Appendix I: Dynamic Program for Pre-bent Struts with Filler

Mathematica Code

Input and initial guesses for dynamic moment (gmd), shear force (gqd) and axial force (gpd):

```
(*Forced small vibrations about prebent strut equilibrium; (2) clamped struts with an intermediate filler
supporting a rigid body; model assumes symmetry about pairs so only the outside struts are modeled,
y1=x1e,y2=y1e,y3=theta1_e, y4=m1e, y5=x1d, y6=y1d, y7=theta1_d, y8=m1d, y9=p1d,y10=q1d,
y21=q1e; Also includes stiffness of filler k and damping coefficient of filler c, given po1,  uo1, frequencies,
b (half of width of rigid body), h (half of height of rigid body), and moment m1  from
ClampedStrutEquil4PI^2, and q1 from ClampedStrutEquil4PI^2_prebent_filler
   this program will run a do loop so that several values of ω can be evaluated*)

Clear[pi,uo1,po1,m1,c1,ω1,q1,gp1d,gq1d,gm1d,uo2,po2,m2,c2,ω2,q2,gp2d,gq2d,gm2d]
pi = N[π];
i=(-1)^0.5;
uo1=0.01;
ao=0.1;
po1=10;
m1=0.209193;
q1=0.016633;
c=1;
r=1;
 g=0;
b=.5;
h=.1;
k=0.1;
gp1d=09.700000+07.5*i;
gq1d=0.029189100+0.5*i;
gm1d=-0.4269851800-0.5*i;
```

Equilibrium equations, boundary conditions and solution (solving for transmissibility) for a range of ω in "do" loop:

```
0>>caseoutdamp.txt
Do[{{ω1=m;

endpt[p1d_?NumberQ,q1d_?NumberQ,m1d_?NumberQ]:=First[NDSolve[{y1'[t]==Cos[y3[t]],y2'[t]==Sin[y
3[t]],y3'[t]==y4[t]+2*pi*ao*Cos[2*pi*t],y4'[t]==-po1*Sin[y3[t]]+y21[t]*Cos[y3[t]],y21'[t]==-k*(y2[t]-
yo[t])/(yo[t]+0.00000001),yo'[t]==Sin[ao*Sin[2*pi*t]],y5'[t]==-
y7[t]*Sin[y3[t]],y6'[t]==y7[t]*Cos[y3[t]],y7'[t]==y8[t],y8'[t]==(y10[t]-po1*y7[t])*Cos[y3[t]]-
(y9[t]+q1*y7[t])*Sin[y3[t]],y9'[t]==(ω1^2)*y5[t],y10'[t]==(ω1^2-i*ω1*c*yo[t]-
(k/(yo[t]+0.00000001)))*y6[t],

y1[0]==0,y2[0]==0,y3[0]==0,y4[0]==m1,y5[0]==uo1,y6[0]==0,y7[0]==0,y8[0]==m1d,y9[0]==p1d,y10[0]==q1d,y
21[0]==q1,yo[0]==0},{y1,y2,y3,y4,y5,y6,y7,y8,y9,y10,y21,yo},{t,0,1},MaxSteps→1000]];

      endpt[gp1d,gq1d,gm1d];
      f1[p1d_?NumberQ,q1d_?NumberQ,m1d_?NumberQ]:=y1[1]/.endpt[p1d,q1d,m1d];
      f2[p1d_?NumberQ,q1d_?NumberQ,m1d_?NumberQ]:=y2[1]/.endpt[p1d,q1d,m1d];
      f3[p1d_?NumberQ,q1d_?NumberQ,m1d_?NumberQ]:=y3[1]/.endpt[p1d,q1d,m1d];
      f5[p1d_?NumberQ,q1d_?NumberQ,m1d_?NumberQ]:=y5[1]/.endpt[p1d,q1d,m1d];
      f6[p1d_?NumberQ,q1d_?NumberQ,m1d_?NumberQ]:=y6[1]/.endpt[p1d,q1d,m1d];
```

```
f7[p1d_?NumberQ,q1d_?NumberQ,m1d_?NumberQ]:=y7[1]/.endpt[p1d,q1d,m1d];
f8[p1d_?NumberQ,q1d_?NumberQ,m1d_?NumberQ]:=y8[1]/.endpt[p1d,q1d,m1d];
f9[p1d_?NumberQ,q1d_?NumberQ,m1d_?NumberQ]:=y9[1]/.endpt[p1d,q1d,m1d];
f10[p1d_?NumberQ,q1d_?NumberQ,m1d_?NumberQ]:=y10[1]/.endpt[p1d,q1d,m1d];
f21[p1d_?NumberQ,q1d_?NumberQ,m1d_?NumberQ]:=y21[1]/.endpt[p1d,q1d,m1d];

Clear[p1d,q1d,m1d];
rts=FindRoot[{f6[p1d,q1d,m1d]==0,f7[p1d,q1d,m1d]==0,
f9[p1d,q1d,m1d]==-
r*po1*ω1^2*(f5[p1d,q1d,m1d])},{p1d,gp1d},{q1d,gq1d},{m1d,gm1d},AccuracyGoal→3,MaxIterations→3
0000];

p1d=p1d/.rts;
q1d=q1d/.rts;
m1d=m1d/.rts;

ω1,
TR1=((((Re[f5[p1d,q1d,m1d]])^2+(Im[f5[p1d,q1d,m1d]])^2))^0.5)/uo1,
gp1d=p1d*.98;
gq1d=q1d*.98;
gm1d=m1d*.98;
}>>>caseoutdamp.txt}
```

Create table of results:

```
Print[PaddedForm[TableForm[{{ω1,TR1,p1d,q1d,m1d}}],{5,6}]],{m,4,6,1}]
```

ω	TR3	p1d	p2d	q1d
4.000000	1.050000	-1.850000 + 0.000027 i	0.003210 - 0.000064 i	-0.052300 + 0.000019 i
5.000000	1.090000	-2.990000 + 0.000092 i	0.015200 - 0.000136 i	-0.087200 + 0.000042 i
6.000000	1.140000	-4.490000 + 0.000267 i	0.042500 - 0.000265 i	-0.136000 + 0.000083 i