結構控制

HW6

R04521202

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1.Modal Strain Energy Method

第一題使用的 Matlab code 皆附於後面附頁，以下針對寫 code 使用的公式與流程及結果作解釋。

(1)Linear viscous damper

1.由題目資訊，已知各樓層皆重 10t，各勁度為$k_1 = 7000000N/m$、$k_2 = 6600000N/m$、$k_3 = 7000000N/m$

由此可組出勁度矩陣$K_s = \begin{bmatrix} k1+k2 & -k2 & 0 \\ -k2 & k2+k3 & -k3 \\ 0 & -k3 & k3 \end{bmatrix}$

透過 eig 指令解 Ks 的 eignvalue 得到模態與 eignvalue of k

2.由第一模態之 k 求出頻率 w 與週期 T，及第一模態正規化

3.透過公式求解 C 值

$$\mathbf{C} = \frac{4\pi\xi_d \sum_i m{\phi_i}^2}{\boldsymbol{T}\sum_j {cos\theta_j}^2 {\phi_{r,j}}^2}$$

其中,

$\xi_d = 15\%$

m 為各樓層質量

ϕ_i該樓層模態

$cos\theta_j = 4/5$

4.由 F_D=$Cu_0\omega$求解

u_0=storydrift*樓高*cosθ storydrift=1%

結果:

C=275.5188 kN-sec/m

$F_D = 77.0460$kN

```
c =

  275.5188


FD =

   77.0460
```

(2)Nonlinear viscous damper with $\boldsymbol{\alpha = 0.3}$

非線性則透過

$$C_j = \frac{2\pi\xi A^{1-\alpha}\omega^{2-\alpha}\sum_i m_i\phi_i^2}{\lambda\sum_j \phi_{rj}^{1+\alpha}\cos^{1+\alpha}\theta_j}$$ 解得 C

其中,

A 最大頂樓變位 A=$\frac{storydrift \times 頂樓高}{最大相對模態值}$

$\lambda = 2^{2+\alpha}\frac{\Gamma^2(1+\frac{\alpha}{2})}{\Gamma(2+\alpha)}$

而 F_D 則透過 $F_D = C\dot{u}^{\alpha} = C\omega u_0$ 解得

結果:

C=86.0250 kN-sec/m

$F_D = 58.6955$kN

```
c =

   86.0250


FD =

   58.6955
```

(3)Nonlinear viscous damper with $\boldsymbol{\alpha = 0.7}$

與(2)小題相同，但 alpha 改為 0.7

結果:

C=168.9274 kN-sec/m

$F_D = 69.2340$kN

```
c =

  168.9274


FD =

   69.2340
```

	C	F_D
Linear viscous damper	275.5188	77.0460
Nonlinear viscous damper with $\alpha = 0.3$	86.0250	58.6955
Nonlinear viscous damper with $\alpha = 0.7$	168.9274	69.2340

所以在線性考量之 VD 的 C 及F_D皆比非線性大且大很多，而非線性若 alpha 越小則這兩個值也會越小。

2.Design Viscous Damper

利用第一題之方式求出需輸入 SAP2000 之參數

而求參數過程中我們需先知道以下數據(由之前 SAP2000 分析得來)

週期 T=0.33384

模態=[2.771E-18;8.499E-18;1.611E-17] 由SAP2000輸出位移知道

A	B	C	D	E	F	G	H	I
TABLE: Joint Displacements								
Joint	OutputCase	CaseType	U1	U2	U3	R1	R2	R3
Text	Text	Text	m	m	m	Radians	Radians	Radians
1	DEAD	LinStatic	0	0	0	0	0	0
2	DEAD	LinStatic	3.178E-18	5.33E-09	-0.000214	-0.00004	-0.000052	2.034E-19
3	DEAD	LinStatic	9.863E-18	0.000025	-0.000335	-0.000064	-0.000075	6.822E-19
4	DEAD	LinStatic	1.859E-17	0.000058	-0.000395	-0.000075	-0.000089	1.24E-18
5	DEAD	LinStatic	0	0	0	0	0	0
6	DEAD	LinStatic	3.178E-18	5.33E-09	-0.000297	-0.000029	5.358E-18	2.034E-19
7	DEAD	LinStatic	9.863E-18	0.000025	-0.000458	-0.000039	1.055E-17	6.822E-19
8	DEAD	LinStatic	1.859E-17	0.000058	-0.000535	-0.000043	1.284E-17	1.24E-18
9	DEAD	LinStatic	0	0	0	0	0	0
10	DEAD	LinStatic	3.178E-18	5.33E-09	-0.000214	-0.00004	0.000052	2.034E-19
11	DEAD	LinStatic	9.863E-18	0.000025	-0.000335	-0.000064	0.000075	6.822E-19
12	DEAD	LinStatic	1.859E-17	0.000058	-0.000395	-0.000075	0.000089	1.24E-18
13	DEAD	LinStatic	0	0	0	0	0	0
14	DEAD	LinStatic	2.771E-18	5.33E-09	-0.000278	-0.000005171	-0.000036	2.034E-19
15	DEAD	LinStatic	8.499E-18	0.000025	-0.000429	-0.000003694	-0.000051	6.822E-19
16	DEAD	LinStatic	1.611E-17	0.000058	-0.000501	-0.000002805	-0.000059	1.24E-18
17	DEAD	LinStatic	0	0	0	0	0	0
18	DEAD	LinStatic	2.77E-18	5.33E-09	-0.000344	1.602E-07	7.362E-18	2.034E-19
19	DEAD	LinStatic	8.50E-18	0.000025	-0.000523	-6.681E-07	1.057E-17	6.822E-19
20	DEAD	LinStatic	1.611E-17	0.000058	-0.000607	-9.177E-07	1.317E-17	1.24E-18
21	DEAD	LinStatic	0	0	0	0	0	0
22	DEAD	LinStatic	2.771E-18	5.33E-09	-0.000278	-0.000005171	0.000036	2.034E-19
23	DEAD	LinStatic	8.499E-18	0.000025	-0.000429	-0.000003694	0.000051	6.822E-19
24	DEAD	LinStatic	1.611E-17	0.000058	-0.000501	-0.000002805	0.000059	1.24E-18

