

# 结构优化设计及弹塑性分析

**Structural Optimization Design and Nonlinear Analysis Application**

**WSP HONG KONG LTD.**

**Associate (Civil and Structural)**

**Dr. Dino Chen Xuewei**

## 主要内容

---

### 1、超高层建筑结构优化设计方法

在传统的概念设计与优化理论设计当中，提出适用于工程设计的优化思想。

### 2、基于ETABS程序进行结构优化设计

基于ETABS的二次开发，提出结构方案的快速优化设计方法  
笔者开发DINOETE结构优化设计软件，将抗震设计与优化相结合

### 3、优化设计的工程应用（深圳超高层项目为例）

以实际工程项目为例，介绍优化设计法设计结构的全过程  
主要采用DINOETE及ETABS对结构进行结构优化设计

## 主要内容

---

### 4、CSI软件的二次开发成果介绍(DinoBox)

介绍若干新型的CSI软件的二次开发成果，包括接口转换，后处理及计算工具。软件的转换功能包括：MIDAS导ETABS/SAP2000，ETABS导ANSYS,ABAQUS,PERFORM,OPENSEES，PKPM导SAFE等，全部程序集成工具箱。  
介绍DINOSEC截面分析工具及DINOETE的出图功能。

## (1)超高层建筑结构优化设计方法

### ➤传统结构优化计算方法

- (1) 传统结构分析程序本身没有具备结构优化功能  
只有ABAQUS,ANSYS或通过二次开发实现结构优化功能
- (2) 传统结构优化，是通过刚度敏感度矩阵+边界条件+优化目标，  
从而计算出最优化的结构尺寸与分布  
传统的结构优化算法，计算量大，一般只用于构件原型研究或找形
- (3) 高层建筑结构，相对约束边界多，结构自由度较大，还受到规范构件验算的  
约束。因此高层建筑结构采用最优化技术，难以应用
- (4) 参考结构最优化，提出“较优化”的方案设计方法，并在ETABS中实现。

