CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The result of the simulation shows the significant comparison displacement response reduction from the uncontrolled-passive off; uncontrolled-passive off and uncontrolled-lyapunov method namely:

- 31.5%, 37.5%, 48.35% (1st floor)
- 30.7%, 30.5%, 40.2% (2nd floor)
- 26.5%, 29.8%, 40% (3rd floor)

5.2 Recommendations

Some recommendations that could improve the analysis by researching unsymmetrical three-dimensional building, other responses to be figured out (acceleration and velocity) and it is necessary to apply other strategies sort of active, passive or hybrid control strategy.

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APPENDIX

```
%COORDINATE
%BASE
n1=coor3(0,0,0);
n2=coor3(4,0,0);
n3=coor3(8,0,0);
n4=coor3(12,0,0);
n5=coor3(0,0,-4);
n6=coor3(4,0,-4);
n7=coor3(8,0,-4);
n8=coor3(12,0,-4);
n9=coor3(0,0,-8);
n10=coor3(4,0,-8);
n11=coor3(8,0,-8);
n12=coor3(12,0,-8);
n13=coor3(0,0,-12);
n14=coor3(4,0,-12);
n15=coor3(8,0,-12);
n16=coor3(12,0,-12);

%1st floor
n17=coor3(0,3,0);
n18=coor3(4,3,0);
n19=coor3(8,3,0);
n20=coor3(12,3,0);
n21=coor3(0,3,-4);
n22=coor3(4,3,-4);
n23=coor3(8,3,-4);
n24=coor3(12,3,-4);
n25=coor3(0,3,-8);
n26=coor3(4,3,-8);
n27=coor3(8,3,-8);
n28=coor3(12,3,-8);
n29=coor3(0,3,-12);
n30=coor3(4,3,-12);
n31=coor3(8,3,-12);
n32=coor3(12,3,-12);

%2nd floor
n33=coor3(0,6,0);
n34=coor3(4,6,0);
n35=coor3(8,6,0);
n36=coor3(12,6,0);
n37=coor3(0,6,-4);
n38=coor3(4,6,-4);
n39=coor3(8,6,-4);
n40=coor3(12,6,-4);
n41=coor3(0,6,-8);
n42=coor3(4,6,-8);
n43=coor3(8,6,-8);
n44=coor3(12,6,-8);
n45=coor3(0,6,-12);
n46=coor3(4,6,-12);
n47=coor3(8,6,-12);
n48=coor3(12,6,-12);

%3rd floor
```

```
n49=coor3(0,9,0);
n50=coor3(4,9,0);
n51=coor3(8,9,0);
n52=coor3(12,9,0);
n53=coor3(0,9,-4);
n54=coor3(4,9,-4);
n55=coor3(8,9,-4);
n56=coor3(12,9,-4);
n57=coor3(0,9,-8);
n58=coor3(4,9,-8);
n59=coor3(8,9,-8);
n60=coor3(12,9,-8);
n61=coor3(0,9,-12);
n62=coor3(4,9,-12);
n63=coor3(8,9,-12);
n64=coor3(12,9,-12);


%Column
[L1,T1]=mem3f(n1,n17,n18);
[L2,T2]=mem3f(n17,n33,n34);
[L3,T3]=mem3f(n33,n49,n50);
[L4,T4]=mem3f(n2,n18,n17);
[L5,T5]=mem3f(n18,n34,n33);
[L6,T6]=mem3f(n34,n50,n49);
[L7,T7]=mem3f(n3,n19,n18);
[L8,T8]=mem3f(n19,n35,n34);
[L9,T9]=mem3f(n35,n51,n50);
[L10,T10]=mem3f(n4,n20,n19);
[L11,T11]=mem3f(n20,n36,n35);
[L12,T12]=mem3f(n36,n52,n51);
[L13,T13]=mem3f(n5,n21,n22);
[L14,T14]=mem3f(n21,n37,n38);
[L15,T15]=mem3f(n37,n53,n54);
[L16,T16]=mem3f(n6,n22,n21);
[L17,T17]=mem3f(n22,n38,n37);
[L18,T18]=mem3f(n38,n54,n53);
[L19,T19]=mem3f(n7,n23,n22);
[L20,T20]=mem3f(n23,n39,n38);
[L21,T21]=mem3f(n39,n55,n54);
[L22,T22]=mem3f(n8,n24,n23);
[L23,T23]=mem3f(n24,n40,n39);
[L24,T24]=mem3f(n40,n56,n55);
[L25,T25]=mem3f(n9,n25,n26);
[L26,T26]=mem3f(n25,n41,n42);
[L27,T27]=mem3f(n41,n57,n58);
[L28,T28]=mem3f(n10,n26,n25);
[L29,T29]=mem3f(n26,n42,n41);
[L30,T30]=mem3f(n42,n58,n57);
[L31,T31]=mem3f(n11,n27,n26);
[L32,T32]=mem3f(n27,n43,n42);
[L33,T33]=mem3f(n43,n59,n58);
[L34,T34]=mem3f(n12,n28,n27);
[L35,T35]=mem3f(n28,n44,n43);
[L36,T36]=mem3f(n44,n60,n59);
[L37,T37]=mem3f(n13,n29,n30);
```

```
[L38,T38]=mem3f(n29,n45,n46);
[L39,T39]=mem3f(n45,n61,n62);
[L40,T40]=mem3f(n14,n30,n29);
[L41,T41]=mem3f(n30,n46,n45);
[L42,T42]=mem3f(n46,n62,n61);
[L43,T43]=mem3f(n15,n31,n30);
[L44,T44]=mem3f(n31,n47,n46);
[L45,T45]=mem3f(n47,n63,n62);
[L46,T46]=mem3f(n16,n32,n31);
[L47,T47]=mem3f(n32,n48,n47);
[L48,T48]=mem3f(n48,n64,n63);


%Beam (X direction)
%1st floor
[L49,T49]=mem3f(n17,n18,n33);
[L50,T50]=mem3f(n18,n19,n34);
[L51,T51]=mem3f(n19,n20,n35);
