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% Written by Calum Iain Torrie 7/98
% modified by K.A. Strain 6/99 version 0.5.1
% coordinates x = longitudinal = u_LIGO roll about this axis
%             y = transverse   = v_LIGO pitch about this axis
%             z = vertical     = w_LIGO yaw about this axis

% top mass is REPRESENTED by a rectangular BLOCK
% in reality it will be larger and less dense.
 g =9.81;
 ux   = 0.10;        %dimensions of UPPER MASS (square)
 uy  =  0.17;
 uz   = 0.10;
 den1 = 7000;     %density (steel with holes)
 m1   = den1* uy* uz* ux;  %mass

 I1x  =  m1*( uy^2+ uz^2)/12; %moment of inertia (transverse roll)
 I1y  =  m1*( uz^2+ ux^2)/12; %moment of inertia (longitudinal pitch)
 I1z  =  m1*( uy^2+ ux^2)/12; %moment of inertia (yaw)
 pend.m1 = m1;
 pend.material1 = 'steel'
 pend.I1x = I1x;
 pend.I1y = I1y;
 pend.I1z = I1z;

%*********************************************************************

 ix   = 0.10;        %dimension of INTERMEDIATE MASS (cylinder)
 ir   = 0.1325;
den2  = 2202;        %density (fused silica)
 m2   = den2*pi* ir^2* ix  ;%intermediate mass
 I2x  = m2*(ir^2/2);    %moment of inertia (transverse roll)
 I2y  = m2*(ir^2/4+ix^2/12);  %moment of inertia (longitudinal pitch)
 I2z  = m2*(ir^2/4+ix^2/12);  %moment of inertia (yaw)

 pend.m2 = m2;
 pend.material2 = 'silica'
 pend.ix = ux;
 pend.ir = uy/2;
 pend.I2x = I2x;
 pend.I2y = I2y;
 pend.I2z = I2z;

%*********************************************************************

tx = 0.10;        %dimensions of TEST MASS (cylinder)
tr = 0.1325;
den3  = 2202;        %density (fused silica)

 m3   = den3*pi*tr^2*tx;   %test mass

 I3x  = m3*(tr^2/2);    %moment of inertia (transverse roll)
 I3y  = m3*(tr^2/4+tx^2/12);  %moment of inertia (longitudinal pitch)
 I3z  = m3*(tr^2/4+tx^2/12);  %moment of inertia (yaw)
 pend.m3 = m3;
 pend.material2 = 'silica'
 pend.tx = tx;
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```
 pend.tr = tr;
 pend.I3x = I3x;
 pend.I3y = I3y;
 pend.I3z = I3z;

%*****************************************************************

 l1   = 0.25;        %upper wire length
 l2   = 0.20;     %intermediate wire length
 l3   = 0.21;        %lower wire length
pend.l1 = l1;
pend.l2 = l2;
pend.l3 = l3;
%*****************************************************************************************

 nw1  =2;         % number of wires (= number of cantilevers if fitted) per stage (2 or 4)
 nw2  =4;
 nw3  =4;
pend.nw1 = nw1;
pend.nw2 = nw2;
pend.nw3 = nw3;
%*****************************************************************************

 r1   =605e-6; % radius of upper wire
 r2   =402e-6; % radius of intermediate wire
 r3   =200e-6; % radius of lower wire
pend.r1 = r1;
pend.r2 = r2;
pend.r3 = r3;
%*****************************************************************************

 Y1   =1.65e11;      % Youngs Modulus of upper wire   (s/steel 302)
 Y2   =1.65e11;      % Youngs Modulus of intermediate wire (s/steel 302)
 Y3   =7e10;         % Youngs Modulus of lower wire   (fused silica)
pend.Y1 = Y1;
pend.Y2 = Y2;
pend.Y3 = Y3;
%*****************************************************************
%blade design - upper blades
 mntb = (m1 +m2 +m3)/2;%total per blade
 mnb  = m1/2;%uncoupled mass
 [uf,lnb,anb,hnb,stn] = opt(mnb,mntb,8e8,0.35,0.05);
 ufc1 = uf;
 pend.l1b = lnb;
 pend.a1b = anb;
 pend.h1b = hnb;
 pend.ufc1 = uf;
 pend.st1  = stn;
 pend.intmode_1 = 55*hnb*0.37^2/(0.002*lnb^2); %scaled from GEO blade

%blade design - lower blades
 mntb = (m2 +m3)/4;%total per blade
 mnb  = m2/4;%uncoupled mass
 [uf,lnb,anb,hnb,stn] = opt(mnb,mntb,8e8,0.20,0.05);
 ufc2 = uf;
 pend.l2b = lnb;
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 pend.a2b = anb;
 pend.h2b = hnb;
 pend.ufc2 = uf;
 pend.st2  = stn;
 pend.intmode_2 = 55*hnb*0.37^2/(0.002*lnb^2); %scaled from GEO blade
 d0   = 0.001; %height of upper wire break-off (above c.of m. upper mass)
 d1   = 0.001; %height of intermediate wire break-off (below c.of m. upper mass)
 d2   = 0.001; %height of intermediate wire break-off (above c.of m. of int. mass)
 d3   = 0.001; %height of lower wire break-off (below c.of m. intermediate mass)
 d4   = 0.001; %height of lower wire break-off (above c.of m.test mass)
 pend.di = 'all 0.001';
%*******************************************************************************

% X direction separation

 su   = 0.00;     % 1/2 separation of upper wires
 si   = 0.04;     % 1/2 separation of intermediate wires
 sl   = 0.015; % 1/2 separation of lower wires
 pend.su = su;
 pend.si = si;
 pend.sl = sl;
 %*******************************************************************************

% Y direction separation

 n0   = 0.13;     % 1/2 separation of upper wires at suspension point
 n1   = 0.06;     % 1/2 separation of upper wires at upper mass
 n2   = 0.04;     % 1/2 separation of intermediate wires at upper mass
 n3   =ir+0.0065; % 1/2 separation of intermedite wires at intermediate mass
 n4   =tr+0.0015; % 1/2 separation of lower wires at intermediate mass
 n5   =tr+0.0015; % 1/2 separation of lower wires at test mass
 pend.n0 = n0;
 pend.n1 = n1;
 pend.n2 = n2;
 pend.n3 = n3;
 pend.n4 = n4;
 pend.n5 = n5;

%*******************************************************************************

% represents small loss

 bd = 0.01; % makes phases of open loop plots look nicer
lever_pitch = 0.04;
lever_roll   = 0.09;
lever_yaw   = 0.1;
pend.lever_pitch=lever_pitch;
pend.lever_roll=lever_roll;
pend.lever_yaw=lever_yaw;
pend
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