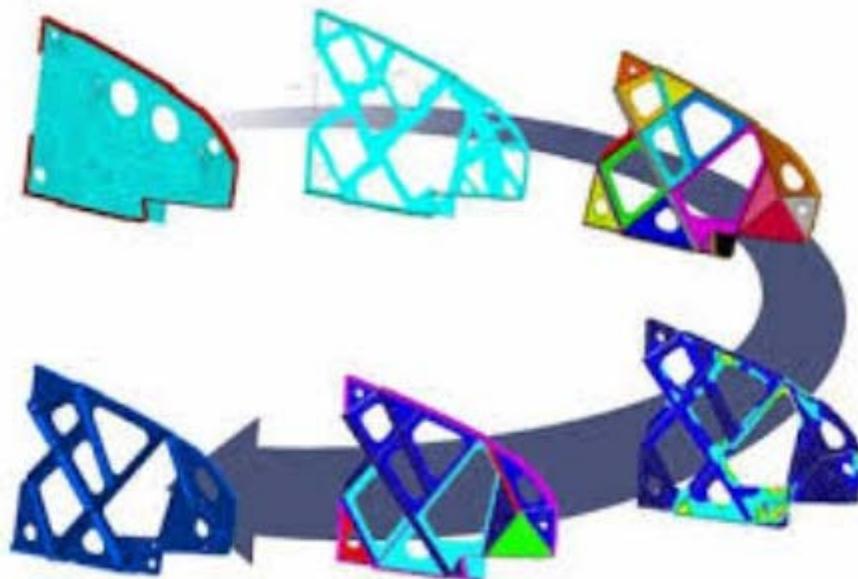


较优化设计

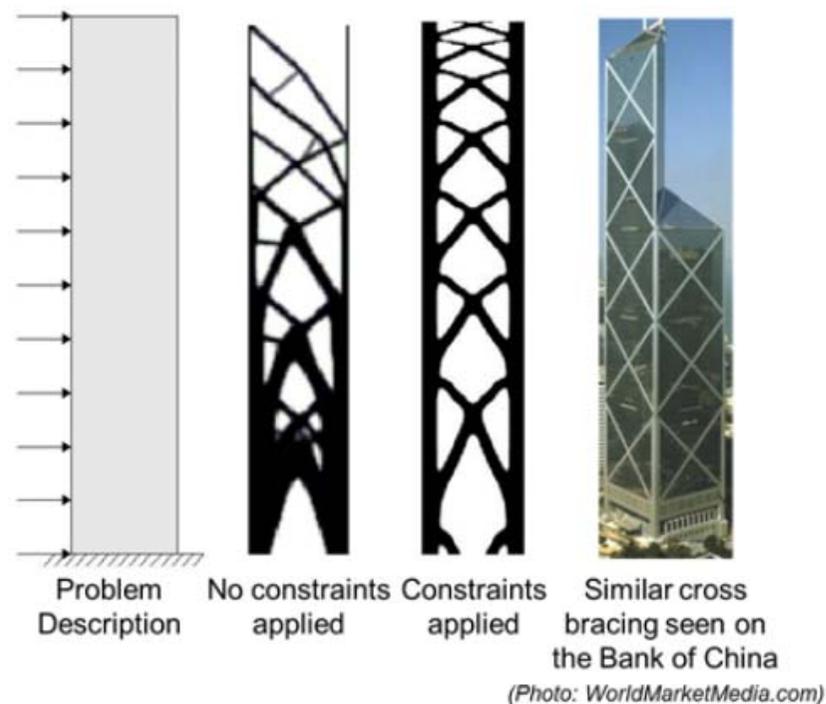


## (1)超高层建筑结构优化设计方法

### ▶传统结构优化计算方法



构件的找型  
采用拓扑优化法



高层建筑结构的原型优化  
原型（基本形态）

## (1)超高层建筑结构优化设计方法

### ➤传统结构设计方法

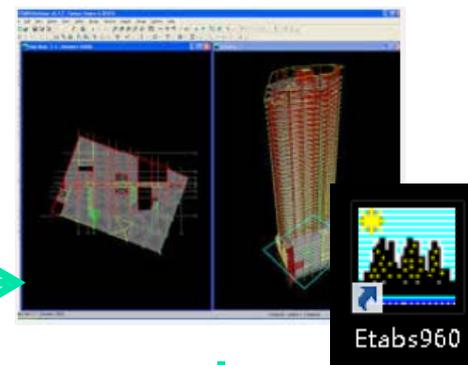


建筑师方案

结构工程师建模



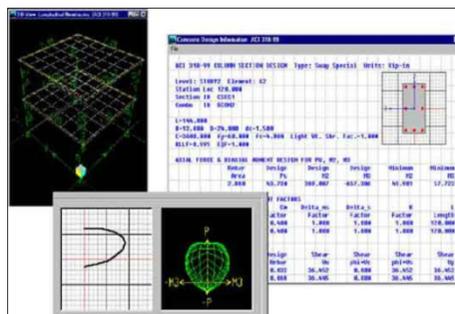
