```matlab
% Units (in, s, lb, degree F) unless otherwise specified

% Inputs
pitch = 0; % pitch angle of arm
    % Square pipe
        lbar = 24; % Length of square pipe
        sbar = 1; % side length of square pipe
        tbar = 0.065; % Wall thickness of square pipe

    % Support bar
        lsup = 10*sqrt(2); % length of support bar

        dsup = 10; % distance from bar hinge to support hinge
        hsup = 3; % distance from support reaction and x direction

    % actuation/external factors
        Wact = 7; % weight of actuation
        dact = lbar + 20; % distance to COM of actuation
        hdis = 0; % height of disconnect force
        Wclamp = 2; % weight of clamp
        Wpipe = 3; % weight of piping
        dpipe = 30; % distance to COM of piping

    % pins/bolts
        diapin = 1/4; % diameter of double shear pin
        diaboltup = 1/4; % diamter of bolts on upper clamp
        diaboltdown = 1/4; % diamter of bolts on lower clamp
        diapinsup = 1/4; % diamter of bolts on lower clamp

% Constants
rhom = 0.284; % density of steel
rhoa = 1.225 ; % density of air [kg/m^3]
pn2o = 1100; % pressure of N2O
Tamb = 120; % ambient temperature
Cdsquare = 2.05; % drag coefficient for flow over a square pipe
Cdsup = 1.17; % drag coefficient for flow over perp plate
V_inf = 8.9408*1.5; % speed of wind [m/s]
E = 29e6; % elastic modulus of steel
axyield = 32000; % axial yield stress for steel
shearyield = axyield/sqrt(3); % yield for steel in shear

% Geometries from known
pitchrad = deg2rad(pitch);
Anoz = pi * (1/8)^2; % area of nozzle
sbarin = sbar - 2*tbar; % inner length of square tube
Vbar = lbar * ((sbar)^2 - (sbarin)^2); % Volume of bar
posttheta = pi/2 + pitchrad; % angle between post and arm
theta3 = asin(dsup*sin(posttheta)/lsup);
thetasup = pi - theta3 - posttheta;
dclamp = lsup * sin(thetasup)/sin(posttheta); % distance between clamps
Ibar = (sbar^4 - sbarin^4)/12; % moment of inertia of the square tube


% Forces
Wbar = rhom * Vbar; % weight of bar

misuse = 20; % load due to misuse
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% BAR FBD
Rsup = (Wact*dact + Wbar*(lbar/2) + misuse*lbar) / (cos(thetasup)*hsup + sin(thetasup)*dsup);
Rxbar = -Rsup*cos(thetasup);
Rybar = Wbar+Wact-Rsup*sin(thetasup)+misuse;

% Support Optimization
% minimize weight while being above the buckling line

ssupguess = linspace(0.1,1,100); % potential support widths
wallsupguess = linspace(0.001,0.02,100); % potential support wall thicknesses
[W,T] = meshgrid(ssupguess,wallsupguess);

Asup = W.^2 - (W-2.*T).^2; % cross sectional area of the support bar
Isup = ((W.^4) - (W-2.*T).^4)./12; % moment of inertia of the support bar

