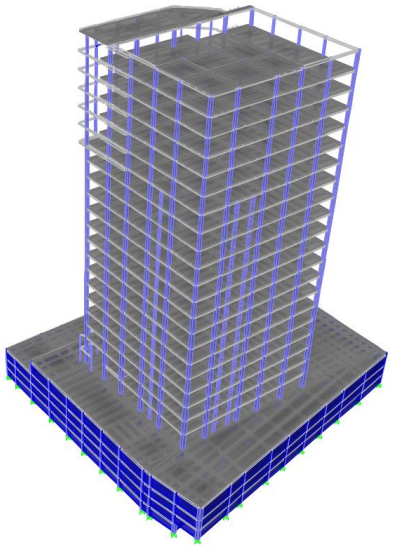
台中市辦公大樓耐震間柱設計



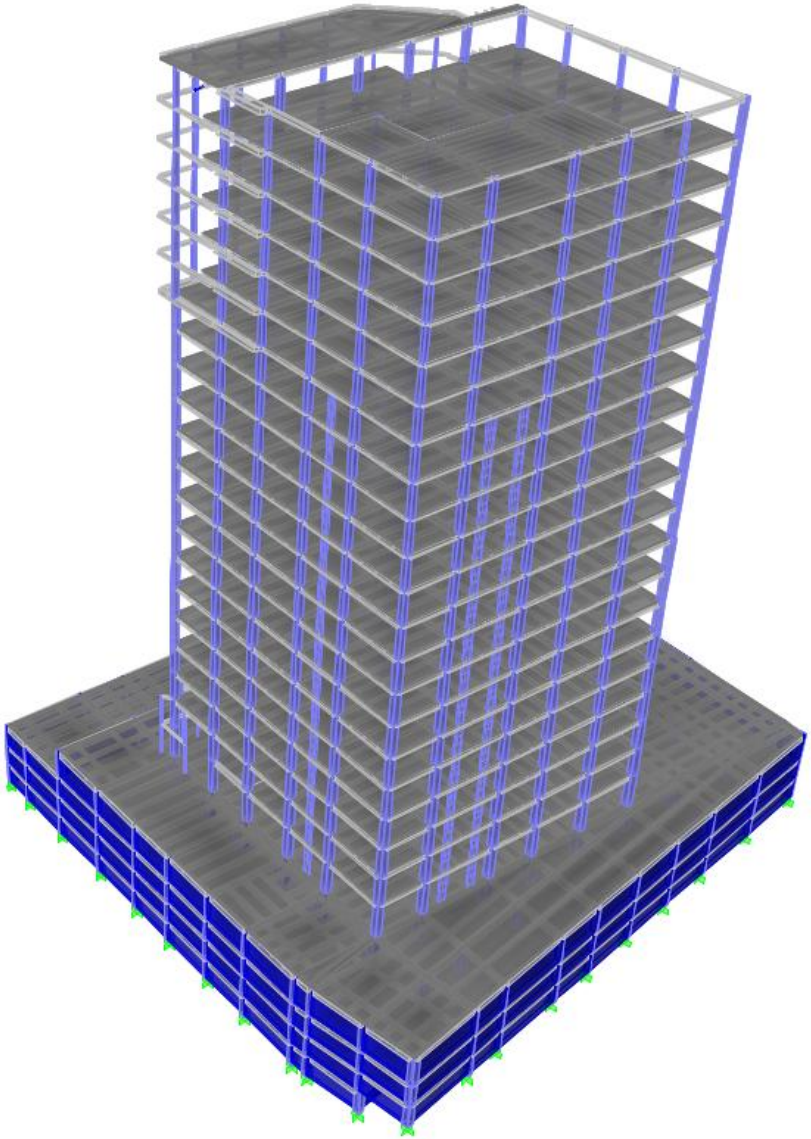
群策工程顧問

栗正暐 結構技師

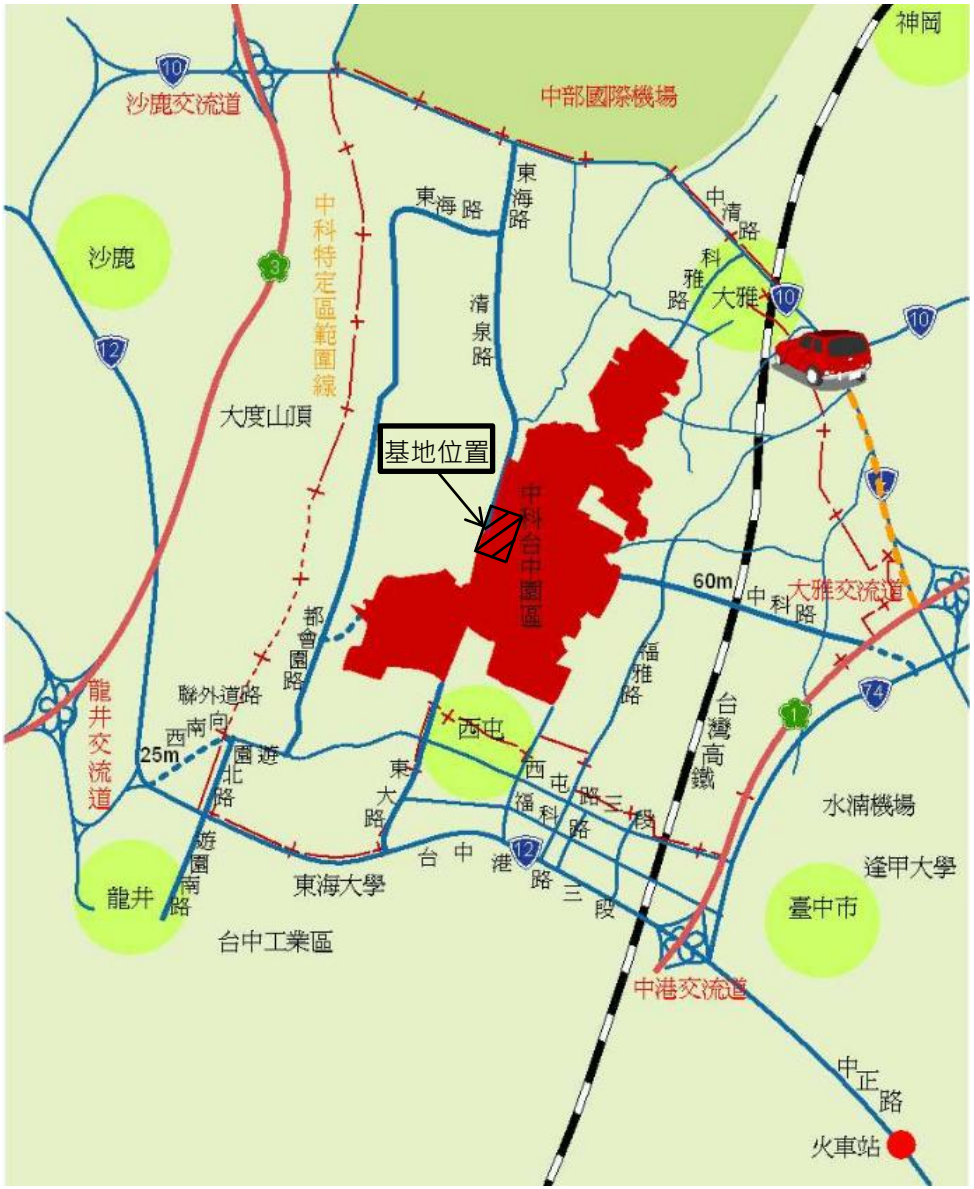
2016/11/03

台中市辦公大樓耐震間柱設計

- 基地位置及建築概述
- 法規地震力
- 耐震間柱配置原則
- ETABS結構分析模型
- 結構體Drift Ratio
- 非線性靜力側推分析
- 耐震間柱施工大樣詳圖
- 施工照片



