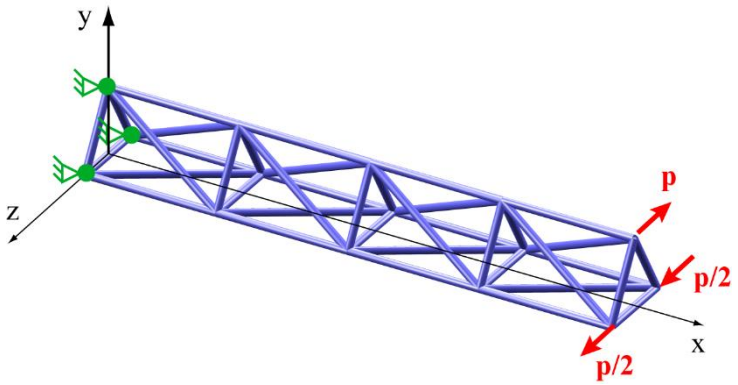

Figure 1. 3D view of truss system with 4 sections.

Instructions for programming and assignment submission:

- Submit a single file (MATLAB code). The file name must be in the format "asurite_hw4.m". Note that the separator is an underscore and you must substitute your ASU id, e.g., jdoe123.
- Code for generating the mesh is supplied in a MATLAB file named "**make_3dtruss.m**". Do not submit this function along with your assignment, i.e., treat **make_3dtruss** as if it were a built-in MATLAB function.
- The file **must** define a function of the same name as the file name (but without the ".m") , e.g.

```
function [d, stress] = asurite_hw4(N, L, w, p)
    if nargin == 0
        L = 12.0;    % Total length of truss (in meters)
        N = 4;       % Total number of segments along truss.
        w = 2.0;     % Width of truss.
        p = 500;
    end
    mesh = make_3dtruss(N, L, w);
    % Write rest of code here.
end
```

- **Input arguments:** N: the number of sections along the truss, L: length of the truss along the x-direction, w: width of the bottom of the truss, p: magnitude of the couple force (in Newton).
- **Output arguments:** d: the nodal displacement vector (dimensions should be 3×*n* by 1, where *n* is the number of nodes), stress: axial stress within each element (dimensions should be *ne* by 1, where *ne* is the number of elements). Compute the element forces from the displacements along the tangent direction of each truss only, i.e., assume small deformations.

Submit your assignment to http://sparky.fulton.asu.edu/fem/

Due date: Feb 12 at 11:59 pm.

You may submit as many times as you like, however only your most recent submission will count for you grade.