修改尺寸再建模



结构工程师根据结果判断

红色：代表需要加强

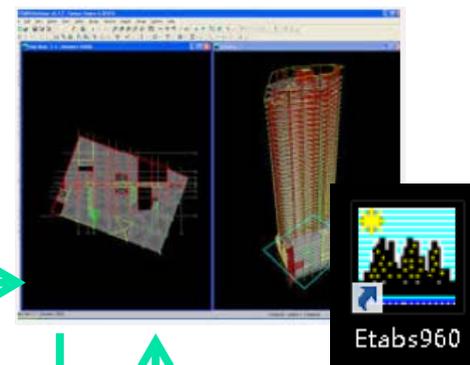
绿色：代表满足要求



## (2) 基于ETABS程序进行结构优化设计

### ► 优化结构方案设计方法

结构工程师建模



Etabs960

发送结果到  
DINOETE

根据结果重新  
建模发给ETABS

DINOETE.  
exe

DINOETE.  
exe

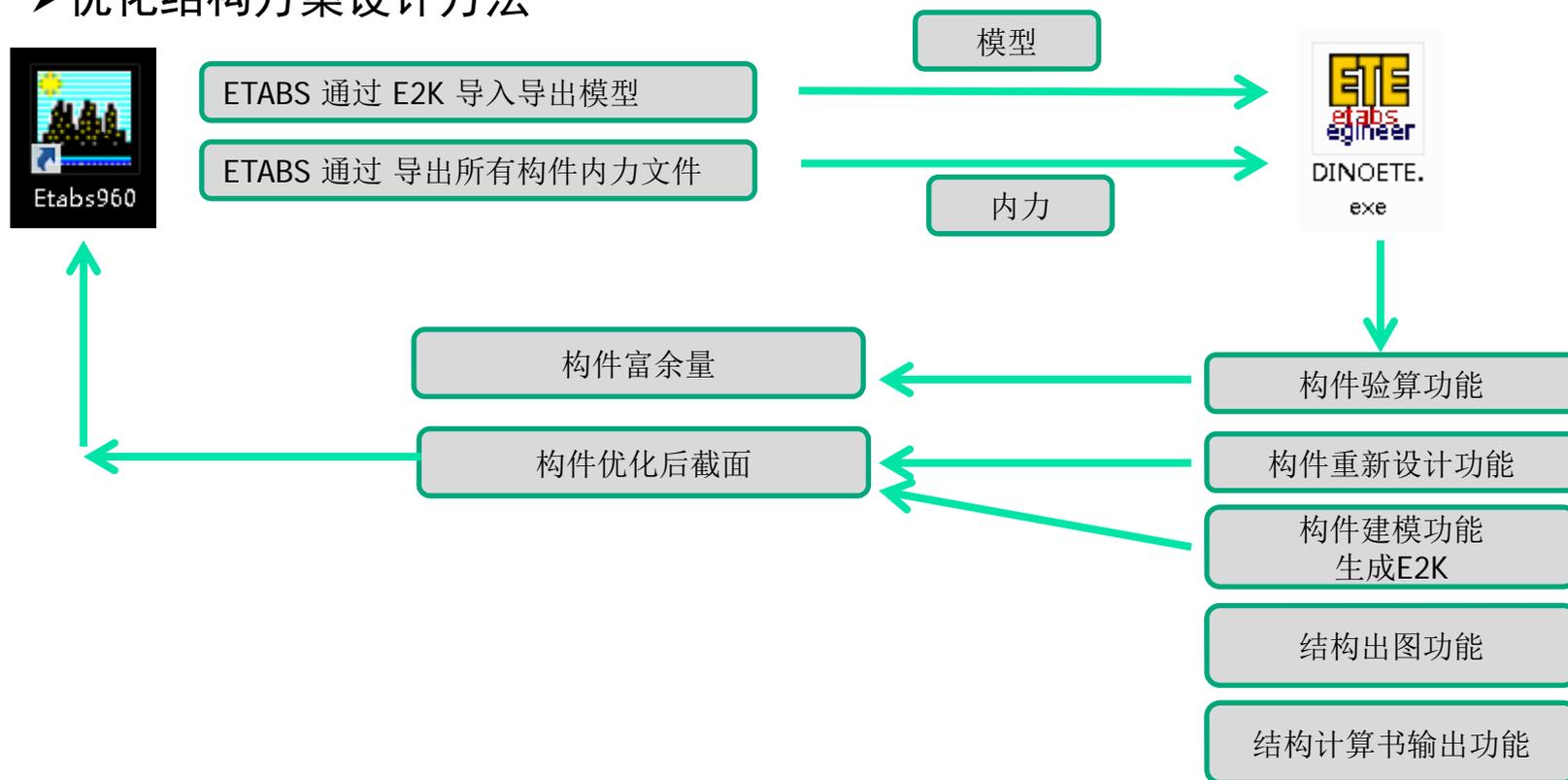
结构工程师局部归并修  
改生成最后方案

满足优化目标后生  
成ETABS模型



