



挫曲束制斜撐構架之應用

副緯工程顧問有限公司 Chuang Wei Structural Engineering Inc.

陳威志 技師



1 新北美術館

O1 基本說明 Introduction

02 結構線性分析 Structure Linear Analysis

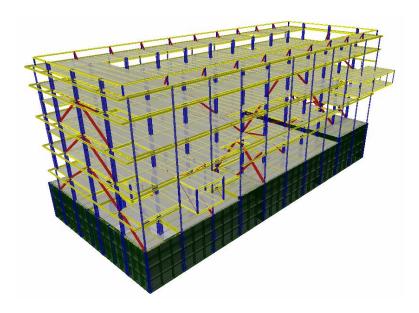


基本說明 Introduction

基本說明

- ▶ 新北市鶯歌區中正段25-9號
- > 鄰近陶瓷博物館、鶯歌老街
- ▶上部結構高36.55公尺,八層樓
- ▶ 樓地板面積37000平方公尺

樓層	用途			
B2F~B3F	停車場、會議室、機房			
1F	藝術街坊、書店、餐廳			
2F~5F	展覽區			
6F	特展區、營運辦公室			
8FL	咖啡廳、屋頂花園、機房			



結構三維參考圖

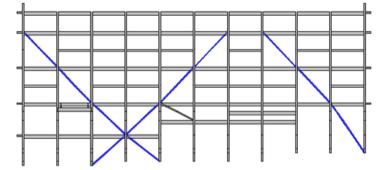


位置參考圖

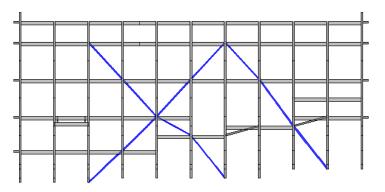


1.1.1 上部結構系統

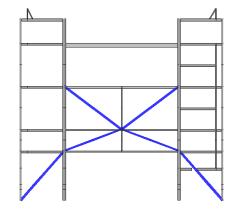
- ▶ 側向載重系統
 - ▶ BRB制震斜撐(長向兩道,短向四道)
 - > 梁柱韌性抗彎矩構架



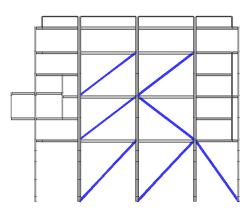
長向 N-line BRB配置圖



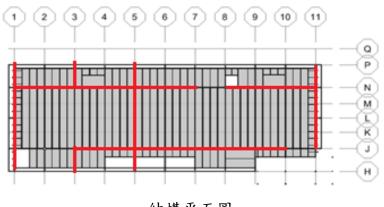
長向 J-line BRB配置圖



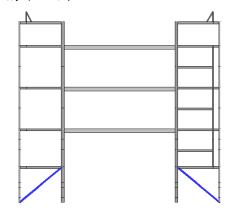
5-Line BRB配置圖



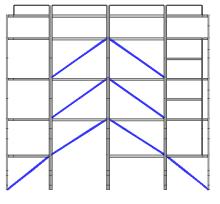
11-Line BRB配置圖



結構平面圖



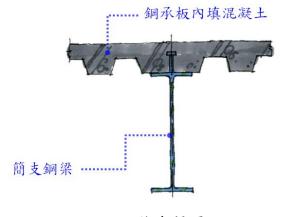
3-Line BRB配置圖



1-Line BRB配置圖

1.1.2 上部結構系統

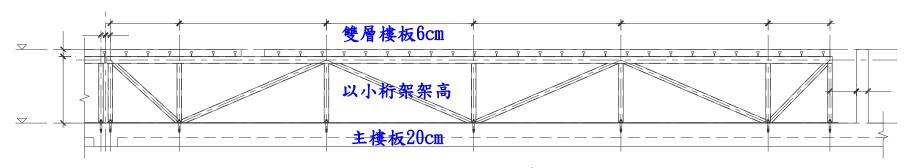
- > 垂直載重系統
 - ▶ 鋼柱、簡支梁及3W鋼承板組成
 - ▶ 展廳樓板跨距22.5m
 - ▶ 鋼承鈑與簡支鋼梁組成複合梁
- > 樓板系統
 - > 二至四樓為階梯狀樓板
 - ▶ 展廳範圍採雙層樓板,空調由地板出風。