[L52,T52]=mem3f(n21,n22,n37);
[L53,T53]=mem3f(n22,n23,n38);
[L54,T54]=mem3f(n23,n24,n39);
[L55,T55]=mem3f(n25,n26,n41);
[L56,T56]=mem3f(n26,n27,n42);
[L57,T57]=mem3f(n27,n28,n43);
[L58,T58]=mem3f(n29,n30,n45);
[L59,T59]=mem3f(n30,n31,n46);
[L60,T60]=mem3f(n31,n32,n47);


%2nd floor
[L61,T61]=mem3f(n33,n34,n49);
[L62,T62]=mem3f(n34,n35,n50);
[L63,T63]=mem3f(n35,n36,n51);
[L64,T64]=mem3f(n37,n38,n53);
[L65,T65]=mem3f(n38,n39,n54);
[L66,T66]=mem3f(n39,n40,n55);
[L67,T67]=mem3f(n41,n42,n57);
[L68,T68]=mem3f(n42,n43,n58);
[L69,T69]=mem3f(n43,n44,n59);
[L70,T70]=mem3f(n45,n46,n61);
[L71,T71]=mem3f(n46,n47,n62);
[L72,T72]=mem3f(n47,n48,n63);


%3rd floor
[L73,T73]=mem3f(n49,n50,n33);
[L74,T74]=mem3f(n50,n51,n34);
[L75,T75]=mem3f(n51,n52,n35);
[L76,T76]=mem3f(n53,n54,n37);
[L77,T77]=mem3f(n54,n55,n38);
[L78,T78]=mem3f(n55,n56,n39);
[L79,T79]=mem3f(n57,n58,n41);
[L80,T80]=mem3f(n58,n59,n42);
[L81,T81]=mem3f(n59,n60,n43);
[L82,T82]=mem3f(n61,n62,n45);
[L83,T83]=mem3f(n62,n63,n46);
[L84,T84]=mem3f(n63,n64,n47);


%BEAM(Z direction)
```

```
%1st floor
[L85,T85]=mem3f(n17,n21,n33);
[L86,T86]=mem3f(n21,n25,n37);
[L87,T87]=mem3f(n25,n29,n41);
[L88,T88]=mem3f(n18,n22,n34);
[L89,T89]=mem3f(n22,n26,n38);
[L90,T90]=mem3f(n26,n30,n42);
[L91,T91]=mem3f(n19,n23,n35);
[L92,T92]=mem3f(n23,n27,n39);
[L93,T93]=mem3f(n27,n31,n43);
[L94,T94]=mem3f(n20,n24,n36);
[L95,T95]=mem3f(n24,n28,n40);
[L96,T96]=mem3f(n28,n32,n44);


%2nd floor
[L97,T97]=mem3f(n33,n37,n49);
[L98,T98]=mem3f(n37,n41,n53);
[L99,T99]=mem3f(n41,n45,n57);
[L100,T100]=mem3f(n34,n38,n50);
[L101,T101]=mem3f(n38,n42,n54);
[L102,T102]=mem3f(n42,n46,n58);
[L103,T103]=mem3f(n35,n39,n51);
[L104,T104]=mem3f(n39,n43,n55);
[L105,T105]=mem3f(n43,n47,n59);
[L106,T106]=mem3f(n36,n40,n52);
[L107,T107]=mem3f(n40,n44,n56);
[L108,T108]=mem3f(n44,n48,n60);


%3rd floor
[L109,T109]=mem3f(n49,n53,n33);
[L110,T110]=mem3f(n53,n57,n37);
[L111,T111]=mem3f(n57,n61,n41);
[L112,T112]=mem3f(n50,n54,n34);
[L113,T113]=mem3f(n54,n58,n38);
[L114,T114]=mem3f(n58,n62,n42);
[L115,T115]=mem3f(n51,n55,n35);
[L116,T116]=mem3f(n55,n59,n39);
[L117,T117]=mem3f(n59,n63,n43);
[L118,T118]=mem3f(n52,n56,n36);
[L119,T119]=mem3f(n56,n60,n40);
[L120,T120]=mem3f(n60,n64,n44);


E=2.5e7;
v=0.3;
G=E/(2*(1+v));

Ab=0.069;  %beam 0.23x0.3
Iyb=3.0418e-4;
Izb=5.175e-4;
Jxb=6.2903e-4;

Ac=0.09;  %column 0.3x0.3
Iyc=6.75e-4;
Izc=6.75e-4;
Jxc=9.9e-4;
```

```
%column
k1=kl3f(E,G,Ac,Iyc,Izc,Jxc,L1);
k2=kl3f(E,G,Ac,Iyc,Izc,Jxc,L2);
k3=kl3f(E,G,Ac,Iyc,Izc,Jxc,L3);
k4=kl3f(E,G,Ac,Iyc,Izc,Jxc,L4);
k5=kl3f(E,G,Ac,Iyc,Izc,Jxc,L5);
k6=kl3f(E,G,Ac,Iyc,Izc,Jxc,L6);
k7=kl3f(E,G,Ac,Iyc,Izc,Jxc,L7);
k8=kl3f(E,G,Ac,Iyc,Izc,Jxc,L8);
k9=kl3f(E,G,Ac,Iyc,Izc,Jxc,L9);
k10=kl3f(E,G,Ac,Iyc,Izc,Jxc,L10);
k11=kl3f(E,G,Ac,Iyc,Izc,Jxc,L11);
k12=kl3f(E,G,Ac,Iyc,Izc,Jxc,L12);
k13=kl3f(E,G,Ac,Iyc,Izc,Jxc,L13);
k14=kl3f(E,G,Ac,Iyc,Izc,Jxc,L14);
k15=kl3f(E,G,Ac,Iyc,Izc,Jxc,L15);
k16=kl3f(E,G,Ac,Iyc,Izc,Jxc,L16);
k17=kl3f(E,G,Ac,Iyc,Izc,Jxc,L17);
k18=kl3f(E,G,Ac,Iyc,Izc,Jxc,L18);
k19=kl3f(E,G,Ac,Iyc,Izc,Jxc,L19);
k20=kl3f(E,G,Ac,Iyc,Izc,Jxc,L20);
k21=kl3f(E,G,Ac,Iyc,Izc,Jxc,L21);
k22=kl3f(E,G,Ac,Iyc,Izc,Jxc,L22);
k23=kl3f(E,G,Ac,Iyc,Izc,Jxc,L23);
k24=kl3f(E,G,Ac,Iyc,Izc,Jxc,L24);
k25=kl3f(E,G,Ac,Iyc,Izc,Jxc,L25);
k26=kl3f(E,G,Ac,Iyc,Izc,Jxc,L26);
k27=kl3f(E,G,Ac,Iyc,Izc,Jxc,L27);
k28=kl3f(E,G,Ac,Iyc,Izc,Jxc,L28);
k29=kl3f(E,G,Ac,Iyc,Izc,Jxc,L29);
k30=kl3f(E,G,Ac,Iyc,Izc,Jxc,L30);
k31=kl3f(E,G,Ac,Iyc,Izc,Jxc,L31);
k32=kl3f(E,G,Ac,Iyc,Izc,Jxc,L32);
k33=kl3f(E,G,Ac,Iyc,Izc,Jxc,L33);
k34=kl3f(E,G,Ac,Iyc,Izc,Jxc,L34);