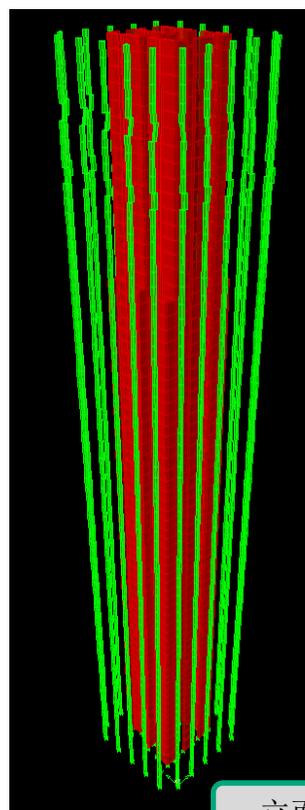
## (2) 基于ETABS程序进行结构优化设计

### ➤ 优化结构方案设计方法

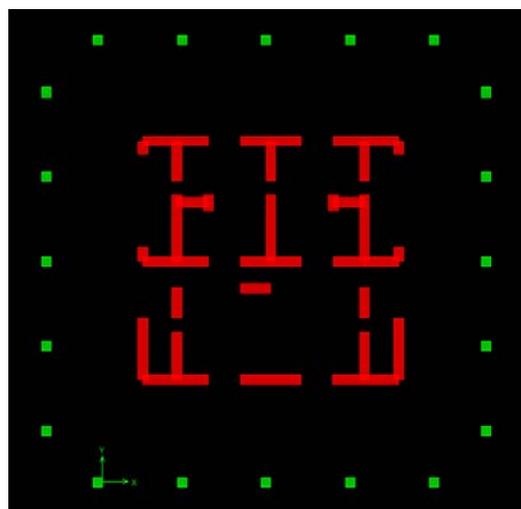


## (2) 基于ETABS程序进行结构优化设计

➤ 以外框柱的优化为例（深圳300米超高层办公楼）



立面图



平面图



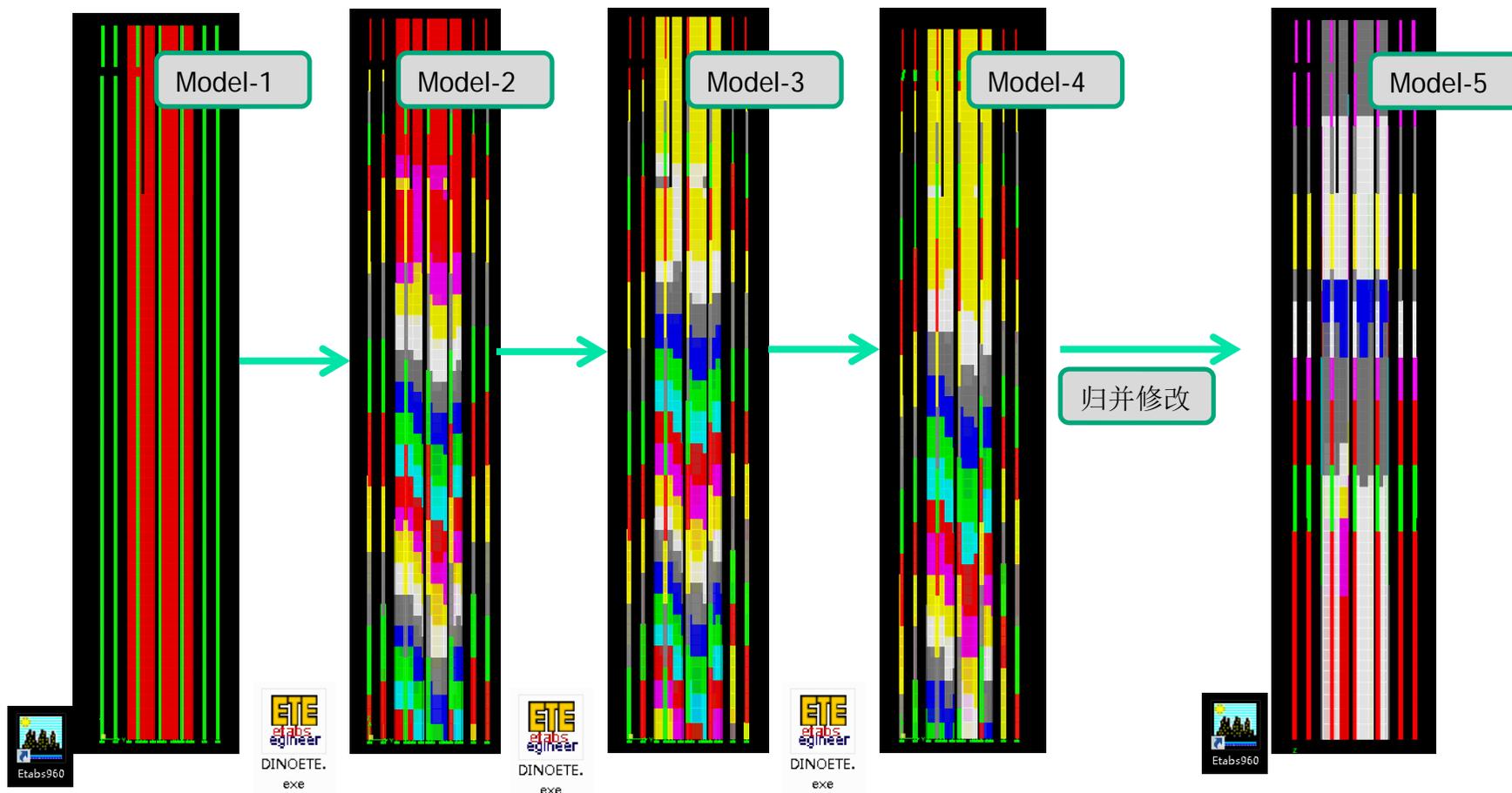
Model 1 : 初始模型  
Column: SRC 1000X1000 (4%)  
Wall: C60 W1000  
考虑风荷载与地震作用（小震）