複合梁圖

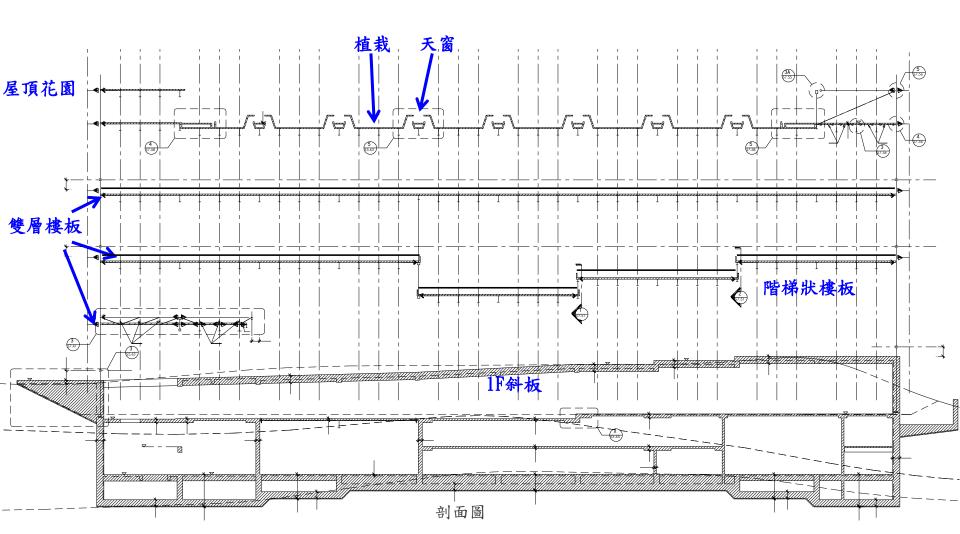


階梯狀樓板



4F、6F雙層樓板系統

1.1.2 上部結構系統





1.1.3 入口雨庇及大樓梯

> 樓梯

- ▶ 踏步採中空鋼管,內灌混凝土, 最大跨距6.4m。
- > 鋼梁底部接合採軸力釋放

▶雨庇

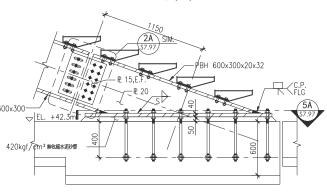
▶ 最大懸挑距離5m

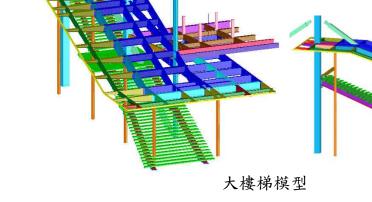


大樓梯



雨庇及大樓梯



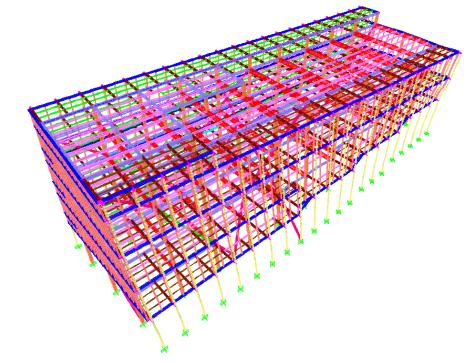


結構線性分析

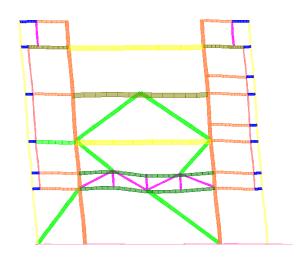
Structure Linear Analysis

結構線性分析

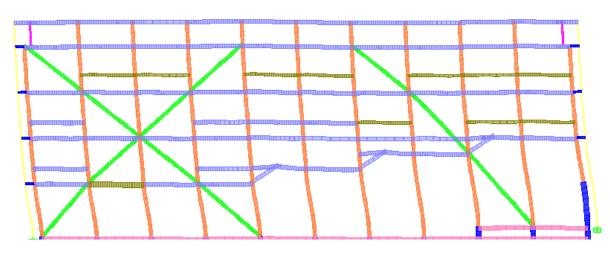
結構基本振態與週期



Mode-3: T= 1.138 sec (扭轉向-Rz)



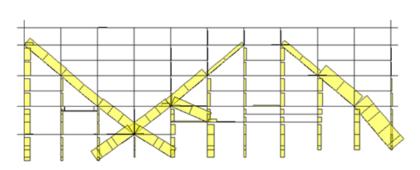
Mode-1: T = 1.437 sec (短向-Y)



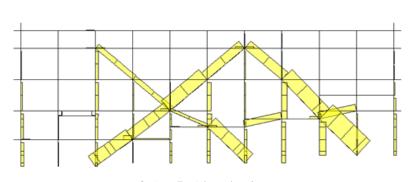
Mode-2: T= 1.386 sec (長向-X)

結構線性分析

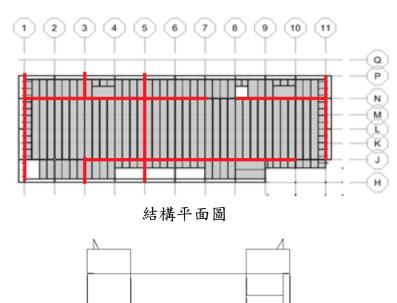
▶ BRB受震軸力反應



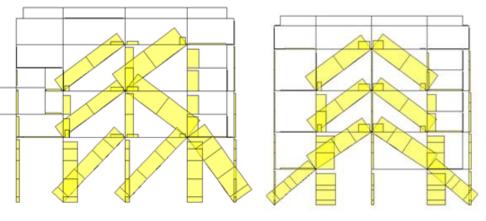
長向 N-line 軸力圖



長向 J-line軸力圖



5-Line軸力圖



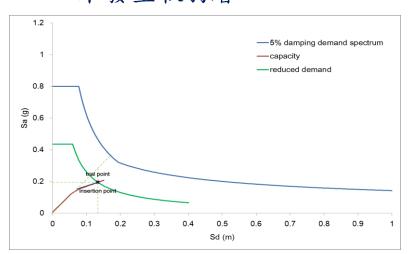
11-Line軸力圖

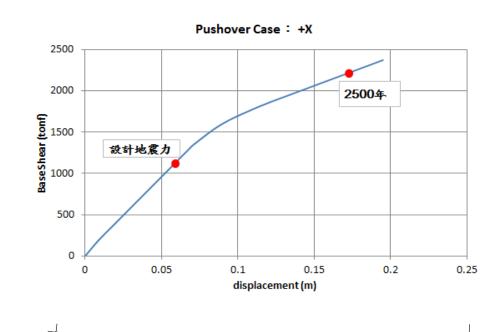
1-Line軸力圖

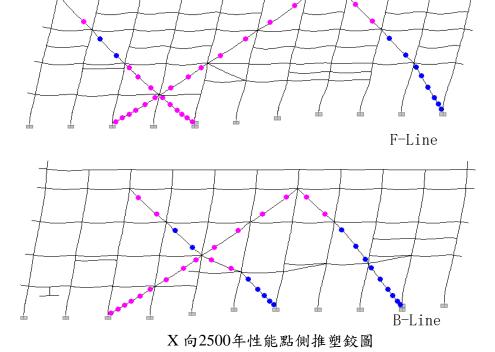
結構非線性分析

Structure Nonlinear Analysis

- ▶ 性能點採用ATC40-承載力譜法
- ➤ X向:2500年回歸期性能點
- > 檢核
 - ▶ BRB及抗彎構架的消能行為
 - > 符合強柱弱梁
 - > 未發生軟弱層



