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% This code produces plots of distance from ceiling vs stress in cables
% AB, AC, and AD

%variable declaring
sAB=1;
sAC=1;
sAD=1;

% for loop counter variable
a=1;

% Gravity (m/s^2)
g= 9.81;

% Masses (kg)
m=[1000 2000];

% Known Dimensions (m)
x1= 3.2;
x2= 2.7;
y1= 4.0;
y2= 3.6;
z= linspace(0.1,6,60); % +.1 increment

% Diameter (mm)
d= linspace(10,30,3); %10,20,30

% Saftey Factor (=UTS/Tensile Stress)
SF= 3;

% Ultimate Tensile Strength (Al 2024) (Pa)
UTS= 469000000;

% Max Allowable Stress (sAB, sAC, sAD need to be less than this)
s= UTS/SF;

for n=1:length(m) %loop for each Masses

    m1=m(n);

    for k=1:length(d) %loop for diameters 10,20,30

        d1= d(k);

        %cross-sectional area
        Ac= (pi.*(d1.^2))./4;
        Acm= Ac./(1000^2); % (m^2)

        for i=1:length(z) %loop for plotting z v. d
            %cable lengths
            LAC= sqrt((x1^2)+(z(i).^2));
            LAB= sqrt((x2^2)+(y2^2)+(z(i).^2));
            LAD= sqrt((x2^2)+(y1^2)+(z(i).^2));

            %tensions
            A= [(-x2)./LAB x1./LAC (-x2)./LAD; (-y2)./LAB 0 y1./LAD; (-z(i))./LAB (-z(i))./LAC (-z(i))./LAD];
            B= [0; 0; -m1*g];
            T= A\B;
            TAB= T(1,1);
            TAC= T(2,1);
            TAD= T(3,1);

            %stresses
            sAB(i)=TAB./Acm;
            sAC(i)=TAC./Acm;
            sAD(i)=TAD./Acm;

            %safety factor
            SF1(i)= UTS./sAC(i);

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end

% plot z v. stress
figure(a);
grid on
title("Mass = " + m1 + "kg" + newline + "d = " + d1 + "mm")
hold on
yline(s, '-.b');
pAB=plot(z,sAB);
pAC=plot(z,sAC);
pAD=plot(z,sAD);
xlabel('z distance from ceiling(m)') ;
ylabel('Tensile Stress (Pa)') ;
legend('Max Allowable Stress for SF=3','Cable AB','Cable AC','Cable AD');
hold off

% plot z v. SF
figure(7);
grid on
hold on
pSF=plot(z,SF1);
title("z vs SF")
xlabel('z distance from ceiling(m)') ;
ylabel('Safety Factor') ;
hold off
legend('m=1000kg d=10mm','m=1000kg d=20mm','m=1000kg d=30mm','m=2000kg d=10mm','m=2000kg d=20mm','m=2000kg d=30mm');
a=a+1;
end

end

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