k35=kl3f(E,G,Ac,Iyc,Izc,Jxc,L35);
k36=kl3f(E,G,Ac,Iyc,Izc,Jxc,L36);
k37=kl3f(E,G,Ac,Iyc,Izc,Jxc,L37);
k38=kl3f(E,G,Ac,Iyc,Izc,Jxc,L38);
k39=kl3f(E,G,Ac,Iyc,Izc,Jxc,L39);
k40=kl3f(E,G,Ac,Iyc,Izc,Jxc,L40);
k41=kl3f(E,G,Ac,Iyc,Izc,Jxc,L41);
k42=kl3f(E,G,Ac,Iyc,Izc,Jxc,L42);
k43=kl3f(E,G,Ac,Iyc,Izc,Jxc,L43);
k44=kl3f(E,G,Ac,Iyc,Izc,Jxc,L44);
k45=kl3f(E,G,Ac,Iyc,Izc,Jxc,L45);
k46=kl3f(E,G,Ac,Iyc,Izc,Jxc,L46);
k47=kl3f(E,G,Ac,Iyc,Izc,Jxc,L47);
k48=kl3f(E,G,Ac,Iyc,Izc,Jxc,L48);


%Beam(X direction)
%1st floor
k49=kl3f(E,G,Ab,Iyb,Izb,Jxb,L49);
k50=kl3f(E,G,Ab,Iyb,Izb,Jxb,L50);
k51=kl3f(E,G,Ab,Iyb,Izb,Jxb,L51);
```

```
k52=kl3f(E,G,Ab,Iyb,Izb,Jxb,L52);
k53=kl3f(E,G,Ab,Iyb,Izb,Jxb,L53);
k54=kl3f(E,G,Ab,Iyb,Izb,Jxb,L54);
k55=kl3f(E,G,Ab,Iyb,Izb,Jxb,L55);
k56=kl3f(E,G,Ab,Iyb,Izb,Jxb,L56);
k57=kl3f(E,G,Ab,Iyb,Izb,Jxb,L57);
k58=kl3f(E,G,Ab,Iyb,Izb,Jxb,L58);
k59=kl3f(E,G,Ab,Iyb,Izb,Jxb,L59);
k60=kl3f(E,G,Ab,Iyb,Izb,Jxb,L60);


%2nd floor
k61=kl3f(E,G,Ab,Iyb,Izb,Jxb,L61);
k62=kl3f(E,G,Ab,Iyb,Izb,Jxb,L62);
k63=kl3f(E,G,Ab,Iyb,Izb,Jxb,L63);
k64=kl3f(E,G,Ab,Iyb,Izb,Jxb,L64);
k65=kl3f(E,G,Ab,Iyb,Izb,Jxb,L65);
k66=kl3f(E,G,Ab,Iyb,Izb,Jxb,L66);
k67=kl3f(E,G,Ab,Iyb,Izb,Jxb,L67);
k68=kl3f(E,G,Ab,Iyb,Izb,Jxb,L68);
k69=kl3f(E,G,Ab,Iyb,Izb,Jxb,L69);
k70=kl3f(E,G,Ab,Iyb,Izb,Jxb,L70);
k71=kl3f(E,G,Ab,Iyb,Izb,Jxb,L71);
k72=kl3f(E,G,Ab,Iyb,Izb,Jxb,L72);


%3rd floor
k73=kl3f(E,G,Ab,Iyb,Izb,Jxb,L73);
k74=kl3f(E,G,Ab,Iyb,Izb,Jxb,L74);
k75=kl3f(E,G,Ab,Iyb,Izb,Jxb,L75);
k76=kl3f(E,G,Ab,Iyb,Izb,Jxb,L76);
k77=kl3f(E,G,Ab,Iyb,Izb,Jxb,L77);
k78=kl3f(E,G,Ab,Iyb,Izb,Jxb,L78);
k79=kl3f(E,G,Ab,Iyb,Izb,Jxb,L79);
k80=kl3f(E,G,Ab,Iyb,Izb,Jxb,L80);
k81=kl3f(E,G,Ab,Iyb,Izb,Jxb,L81);
k82=kl3f(E,G,Ab,Iyb,Izb,Jxb,L82);
k83=kl3f(E,G,Ab,Iyb,Izb,Jxb,L83);
k84=kl3f(E,G,Ab,Iyb,Izb,Jxb,L84);


%BEAM(Z direction)
%1st floor
k85=kl3f(E,G,Ab,Iyb,Izb,Jxb,L85);
k86=kl3f(E,G,Ab,Iyb,Izb,Jxb,L86);
k87=kl3f(E,G,Ab,Iyb,Izb,Jxb,L87);
k88=kl3f(E,G,Ab,Iyb,Izb,Jxb,L88);
k89=kl3f(E,G,Ab,Iyb,Izb,Jxb,L89);
k90=kl3f(E,G,Ab,Iyb,Izb,Jxb,L90);
k91=kl3f(E,G,Ab,Iyb,Izb,Jxb,L91);
k92=kl3f(E,G,Ab,Iyb,Izb,Jxb,L92);
k93=kl3f(E,G,Ab,Iyb,Izb,Jxb,L93);
k94=kl3f(E,G,Ab,Iyb,Izb,Jxb,L94);
k95=kl3f(E,G,Ab,Iyb,Izb,Jxb,L95);
k96=kl3f(E,G,Ab,Iyb,Izb,Jxb,L96);


%2nd floor
k97=kl3f(E,G,Ab,Iyb,Izb,Jxb,L97);
k98=kl3f(E,G,Ab,Iyb,Izb,Jxb,L98);
```

```
k99=kl3f(E,G,Ab,Iyb,Izb,Jxb,L99);              K30=kg(k30,T30);
k100=kl3f(E,G,Ab,Iyb,Izb,Jxb,L100);            K31=kg(k31,T31);
k101=kl3f(E,G,Ab,Iyb,Izb,Jxb,L101);            K32=kg(k32,T32);
k102=kl3f(E,G,Ab,Iyb,Izb,Jxb,L102);            K33=kg(k33,T33);
k103=kl3f(E,G,Ab,Iyb,Izb,Jxb,L103);            K34=kg(k34,T34);
k104=kl3f(E,G,Ab,Iyb,Izb,Jxb,L104);            K35=kg(k35,T35);
k105=kl3f(E,G,Ab,Iyb,Izb,Jxb,L105);            K36=kg(k36,T36);
k106=kl3f(E,G,Ab,Iyb,Izb,Jxb,L106);            K37=kg(k37,T37);
k107=kl3f(E,G,Ab,Iyb,Izb,Jxb,L107);            K38=kg(k38,T38);
k108=kl3f(E,G,Ab,Iyb,Izb,Jxb,L108);            K39=kg(k39,T39);
                                               K40=kg(k40,T40);
                                               K41=kg(k41,T41);
%3rd floor                                     K42=kg(k42,T42);
k109=kl3f(E,G,Ab,Iyb,Izb,Jxb,L109);            K43=kg(k43,T43);
k110=kl3f(E,G,Ab,Iyb,Izb,Jxb,L110);            K44=kg(k44,T44);
k111=kl3f(E,G,Ab,Iyb,Izb,Jxb,L111);            K45=kg(k45,T45);
k112=kl3f(E,G,Ab,Iyb,Izb,Jxb,L112);            K46=kg(k46,T46);
k113=kl3f(E,G,Ab,Iyb,Izb,Jxb,L113);            K47=kg(k47,T47);
k114=kl3f(E,G,Ab,Iyb,Izb,Jxb,L114);            K48=kg(k48,T48);
k115=kl3f(E,G,Ab,Iyb,Izb,Jxb,L115);