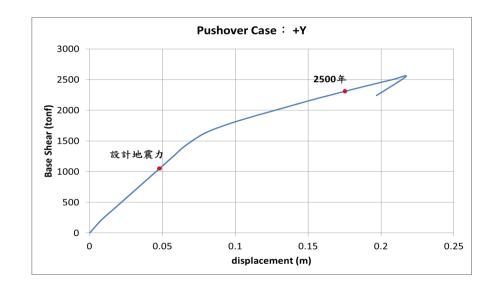


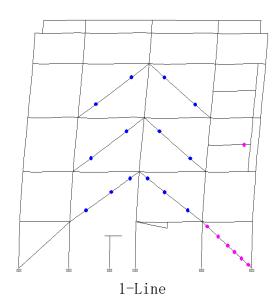


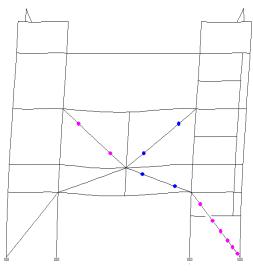
非線性側推分析

► Y向:2500年回歸期性能點

- > 檢核
 - ▶ BRB及抗彎構架的消能行為
 - > 符合強柱弱梁
 - > 未發生軟弱層







5-Line

Y向2500年性能點側推塑鉸圖

2 新店行政園區

O1 基本說明 Introduction



結構非線性分析

Structure Nonlinear Analysis

基本說明

Introduction

基本說明

- ▶ 新北市新店區行政段547等22組地號
- ▶ 基地面積12003.9平方公尺
- > 三棟結構物
 - ▶ 運動中心(9層樓) 37m高
 - □運動場、游泳池、健身中心
 - ▶ 辦公棟(31層樓) 125m高
 - □ 警察局、區公所、中華電信、辦公室
 - ▶ 住宅 (30層樓) 104.6m高



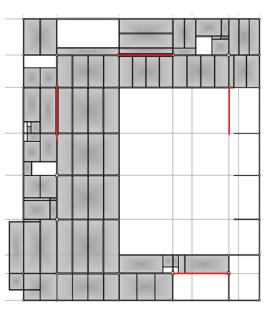
建築外觀圖



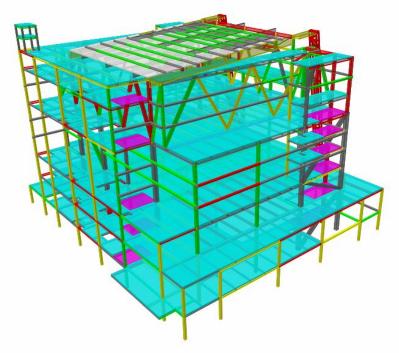
基地位置

結構系統說明

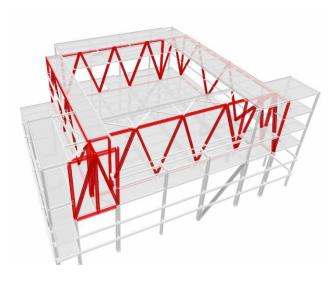
- ▶ 運動中心 (I=1.25) 9層樓 37m高
- ▶上部結構鋼構構造
- > 下部結構鋼筋混凝土構造
- ▶ 外圍採用含BRB制震斜撐之構架系統
- ▶運動場最大樓高11.4m
- ▶運動場最大跨距31m



BRB 配置位置



結構分析3D圖



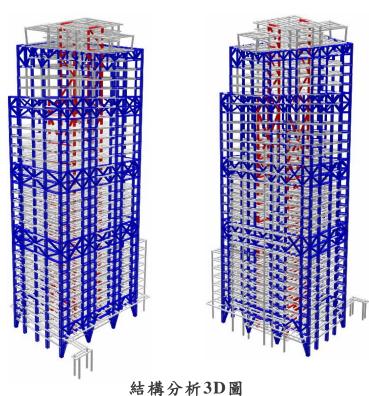
屋頂桁架系統

結構系統說明

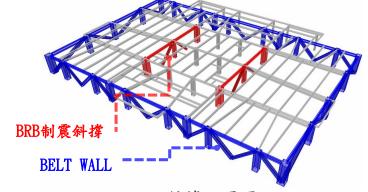
▶ 辦公棟 (I=1.5) 31樓 125m高

BRB

- ➤ MEGA COL & BELT WALL
- ▶ 中央核心區之Y向BRB制震斜撐
- ▶ 辦公空間柱距達16m



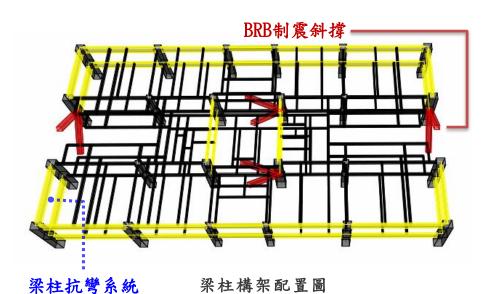
Outrigger MEGA CO 結構系統配置立面

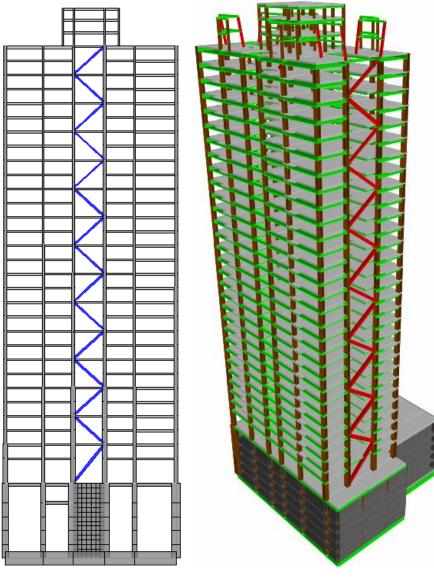


斜撐配置圖

結構系統說明

- ▶ 住宅棟 (I=1.07)
- ▶ 30層樓 104.6m高
- ▶ BRB制震斜撐與梁柱韌性抗彎矩構架
- ▶ 小梁與15公分BARDEK傳導垂直載重





結構分析投影圖

結構分析3D圖

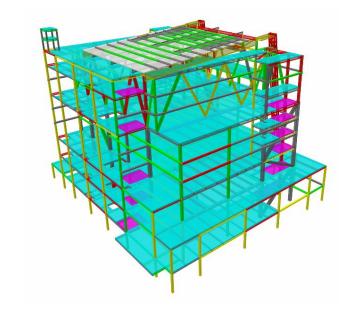
結構線性分析

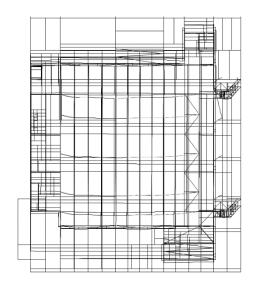
Structure Linear Analysis

結構線性分析

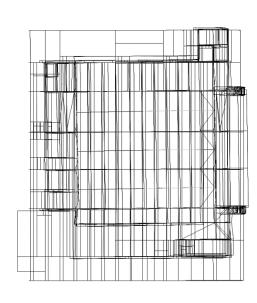
結構基本振態與週期

▶運動中心

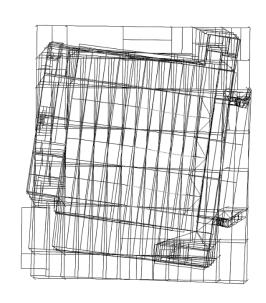




Mode-1: T = 1.464 sec (短向-Y)



