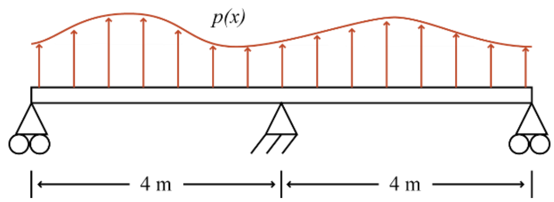
MAE 404/598 Finite Elements in Engineering
Programming assignment #9

Write a program to solve for the displacements of a beam using 2-node beam elements.



Note that a positive pressure applies a compressive force; i.e. opposite in direction to the outward normal direction. The flexural modulus of the beam is EI = $2\text{x}10^7$ N m^2.

Instructions for programming and assignment submission:

- For this assignment, you will submit only a single file (MATLAB code), with file name **must** be in the format "**asurite_hw9.m**". Note that the separator is an underscore.
- The file **must** define a function of the same name as the file name (but without the ".m") , e.g.

```
function [d] = asurite_hw9(num_nodes, p)
    mesh.x = linspace(0, 8, num_nodes);
    mesh.conn = [1:num_nodes-1; 2:num_nodes];
    % Compute K and f here.
    % Set boundary conditions on K and f here.
    d = K\f;
    % For debugging, use plot_solution(mesh, d) to check result here.
end

function [f] = plot_solution(mesh, d)
    position = [];
    displacement = [];
    for c = mesh.conn
        xe = mesh.x(c);
        h = xe(2)-xe(1);
        sctr(1:2:4) = 2*c-1;
        sctr(2:2:4) = 2*c;
        de = d(sctr)';
        % Interpolates solution along the element.
        for q = linspace(-1,1)
            % Use a linear mapping from element to global coordinates.
            N2 = 0.5*[1-q(1); 1+q(1)];
            position(end+1) = xe*N2;
            % Use the cubic (Hermite polynomial shape functions) mapping to interpolate displacement.
            N = shape(q(1), h);
            displacement(end+1) = de * N;
        end
    end
    plot(position, displacement); hold on;
    plot(mesh.x, d(1:2:end), 'o')
end
```

- **Input:** Number of nodes (num_nodes) – you can assume this will always be an odd number.
- **Input:** Transverse distributed force (p) This is a function that you can call (e.g. p(x)).
- **Output:** Global degree of freedom vector (d) has to be 2*num_nodes x 1 with the ordering $[u_1, \theta_1, u_2, \theta_2, u_3, \theta_3, \ldots]$.
- Use a three point integration rule to integrate the nodal forces arising from the distributed load.

Your submission will be graded electronically. Failure to comply with the above instructions may result in zero credit.

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

Can be resubmitted daily until: Thursday, April 28 at midnight.