● 基地位置及建築概述



◆ 建築物概述

1.地下4層RC構造/地上鋼構造

a. 裙樓 - 地上層8F

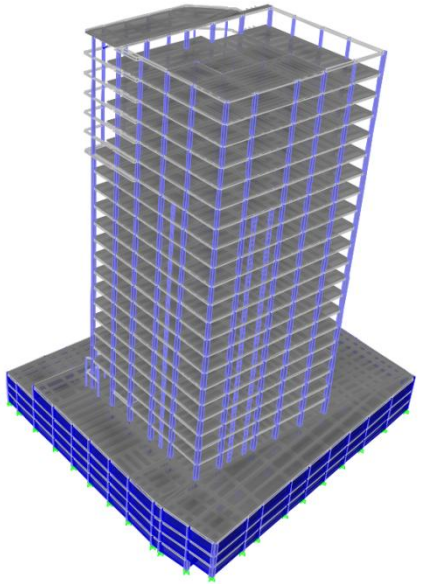
b. 塔樓 - 地上層20F

2. 地上層樓高H=4.5m

a. 裙樓 - 總樓高36m

b. 塔樓 - 總樓高91m

3. 地上層建築物外牆 - 玻璃帷幕



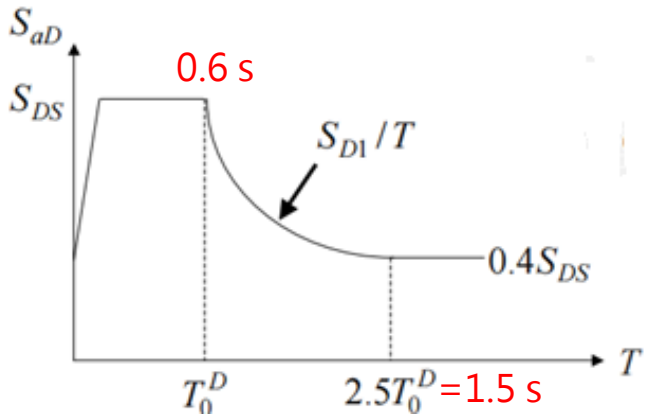
● 法規地震力 - 塔樓

1. 地盤分類:第一類地盤
2. 地震分區:台中市大雅區(近屯子腳斷層約6km)

   S_S^D=0.8 S_1^D=0.45 S_S^M=1.0 S_1^M=0.55
3. 韌性容量: R_x=R_y=4.0
4. 用途係數: I=1.0
5. 起始降伏地震力大倍數: α_y=1.0
6. 法規週期(T_c=0.085H^3/4): T_c=2.494 s

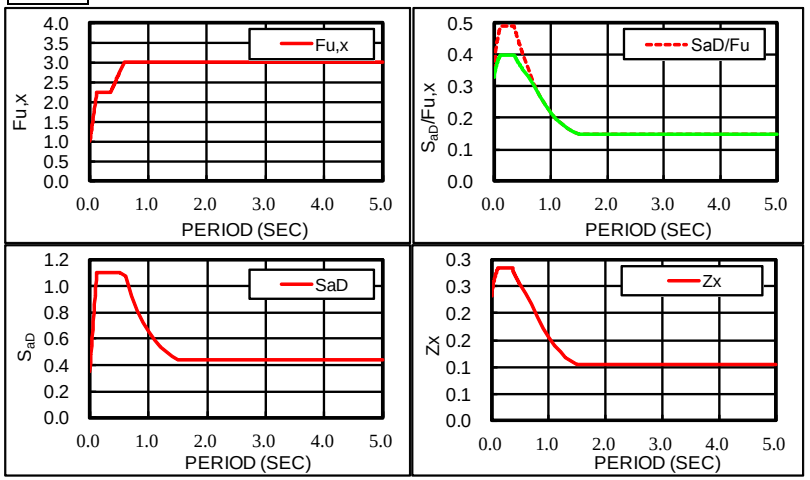
   (EBF,T_c=0.07H^3/4): T_c=2.062 s
7. 法規上限週期: T_c=3.492 s
8. 結構體動力週期 - T_x=2.782 s T_y=2.857 s
9. 基層剪力係數 - V_x=0.0838 V_y=0.0838

