CHAPTER 5
CONCLUSIONS AND SUGGESTIONS

5.1 Conclusions

Based on discussion on analysis result on simulation analysis and ekperiment analysis, can be take several conclusion:

1) For FFD method in numerical simulation resulted in f_1 = 1.757% and f_2 = 0.462% differences in predicting the frequency , mode1 = 2.06% and mode2= 5.17 % differences in predicting modeshape and damping at 16% and 3% difference.
2) For FFD method in eksperimental model resulted in f_1 = 6.31% and f_2 = 7.73 % differences in predicting the frequency , mode 1= 201.63% and mode2 = 156.77% differences in predicting mode shape.
3) From simulation analysis of FDD, it can be concluded than FFD method is very accurate (less than 5 percent difference) to predict the frequency and mode shape of structure in idealized environment and fairly good for predicting damping at maximum 16% difference.
4) From eksperimental analysis, it can be concluded than FFD method on experimental model is fairly accurate (less than 10 percent difference) to predict the frequency of the structure. But for mode shape of structure the difference from target is very big, therefore can be concluded that FFD method cannot detect these property in the data.

5.2 Suggestions

Based on discussion on analysis result on simulation analysis and ekperiment analysis, several point can be improved in this research:

- The damping of structure have not been calculated therefore cannot be compared with FDD data, More stuctrure data such as damping should be calculated to be compared with the result of FDD method.
- FFD method is accurate in idealized environment with clean signal and random distribution therefore with better quality data the result can significantly improve.
- Processing method to improve the quality of data is needed such as detrend, denoising algorithm, and filtering algorithm for the data.
- The source of the random vibration can be changed to simulate more realistic load on building such as loading vibration or wind vibration.

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INPUT SIMULATION
(thesis_model.m)

```
%----------------------Random Acceleration Code----------------------%
clear all
t=(0:0.01:4999);
a=-0.15 + (0.15+0.15)*rand(length(t),1);
%randn(length(t),1);
plot (t,a,'-.k')
pause
acc=[t' a];

t=acc(:,1);
iul=9.81*acc(:,2);
%------------------------------------------------------------------%
%-------------------------Stiffness Matrixs-------------------------%
n1=coor(0,0);
n2=coor(0.30,0);
n3=coor(0,0.4);
n4=coor(0.30,0.4);
n5=coor(0,0.8);
n6=coor(0.30,0.8);

E= 2e8  % kN/m^2
v=0.2;

Aa=2*0.003*0.018%m2s
Ab=2*0.018*0.003%m2s
mbar= 0.2826 %kg/m' %7850 kg/m3*A
Ia=1/12*0.003*0.018^3
Ib=1/12*0.018*0.003^3

A1=Aa;
I1=Ia;
f1=6/5;
ri1=0.009;
rj1=0.45;
[L1,T1]=memf(n3,n4);
k1=klf(E,A1,I1,L1);
K1=kg(k1,T1);
ID1=[9 1 2 9 3 4];

A2=Aa;
I2=Ia;
f2=f1;
ri2=ri1;
rj2=rj1;
[L2,T2]=memf(n5,n6);
k2=klf(E,A2,I2,L2);
K2=kg(k2,T2);
ID2=[10 5 6 10 7 8];

A3=Ab;
I3=Ib;
ri3=0;
rj3=0.018;
```

```
[L3,T3]=memf(n1,n3);
k3=klf(E,A3,I3,L3);
K3=kg(k3,T3);
ID3=[ 0 0 0 9 1 2];

A4=Ab;
I4=Ib;
[L4,T4]=memf(n2,n4);
k4=klf(E,A4,I4,L4);
K4=kg(k3,T3);
ID4=[0 0 0 9 3 4];

A5=Ab;
I5=Ib;
[L5,T5]=memf(n3,n5);
k5=klf(E,A5,I5,L5);
K5=kg(k5,T5);
ID5=[9 1 2 10 5 6];

A6=Ab;
I6=Ib;
[L6,T6]=memf(n4,n6);
k6=klf(E,A6,I6,L6);
K6=kg(k6,T6);
ID6=[9 3 4 10 7 8];

dof=10;
K=assf(K1,ID1,dof);
K=K+assf(K2,ID2,dof);
K=K+assf(K3,ID3,dof);
K=K+assf(K4,ID4,dof);
K=K+assf(K5,ID5,dof);
K=K+assf(K6,ID6,dof);
%-------------------------------------------------------------------%
%------------------------Matrix Condensation------------------------%
Klat=kcon (K,8,2)

M=[0.007 0; 0 0.007]
[eigv,eigval]=eig(M\Klat)

[n1,n2]=size(M);
n=n1;
%-------------------------------------------------------------------%
%--------------Eigenfactor Function (Wo dan Modeshape)---------------%
[wo,worder]=sort(sqrt(diag(eigval)))
mode=eigv(:,worder)

modeshape(:,1)=mode(:,1)/(mode(n,1))
modeshape(:,2)=mode(:,2)/ (mode(n,2))

T1=2*pi/wo(1)
T2=2*pi/wo(2)
%-------------------------State Space Model--------------------------%
```

```
psil1=0.05;
ak=2*psil1/wo(1)
C=ak*Klat

eo=[-0.05;-0.05];
A= [zeros(n,n) eye(n); -inv(M)*Klat -inv(M)*C ]
E=[zeros(n,1); inv(M)*eo]

N=2*n
Cy=eye(N)
Dy=zeros(N,1)

sys1=ss(A,E,Cy,Dy);
%--------------------------------------------------------------------%
%------------------------Response Simulation-------------------------%
[y1,t1,z1]=lsim(sys1,iul,t);

a=-inv(M)*[Klat C]*z1';  %-inv(M)*eo*iul';
subplot 211
plot (t,a(1,:),'-.k') %Acc First floor
legend('first floor')
xlabel('time(s)');
ylabel('acceleration (m/s2)');
subplot 212
plot (t,a(2,:),'r-.') %Acc Second floor
legend('second floor')
xlabel('time(s)');
ylabel('acceleration (m/s2)');

a1max=max(abs(a(:,1)));
a2max=max(abs(a(:,2)));

f1=1/(2*pi()/wo(1,1))

f2=1/(2*pi()/wo(2,1))
%--------------------------------------------------------------------%
%----------------------------Ekspor Data-----------------------------%
Az=a;
phi=modeshape;
zeta=[0.005 0.005];
wn=[wo(1,1) wo(2,1)];
t1=t';
save ('frame_1.mat', 'Az', 'phi', 't1', 'zeta', 'wn')
%--------------------------------------------------------------------%
```