k116=kl3f(E,G,Ab,Iyb,Izb,Jxb,L116);
k117=kl3f(E,G,Ab,Iyb,Izb,Jxb,L117);            %Beam(X direction)
k118=kl3f(E,G,Ab,Iyb,Izb,Jxb,L118);            %1st floor
k119=kl3f(E,G,Ab,Iyb,Izb,Jxb,L119);            K49=kg(k49,T49);
k120=kl3f(E,G,Ab,Iyb,Izb,Jxb,L120);            K50=kg(k50,T50);
                                               K51=kg(k51,T51);
                                               K52=kg(k52,T52);
                                               K53=kg(k53,T53);
%column                                        K54=kg(k54,T54);
K1=kg(k1,T1);                                  K55=kg(k55,T55);
K2=kg(k2,T2);                                  K56=kg(k56,T56);
K3=kg(k3,T3);                                  K57=kg(k57,T57);
K4=kg(k4,T4);                                  K58=kg(k58,T58);
K5=kg(k5,T5);                                  K59=kg(k59,T59);
K6=kg(k6,T6);                                  K60=kg(k60,T60);
K7=kg(k7,T7);
K8=kg(k8,T8);
K9=kg(k9,T9);                                  %2nd floor
K10=kg(k10,T10);                               K61=kg(k61,T61);
K11=kg(k11,T11);                               K62=kg(k62,T62);
K12=kg(k12,T12);                               K63=kg(k63,T63);
K13=kg(k13,T13);                               K64=kg(k64,T64);
K14=kg(k14,T14);                               K65=kg(k65,T65);
K15=kg(k15,T15);                               K66=kg(k66,T66);
K16=kg(k16,T16);                               K67=kg(k67,T67);
K17=kg(k17,T17);                               K68=kg(k68,T68);
K18=kg(k18,T18);                               K69=kg(k69,T69);
K19=kg(k19,T19);                               K70=kg(k70,T70);
K20=kg(k20,T20);                               K71=kg(k71,T71);
K21=kg(k21,T21);                               K72=kg(k72,T72);
K22=kg(k22,T22);
K23=kg(k23,T23);
K24=kg(k24,T24);                               %3rd floor
K25=kg(k25,T25);                               K73=kg(k73,T73);
K26=kg(k26,T26);                               K74=kg(k74,T74);
K27=kg(k27,T27);                               K75=kg(k75,T75);
K28=kg(k28,T28);                               K76=kg(k76,T76);
K29=kg(k29,T29);                               K77=kg(k77,T77);
                                               K78=kg(k78,T78);
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K79=kg(k79,T79);                          id6=id3fs(34,50,64,16,0);
K80=kg(k80,T80);                          id7=id3fs(3,19,64,16,1);
K81=kg(k81,T81);                          id8=id3fs(19,35,64,16,0);
K82=kg(k82,T82);                          id9=id3fs(35,51,64,16,0);
K83=kg(k83,T83);                          id10=id3fs(4,20,64,16,1);
K84=kg(k84,T84);                          id11=id3fs(20,36,64,16,0);
                                          id12=id3fs(36,52,64,16,0);
                                          id13=id3fs(5,21,64,16,1);
%BEAM(Z direction)                        id14=id3fs(21,37,64,16,0);
%1st floor                                id15=id3fs(37,53,64,16,0);
K85=kg(k85,T85);                          id16=id3fs(6,22,64,16,1);
K86=kg(k86,T86);                          id17=id3fs(22,38,64,16,0);
K87=kg(k87,T87);                          id18=id3fs(38,54,64,16,0);
K88=kg(k88,T88);                          id19=id3fs(7,23,64,16,1);
K89=kg(k89,T89);                          id20=id3fs(23,39,64,16,0);
K90=kg(k90,T90);                          id21=id3fs(39,55,64,16,0);
K91=kg(k91,T91);                          id22=id3fs(8,24,64,16,1);
K92=kg(k92,T92);                          id23=id3fs(24,40,64,16,0);
