Assignment #3

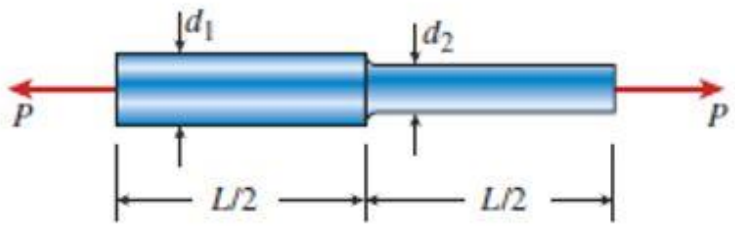
ME135-02L-Spring2018

Feb/19/2018

By Yeash Patel

Problem 1.

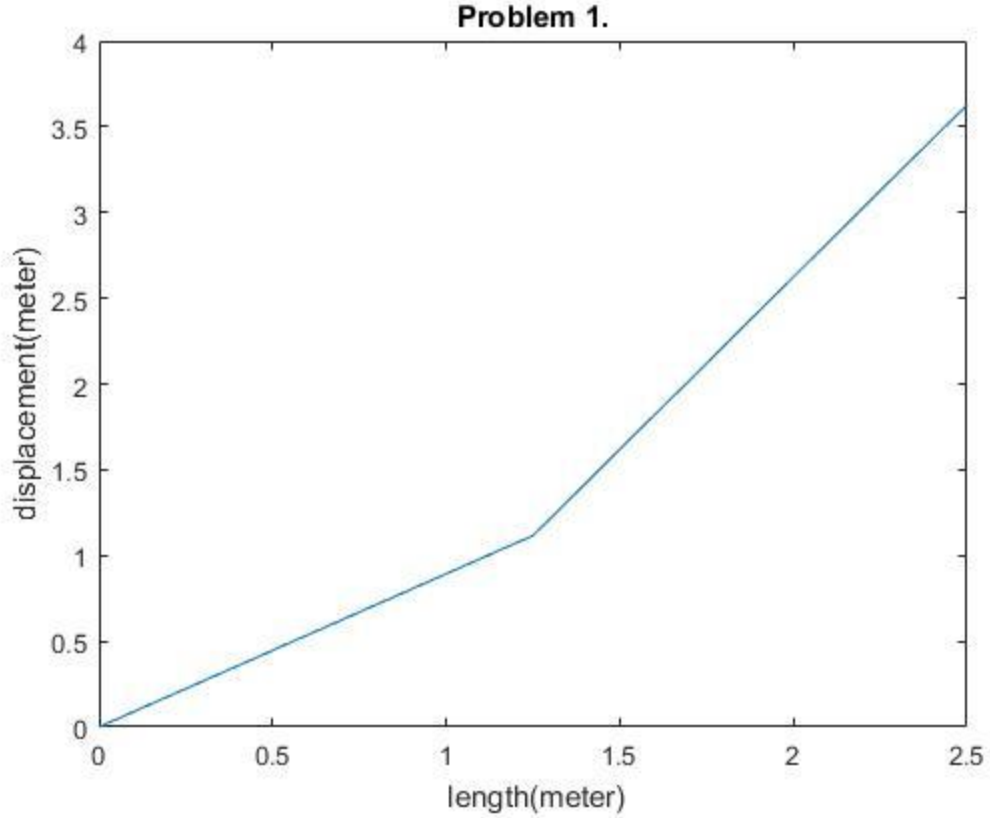
A brass bar ($E = 110\ MPa$)of length $L = 2.5\ m$ has diameter $d_1 = 18\ mm$ over one-half of its length and diameter $d_2 = 12\ mm$ over the other half. Compare this nonprismatic bar to a prismatic bar of the same volume of material with constant diameter d and length L. The bar is under load $P = 25\ KN$. Using finite element analysis find the elongation.
(Hint: you can assume one of the ends is fixed)



To solve this problem, we needed to use the finite element direct formulation We fixed the left-hand side of the bar. We found the displacement to be large. However, when considering the given the amount of stress and force the bar was exposed it seems more reasonable. The code used is available the appendix and on GitHub[https://github.com/Yeash96/Eng135.FEA/tree/master/Assigment_3]

Matlab input and output

>>Pr1


Problem 1.
displacement(meter)
length(meter)
0
0.5
1
1.5
2
2.5
3
3.5
4

Appendix

Pr1.m

```
clc
clear all
close all
%Given prameters
E=110*10^6;
L=2.5;
A1=pi()/4*(18*10^-3)^2;
A2=pi()/4*(12*10^-3)^2;
F=25*10^3;

%step size
dx=0.01;

%discretizes bar
x=0:dx:L;

%matrices initializataion

S= zeros(length(x),length(x)); %stiffness matrix
C=zeros(length(x),1); % load

% calculating K
for i=1:length(x)-1
   if (x(i)<L/2) % we have two areas at diffrent ends
       k(i)=E*A1/(x(i+1)-x(i));
   else
    k(i)=E*A2/(x(i+1)-x(i));
   end
end

%boundary conditions and filling the ends of the stiffnes matrics
S(1,1)=1;
S(length(x),length(x)-1)=-k(length(x)-1);
S(length(x),length(x))=k(length(x)-1);
C(length(x),1)=F;

for i=2:length(x)-1 % filling out the rest of the matrix

    S(i,i-1)=-k(i-1);
    S(i,i)=k(i-1)+k(i);
    S(i,i+1)=-k(i);

end

U=S\C

plot(x,U)
title('Problem 1.')
xlabel(' length(meter)')
ylabel('displacement(meter)')
```