S_{aD}: 工址設計水平譜加速度係數

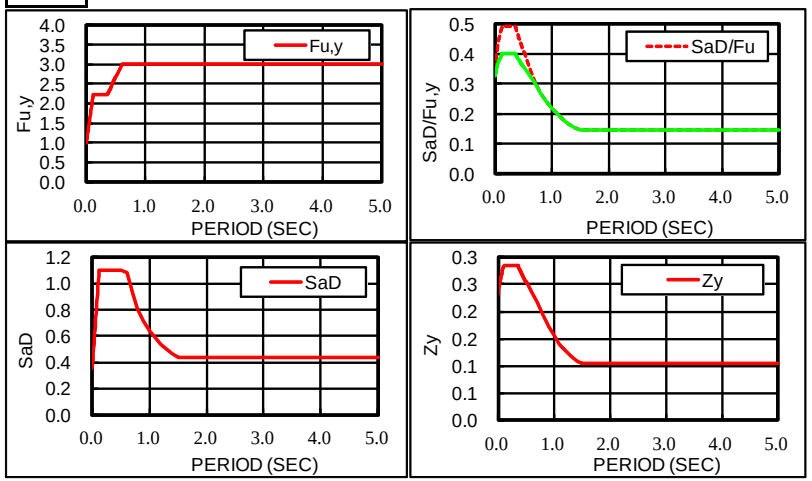


◆ S_{aD}計算結果

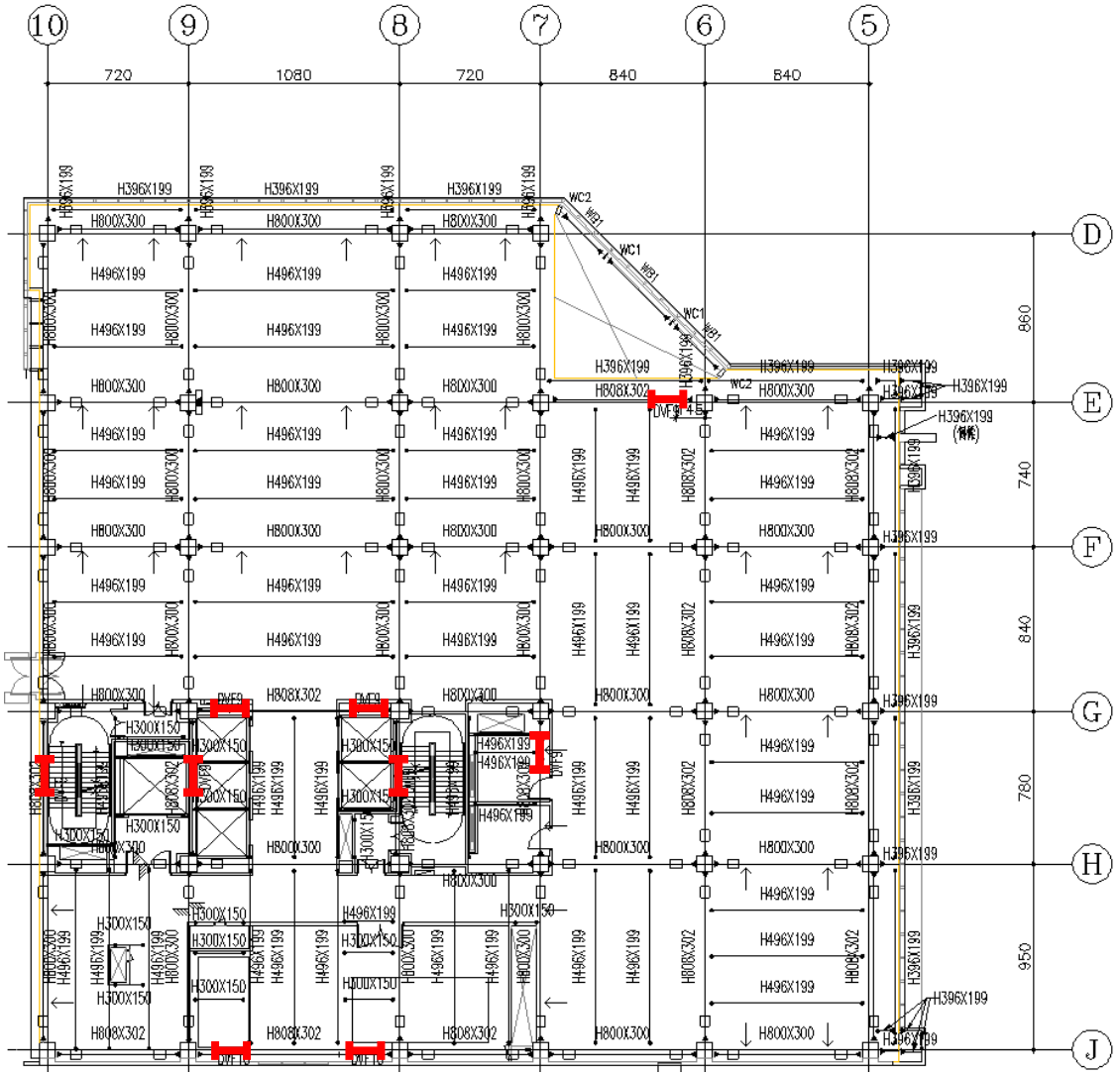
X-dir



Y-dir



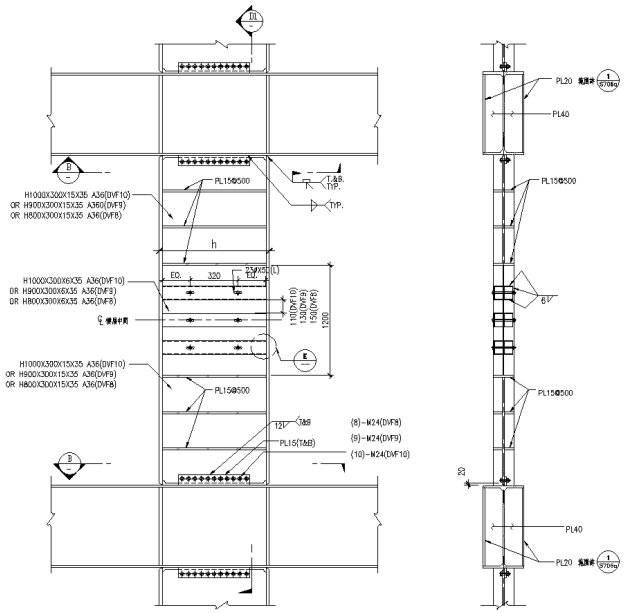
● 耐震間柱配置原則



塔樓標準層結構平面

◆ 配置原則(▬:耐震間柱位置)

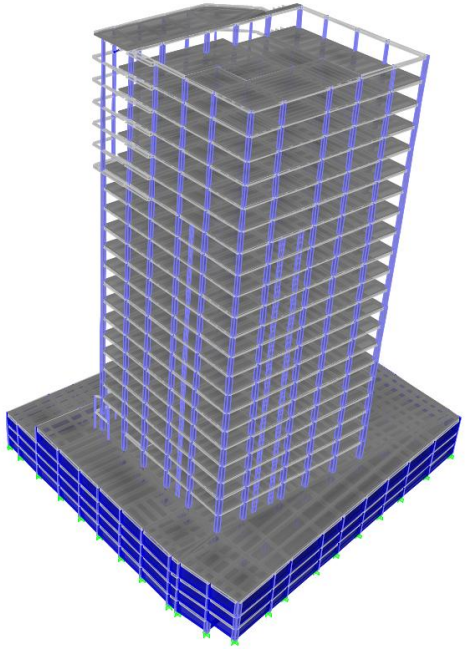
1. 採對稱原則配置
2. 樓電梯間
3. 外牆位置



耐震間柱詳圖

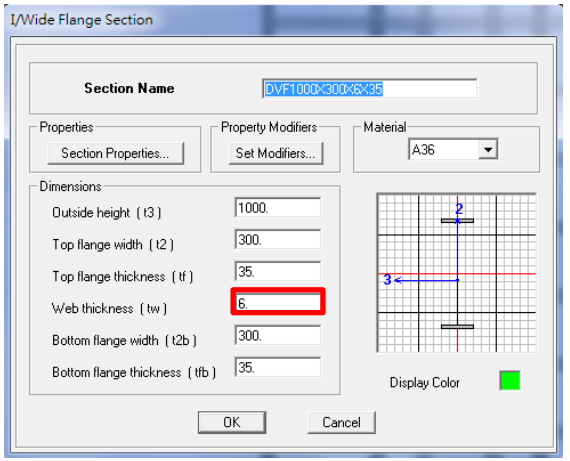
● ETABS結構分析模型

◆ 塔樓模型

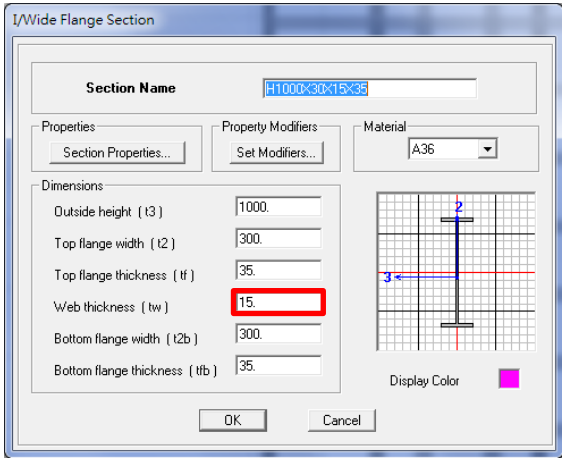


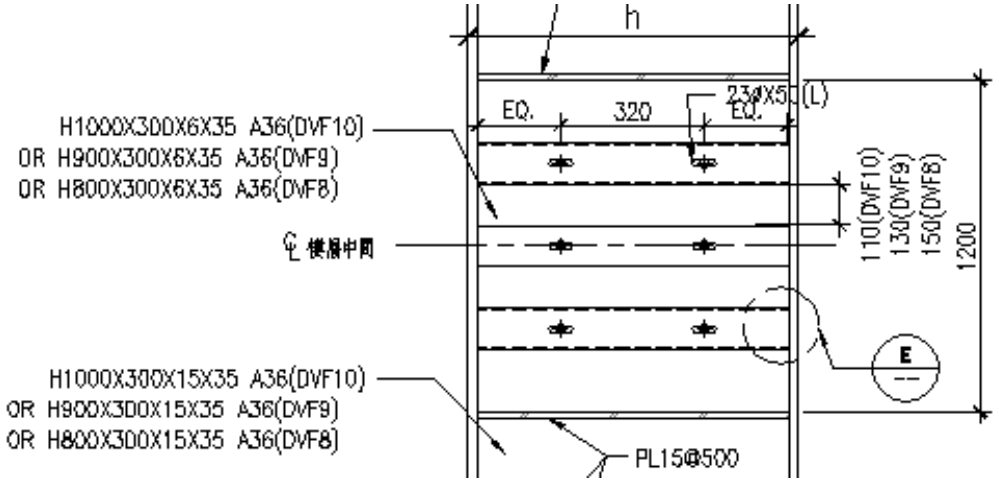
◆ 耐震間柱斷面設定

1. 間柱中間段L=1200mm(腹板厚度=6mm)