K93=kg(k93,T93);                          id24=id3fs(40,56,64,16,0);
K94=kg(k94,T94);                          id25=id3fs(9,25,64,16,1);
K95=kg(k95,T95);                          id26=id3fs(25,41,64,16,0);
K96=kg(k96,T96);                          id27=id3fs(41,57,64,16,0);
                                          id28=id3fs(10,26,64,16,1);
                                          id29=id3fs(26,42,64,16,0);
%2nd floor                                id30=id3fs(42,58,64,16,0);
K97=kg(k97,T97);                          id31=id3fs(11,27,64,16,1);
K98=kg(k98,T98);                          id32=id3fs(27,43,64,16,0);
K99=kg(k99,T99);                          id33=id3fs(43,59,64,16,0);
K100=kg(k100,T100);                       id34=id3fs(12,28,64,16,1);
K101=kg(k101,T101);                       id35=id3fs(28,44,64,16,0);
K102=kg(k102,T102);                       id36=id3fs(44,60,64,16,0);
K103=kg(k103,T103);                       id37=id3fs(13,29,64,16,1);
K104=kg(k104,T104);                       id38=id3fs(29,45,64,16,0);
K105=kg(k105,T105);                       id39=id3fs(45,61,64,16,0);
K106=kg(k106,T106);                       id40=id3fs(14,30,64,16,1);
K107=kg(k107,T107);                       id41=id3fs(30,46,64,16,0);
K108=kg(k108,T108);                       id42=id3fs(46,62,64,16,0);
                                          id43=id3fs(15,31,64,16,1);
                                          id44=id3fs(31,47,64,16,0);
%3rd floor                                id45=id3fs(47,63,64,16,0);
K109=kg(k109,T109);                       id46=id3fs(16,32,64,16,1);
K110=kg(k110,T110);                       id47=id3fs(32,48,64,16,0);
K111=kg(k111,T111);                       id48=id3fs(48,64,64,16,0);
K112=kg(k112,T112);                       id49=id3fs(17,18,64,16,0);
K113=kg(k113,T113);                       id50=id3fs(18,19,64,16,0);
K114=kg(k114,T114);                       id51=id3fs(19,20,64,16,0);
K115=kg(k115,T115);                       id52=id3fs(21,22,64,16,0);
K116=kg(k116,T116);                       id53=id3fs(22,23,64,16,0);
K117=kg(k117,T117);                       id54=id3fs(23,24,64,16,0);
K118=kg(k118,T118);                       id55=id3fs(25,26,64,16,0);
K119=kg(k119,T119);                       id56=id3fs(26,27,64,16,0);
K120=kg(k120,T120);                       id57=id3fs(27,28,64,16,0);
                                          id58=id3fs(29,30,64,16,0);
                                          id59=id3fs(30,31,64,16,0);
%ID=id3fs(NI,NJ,NTJ,NRJ,NCODE)            id60=id3fs(31,32,64,16,0);
id1=id3fs(1,17,64,16,1);                  id61=id3fs(33,34,64,16,0);
id2=id3fs(17,33,64,16,0);                 id62=id3fs(34,35,64,16,0);
id3=id3fs(33,49,64,16,0);
id4=id3fs(2,18,64,16,1);
id5=id3fs(18,34,64,16,0);
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id63=id3fs(35,36,64,16,0);          id120=id3fs(60,64,64,16,0);
id64=id3fs(37,38,64,16,0);          id121=id3fs(2,65,64,16,0);
id65=id3fs(38,39,64,16,0);          id122=id3fs(3,65,64,16,0);
id66=id3fs(39,40,64,16,0);          id123=id3fs(14,66,64,16,0);
id67=id3fs(41,42,64,16,0);          id124=id3fs(15,66,64,16,0);
id68=id3fs(42,43,64,16,0);
id69=id3fs(43,44,64,16,0);          Ka1=ass3f(K1,id1,288);
id70=id3fs(45,46,64,16,0);          Ka2=ass3f(K2,id2,288);
id71=id3fs(46,47,64,16,0);          Ka3=ass3f(K3,id3,288);
id72=id3fs(47,48,64,16,0);          Ka4=ass3f(K4,id4,288);
id73=id3fs(49,50,64,16,0);          Ka5=ass3f(K5,id5,288);
id74=id3fs(50,51,64,16,0);          Ka6=ass3f(K6,id6,288);
id75=id3fs(51,52,64,16,0);          Ka7=ass3f(K7,id7,288);