Mode-2: T= 1.265sec (長向-X)

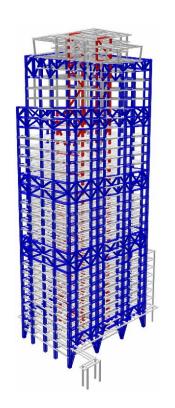


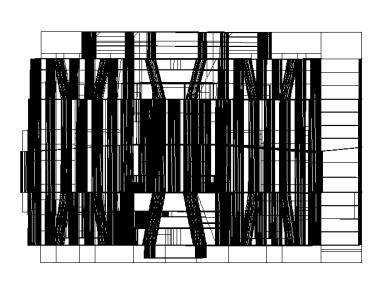
Mode-3: T= 0.912 sec (扭轉向-Rz)

結構線性分析

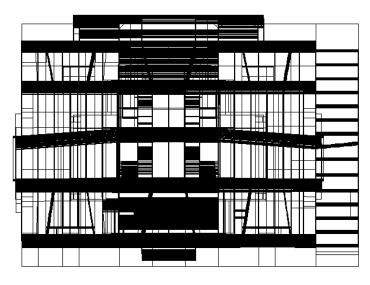
結構基本振態與週期

> 辦公棟

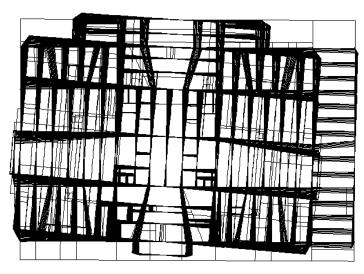




Mode-2: T= 3.417sec (長向-X)



Mode-1: T = 3.443sec (短向-Y)

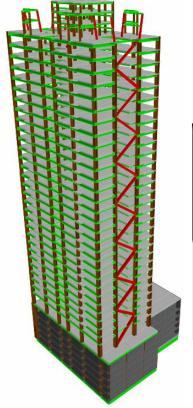


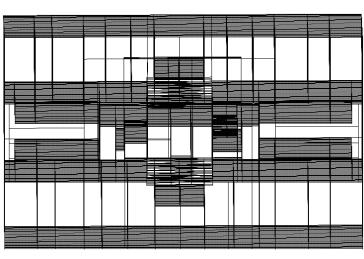
Mode-3: T= 2.508 sec (扭轉向-Rz)

結構線性分析

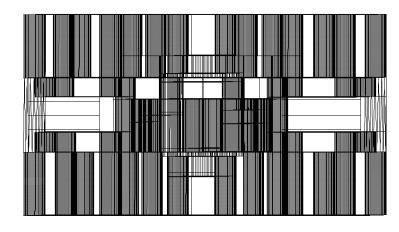
結構基本振態與週期

产住宅棟

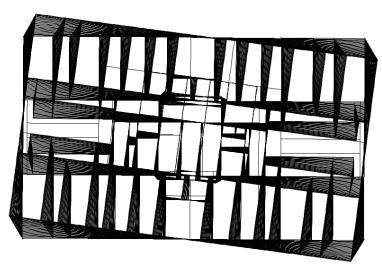




Mode-2: T= 4.228sec (短向-Y)



Mode-1: T = 4.649sec (長向-X)

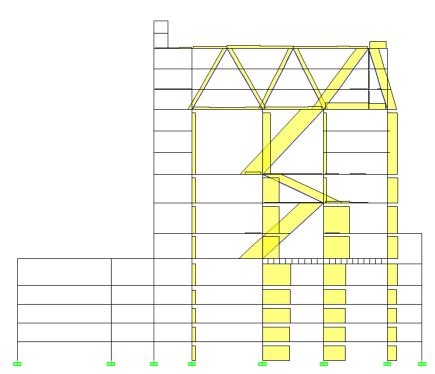


Mode-3: T= 2.736 sec (扭轉向-Rz)