外框柱优化目标：  
满足一级轴压比要求。

## (2) 基于ETABS程序进行结构优化设计

➤ 以外框柱的优化为例（满足轴压比要求）



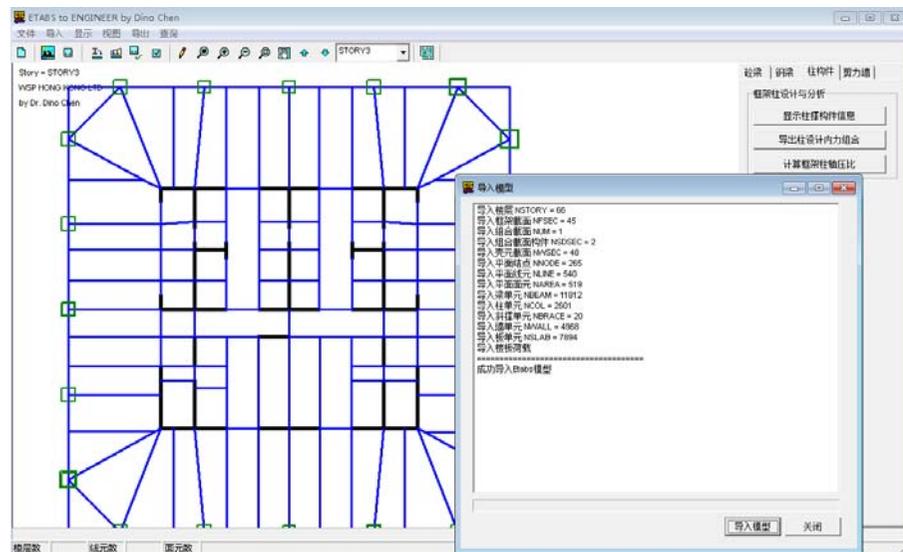
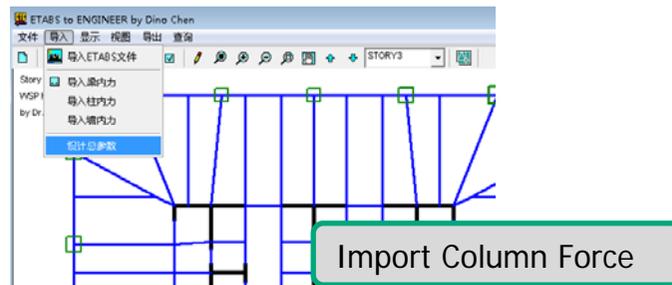
## (2) 基于ETABS程序进行结构优化设计

▶ 以外框柱的优化为例（满足轴压比要求）



Model.e2k file

Column force text file



Model e2k import to DINOETE program

### 外框柱轴压比计算及优化

组合柱优化参数设置

- 轴压比计算时钢强度 $f_a$ : 250
- 最方柱尺寸: 800
- 轴压比控制限值: 0.55
- 优化计算时混凝土强度: 60
- 优化计算时采用型钢: Q345
- 优化计算含钢率: 4.0