id76=id3fs(53,54,64,16,0);          Ka8=ass3f(K8,id8,288);
id77=id3fs(54,55,64,16,0);          Ka9=ass3f(K9,id9,288);
id78=id3fs(55,56,64,16,0);          Ka10=ass3f(K10,id10,288);
id79=id3fs(57,58,64,16,0);          Ka11=ass3f(K11,id11,288);
id80=id3fs(58,59,64,16,0);          Ka12=ass3f(K12,id12,288);
id81=id3fs(59,60,64,16,0);          Ka13=ass3f(K13,id13,288);
id82=id3fs(61,62,64,16,0);          Ka14=ass3f(K14,id14,288);
id83=id3fs(62,63,64,16,0);          Ka15=ass3f(K15,id15,288);
id84=id3fs(63,64,64,16,0);          Ka16=ass3f(K16,id16,288);
id85=id3fs(17,21,64,16,0);          Ka17=ass3f(K17,id17,288);
id86=id3fs(21,25,64,16,0);          Ka18=ass3f(K18,id18,288);
id87=id3fs(25,29,64,16,0);          Ka19=ass3f(K19,id19,288);
id88=id3fs(18,22,64,16,0);          Ka20=ass3f(K20,id20,288);
id89=id3fs(22,26,64,16,0);          Ka21=ass3f(K21,id21,288);
id90=id3fs(26,30,64,16,0);          Ka22=ass3f(K22,id22,288);
id91=id3fs(19,23,64,16,0);          Ka23=ass3f(K23,id23,288);
id92=id3fs(23,27,64,16,0);          Ka24=ass3f(K24,id24,288);
id93=id3fs(27,31,64,16,0);          Ka25=ass3f(K25,id25,288);
id94=id3fs(20,24,64,16,0);          Ka26=ass3f(K26,id26,288);
id95=id3fs(24,28,64,16,0);          Ka27=ass3f(K27,id27,288);
id96=id3fs(28,32,64,16,0);          Ka28=ass3f(K28,id28,288);
id97=id3fs(33,37,64,16,0);          Ka29=ass3f(K29,id29,288);
id98=id3fs(37,41,64,16,0);          Ka30=ass3f(K30,id30,288);
id99=id3fs(41,45,64,16,0);          Ka31=ass3f(K31,id31,288);
id100=id3fs(34,38,64,16,0);         Ka32=ass3f(K32,id32,288);
id101=id3fs(38,42,64,16,0);         Ka33=ass3f(K33,id33,288);
id102=id3fs(42,46,64,16,0);         Ka34=ass3f(K34,id34,288);
id103=id3fs(35,39,64,16,0);         Ka35=ass3f(K35,id35,288);
id104=id3fs(39,43,64,16,0);         Ka36=ass3f(K36,id36,288);
id105=id3fs(43,47,64,16,0);         Ka37=ass3f(K37,id37,288);
id106=id3fs(36,40,64,16,0);         Ka38=ass3f(K38,id38,288);
id107=id3fs(40,44,64,16,0);         Ka39=ass3f(K39,id39,288);
id108=id3fs(44,48,64,16,0);         Ka40=ass3f(K40,id40,288);
id109=id3fs(49,53,64,16,0);         Ka41=ass3f(K41,id41,288);
id110=id3fs(53,57,64,16,0);         Ka42=ass3f(K42,id42,288);
id111=id3fs(57,61,64,16,0);         Ka43=ass3f(K43,id43,288);
id112=id3fs(50,54,64,16,0);         Ka44=ass3f(K44,id44,288);
id113=id3fs(54,58,64,16,0);         Ka45=ass3f(K45,id45,288);
id114=id3fs(58,62,64,16,0);         Ka46=ass3f(K46,id46,288);
id115=id3fs(51,55,64,16,0);         Ka47=ass3f(K47,id47,288);
id116=id3fs(55,59,64,16,0);         Ka48=ass3f(K48,id48,288);
id117=id3fs(59,63,64,16,0);         Ka49=ass3f(K49,id49,288);
id118=id3fs(52,56,64,16,0);         Ka50=ass3f(K50,id50,288);
id119=id3fs(56,60,64,16,0);         Ka51=ass3f(K51,id51,288);
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Ka52=ass3f(K52,id52,288);
Ka53=ass3f(K53,id53,288);
Ka54=ass3f(K54,id54,288);
Ka55=ass3f(K55,id55,288);
Ka56=ass3f(K56,id56,288);
Ka57=ass3f(K57,id57,288);
Ka58=ass3f(K58,id58,288);
Ka59=ass3f(K59,id59,288);
Ka60=ass3f(K60,id60,288);
Ka61=ass3f(K61,id61,288);
Ka62=ass3f(K62,id62,288);
Ka63=ass3f(K63,id63,288);
Ka64=ass3f(K64,id64,288);
Ka65=ass3f(K65,id65,288);
Ka66=ass3f(K66,id66,288);
Ka67=ass3f(K67,id67,288);
Ka68=ass3f(K68,id68,288);
Ka69=ass3f(K69,id69,288);
Ka70=ass3f(K70,id70,288);
Ka71=ass3f(K71,id71,288);
Ka72=ass3f(K72,id72,288);
Ka73=ass3f(K73,id73,288);
Ka74=ass3f(K74,id74,288);
Ka75=ass3f(K75,id75,288);
Ka76=ass3f(K76,id76,288);
Ka77=ass3f(K77,id77,288);
Ka78=ass3f(K78,id78,288);
Ka79=ass3f(K79,id79,288);
Ka80=ass3f(K80,id80,288);