ANALYSIS SIMULATION
(solveFDD_simulation.m)

```
%----------------------Loading Acceleration data----------------------%
clearvars;close all;clc;
load('frame_1.mat')
wn= [12.7304 33.4607];
phi= [0.61235 -1.63305;1 1];
zeta=[0.005 0.005];
%---------------------------------------------------------------------%
%------------------------------FDD Analysis---------------------------%
fn = wn/(2*pi);
Nmodes = 2;
fs = 100;
rng(1)
tic
[phi_FDD,fn_FDD,zeta] = AFDD(Az,t1,Nmodes,'PickingMethod','manual');
toc

% The theoretical and measured eigenfrequencies agrees well !
disp('left: target eigen frequencies. Right: Measured eigenfrequencies')
disp([fn(:),fn_FDD(1:Nmodes)'])
disp('left: target damping. Right: Measured damping')
disp([5e-3*ones(Nmodes,1),zeta(:),])
disp('left: target modeshapes. Right: Measured modeshapes')
disp([phi(:),phi_FDD(:)])
%--------------------------------------------------------------------%
```

INPUT EXPERIMENTAL
(data_procces.m)

```
clear all;
n=500000;
A=[1:n]';

%------------------------------Data Sensor 1-------------------------------%
data1=csvread('DATA-lt1full.CSV');
Amentah1=data1(A,2);
A1=Amentah1/2048;
Acc1=A1*9.81;
t1=data1(A,1);
%--------------------------------------------------------------------------%
%------------------------------Data Sensor 2-------------------------------%
data2=csvread('DATA-lt2full.CSV');
Amentah2=data2(A,2);
A2=Amentah2/2048;
Acc2=A2*9.81;
t2=data2(A,1);
%--------------------------------------------------------------------------%
%---------------------------Plot Acceleration 1----------------------------%
subplot 211
plot (t1,Acc1,'k')
legend('Lantai pertama')
xlabel('waktu (detik)');
ylabel('percepatan (m/s2)');
%--------------------------------------------------------------------------%
%---------------------------Plot Acceleration 2----------------------------%
subplot 212
plot (t2,Acc2,'r')
legend('lantai kedua')
xlabel('waktu (detik)');
ylabel('percepatan (m/s2)');
%--------------------------------------------------------------------------%
%--------------------------------Export Data-------------------------------%
Acc=[Acc1,Acc2];
Az=Acc';
t=t1';
save ('accdata.mat','Acc','Az','t')
%--------------------------------------------------------------------------%
```

ANALYSIS EXPERIMENT
(solveFDD_experiment.m)

```
%----------------------Loading Acceleration data----------------------%
clearvars;close all;clc;
load('accdata.mat')
wn= [12.7304 33.4607];
phi= [0.61235 -1.63305;1 1];
%---------------------------------------------------------------------%
%------------------------------FDD Analysis---------------------------%
fn = wn/(2*pi);
Nmodes = 2;
fs = 100;
rng(1)

tic
[phi_FDD,fn_FDD,zeta] = AFDD(Az,t,Nmodes,'PickingMethod','manual');
toc

% The theoretical and measured eigenfrequencies agrees well !
disp('left: target eigen frequencies. Right: Measured eigenfrequencies)
disp([fn(:),fn_FDD(1:Nmodes)'])
disp('left: target damping. Right: Measured damping)
disp([5e-3*ones(Nmodes,1),zeta(:),])
disp('left: target modeshapes. Right: Measured modeshapes)
disp([phi(:),phi_FDD(:)])
%---------------------------------------------------------------------%
```