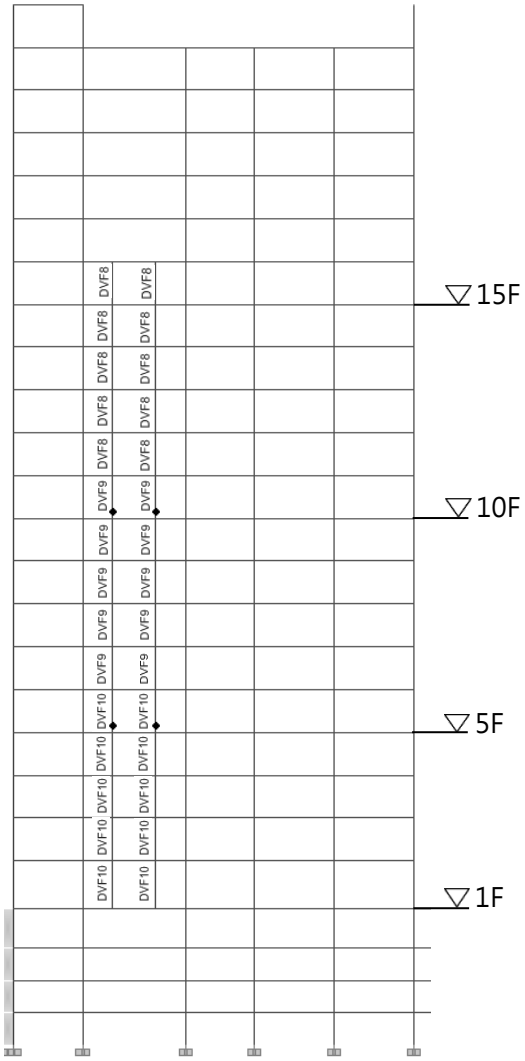
2. 間柱上、下段(腹板厚度=15mm)



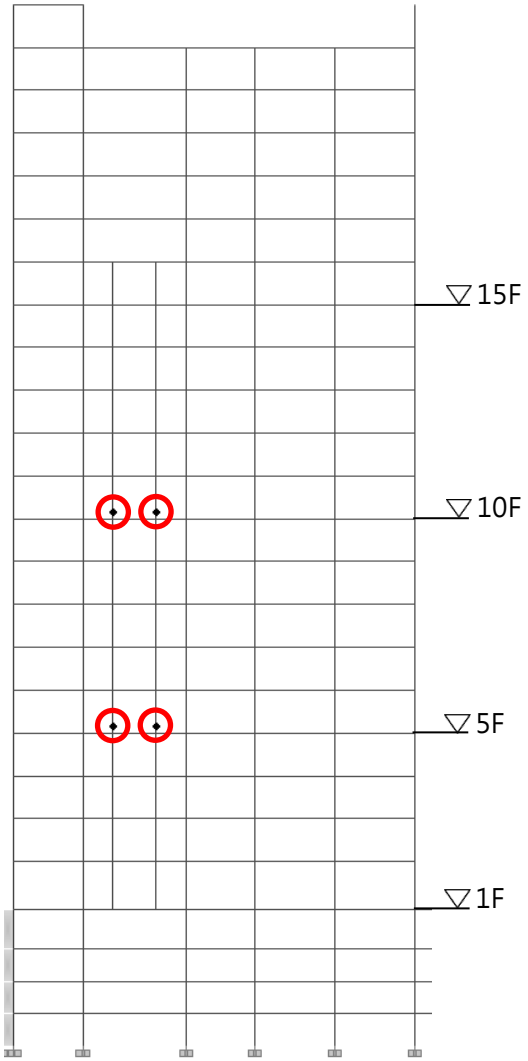


● ETABS結構分析模型

◆ 耐震間柱斷面深度 - 1000、900及800mm

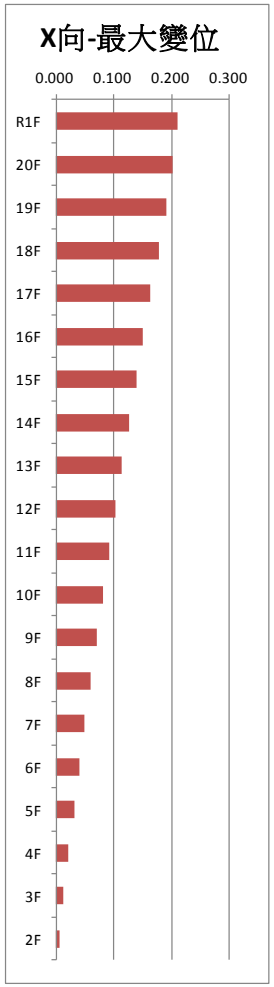


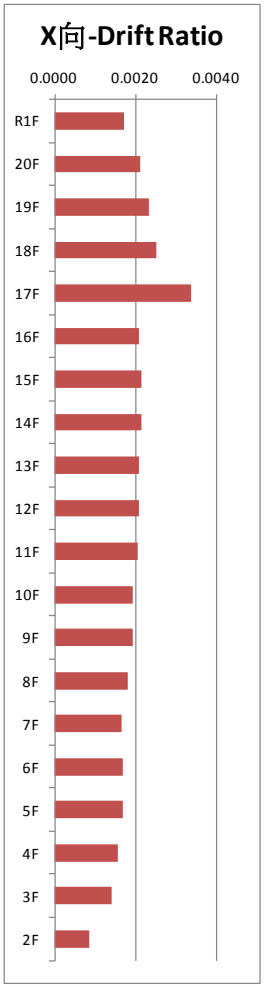
◆ 耐震間柱 - 釋放軸力(○)