分析摘要

楼层	柱号	轴压比	截面宽	截面高	轴力	轴压比
STORY3	C5	30.0	40867	1300	1300	0
STORY4	C14	30.0	54377	1500	1500	0
STORY5	C12	30.0	78719	1800	1800	0
STORY6	C21	30.0	41042	1300	1300	0
STORY7	C17	30.0	47631	1400	1400	0
STORY8	C11	30.0	47052	1400	1400	0
STORY9	C5	30.0	34746	1200	1200	0
STORY10	C12	30.0	69901	1700	1700	0
STORY11	C12	30.0	68140	1700	1700	0
STORY12	C15	30.0	41049	1300	1300	0
STORY13	C18	30.0	34491	1200	1200	0
STORY14	C4	30.0	29041	1100	1100	0
STORY15	C3	30.0	34732	1200	1200	0
STORY16	C19	30.0	29002	1100	1100	0
STORY17	C19	30.0	28162	1100	1100	0
STORY18	C20	30.0	29315	1100	1100	0
STORY19	C11	30.0	34995	1200	1200	0
STORY20	C14	30.0	34877	1200	1200	0

计算轴压比 | 显示轴压比 | 优化截面 | 显示截面 | 输出截面

Compression Ratio Checking  
Section Optimization

## (2) 基于ETABS程序进行结构优化设计

▶ 以外框柱的优化为例 (满足轴压比要求)



```
COL_SECTIONS.TXT - 记事本
文件(F) 编辑(E) 格式(O) 查看(V) 帮助(H)
FRAMESECTION "RC100X100" MATERIAL "C60" SHAPE "Rectangular" D 100 B 100
FRAMESECTION "RC200X200" MATERIAL "C60" SHAPE "Rectangular" D 200 B 200
FRAMESECTION "RC300X300" MATERIAL "C60" SHAPE "Rectangular" D 300 B 300
FRAMESECTION "RC400X400" MATERIAL "C60" SHAPE "Rectangular" D 400 B 400
FRAMESECTION "RC500X500" MATERIAL "C60" SHAPE "Rectangular" D 500 B 500
FRAMESECTION "RC600X600" MATERIAL "C60" SHAPE "Rectangular" D 600 B 600
FRAMESECTION "RC700X700" MATERIAL "C60" SHAPE "Rectangular" D 700 B 700
FRAMESECTION "RC800X800" MATERIAL "C60" SHAPE "Rectangular" D 800 B 800
FRAMESECTION "RC900X900" MATERIAL "C60" SHAPE "Rectangular" D 900 B 900
FRAMESECTION "RC1000X1000" MATERIAL "C60" SHAPE "Rectangular" D 1000 B 1000
FRAMESECTION "RC1100X1100" MATERIAL "C60" SHAPE "Rectangular" D 1100 B 1100
FRAMESECTION "RC1200X1200" MATERIAL "C60" SHAPE "Rectangular" D 1200 B 1200
FRAMESECTION "RC1300X1300" MATERIAL "C60" SHAPE "Rectangular" D 1300 B 1300
FRAMESECTION "RC1400X1400" MATERIAL "C60" SHAPE "Rectangular" D 1400 B 1400
FRAMESECTION "RC1500X1500" MATERIAL "C60" SHAPE "Rectangular" D 1500 B 1500
FRAMESECTION "RC1600X1600" MATERIAL "C60" SHAPE "Rectangular" D 1600 B 1600
FRAMESECTION "RC1700X1700" MATERIAL "C60" SHAPE "Rectangular" D 1700 B 1700
FRAMESECTION "RC1800X1800" MATERIAL "C60" SHAPE "Rectangular" D 1800 B 1800
FRAMESECTION "RC1900X1900" MATERIAL "C60" SHAPE "Rectangular" D 1900 B 1900
```

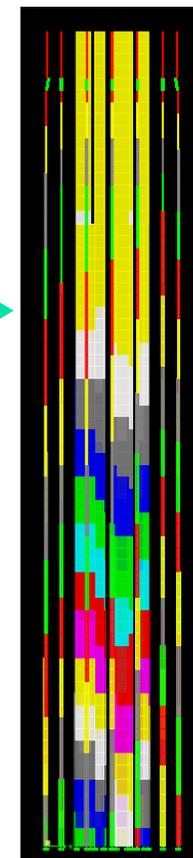
Column Section properties

```
COL_DESIGN_SEC.TXT - 记事本
文件(F) 编辑(E) 格式(O) 查看(V) 帮助(H)
LINEASSIGN "C7" "STORY54" SECTION "RC600X600" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C8" "STORY54" SECTION "RC600X600" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C9" "STORY54" SECTION "RC500X300" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C10" "STORY54" SECTION "RC600X600" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C11" "STORY54" SECTION "RC600X600" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C2" "STORY54" SECTION "RC700X700" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C3" "STORY54" SECTION "RC600X600" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C4" "STORY54" SECTION "RC500X300" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C5" "STORY54" SECTION "RC600X600" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C6" "STORY54" SECTION "RC600X600" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C12" "STORY54" SECTION "RC800X800" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C17" "STORY54" SECTION "RC700X700" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C13" "STORY54" SECTION "RC700X700" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C18" "STORY54" SECTION "RC600X600" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C14" "STORY54" SECTION "RC700X700" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C19" "STORY54" SECTION "RC700X700" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C15" "STORY54" SECTION "RC700X700" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C20" "STORY54" SECTION "RC700X700" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C16" "STORY54" SECTION "RC700X700" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C21" "STORY54" SECTION "RC700X700" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C7" "STORY63" SECTION "RC400X400" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C8" "STORY63" SECTION "RC400X400" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C9" "STORY63" SECTION "RC400X400" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C10" "STORY63" SECTION "RC400X400" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C11" "STORY63" SECTION "RC400X400" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
LINEASSIGN "C2" "STORY63" SECTION "RC400X400" ANG 0 MINNUMSTA 3 CARDINALPT 8 MESH "POINTSANDLINES"
```