各樓層質量同樣透過 SAP2000 知道分別為(需另外加上版上之呆載重)

m1=2548.95+9000

m2=2543.27+9000

m3=2541.18+6750

cos 角度值也須依圖面調整

所以修正第一題 code 後得到三種 case 的 C 值

	C(kN-(sec/m)^alpha)
Linear	736.6181
Alpha=0.3	124.9824
Alpha=0.7	348.4708

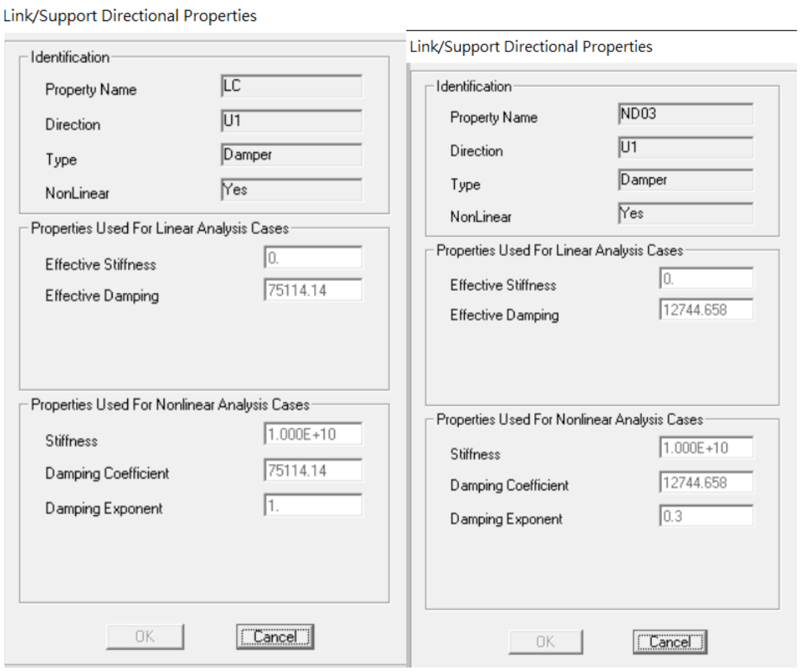
```
c =

  736.6181


c =

  124.9824


c =

  348.4708
```

接著將求得 C 值建進 SAP2000 模型中

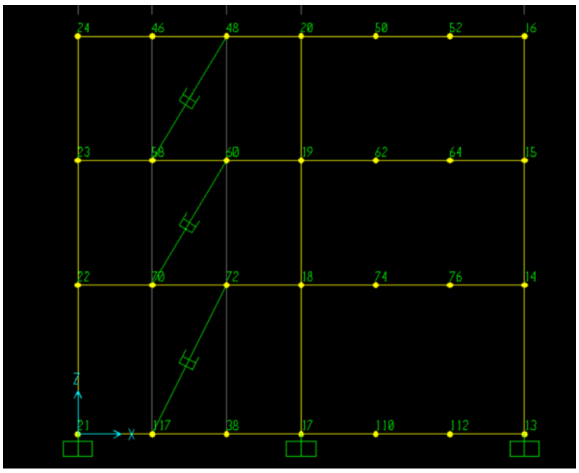
1. 設定 damper 參數

   (Define-Section Properties-Link/Support Properties)

   設定 C 值，非線性需調整 alpha 值



2. 繪製 damper

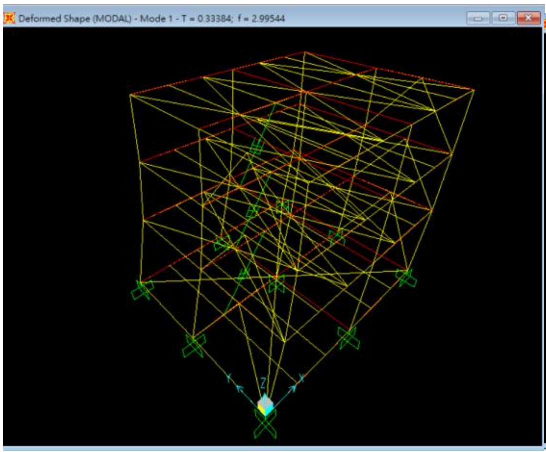


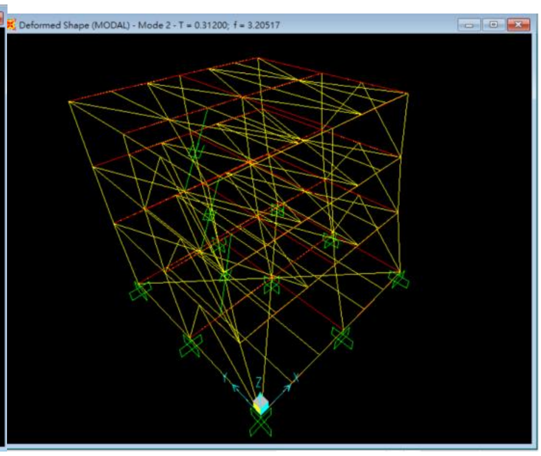
之後進行模態分析。

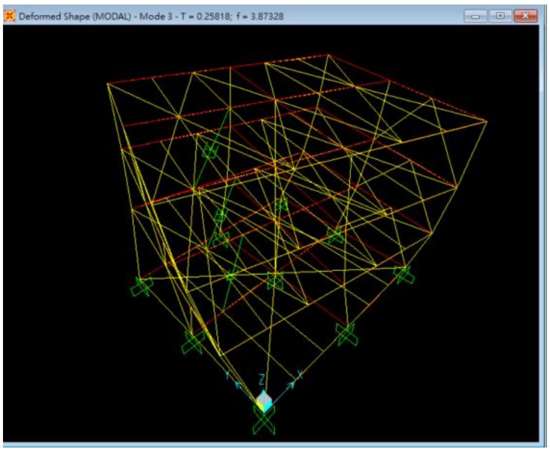
由模態分析及 VD 不提供勁度等知 VD 不改變結構週期，因此三種 case 結果一樣，以下只列出一個表格

Period(sec)	1sr mode	2^{nd} mode	3^{rd} mode
Bare frame	0.33384	0.31200	0.25818
Bare frame with VD	0.33384	0.31200	0.25818