● 結構體Drift Ratio

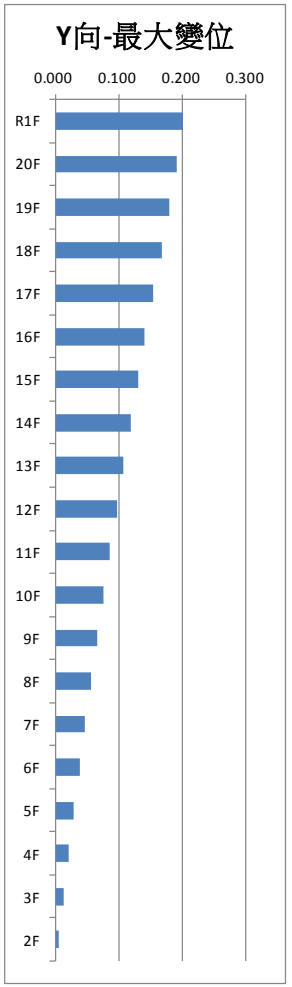
◆ X向地震力

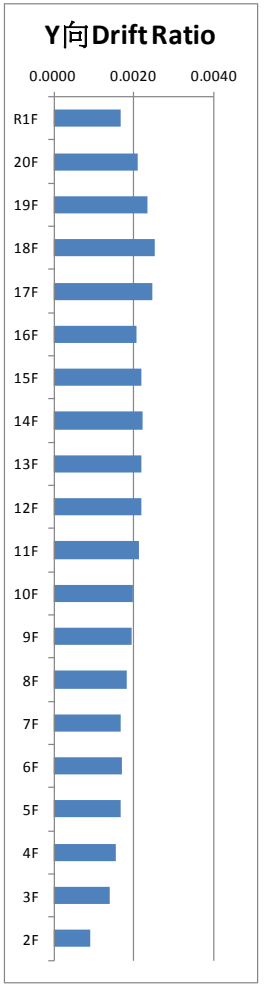




	最大變形	最大轉角
X向	0.211	0.0034
Y向	0.202	0.0025

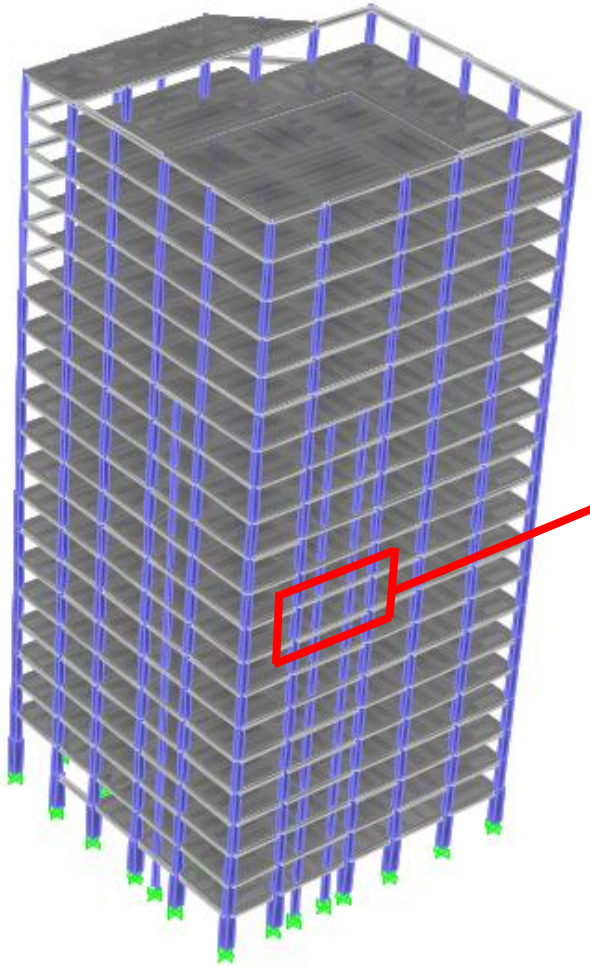
◆ Y向地震力





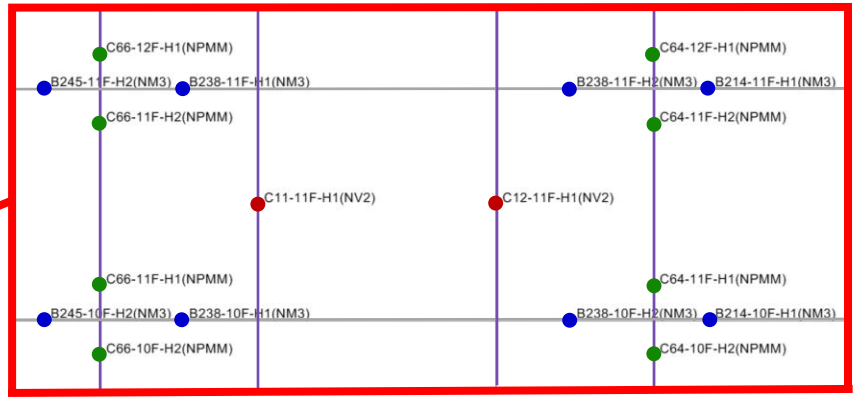
● 非線性靜力側推分析

◆ ETABS 結構模型



◆ Pushover分析載重→1.0DL+0.5LL

◆ 構架塑鉸設定

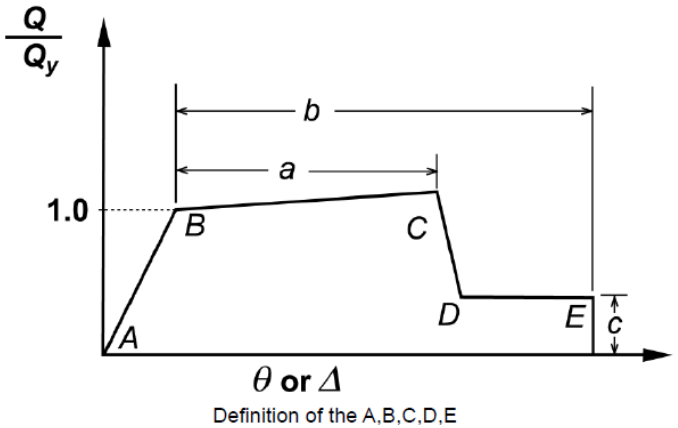


- 耐震間柱剪力塑鉸V2
- 柱軸力&彎矩塑鉸PMM3
- 梁彎矩塑鉸M3

● 非線性靜力側推分析

◆ 塑鉸參數設定

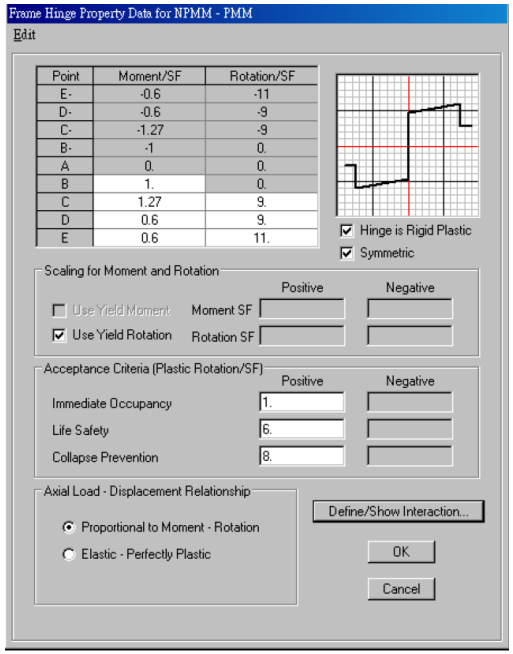
FEMA 273 Acceptance Criteria



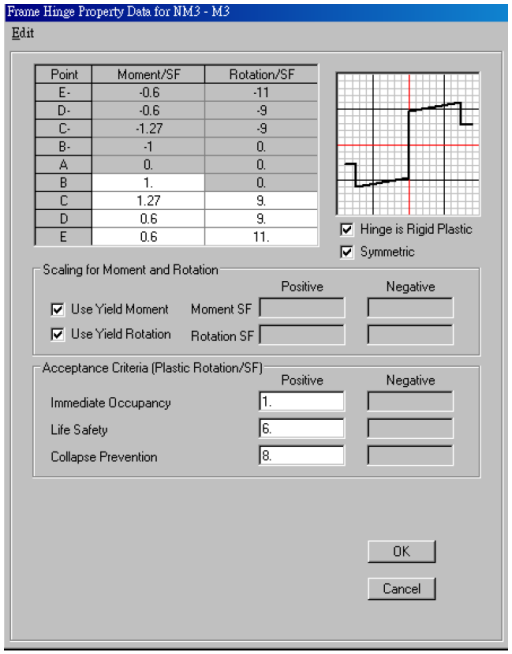
Definition of the A,B,C,D,E

steel	Plastic Rotation Angles, Radians		Residual strength ratio	Plastic Rotation Angles, Radians		
	a	b	c	IO	LS	CP
PMM	9 θy	11 θy	0.6	1 θy	6 θy	8 θy
M3	9 θy	11 θy	0.6	1 θy	6 θy	8 θy
V2	14 θy	16 θy	0.7	0.5 θy	10 θy	13 θy

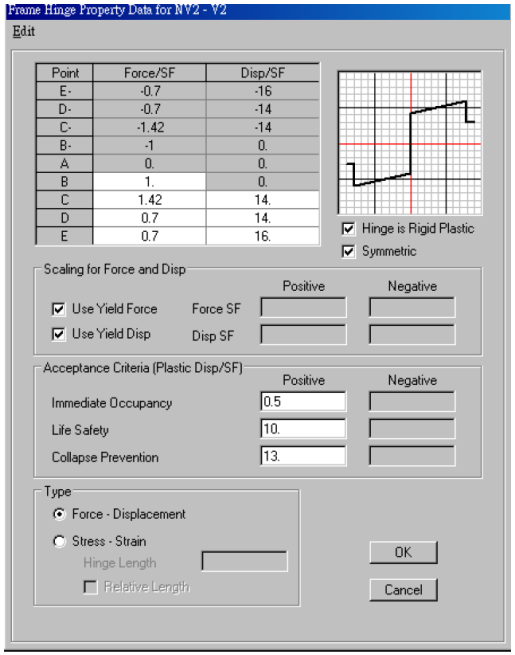
鋼構塑角設定



PMM(鋼柱)



M3(梁)