Frame section Assign



model8.e2k



## (2) 基于ETABS程序进行结构优化设计



(1) 快速结构分析：结构分析与构件验算功能分开

(2) 可通过文本导入结构模型

(3) 允许局部修改文本导入模型进行修改

(4) 分析后可输出结构内力计算结果



(1) 外框柱采用按轴压比优化尺寸

(2) 外框梁采用弯矩优化尺寸

(3) 剪力墙构件采用轴压比优化尺寸

(4) 型钢混凝土柱采用PMM包络法快速设计

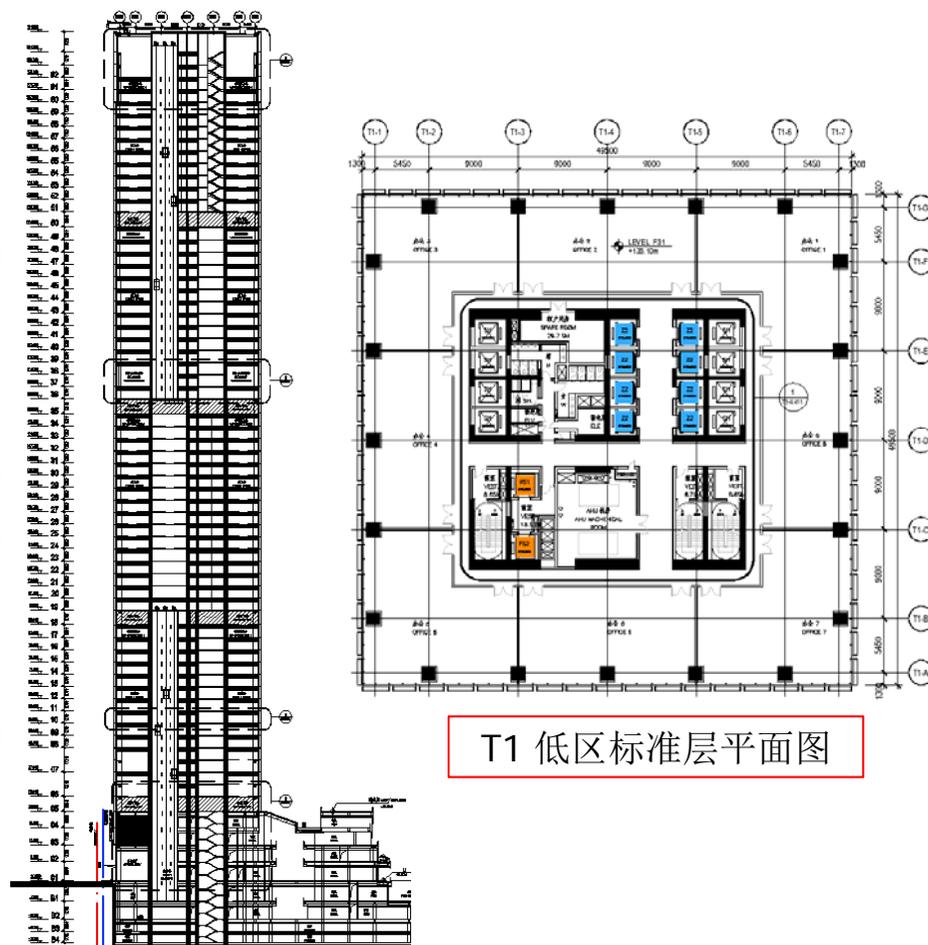
结构优化方法

适用于6/7度区

风控为主的超高层

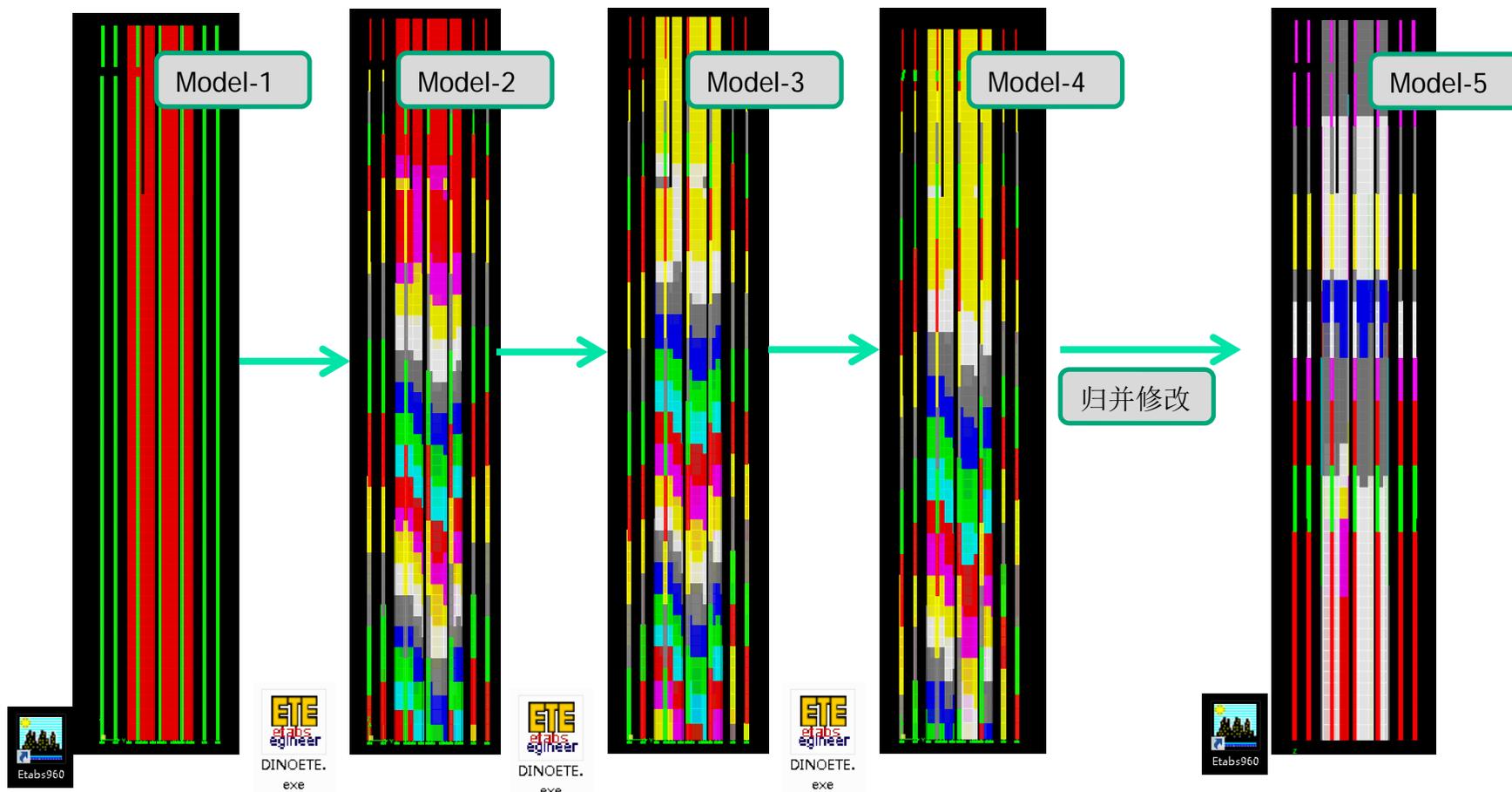
## (2) 优化设计的工程应用

► 深圳某超高层办公楼 (T1 300m)