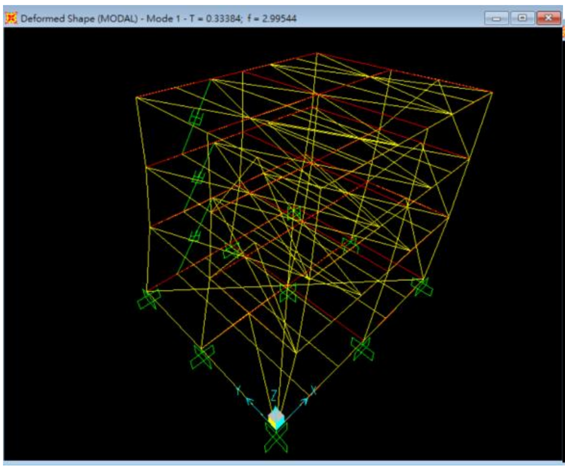
∗Linear

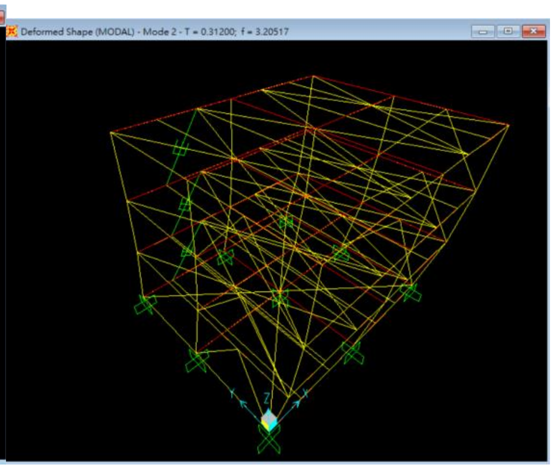


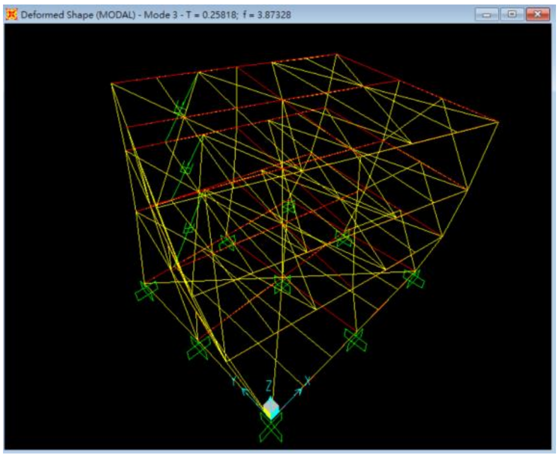




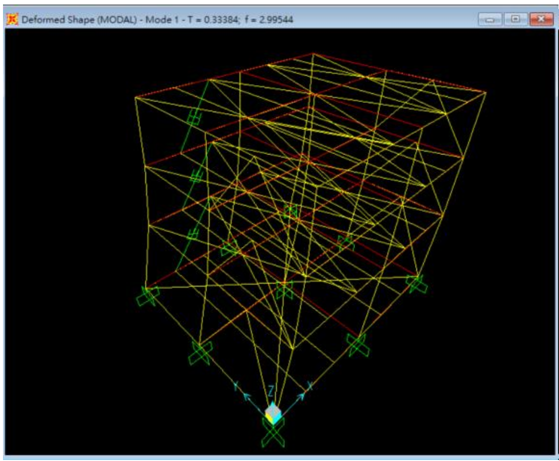
∗Alpha=0.3

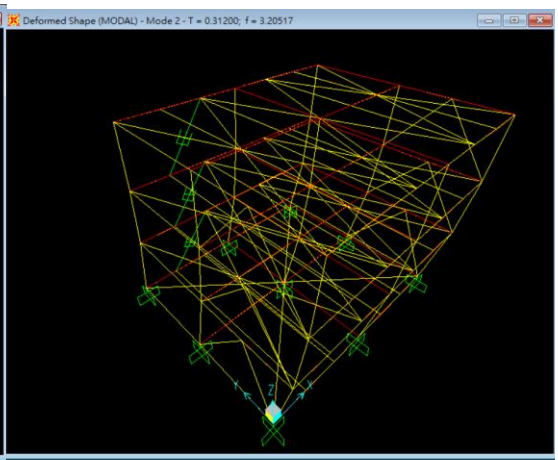


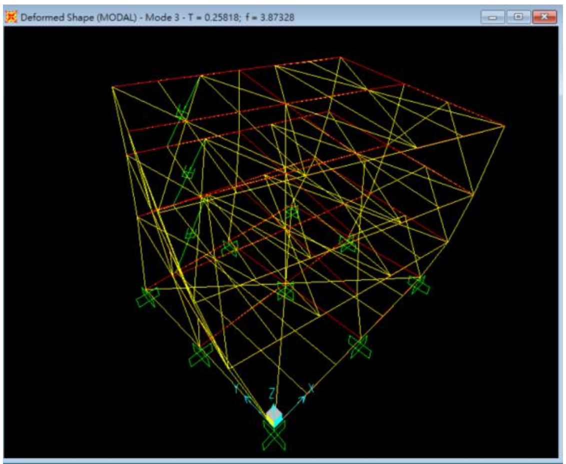




＊Alpha=0.7





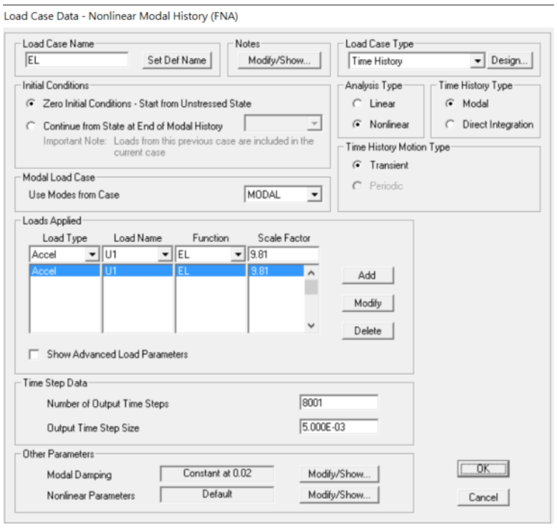


(1) Time history analysis

1.輸入地震歷時(地震歷時需先正規化至 0.33g，利用前次作業 code)

