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%a script to calculate force necessary to elongate a bar in a frame
% calculated with the small displacement approximation and without

%set some constants
delta = 0:0.001:1;      %range of horizontal displacement
E = 100 * 10^6;         %elastic modulus
A = 0.001;              %cross-sectional area
L_ref = 5;              %reference (initial) length

%calculate force with small displacement approximation
P_small = ((32*E*A).*delta)/(25*L_ref);

%calculate elongation without approximation (stepwise)
L_new=sqrt(9+(4+delta).^2); %find new length of bar
strain = (L_new - L_ref)./L_ref;    %find strain of bar
angle = (4+delta)./L_new;       %find new angle of bar after elongation
P_large = 2*E*A.*strain.*angle; %clacluate force necessary

%find error of small displacement approximation assuming P_large is the
%"correct" value
error = ((P_small - P_large)./P_large).*100;

%plotting results

% figure (1); hold on; grid on;
% plot(delta,P_small);
% plot(delta,P_large);
% title ("Displacement of Two-Member Frame Under Load");
% xlabel ("Horizontal Displacement (\delta) (m)");
% ylabel ("Horizontal Force (P) (N)");
%
% figure(2);
% plot(delta,error);
% title ("Error Between Predicted Forces Under Small Disp. and True Value");
% xlabel ("Horizontal Displacement (\delta) (m)");
% ylabel ("Percentage Error Between Predicted Forces (P) (N)");
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