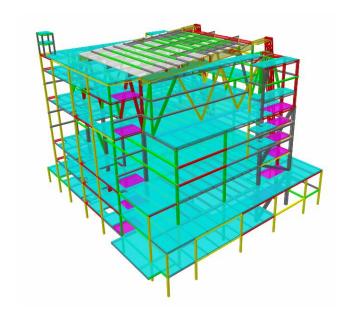
結構線性分析

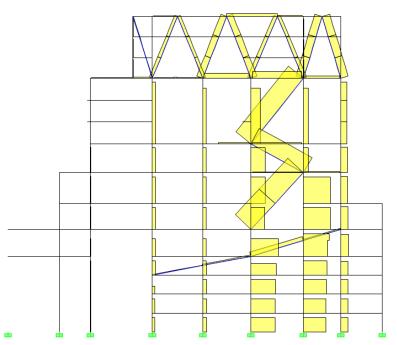
BRB軸力分布情形

▶運動中心



長向-X 受震軸力分布



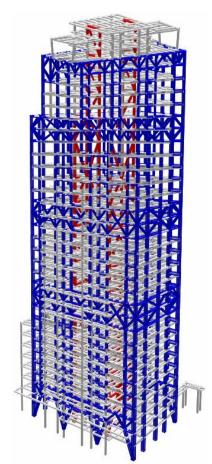


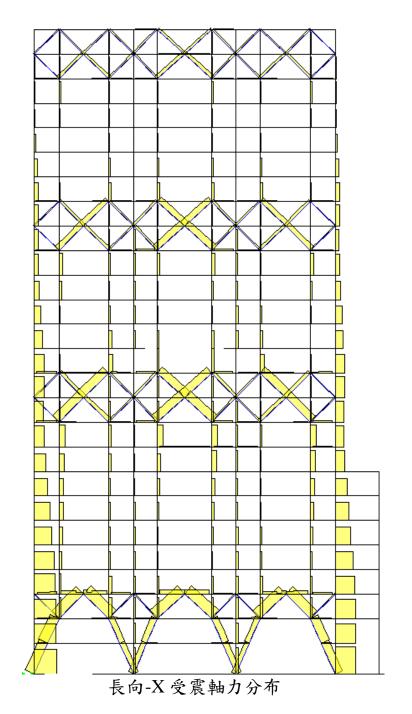
短向-Y受震軸力分布

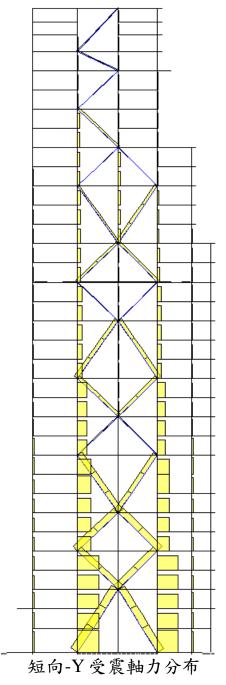
結構線性分析

軸力分布情形

> 辨公棟



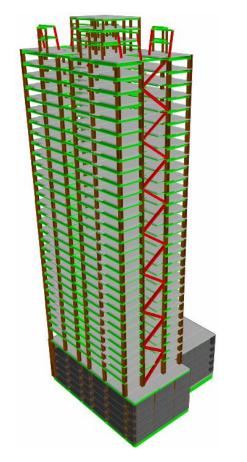


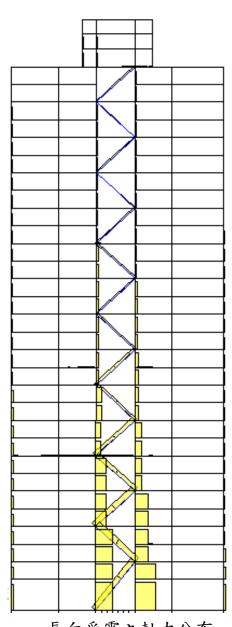


結構線性分析

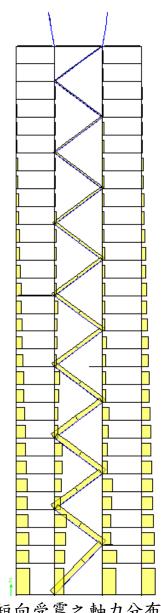
軸力分布情形

产住宅棟





長向受震之軸力分布

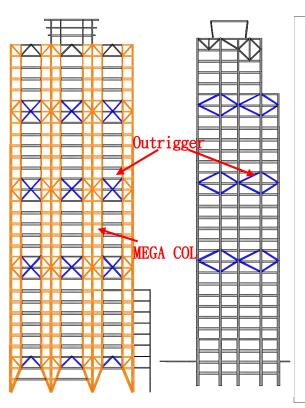


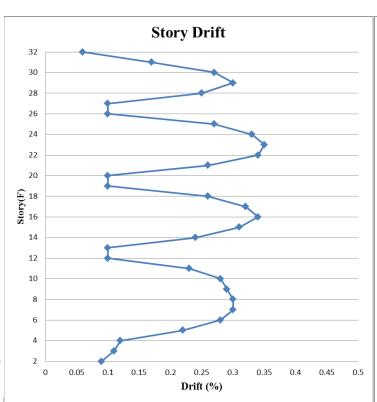
短向受震之軸力分布

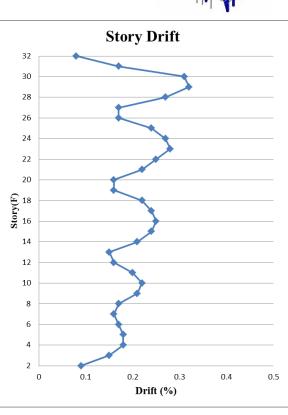
結構線性分析

結構層間位移角

> 辨公棟







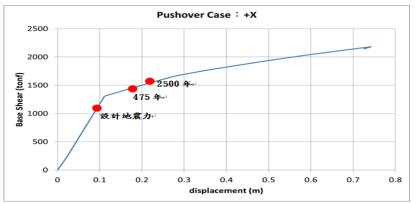
層間位移角(長向-X)

層間位移角(短向-Y)