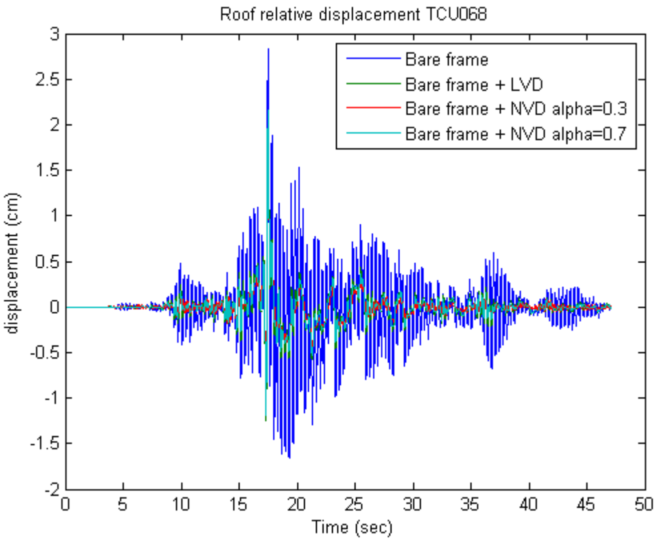
2.設定地震

非線性 case 要選 nonlinear

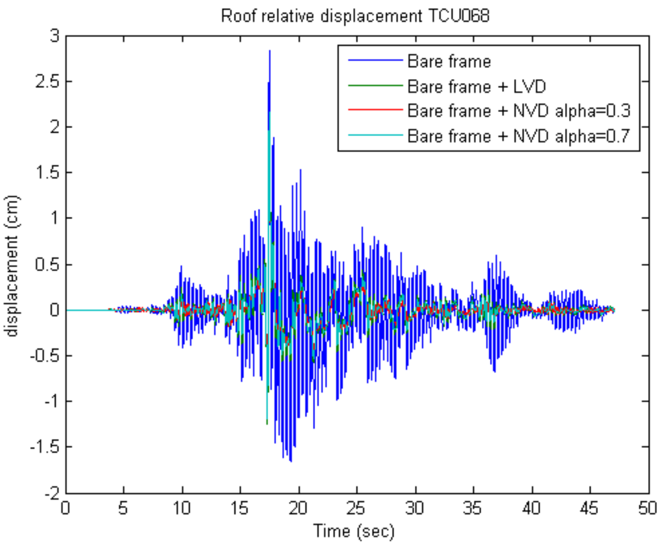


3.輸出所需資料

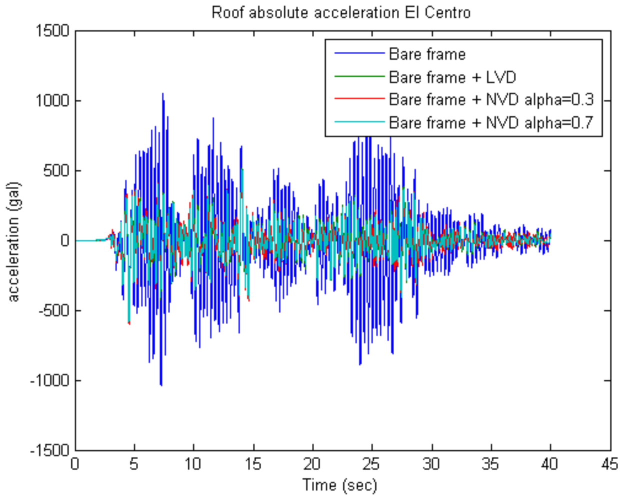
*Roof acceleration for TCU068



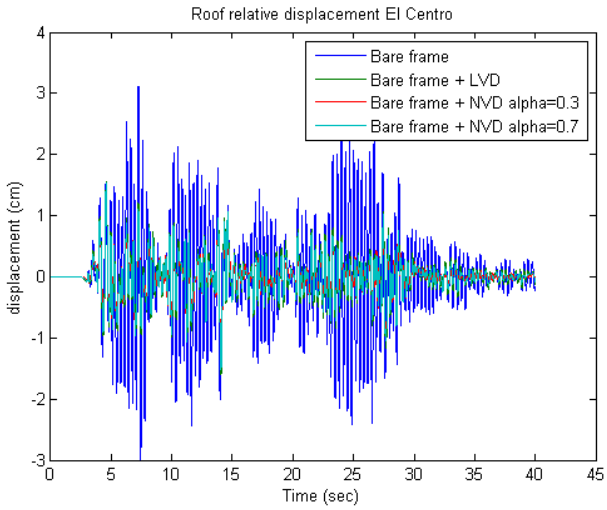
*Roof displacement for TCU068



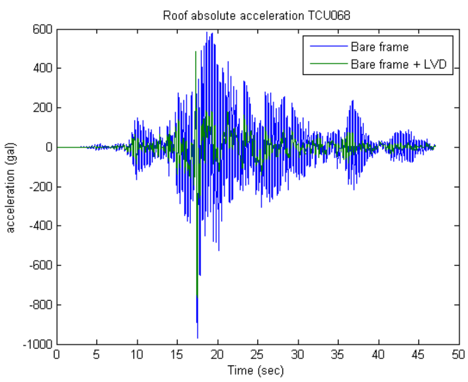
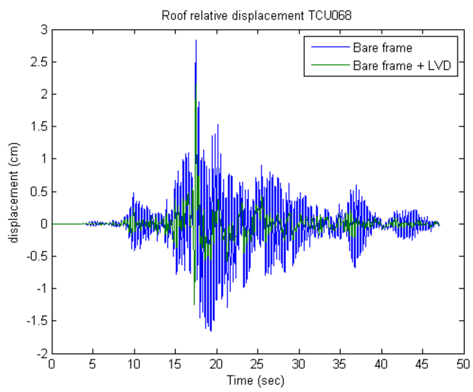
*Roof acceleration for El Centro

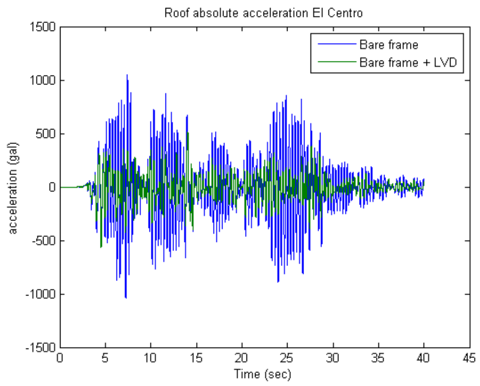
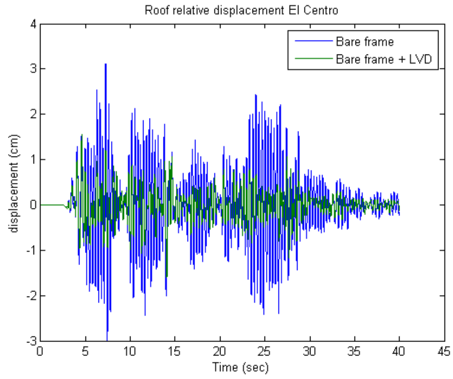


*Roof displacement for El Centro

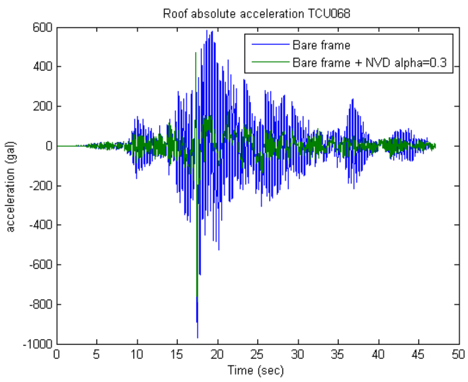
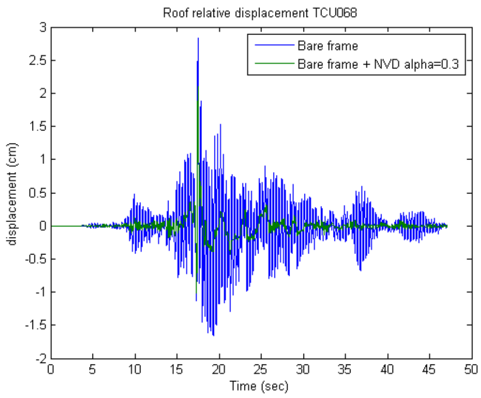
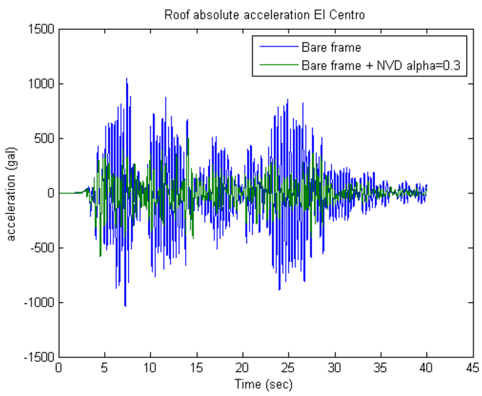
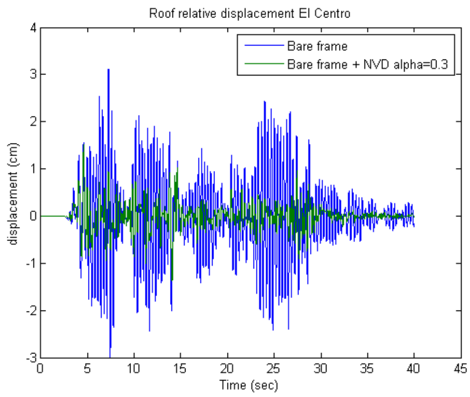