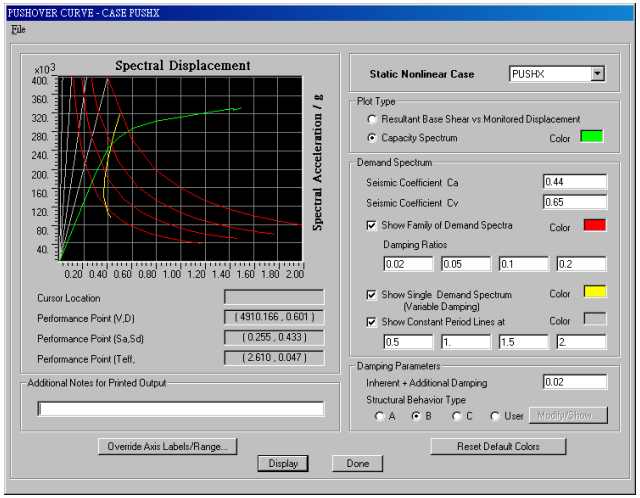


V2(耐震間柱)

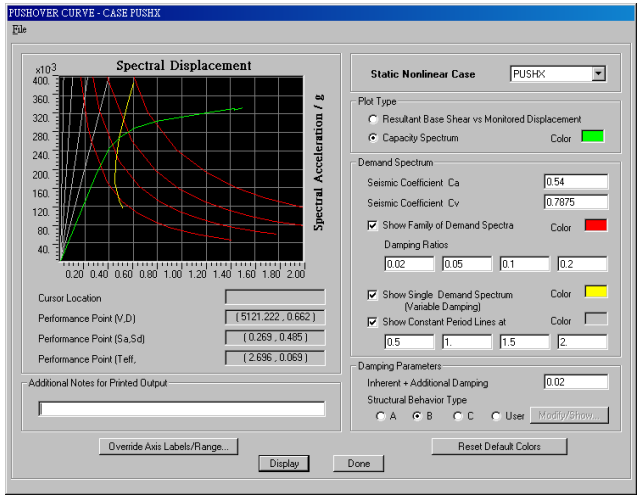
● 非線性靜力側推分析

◆ Pushover 側推分析結果

X方向：

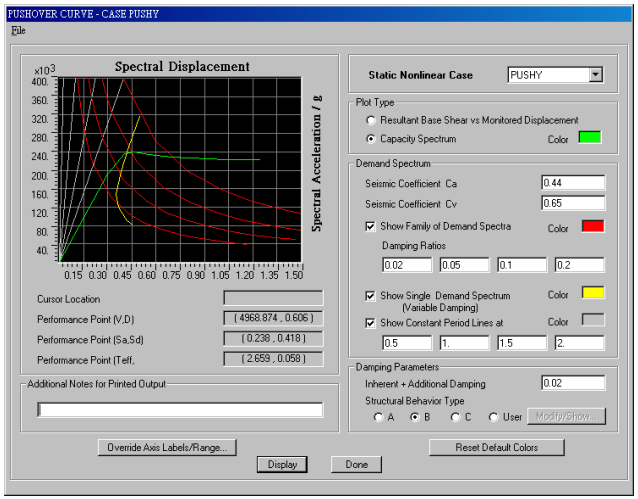


475年回歸期

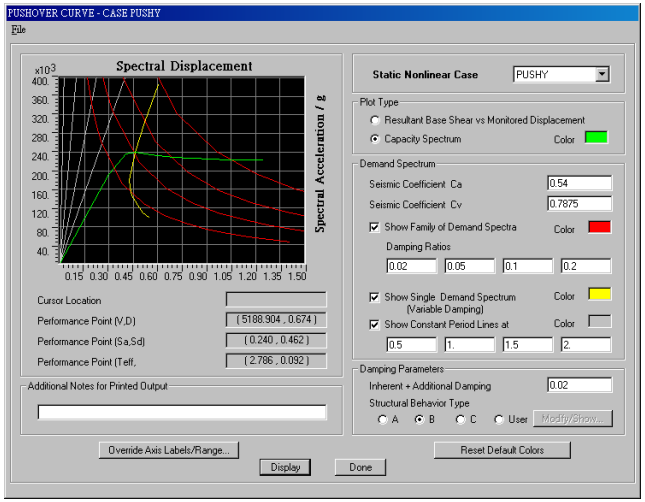


2500年回歸期

Y方向：



475年回歸期

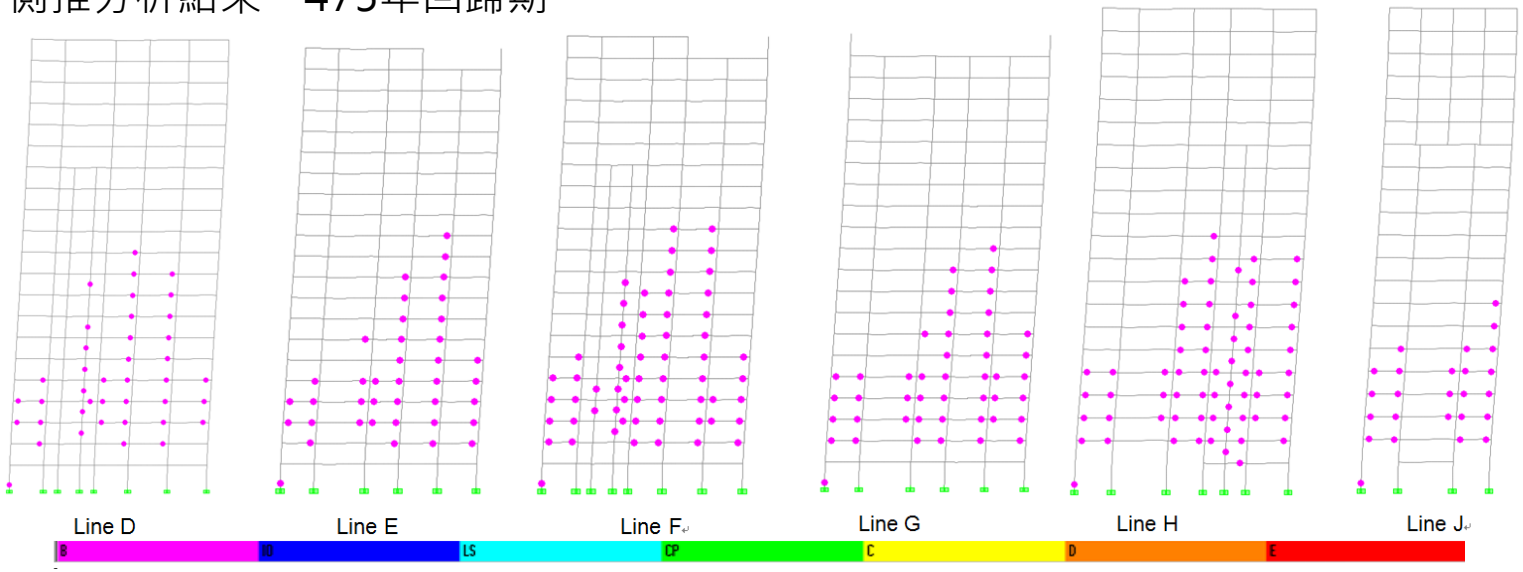


2500年回歸期

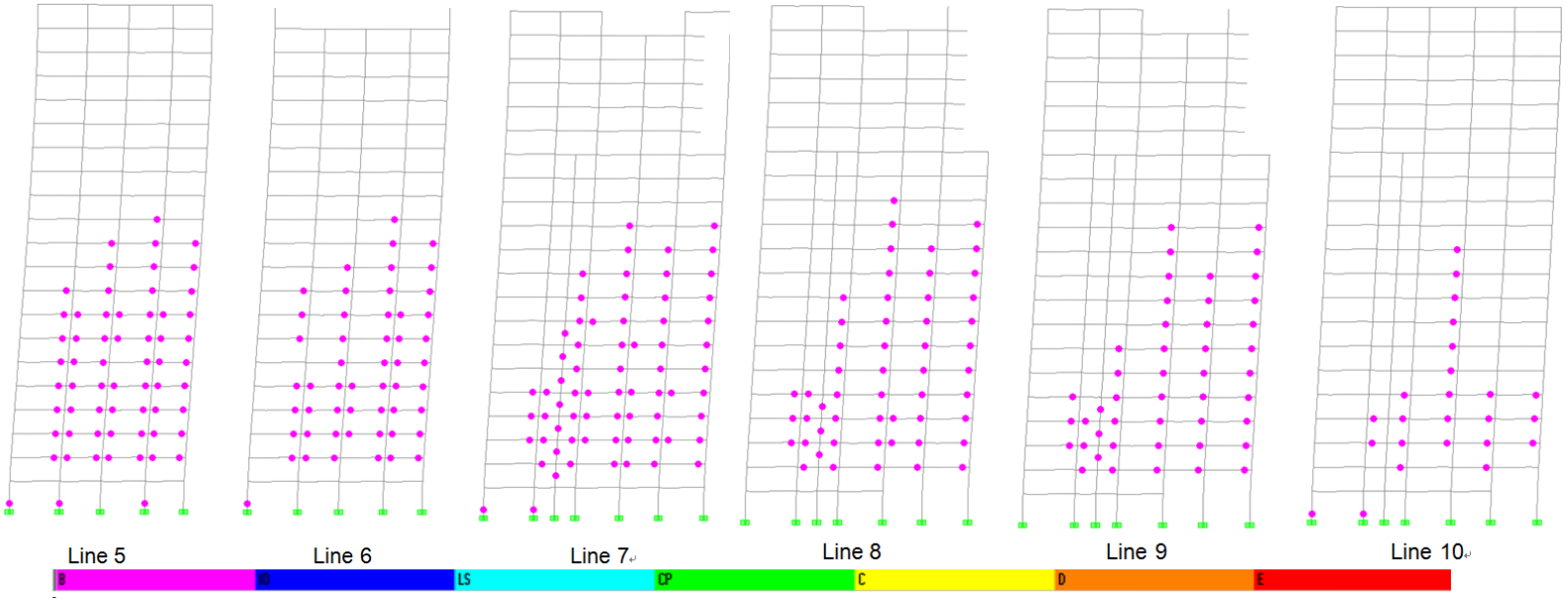
● 非線性靜力側推分析

