Anexo F

Programas MatLab

En este anexo se recogen los distintos códigos generados durante el proyecto en software MatLab. Estos programas se han utilizado para obtener distintas soluciones teóricas o para determinar distintos parámetros necesarios antes del ensayo. Estos programas son:

- Calculosprevios.m
- Frecuenciasbarranalitico.m
- Frecuenciasbarramatrices.m

F1. Calculosprevios.m

```
%%%%%%% Calculo inicial de frecuencias
%%%%%%% caracteristicas de la barra
b=15e-3;
c=20e-3;
I=1/12*b^3*c;
L=0.9;
ro=7850;
E=210e9;
%%%%%% Calculo de los valores de la funcion
a=[0:1e-2:15];
for i=1:length(a)
f(i)=cosh(a(i))*cos(a(i))+1;
end
%%%%%% Busqueda de ceros
j=1;
for i=1:length(a)-1
    if f(i)*f(i+1)<0
        sol(j)=(a(i)+a(i+1))/2;
        j=j+1;
    else
    end
end
solu=sol/L;
factor=1/(2*pi)*sqrt(E*I/ro/(b*c));
frec=factor*(solu.^2)
%%%%%% representacion
x=[0:1e-3:0.9];
for i=1:5
    aa=1;
    bb=-1;
    cc=-1;
    dd=1;
    alpha=(sinh(sol(i))+sin(sol(i)))/(cosh(sol(i))+cos(sol(i)));


y(i,:)=aa*sin(x*sol(i))+bb*sinh(x*sol(i))+alpha*(cc*cos(x*sol(i))+dd*c
osh(x*sol(i)));
    subplot(5,1,i)
    plot(x,y(i,:))

end
```

F2.Frecuenciasbarranalitico.m

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%% PROPIEDADES SECCION LLENA %%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
L=0.9;
b=20e-3;
ancho=15e-3;
E=210e9;
ro=7850;
h=10e-3;
I=1/12*b^3*ancho;
mraya=ro*b*ancho;
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%% PROPIEDADES BASE1 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% h=35e-3;  %%%%%%% Valor de diseño
K=2/3*E*h^3;
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%% 3 PRIMERAS FRECUENCIAS IDEALES EMPOTRAMIENTO PERFEC%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
k=[1.875,4.694,7.855,sqrt(121)];
frecuenciaideal=k.^2*sqrt(E*I/mraya/L^4)/2/pi;
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%% CALCULO DE FREC BARRA CON BAES1, MODELO MUELLE RIGIDEZ K
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

%%%% se recorrera valores de a y se calculara el determinante
%%%% formado cn las condiciones de contorno del problema
a=[0:0.001:25]; %% a^4=w^2*m/E/I
for i=1:length(a)
    BB=[1,0,1,0 ;
        E*I/K*a(i),1,-E*I/K*a(i),1
        -cos(a(i)*L),-sin(a(i)*L),cosh(a(i)*L),sinh(a(i)*L);
        sin(a(i)*L),-cos(a(i)*L),sinh(a(i)*L),cosh(a(i)*L)];
    funcion(i)=det(BB);
end
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%% SE CALCULAN LOS CEROS DEL DETERMINANTE%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
jj=1; %para ir registrando las frecuencias encontradas
for ii=1:length(a)-1 %recorriendo todos los valores de a
izqa=a(ii);
dera=a(ii+1);
izq=funcion(ii);
der=funcion(ii+1);
if izq*der<0
    centro=(izqa+dera)/2;
    frecplaca(jj)=sqrt(E*I*centro^4/mraya)/2/pi;
    aa(jj)=centro;
jj=jj+1;
else
end
end
jj=jj-1;
```

F3. Frecuenciasbarramatrices.m

```
n=10 %numero de nodos
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%% Propiedades de la barra %%%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
Longitud=0.9;
b=20e-3;
c=15e-3;
E=210e9;
I=1/12*b^3*c;
mraya=7850*b*c;
h=15e-3;
Kraya=2/3*E*h^3;
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%% Problema matricial, definicion %%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
elem=n-1;
L=Longitud/elem;
coordx=[0:L:0.9];
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%% Definicion de las matrices K y M %%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
K=zeros(2*n,2*n);
M=zeros(2*n,2*n);

M1=mraya*L/420*[156 54 22*L -13*L;54 156 13*L -22*L;22*L 13*L 4*L^2 -
3*L^2;-13*L -22*L -3*L^2 4*L^2];
q1=M1(2,:);
q2=M1(3,:);
M1(2,:)=q2;
M1(3,:)=q1;
q1=M1(:,2);
q2=M1(:,3);
M1(:,2)=q2;
M1(:,3)=q1;

K1=2*E*I/L^3*[6 -6 3*L 3*L; -6 6 -3*L -3*L;3*L -3*L 2*L^2 L^2;3*L -3*L
L^2 2*L^2];
q1=K1(2,:);
q2=K1(3,:);
K1(2,:)=q2;
K1(3,:)=q1;
q1=K1(:,2);
q2=K1(:,3);
K1(:,2)=q2;
K1(:,3)=q1;

for i=1:2:2*n-3
K(i:i+3,i:i+3)=K(i:i+3,i:i+3)+K1;
M(i:i+3,i:i+3)=M(i:i+3,i:i+3)+M1;
end
K(2,2)=K(2,2)+Kraya;

KK=K(2:end,2:end);
MM=M(2:end,2:end);
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%% CALCULO DE FREC Y MODOS %%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

```
[V,D] = eig(inv(MM)*KK);
frecuency=sqrt(D)/2/pi;
frecuency=diag(frecuency);
frecuency=frecuency(end:-1:1);
V=V(:,end:-1:1);
m=V'*MM*V;
m=diag(m)';
fi=V;
for i=1:length(m)
fi(:,i)=V(:,i)/sqrt(m(i));
end
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%%% REORDEN %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fi=[zeros(1,length(m));fi];
for i=1:length(m)
    if fi(3,i)<0
        fi(:,i)=-fi(:,i);
    else
    end
end
```