*Linear viscous damper

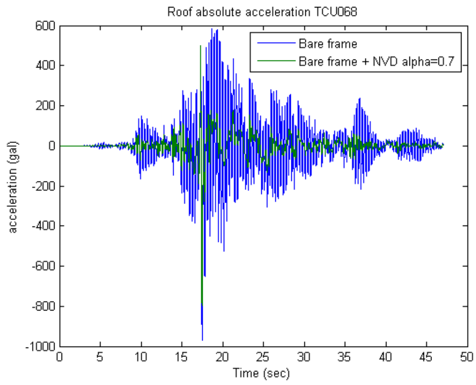
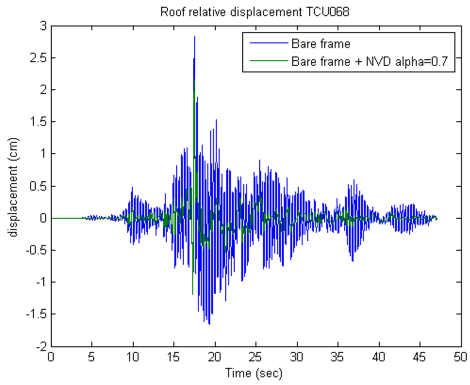
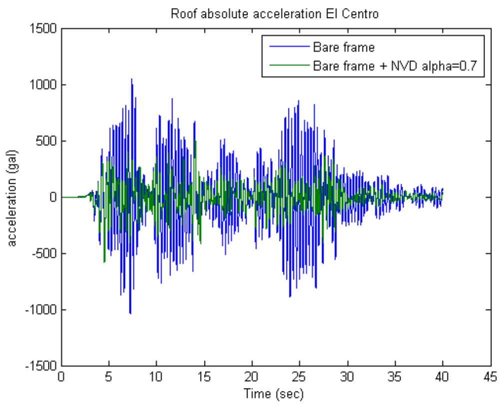
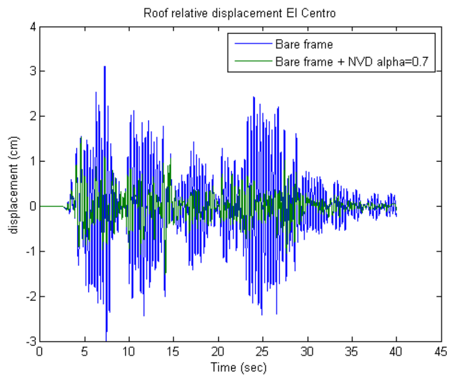
Roof acceleration for TCU068	Roof displacement for TCU068
	

Roof acceleration for El Centro	Roof displacement for El Centro
	

∗<u>Nonlinear viscous damper with alpha=0.3</u>

Roof acceleration for TCU068	Roof displacement for TCU068
	
Roof acceleration for El Centro	**Roof displacement for El Centro**
	

＊Nonlinear viscous damper with alpha=0.7

Roof acceleration for TCU068	Roof displacement for TCU068
	
Roof acceleration for El Centro	Roof displacement for El Centro
	

＊討論:

由以上圖形結果知道加了 VD 之後結構物無論是加速度或是位移的反應皆下降很多，若將三種 case 分開來看，發現 Linear VD 的效果較 Nonlinear VD 的效果差，但 Nonlinear VD 的 alpha=0.7 效果與 Linear VD 差不多，而 Nonlinear VD 的 alpha=0.3 時效果更顯著，所以可以知道 alpha 越小對於抑制地震力造成的位移與加速度的效果越好。

(2) **＊Linear VD：**

El Centro									
Floor	Bare frame			Bare frame + LVD			Ratio of response		
	(1)	(2)	(3)	(4)	(5)	(6)	(4)/(1)	(5)/(2)	(6)/(3)
	Dis.	Vel.	Acc.	Dis.	Vel.	Acc.	Dis. Ratio	Vel. Ratio	Acc. Ratio
	cm	cm/s	gal	cm	cm/s	gal			
3	3.1127	53.2433	1.04E+03	1.599	19.68	566.3832	0.513702	0.369624	5.42E-01
2	2.6715	44.6369	951.1209	1.38	16.7	503.35	0.516564	0.37413	5.29E-01
1	1.829	30.0794	761.9031	0.95	11.54	459.35	0.51941	0.383651	6.03E-01

El Centro		
Floor	Story Drift (%)	
	Bare frame	Bare frame +LVD
3	2.49016	1.2792
2	2.1372	1.104
1	1.2193333	0.633333333

TCU068									
Floor	Bare frame			Bare frame + LVD			Ratio of response		
	(1)	(2)	(3)	(4)	(5)	(6)	(4)/(1)	(5)/(2)	(6)/(3)
	Dis.	Vel.	Acc.	Dis.	Vel.	Acc.	Dis. Ratio	Vel. Ratio	Acc. Ratio
	cm	cm/s	gal	cm	cm/s	gal			
3	2.9	36.4	971.0919	2.1558	29.39	764.8949	0.743379	0.807418	0.787665
2	2.5	30.6	847.8783	1.85	25.04	667.72	0.74	0.818301	0.787519
1	1.7	20.8	687.4848	1.27E+00	17.27	538.86	0.747059	0.830288	0.783814

TCU068		
Floor	Story Drift (%)	
	Bare frame	Bare frame +LVD
3	2.32	1.72464
2	2	1.48
1	1.13333333	8.47E-01

＊Nonlinear VD alpha=0.3

El Centro									
Floor	Bare frame			Bare frame + NVD α =0.3			Ratio of response		
	(1)	(2)	(3)	(4)	(5)	(6)	(4)/(1)	(5)/(2)	(6)/(3)
	Dis.	Vel.	Acc.	Dis.	Vel.	Acc.	Dis. Ratio	Vel. Ratio	Acc. Ratio
	cm	cm/s	gal	cm	cm/s	gal			
3	3.1127	53.2433	1.04E+03	1.5114	20.01	599.7506	0.485559161	0.375821934	5.74E-01
2	2.6715	44.6369	951.1209	1.3	16.72	525.29	0.486618005	0.374577984	5.52E-01
1	1.829	30.0794	761.9031	0.9	11.21	424.96	0.492072171	0.372680306	5.58E-01