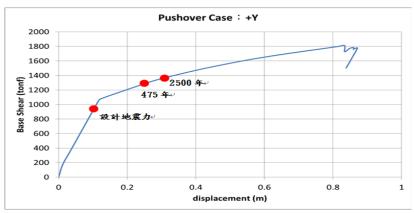
結構非線性分析

Structure Nonlinear Analysis

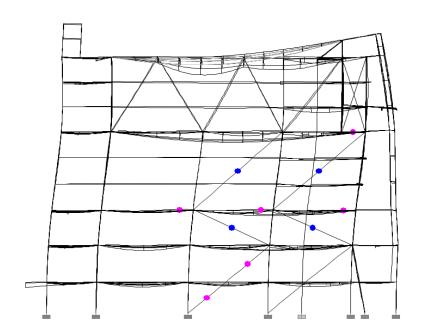
- > 運動中心
- ▶ ATC40-承載力譜法



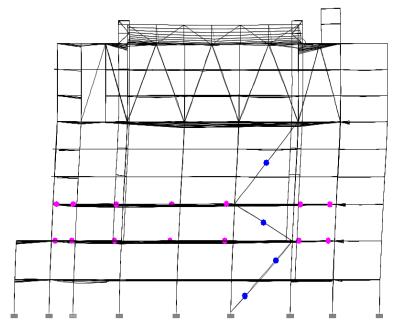
X向性能點基底剪力



Y向性能點基底剪力

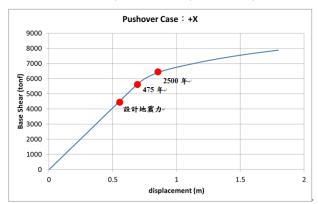


沿X向側推分析圖

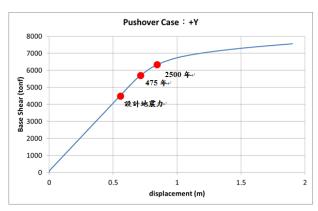


沿Y向側推分析圖

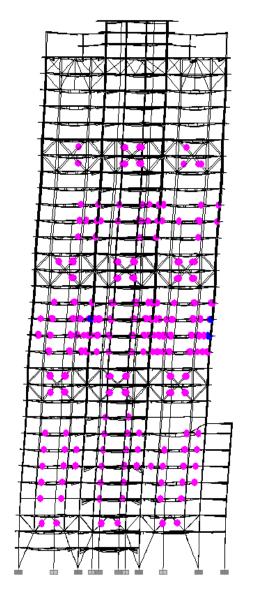
- > 辦公棟
- > 強柱弱梁、無軟弱層



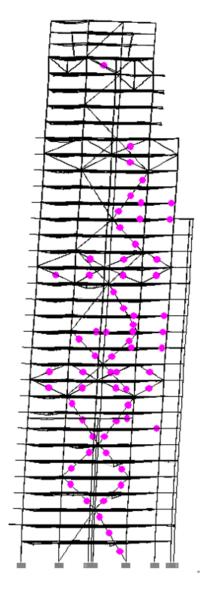
X向性能點基底剪力



Y向性能點基底剪力

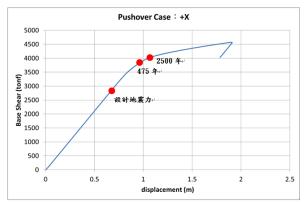


沿X向側推分析圖

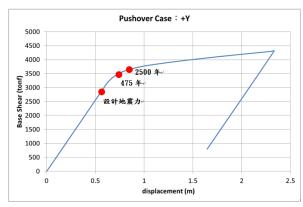


沿Y向側推分析圖

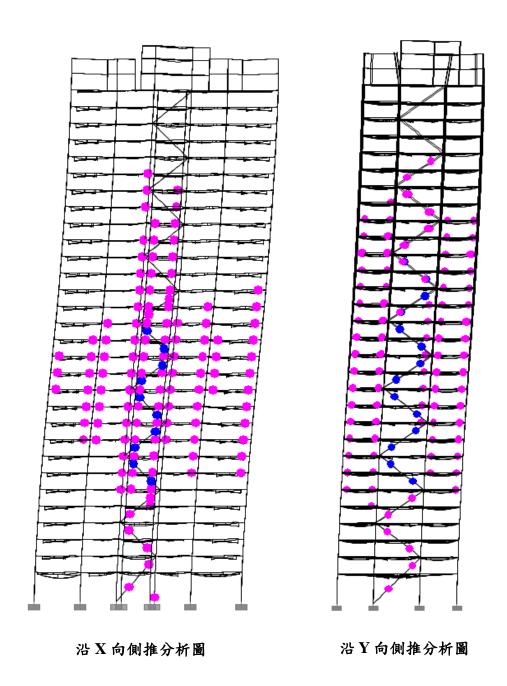
- ▶ 住宅棟
- > 強柱弱梁、無軟弱層



X向性能點基底剪力



Y向性能點基底剪力



O1 基本說明
Fundamental Introduction

02

結構線性分析

Structure Linear Analysis

03

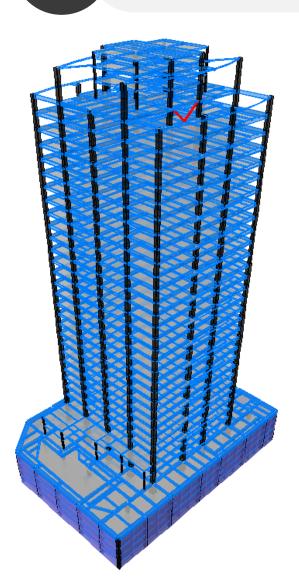
結構非線性分析

Structure Nonlinear Analysis

04

非線性有限元素分析

Nonlinear Finite Element Analysis



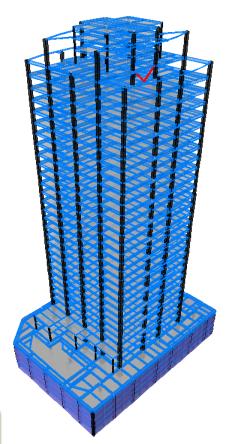
基本說明

Introduction

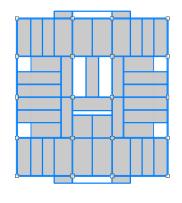
基本說明

- ▶ 新北市新莊區思源路與中原東路交叉口
- ▶ 面積為4082.58平方公尺
- ▶ 共29層樓,高99.55m

樓層	用途		
B1F~B4F	機房、停車場、水箱		
1F~2F	大廳、店鋪、景觀		
3F	一般事務所		
4F~29F	集合住宅		
RF1~RF3	屋頂、機房、水箱		