Ka81=ass3f(K81,id81,288);
Ka82=ass3f(K82,id82,288);
Ka83=ass3f(K83,id83,288);
Ka84=ass3f(K84,id84,288);
Ka85=ass3f(K85,id85,288);
Ka86=ass3f(K86,id86,288);
Ka87=ass3f(K87,id87,288);
Ka88=ass3f(K88,id88,288);
Ka89=ass3f(K89,id89,288);
Ka90=ass3f(K90,id90,288);
Ka91=ass3f(K91,id91,288);
Ka92=ass3f(K92,id92,288);
Ka93=ass3f(K93,id93,288);
Ka94=ass3f(K94,id94,288);
Ka95=ass3f(K95,id95,288);
Ka96=ass3f(K96,id96,288);
Ka97=ass3f(K97,id97,288);
Ka98=ass3f(K98,id98,288);
Ka99=ass3f(K99,id99,288);
Ka100=ass3f(K100,id100,288);
Ka101=ass3f(K101,id101,288);
Ka102=ass3f(K102,id102,288);
Ka103=ass3f(K103,id103,288);
Ka104=ass3f(K104,id104,288);
Ka105=ass3f(K105,id105,288);
Ka106=ass3f(K106,id106,288);
Ka107=ass3f(K107,id107,288);
Ka108=ass3f(K108,id108,288);

Ka109=ass3f(K109,id109,288);
Ka110=ass3f(K110,id110,288);
Ka111=ass3f(K111,id111,288);
Ka112=ass3f(K112,id112,288);
Ka113=ass3f(K113,id113,288);
Ka114=ass3f(K114,id114,288);
Ka115=ass3f(K115,id115,288);
Ka116=ass3f(K116,id116,288);
Ka117=ass3f(K117,id117,288);
Ka118=ass3f(K118,id118,288);
Ka119=ass3f(K119,id119,288);
Ka120=ass3f(K120,id120,288);

%summing up
Ksi=Ka1+Ka2+Ka3+Ka4+Ka5+Ka6+Ka7+Ka8
+Ka9+Ka10+Ka11+Ka12+Ka13+Ka14+Ka15+
Ka16+Ka17+Ka18+Ka19+Ka20+Ka21+Ka21+
Ka22+Ka23+Ka24+Ka25+Ka26+Ka27+Ka28+
Ka29+Ka30+Ka31+Ka32+Ka33+Ka34+Ka35+
Ka36+Ka37+Ka38+Ka39+Ka40+Ka41+Ka42+
Ka43+Ka44+Ka45+Ka46+Ka47+Ka48+Ka49+
Ka50+Ka51+Ka52+Ka53+Ka54+Ka55+Ka56+
Ka57+Ka58+Ka59+Ka60+Ka61+Ka62+Ka63+
Ka63+Ka64+Ka65+Ka66+Ka67+Ka68+Ka69+
Ka70+Ka71+Ka72+Ka73+Ka74+Ka75+Ka76+
Ka77+Ka78+Ka79+Ka80+Ka81+Ka82+Ka83+
Ka84+Ka85+Ka86+Ka87+Ka88+Ka89+Ka90+
Ka91+Ka92+Ka93+Ka94+Ka95+Ka96+Ka97+
Ka98+Ka99+Ka100+Ka101+Ka102+Ka103+K
a104+Ka105+Ka106+Ka107+Ka108+Ka109+
Ka110+Ka111+Ka112+Ka113+Ka114+Ka115
+Ka116+Ka117+Ka118+Ka119+Ka120;
nf=size(Ksi);
nn=nf/2;

%Condensation dofs that do not
relate to rigid floor dof
Kc=kcon(Ksi,144,144);

a17=trjs(6,6);
a18=trjs(6,2);
a19=trjs(6,-2);
a20=trjs(6,-6);
a21=trjs(2,6);
a22=trjs(2,2);
a23=trjs(2,-2);
a24=trjs(2,-6);
a25=trjs(-2,6);
a26=trjs(-2,2);
a27=trjs(-2,-2);
a28=trjs(-2,-6);
a29=trjs(-6,6);
a30=trjs(-6,2);
a31=trjs(-6,-2);
a32=trjs(-6,-6);
a33=trjs(6,6);
```
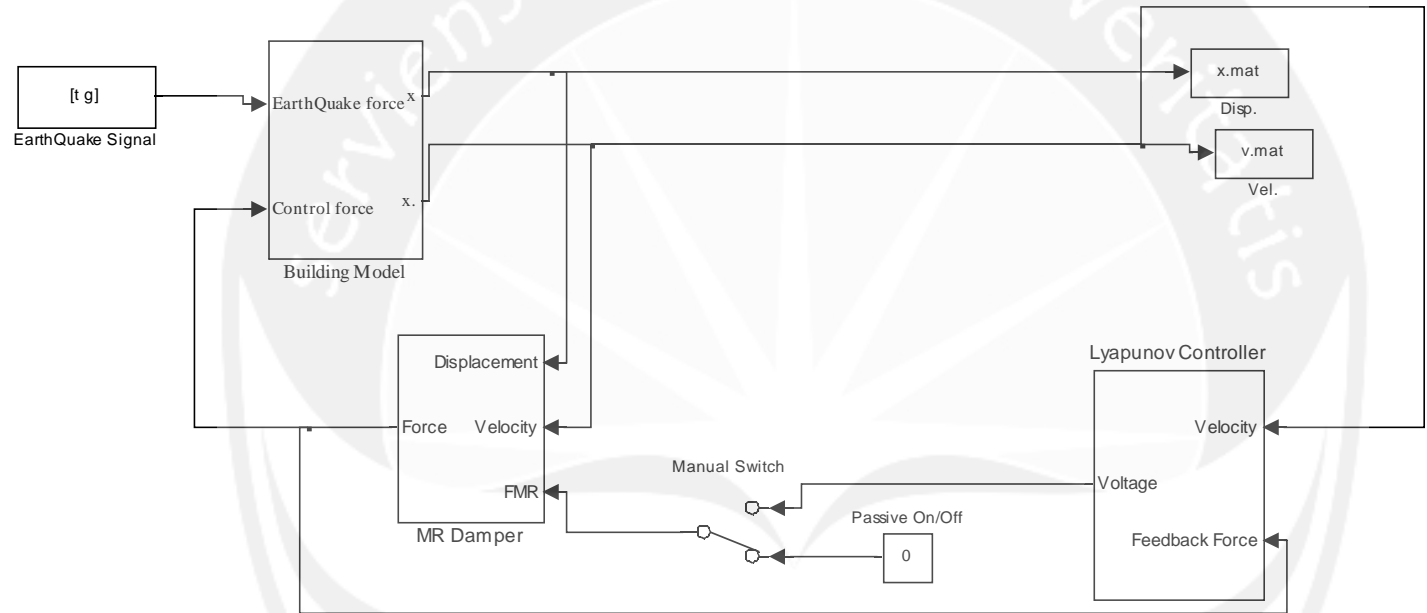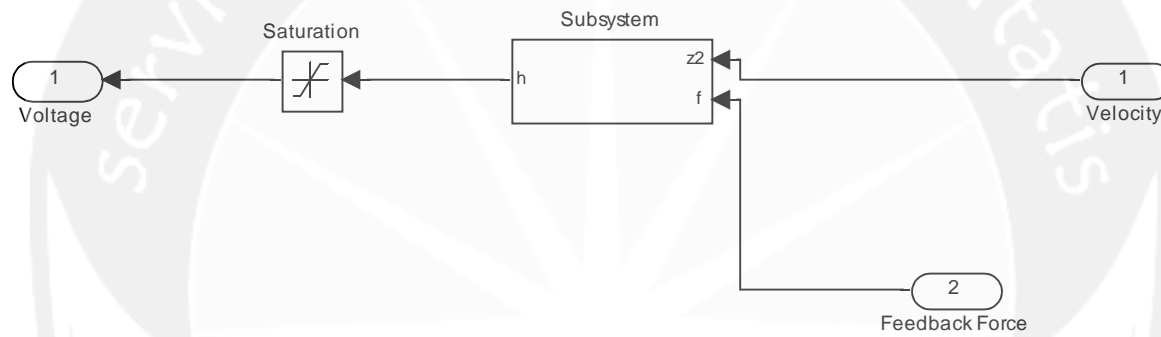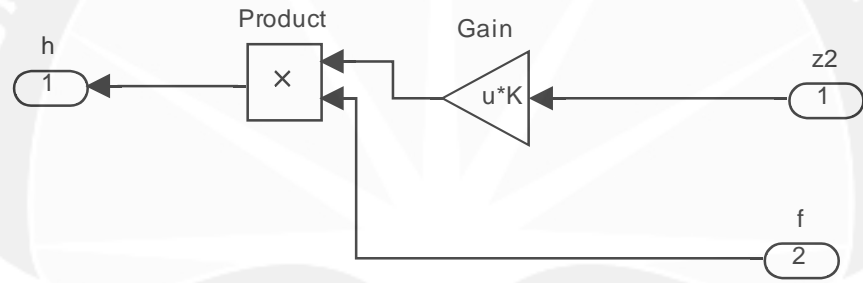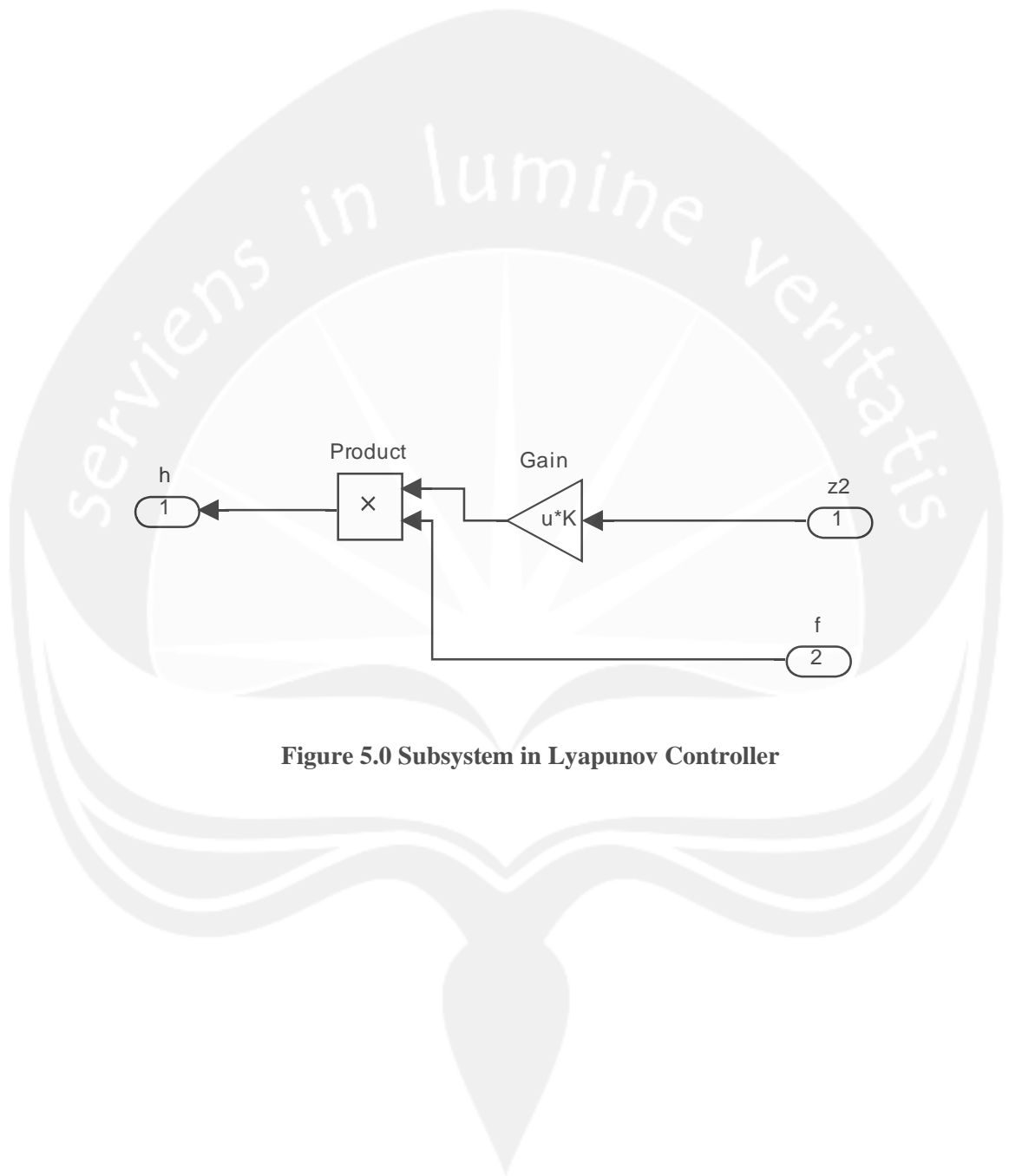
```matlab
a34=trjs(6,2);
a35=trjs(6,-2);
a36=trjs(6,-6);
a37=trjs(2,6);
a38=trjs(2,2);
a39=trjs(2,-2);
a40=trjs(2,-6);
a41=trjs(-2,6);
a42=trjs(-2,2);
a43=trjs(-2,-2);
a44=trjs(-2,-6);
a45=trjs(-6,6);
a46=trjs(-6,2);
a47=trjs(-6,-2);
a48=trjs(-6,-6);
a49=trjs(6,6);
a50=trjs(6,2);
a51=trjs(6,-2);
a52=trjs(6,-6);
a53=trjs(2,6);
a54=trjs(2,2);
a55=trjs(2,-2);
a56=trjs(2,-6);
a57=trjs(-2,6);
a58=trjs(-2,2);
a59=trjs(-2,-2);
a60=trjs(-2,-6);
a61=trjs(-6,6);
a62=trjs(-6,2);
a63=trjs(-6,-2);
a64=trjs(-6,-6);

R1=[a17;a18;a19;a20;a21;a22;a23;a24
;a25;a26;a27;a28;a29;a30;a31;a32];
R2=[a33;a34;a35;a36;a37;a38;a39;a40
;a41;a42;a43;a44;a45;a46;a47;a48];
R3=[a49;a50;a51;a52;a53;a54;a55;a56
;a57;a58;a59;a60;a61;a62;a63;a64];

R4=[R1;zeros(96,3)];
R5=[zeros(48,3);R2;zeros(48,3)];
R6=[zeros(96,3);R3];

Rt=[R4 R5 R6];

%building stiffness matrix
K3D=Rt'*Kc*Rt

%Building Mass Matrix
M3D=[42.275 0 0 0 0 0 0 0 0
0 42.275 0 0 0 0 0 0 0
0 0 1014.6 0 0 0 0 0 0
0 0 0 42.275 0 0 0 0 0
0 0 0 0 42.275 0 0 0 0
0 0 0 0 0 1014.6 0 0 0
0 0 0 0 0 0 42.275 0 0
0 0 0 0 0 0 0 42.275 0
0 0 0 0 0 0 0 0 1014.6]

%Stiffness Proportional Damping
C3D=1.730702665e-3*K3D

%System matrix
[n,n]=size(K3D);
A3D=[zeros(n,n) eye(n);
    -M3D\K3D -M3D\C3D];
damp(A3D)
```