El Centro		
Floor	Story Drift (%)	
	Bare frame	Bare frame + NVD α=0.3
3	2.49016	1.20912
2	2.1372	1.04
1	1.219333333	0.6

TCU068									
Floor	Bare frame			Bare frame + NVD α=0.3			Ratio of response		
	(1)	(2)	(3)	(4)	(5)	(6)	(4)/(1)	(5)/(2)	(6)/(3)
	Dis.	Vel.	Acc.	Dis.	Vel.	Acc.	Dis. Ratio	Vel. Ratio	Acc. Ratio
	cm	cm/s	gal	cm	cm/s	gal			
3	2.9	36.4	971.0919	2.0998	27.42	785.7935	0.724068966	0.753296703	0.809185516
2	2.5	30.6	847.8783	1.8	22.99	687.82	0.72	0.75130719	0.811224913
1	1.7	20.8	687.4848	1.24E+00	15.75	567.63	0.729411765	0.757211538	0.825661891

TCU068		
Floor	Story Drift (%)	
	Bare frame	Bare frame + NVD α=0.3
3	2.32	1.67984
2	2	1.44
1	1.133333333	8.27E-01

＊Nonlinear VD alpha=0.7

El Centro									
Floor	Bare frame			Bare frame + NVD α=0.7			Ratio of response		
	(1)	(2)	(3)	(4)	(5)	(6)	(4)/(1)	(5)/(2)	(6)/(3)
	Dis.	Vel.	Acc.	Dis.	Vel.	Acc.	Dis. Ratio	Vel. Ratio	Acc. Ratio
	cm	cm/s	gal	cm	cm/s	gal			
3	3.1127	53.2433	1.04E+03	1.5278	20.03	587.4247	0.490827899	0.376197569	5.63E-01
2	2.6715	44.6369	951.1209	1.32	16.87	504.69	0.494104436	0.377938432	5.31E-01
1	1.829	30.0794	761.9031	0.91	11.5	450.39	0.497539639	0.382321456	5.91E-01

El Centro		
Floor	Story Drift (%)	
	Bare frame	Bare frame + NVD α=0.7
3	2.49016	1.22224
2	2.1372	1.056
1	1.219333333	0.606666667

TCU068									
Floor	**Bare frame**			**Bare frame + NVD α=0.7**			**Ratio of response**		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(4)/(1)**	**(5)/(2)**	**(6)/(3)**
	Dis.	Vel.	Acc.	Dis.	Vel.	Acc.	Dis. Ratio	Vel. Ratio	Acc. Ratio
	cm	cm/s	gal	cm	cm/s	gal			
3	2.9	36.4	971.0919	2.1534	29.25	797.5312	0.742551724	0.803571429	0.821272631
2	2.5	30.6	847.8783	1.85	24.83	692.47	0.74	0.811437908	0.81670919
1	1.7	20.8	687.4848	1.27E+00	17.14	561.69	0.747058824	0.824038462	0.8170217

TCU068		
Floor	**Story Drift (%)**	
	Bare frame	**Bare frame + NVD α=0.7**
3	2.32	1.72272
2	2	1.48
1	1.133333333	8.47E-01

討論：

1. VD與VE相同可以降低許多結構物反應。
2. 同樣地EL Centro下的降低效果較好，而TCU068效果較差。
3. 從各項反應比來看可以得到與先前圖片比較部份的結果，效果依序為VD alpha=0.7>alpha=0.3>LVD，由數據趨勢來看也是如此，但由數字觀察發現其實三者差別並不大。
4. 而從story-drift來看也是如此，EL Centro下效果較好，非線性VD表現較佳。

3.Reading assignment

Comparative study of frames using viscoelastic and viscous dampers

這篇 paper 首先要先探討兩個無因次的參數，並用這兩個參數表示 viscoelastic 以及 viscous damper，透過參數分析來表示 viscoelastic 和 viscous damper 的性質。通常 VE 和 VS 會提供結構物額外的勁度與阻尼，但這些增加的勁度與阻尼不全然只與阻尼器有關，阻尼器與其他構架的構件的交互影響，亦可能是這些額外增加勁度與阻尼的因素。而在低頻下，VS damper 造成的勁度增加是可以忽略的。這篇 paper 透過 10 層樓鋼構架為例子進行 VE 以及 VS 的探討。

VE 以及 VS 透過兩端產生的相對速度產生阻尼效果，其中 VE 受到頻率與溫度影響，而 VS 可以提供純阻尼力，因此阻尼抗力是與阻尼器變形的相外。但額外增加的 component 通常會提供抗力在相內、相外，與無論是不是 VS 無關，所以這現象提供描述 VE 與 VS 的數學描述與兩個系統比較的材料。所以這篇 paper 最主要描述比較這兩個系統的差異。

高阻尼系統會衰減很快，其峰值會受到諧和反應的控制，基於這個原因，我們可以透過諧和理論導出 VE 與 VS 的閉合解，因此這提供了這兩個系統與原先未加阻尼時系統的反應預測方法，透過兩個參數的使用與調整，我們可以不用透過動力分析，來了解到阻尼系統的反應。

最後，VE 以及 VS 皆會因其的 brace 造成系統的阻尼與勁度增加，但在低頻下 VS 的增加勁度可以忽略。在和諧外力下，阻尼有效的降低位移峰值的反應，進而減低像是柱與梁彎矩等。但衝擊外力下，勁度為造成更多影響的腳色，也就是勁度的影響比阻尼大。而 VS 可以達到 90 度的相外的柱彎矩，但這是不必要的，因為若 VE 及 VS 對構架造成的增加阻尼比是一樣的話，他們對於柱軸力影響是一樣的，所以沒必要達到向外 90 度。另外在其他構件相同變形下，VS 可以有比 VE 更多變形，所以 VS 的消能效率是比 VE 來得好，在本 paper 的實驗中 VS 的效果也是萊德彼 VE 好一點點，然而若是相同阻尼比下，實驗結果是 VE 的表現較好，但不論是哪一種阻尼器，都可以達到很好得降低地震力與位移的效果。最後這篇 paper 建議斜撐對構架的勁度比約是 10，阻尼器損失勁度比上構架勁度約是 1~1.5，而本篇 paper 提出的反應預測方法在結構週期 0.5~2.5sec 時有很好的結果，未來可以在降低阻尼、週期相位、譜加速度與譜位移等方面進行更進一步探討。

所以透過這篇 paper 可以幫助我們更近一步對 VE 以及 VS 性質有所了解，同時也了解到其他相關構件對於阻尼器效果的影響，以及如何建立出兩個參數來幫助我們對於結構物在有阻尼器安裝下的反應預測。