% support yield / buckling
% rgyro = sqrt(Isup./Asup);
% slendrat = lsup./rgyro;

kbuck = 1;
Pcrit_b = (pi^2*E.*Isup)./(kbuck*lsup).^2;
SFsupbuck = Pcrit_b./Rsup;

sigsup = Rsup./(Asup); % axial stress in support
SFsupcomp = axyield./sigsup;

[C, h] = contour(W, T, SFsupbuck,[3,3]); % only plot where SFsupbuck = 3
set(h, 'EdgeColor', 'red'); % Set the color to red
clabel(C, h, 3); % label the contour line
xlabel('Support Width (in)');
ylabel('Support Wall Thickness (in)');
hold on
[C, h] = contour(W, T, SFsupcomp,[2,2]); % only plot where SFsupcomp = 2
set(h, 'EdgeColor', 'blue'); % Set the color to red
clabel(C, h, 2); % label the contour line
hold off
legend('Buckling','Axial Yielding')

ssup = 0.5;
wallsupmin = min(T(SFsupcomp(:,45) >= 2, 45));
wallsup = 0.049;

% Support FBD
Wsup = rhom * lsup* (ssup^2-(ssup-2*wallsup)^2);
Rxsup = Rsup*cos(thetasup);
Rysup = Wsup + Rsup*sin(thetasup);

% Double shear pin at clamp
Rbarshear = sqrt(Rxbar^2+Rybar^2);
taudshear = (4/3)*Rbarshear/(2*(pi * diapin^2/4));

% Single shear pin at clamp
Rclampdown = sqrt(Rxsup^2 + Rysup^2);
tausshear = (4/3)*Rclampdown/(pi*diapinsup^2/4);

% Single shear pin at bar and support
taushearsup = Rsup/(pi*diapinsup^2/4);

% FBD of upper clamp
Ffup = Wclamp - Rybar;
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    % Clamping force needed
    K = 0.3; % Nut factor
    mus = 0.74; % static friction factor of clamp on post
    Tboltup = K * (Ffup/mus)*diaboltup;

% FBD of lower clamp with clamping force
Ffdown = Wclamp - Rysup;
    % Clamping force needed

    Tboltdown = K * (Ffdown/mus)*diaboltdown;

% bearing stress
    % upper clamp
    metalt = 1/8; % thickness of bearing support
    Abarbear = metalt * (diapin *sin(pi/3)); % projected area of when 1/3 of bolt is in contact
    sigbear = (Rbarshear/2)/Abarbear;
    SFbearA = axyield/sigbear;

    % support/bar reaction
    sigbearsup = Rsup/Abarbear;
    SFbearB = axyield/sigbearsup;

    % lower clamp
    sigbearlower = Rclampdown/Abarbear;
    SFbearC = axyield/sigbearlower;

SFdshear = shearyield/taudshear;
SFsshear = shearyield/tausshear;
SFshearsup = shearyield/taushearsup;

% Prints
Wtotal = Wbar + Wact + Wsup + 2*Wclamp;
CG = Wbar*(lbar/2)/Wtotal + Wsup/Wtotal * (lsup*cos(thetasup)/2)+ Wact/Wtotal * (dact) + Wclamp*2/Wtotal * (3) ;


% square tube bending
Mbar = Wbar*((lbar-dsup)/lbar) * ((lbar-dsup)/2) + misuse*(lbar-dsup)+Wact*(dact-dsup);
sigbend = Mbar * (sbar/2)/Ibar;
SFbend = axyield/sigbend;
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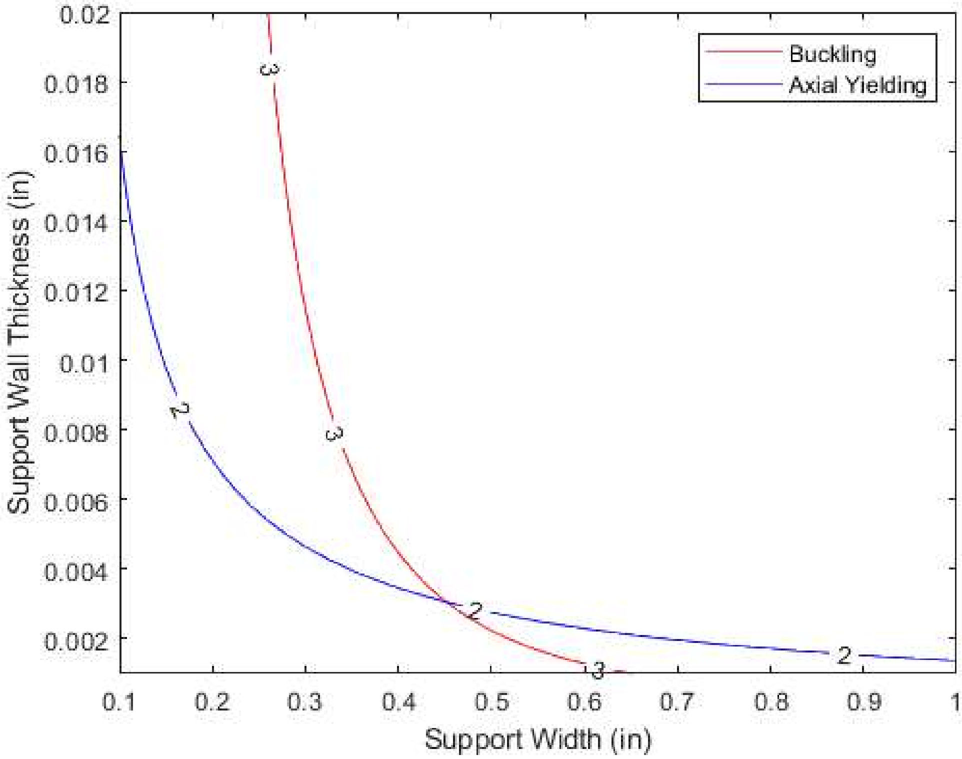

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