Figure 4.7 Semi-Active System Using MR Damper

Figure 4.8 MR Damper System

Figure 4.9Lyapunov Controller System

Figure 5.0 Subsystem in Lyapunov Controller
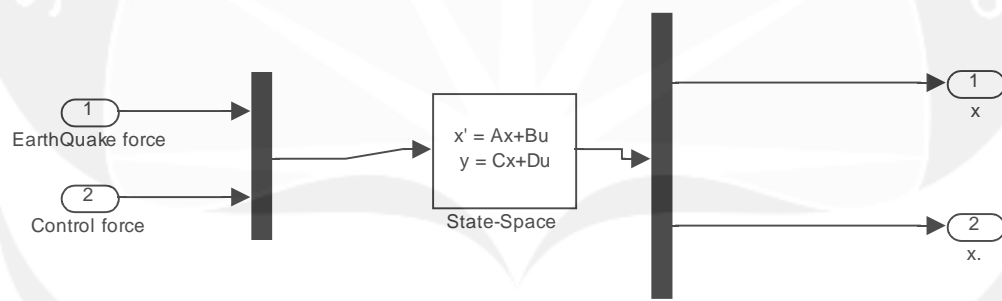
1

EarthQuake force

2

Control force

x' = Ax+Bu
y = Cx+Du

State-Space

1

x

2

x.

Figure 5.1 Building Model System