CODE

```
%% linear
clc
clear
m=10*1000;
k1=7000000;
k2=6600000;
k3=7000000;
%find eigvalue of ks
ks=[k1+k2 -k2 0;-k2 k2+k3 -k3;0 -k3 k3];
[modeshape eigk]=eig(ks);
%find period of 1st mode
w=(eigk(1,1)/m)^0.5;
T=2*pi/w;
%normailzed the mode shape
nmodeshape=modeshape(:,1)/modeshape(3,1);

%find c
%m*phi^2 part
mphi=0;
for i=1:3
mphi=mphi+m*nmodeshape(i)^2;
end
%phi^2*cos^2 part
phicos=0;
cos=4/5;
    %relative modeshape
    for i=1:3
        if i==1
           remodeshape(1)=nmodeshape(1);
        else
            remodeshape(i)=nmodeshape(i)-nmodeshape(i-1);
        end
    end
for i=1:3
phicos=phicos+(remodeshape(i))^2*(cos)^2;
end
```

```
kersi=0.15;
c=4*pi*kersi*mphi/T/phicos/1000

%find FD
drift=0.01;
h=3;
u0=drift*h*cos;
FD=c*u0*w

%% nonlinear alpha=0.3
alpha=0.3;
A=drift*h/max(remodeshape);

rada=2^(2+alpha)*(gamma(1+alpha/2))^2/gamma(2+alpha);
phicos=0;
for i=1:3
phicos=phicos+(remodeshape(i))^(1+alpha)*(cos)^(1+alpha)*rada;
end

c=kersi*2*pi*A^(1-alpha)*w^(2-alpha)*mphi/phicos/1000
FD=c*(w*u0*1)^alpha

%% nonlinear alpha=0.7
alpha=0.7;
A=drift*h/max(remodeshape);

rada=2^(2+alpha)*(gamma(1+alpha/2))^2/gamma(2+alpha);
phicos=0;
for i=1:3
phicos=phicos+(remodeshape(i))^(1+alpha)*(cos)^(1+alpha)*rada;
end

c=kersi*2*pi*A^(1-alpha)*w^(2-alpha)*mphi/phicos/1000
FD=c*(w*u0*1)^alpha
```