◆ Pushover 側推分析結果 - 475年回歸期

X方向：



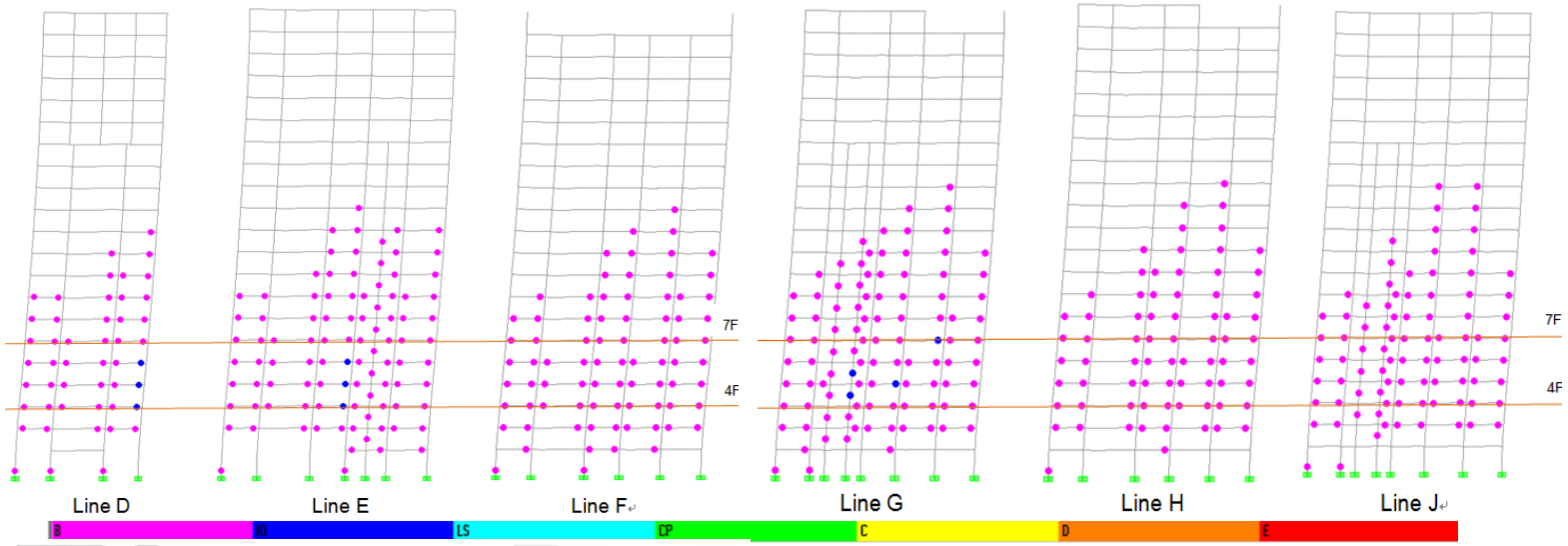
Y方向：



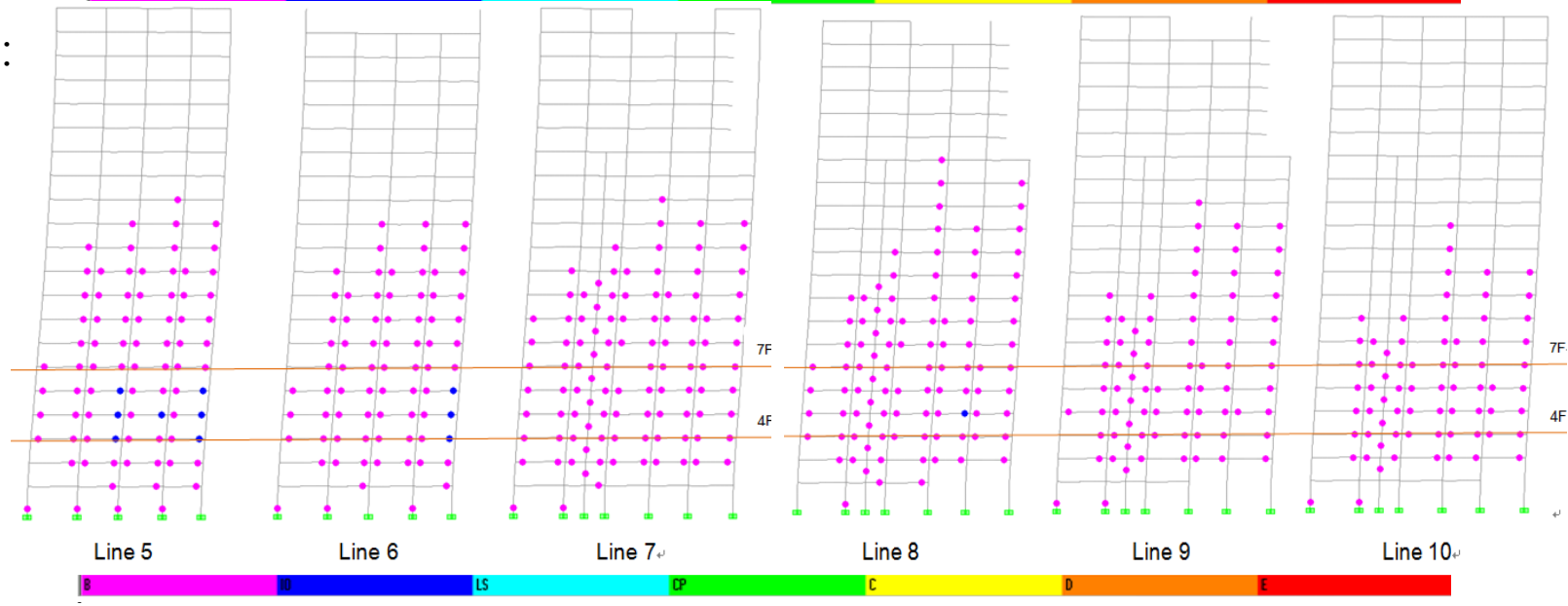
● 非線性靜力側推分析

◆ Pushover 側推分析結果 - 2500年回歸期

X方向：



Y方向：



● 非線性靜力側推分析

◆ Pushover 側推分析結論

1. 475年回歸期地震危害水準下(BSE-1)達到Immediate Occupancy Performance Level(1-B)
   2500年回歸期地震危害水準下(BSE-2)達到Life Safety Performance Level(3-C)