結構三維參考圖



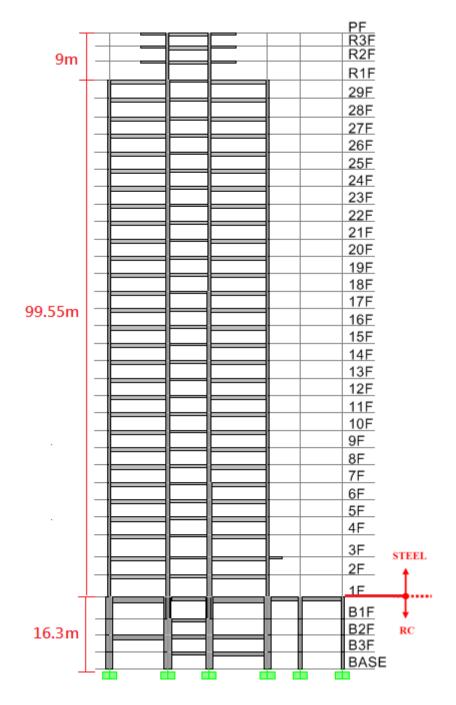
結構平面參考圖





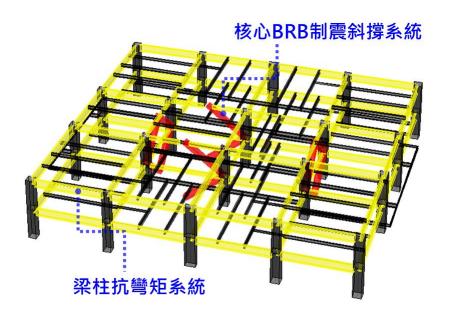
基本說明 結構系統說明

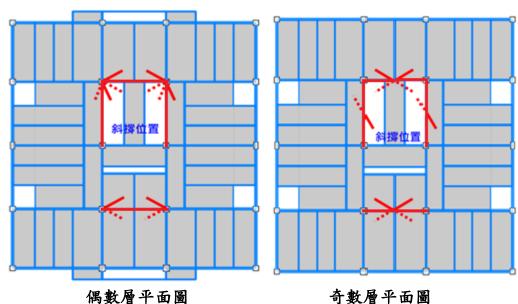
上部結構	鋼結構	
	柱牆相接處以10公分厚混凝土包覆	
	標準樓層高3.35m	
	1F高4.2m	
下部結構	鋼筋混凝土	
	B1F高4.2m	
	B2F~B4F高3.2m	



3.1.1 上部結構系統

- ▶ BRB制震斜撐
- > 梁柱韌性抗彎矩構架
- ▶ 小梁傳導垂直載重
- ▶ 15公分BARDEK樓板

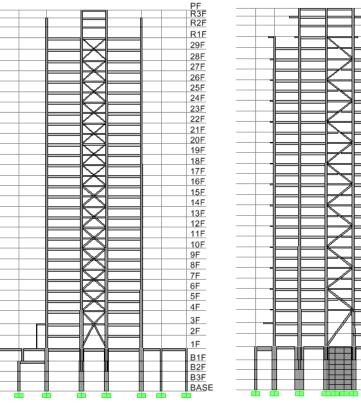




奇數層平面圖

27F

13F

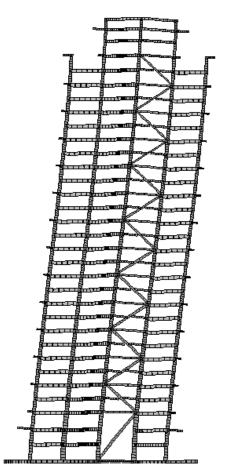


結構線性分析

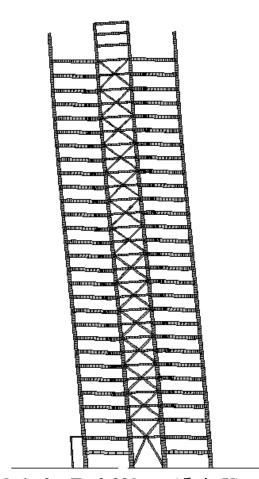
Structure Linear Analysis

結構線性分析

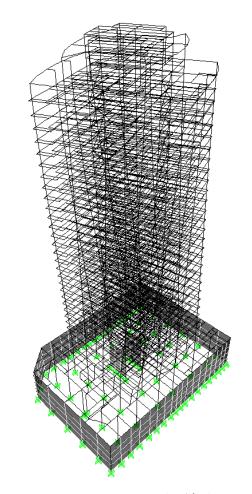
結構基本振態與週期



Mode-1: T = 3.489 sec (短向-Y)



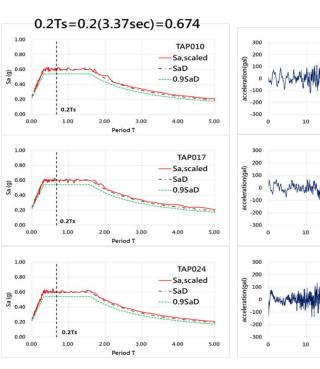
Mode-2: T= 3.389 sec (長向-X)

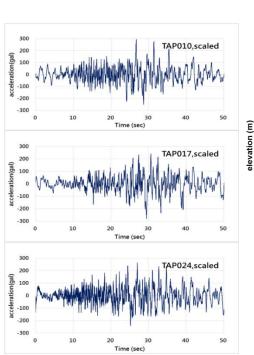


Mode-3: T= 3.241 sec (扭轉向-Rz)

結構動力歷時分析

- ▶ 採ETABS及PISA3D建模
- ▶ 三組附近測站於921地震歷時記錄
- ▶ 調整測站反應譜至與設計反應譜相符



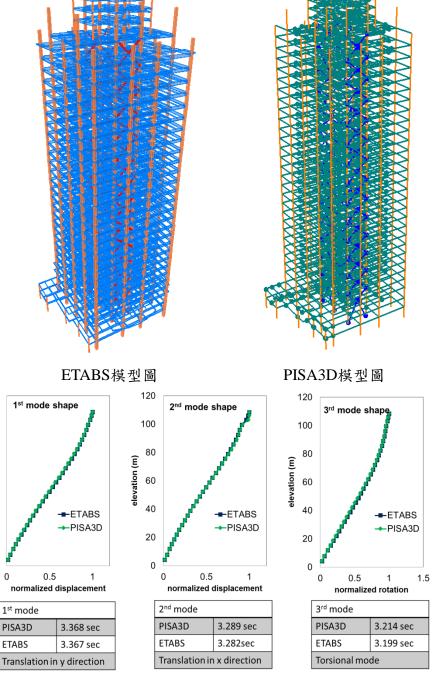


120

100

60

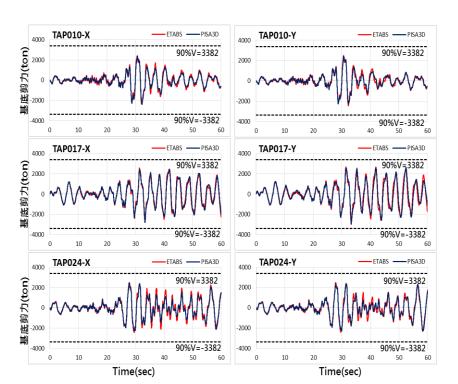
20



模型模態、週期比較圖

結構動力歷時分析

- ▶ 基底剪力歷時
- ▶ 最大基底剪力:動力 < 静力
- ► ETABS 與 PISA3D分析結果相近



歷時分析最大剪力與90%靜力分析剪力之比值

 $90\% V_{design} = 3382 ton$

		ratio X		ratio Y	
∣ т	Time History	TallO A		ratio Y	
Time History	ETABS	PISA3D	ETABS	PISA3D	
	TAP010	0.71	0.71	0.73	0.72
	TAP017	0.76	0.82	0.88	0.86
	TAP024	0.73	0.73	0.73	0.71