CODE

```
%% linear
clc
clear


%find period of 1st mode

T=0.33384;
w=2*pi/T;
modeshape=[2.771E-18;8.499E-18;1.611E-17] ;


%normailzed the mode shape
nmodeshape=modeshape(:,1)/modeshape(3,1);
%mass
m1=2548.95+9000;
m2=2543.27+9000;
m3=2541.18+6750;
m=[m1;m2;m3];
%find c
%m*phi^2 part
mphi=0;
for i=1:3
mphi=mphi+m(i)*nmodeshape(i)^2;
end
%phi^2*cos^2 part
phicos=0;
c23=(2.25/3)/((2.25/3)^2+1.25^2)^0.5;
c1=(2.25/3)/((2.25/3)^2+1.5^2)^0.5;
cos=[c1;c23;c23];
    %relative modeshape
```

```
    for i=1:3
        if i==1
           remodeshape(1)=nmodeshape(1);
        else
            remodeshape(i)=nmodeshape(i)-nmodeshape(i-1);
        end
    end
for i=1:3
phicos=phicos+(remodeshape(i))^2*(cos(i))^2;
end

kersi=0.15;
c=4*pi*kersi*mphi/T/phicos/1000



drift=0.01;
hf=1.25;
%% nonlinear alpha=0.3
alpha=0.3;
A=drift*hf/max(remodeshape);

rada=2^(2+alpha)*(gamma(1+alpha/2))^2/gamma(2+alpha);
phicos=0;
for i=1:3
phicos=phicos+(remodeshape(i))^(1+alpha)*(cos(i))^(1+alpha)*rada;
end

c=kersi*2*pi*A^(1-alpha)*w^(2-alpha)*mphi/phicos/1000



%% nonlinear alpha=0.7
alpha=0.7;
A=drift*hf/max(remodeshape);

rada=2^(2+alpha)*(gamma(1+alpha/2))^2/gamma(2+alpha);
phicos=0;
for i=1:3
phicos=phicos+(remodeshape(i))^(1+alpha)*(cos(i))^(1+alpha)*rada;
```

```
end

c=kersi*2*pi*A^(1-alpha)*w^(2-alpha)*mphi/phicos/1000
```

```
CODE
clc
clear all
%empty
% [ETDT
ETDD]=textread('C:\Users\USER\Desktop\PaC\EM\TCU2FD.txt','%f%f','head
erlines',12);
% [EEDT
EEDD]=textread('C:\Users\USER\Desktop\PaC\EM\EL2FD.txt','%f%f','heade
rlines',12);
% [ETAT
ETAA]=textread('C:\Users\USER\Desktop\PaC\EM\TCU2FA.txt','%f%f','head
erlines',12);
% [EEAT
EEAA]=textread('C:\Users\USER\Desktop\PaC\EM\EL2FA.txt','%f%f','heade
rlines',12);
% [ETAT
ETVV]=textread('C:\Users\USER\Desktop\PaC\EM\TCU2FV.txt','%f%f','head
erlines',12);
% [EEAT
EEVV]=textread('C:\Users\USER\Desktop\PaC\EM\EL2FV.txt','%f%f','heade
rlines',12);
%linear
[TDT
TDD]=textread('C:\Users\USER\Desktop\PaC\LVD\TCU1FD.txt','%f%f','head
```

```
erlines',12);
[EDT
EDD]=textread('C:\Users\USER\Desktop\PaC\LVD\EL1FD.txt','%f%f','heade
rlines',12);
[TAT
TAA]=textread('C:\Users\USER\Desktop\PaC\LVD\TCU1FA.txt','%f%f','head
erlines',12);
[EAT
EAA]=textread('C:\Users\USER\Desktop\PaC\LVD\EL1FA.txt','%f%f','heade
rlines',12);
[TAT
TVV]=textread('C:\Users\USER\Desktop\PaC\LVD\TCU1FV.txt','%f%f','head
erlines',12);
[EAT
EVV]=textread('C:\Users\USER\Desktop\PaC\LVD\EL1FV.txt','%f%f','heade
rlines',12);
%alpha=0.3
[TDT3
TDD3]=textread('C:\Users\USER\Desktop\PaC\NVD03\TCU1FD.txt','%f%f','h
eaderlines',12);
[EDT3
EDD3]=textread('C:\Users\USER\Desktop\PaC\NVD03\EL1FD.txt','%f%f','he
aderlines',12);
[TAT3
TAA3]=textread('C:\Users\USER\Desktop\PaC\NVD03\TCU1FA.txt','%f%f','h
eaderlines',12);
[EAT3
EAA3]=textread('C:\Users\USER\Desktop\PaC\NVD03\EL1FA.txt','%f%f','he
aderlines',12);
[TAT3
TVV3]=textread('C:\Users\USER\Desktop\PaC\NVD03\TCU1FV.txt','%f%f','h
eaderlines',12);
[EAT3
EVV3]=textread('C:\Users\USER\Desktop\PaC\NVD03\EL1FV.txt','%f%f','he
aderlines',12);
%alpha=0.7
[TDT7
TDD7]=textread('C:\Users\USER\Desktop\PaC\NVD07\TCU1FD.txt','%f%f','h
```

```
eaderlines',12);
[EDT7
EDD7]=textread('C:\Users\USER\Desktop\PaC\NVD07\EL1FD.txt','%f%f','he
aderlines',12);
[TAT7
TAA7]=textread('C:\Users\USER\Desktop\PaC\NVD07\TCU1FA.txt','%f%f','h
eaderlines',12);
[EAT7
EAA7]=textread('C:\Users\USER\Desktop\PaC\NVD07\EL1FA.txt','%f%f','he
aderlines',12);
[TAT7
TVV7]=textread('C:\Users\USER\Desktop\PaC\NVD07\TCU1FV.txt','%f%f','h
eaderlines',12);
[EAT7
EVV7]=textread('C:\Users\USER\Desktop\PaC\NVD07\EL1FV.txt','%f%f','he
aderlines',12);

%no
% ed=max(abs(EEDD))
% ev=max(abs(EEVV))
% ea=max(abs(EEAA))
%
% td=max(abs(ETDD))
% tv=max(abs(ETVV))
% ta=max(abs(ETAA))

%with
Ved=max(abs(EDD))
Vev=max(abs(EVV))
Vea=max(abs(EAA))

Vtd=max(abs(TDD))
Vtv=max(abs(TVV))
Vta=max(abs(TAA))

%
Ved=max(abs(EDD3))
Vev=max(abs(EVV3))
```

```
Vea=max(abs(EAA3))

Vtd=max(abs(TDD3))
Vtv=max(abs(TVV3))
Vta=max(abs(TAA3))

%
Ved=max(abs(EDD7))
Vev=max(abs(EVV7))
Vea=max(abs(EAA7))

Vtd=max(abs(TDD7))
Vtv=max(abs(TVV7))
Vta=max(abs(TAA7))

% figure(1)
% plot(ETDT,ETDD,TDT,TDD);
% title('Roof relative displacement TCU068');
% xlabel('Time (sec)');
% ylabel('displacement (cm)');
% legend('Bare frame','Bare frame + LVD');
%
% figure(2)
% plot(EEDT,EEDD,EDT,EDD);
% title('Roof relative displacement El Centro');
% xlabel('Time (sec)');
% ylabel('displacement (cm)');
% legend('Bare frame','Bare frame + LVD');
%
% figure(3)
% plot(ETAT,ETAA,TAT,TAA);
% title('Roof absolute acceleration TCU068');
% xlabel('Time (sec)');
% ylabel('acceleration (gal)');
% legend('Bare frame','Bare frame + LVD');
%
% figure(4)
% plot(EEAT,EEAA,EAT,EAA);
```

```
% title('Roof absolute acceleration El Centro');
% xlabel('Time (sec)');
% ylabel('acceleration (gal)');
% legend('Bare frame','Bare frame + LVD');
% %%
% figure(5)
% plot(ETDT,ETDD,TDT3,TDD3);
% title('Roof relative displacement TCU068');
% xlabel('Time (sec)');
% ylabel('displacement (cm)');
% legend('Bare frame','Bare frame + NVD alpha=0.3');
%
% figure(6)
% plot(EEDT,EEDD,EDT3,EDD3);
% title('Roof relative displacement El Centro');
% xlabel('Time (sec)');
% ylabel('displacement (cm)');
% legend('Bare frame','Bare frame + NVD alpha=0.3');
%
% figure(7)
% plot(ETAT,ETAA,TAT3,TAA3);
% title('Roof absolute acceleration TCU068');
% xlabel('Time (sec)');
% ylabel('acceleration (gal)');
% legend('Bare frame','Bare frame + NVD alpha=0.3');
%
% figure(8)
% plot(EEAT,EEAA,EAT7,EAA7);
% title('Roof absolute acceleration El Centro');
% xlabel('Time (sec)');
% ylabel('acceleration (gal)');
% legend('Bare frame','Bare frame + NVD alpha=0.3');
% %%
% figure(9)
% plot(ETDT,ETDD,TDT7,TDD7);
% title('Roof relative displacement TCU068');
% xlabel('Time (sec)');
% ylabel('displacement (cm)');
```

```
% legend('Bare frame','Bare frame + NVD alpha=0.7');
%
% figure(10)
% plot(EEDT,EEDD,EDT7,EDD7);
% title('Roof relative displacement El Centro');
% xlabel('Time (sec)');
% ylabel('displacement (cm)');
% legend('Bare frame','Bare frame + NVD alpha=0.7');
%
% figure(11)
% plot(ETAT,ETAA,TAT7,TAA7);
% title('Roof absolute acceleration TCU068');
% xlabel('Time (sec)');
% ylabel('acceleration (gal)');
% legend('Bare frame','Bare frame + NVD alpha=0.7');
%
% figure(12)
% plot(EEAT,EEAA,EAT7,EAA7);
% title('Roof absolute acceleration El Centro');
% xlabel('Time (sec)');
% ylabel('acceleration (gal)');
% legend('Bare frame','Bare frame + NVD alpha=0.7');
%
% %%
% figure(13)
% plot(ETDT,ETDD,TDT,TDD,TDT3,TDD3,TDT7,TDD7);
% title('Roof relative displacement TCU068');
% xlabel('Time (sec)');
% ylabel('displacement (cm)');
% legend('Bare frame','Bare frame + LVD','Bare frame + NVD
alpha=0.3','Bare frame + NVD alpha=0.7');
%
% figure(14)
% plot(EEDT,EEDD,EDT,EDD,EDT3,EDD3,EDT7,EDD7);
% title('Roof relative displacement El Centro');
% xlabel('Time (sec)');
% ylabel('displacement (cm)');
% legend('Bare frame','Bare frame + LVD','Bare frame + NVD
```

```
alpha=0.3','Bare frame + NVD alpha=0.7');
%
% figure(15)
% plot(ETAT,ETAA,TAT,TAA,TAT3,TAA3,TAT7,TAA7);
% title('Roof absolute acceleration TCU068');
% xlabel('Time (sec)');
% ylabel('acceleration (gal)');
% legend('Bare frame','Bare frame + LVD','Bare frame + NVD
alpha=0.3','Bare frame + NVD alpha=0.7');
%
% figure(16)
% plot(EEAT,EEAA,EAT,EAA,EAT3,EAA3,EAT7,EAA7);
% title('Roof absolute acceleration El Centro');
% xlabel('Time (sec)');
% ylabel('acceleration (gal)');
% legend('Bare frame','Bare frame + LVD','Bare frame + NVD
alpha=0.3','Bare frame + NVD alpha=0.7');
```