2. 極限層剪力採475年及2500年回歸期(I=1.25)Pushover結果與設計地震力比值(Vn/Ve)值Pu/Py(2.2~2.4)。

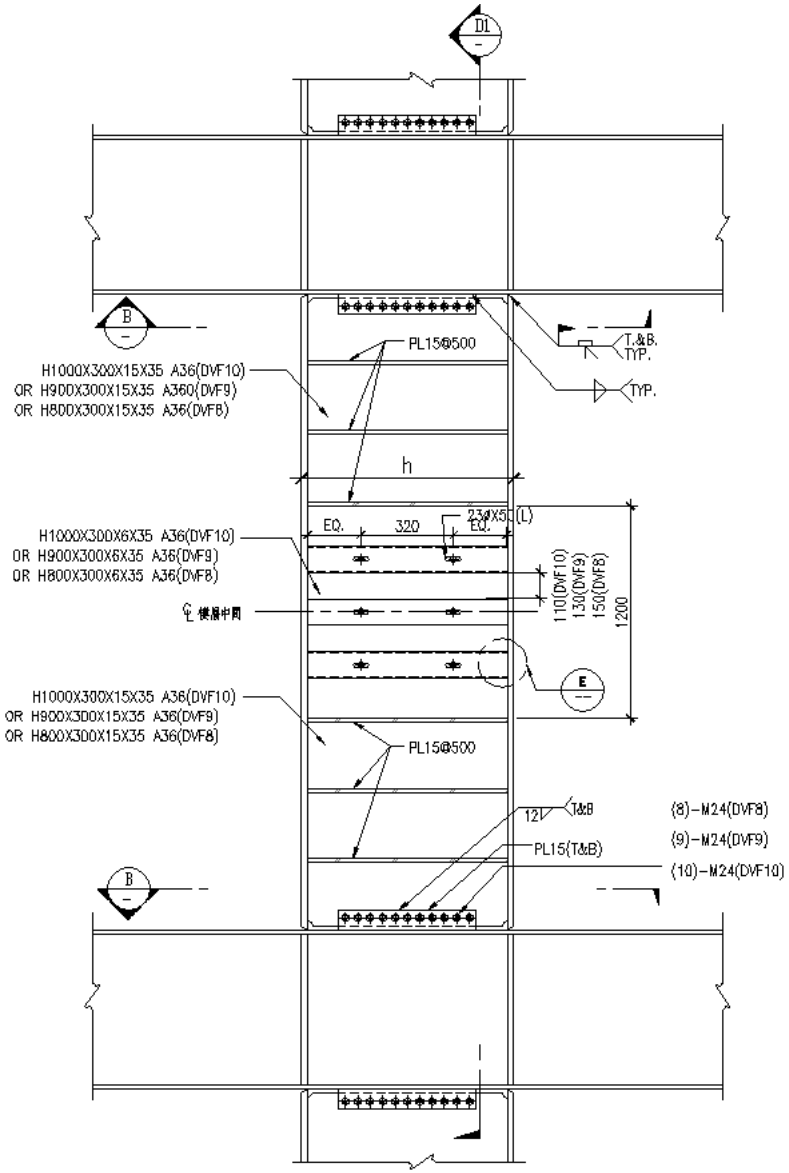
1F柱採鋼柱模擬	Performance Point		Drift Ratio	Pu/Py	Δu/Δy
	Pu (ton)	Δu (cm)	Δu/總樓高		
X向-475年回歸期	4880	60.5	0.0067	2.20	1.94
X向-2500年回歸期	5087	66.7	0.0074	2.29	2.14
Y向-475年回歸期	4929	61.2	0.0068	2.22	1.94
Y向-2500年回歸期	5150	68.0	0.0075	2.32	2.16

3. 2500年回歸期地震力作用下，4F~7F部分梁塑性轉角達1.0θy~2.0θy(Life Safety)，於4F~7F大梁梁翼切削。

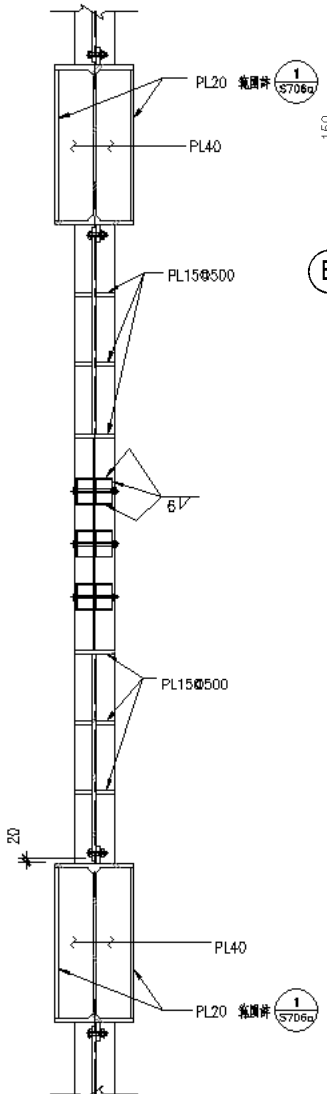
4. 建物達Collapse Prevention Performance Level (CP)時，Δu/Δy值約為4.6。

	Δu (cm)	Δu/Δy	R
X向-達CP性能階段	144	4.6	4
Y向-達CP性能階段	145	4.6	4

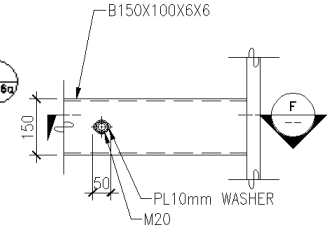
● 耐震間柱施工大樣詳圖



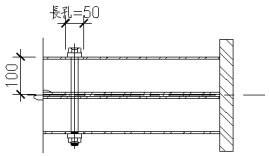
A1 耐震間柱立面示意圖



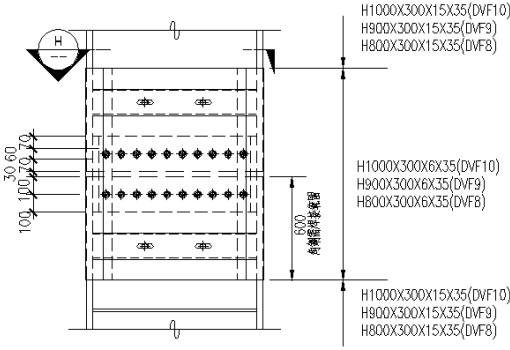
D1 耐震間柱剖面示意圖



E 耐震間柱大樣詳圖

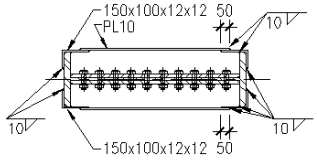


F 耐震間柱大樣詳圖



G 耐震間柱大樣詳圖

5F,10F,



H 耐震間柱大樣詳圖

● 施工照片

◆ 安裝位置 - 1F

◆ 安裝位置 - 5F(釋放軸力)

感 謝 聆 聽