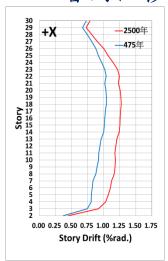
歷時分析最大剪力

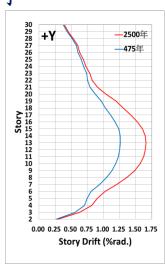
Time History	MaxBaseShear X		MaxBaseShear Y	
Tillic History	ETABS	PISA3D	ETABS	PISA3D
TAP010	2398	2415	2485	2430
TAP017	2564	2775	2977	2914
TAP024	2485	2477	2474	2386

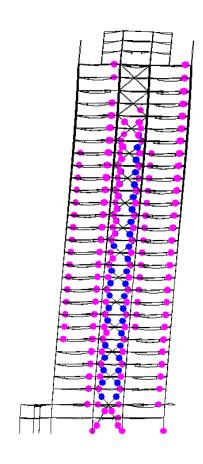
結構非線性分析

Structure Nonlinear Analysis

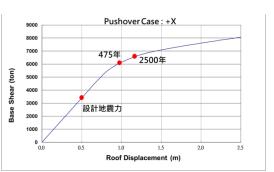
- ▶ 性能點採用ATC40-承載力譜法
- ▶ 2500年回歸期性能點
- > 檢核
 - ▶ BRB及抗彎構架的消能行為
 - > 強柱弱梁及軟弱層
 - ▶層間位移角



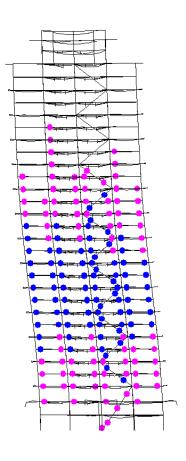




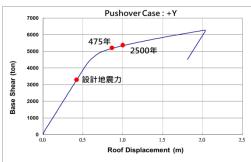
沿X向側推分析圖



X向性能點基底剪力



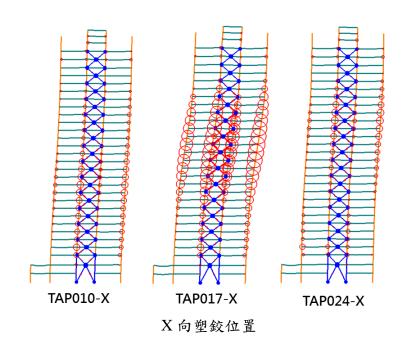
沿Y向側推分析圖

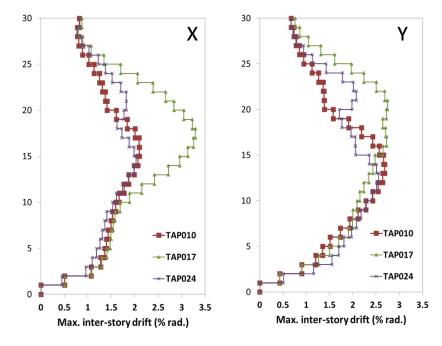


Y向性能點基底剪力

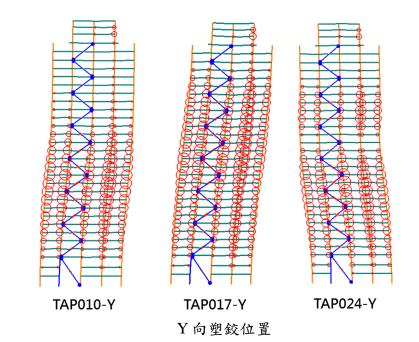
非線性動力歷時分析

- ▶ PISA3D模型輸入三地震歷時進行分析
- ▶ 歷時下之最大層間位移角
- ▶ 塑鉸發生在大梁及斜撐桿件
- ▶ 整棟結構各樓層柱皆保持彈性



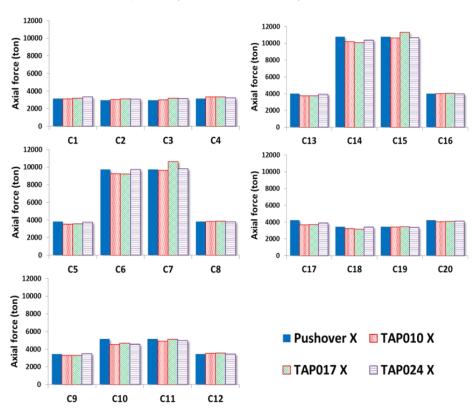


層間位移角

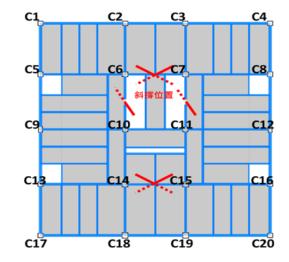


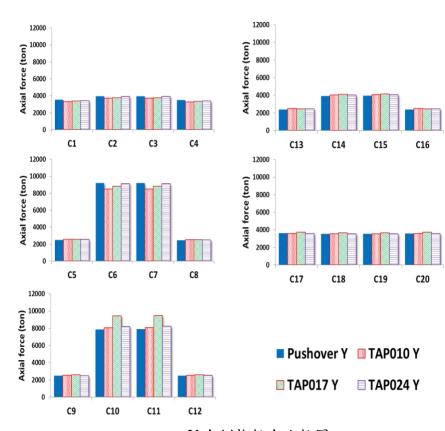
非線性動力歷時分析

- > 柱軸力
 - ▶ 2500年回歸期地震
 - ▶ 歷時分析與側推分析之比較



X向側推軸力比較圖





Y向側推軸力比較圖

THANK YOU!

CANGE |

創緯工程顧問有限公司 Chuang Wei Structural Engineering Inc.