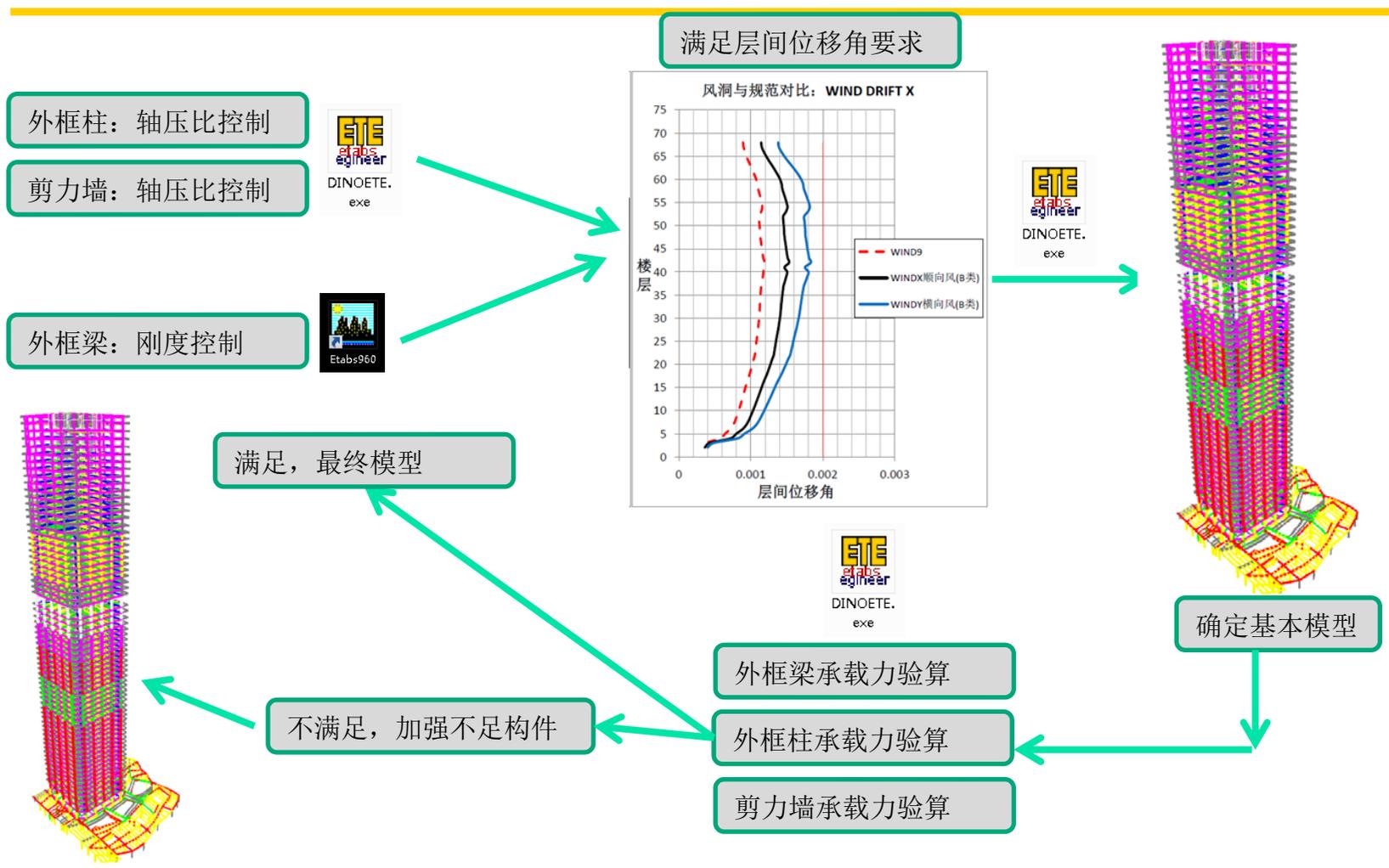


T1 低区标准层平面图

## ➤ 深圳某超高层办公楼 (T1 300m)

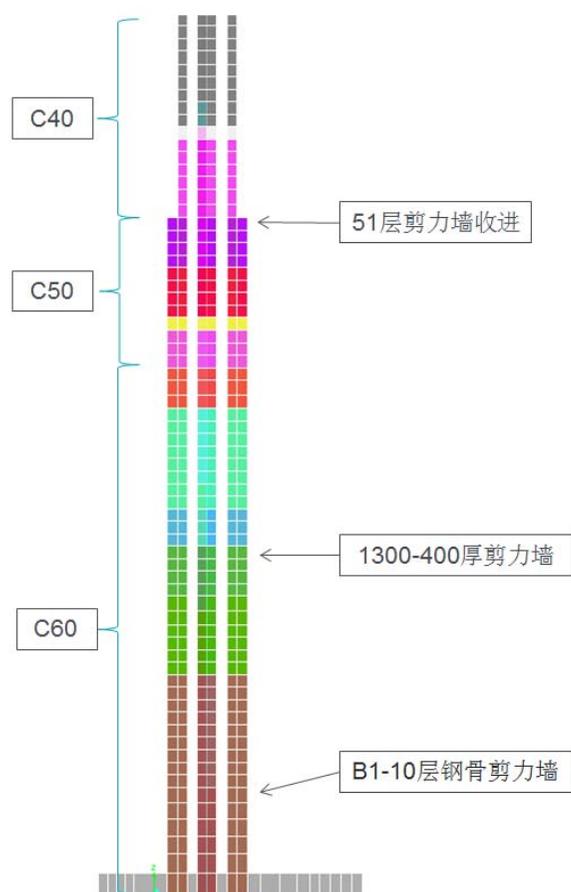


#### 深圳某超高层办公楼 (T1 300m)

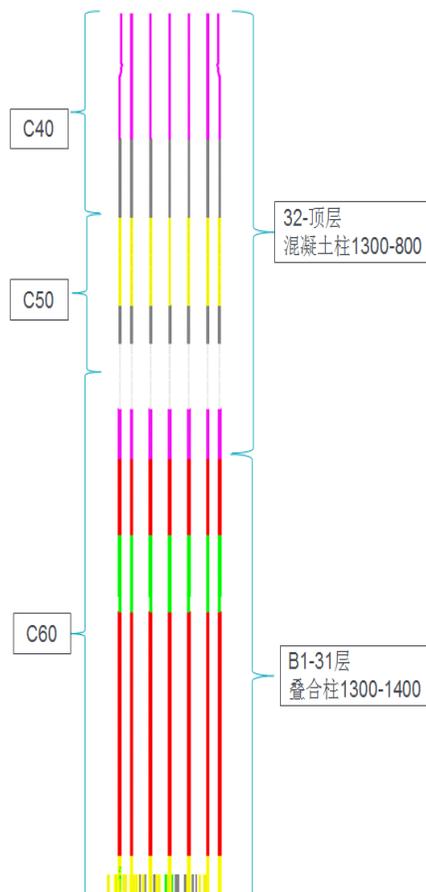


## 深圳某超高层办公楼 (T1 300m)

结构剪力墙立面布置方案



典型结构剪力墙及钢骨布置方案



62/F-Roof	C40	砼柱	800x800	
61/F	C40	砼柱	800x1300	
57/F-60/F	C40	砼柱	800x800	
51/F-56/F	C40	砼柱	900x900	
46/F-50/F	C50	砼柱	1000x1000	
42/F-45/F	C50	砼柱	1100x1100	
41/F	C60	砼柱	1100x1100	
36/F-40/F	C60	砼柱	1200x1200	
32/F-35/F	C60	砼柱	1300x1300	
26/F-31/F	C60	叠合柱	1300x1300 D900x12	1.98%
20/F-25/F	C60	叠合柱	1300x1300 D900x25	4.06%
2/F-19/F	C60	叠合柱	1400x1400 D1000x28	4.36%
B1/F-1/F	C60	叠合柱	1400x1400 D1000x30	4.66%
B4/F-B2/F	C60	叠合柱	1500x1500 D1100x40	5.92%
层号	混凝土等级		KZ1	含钢率

57/F-Roof	C40	400	400	400	400	400
54/F-56/F	C40	500	400	400	400	400
51/F-53/F	C40	600	400	400	400	400
47/F-50/F	C50	600	400	400	400	500
42/F-46/F	C50	700	400	400	500	600
39/F-41/F	C60	800	400	400	500	600
36/F-38/F	C60	900	400	400	500	600
30/F-35/F	C60	1000	500	500	600	700
28/F-29/F	C60	1000	500	500	700	700
25/F-27/F	C60	1000	500	600	700	800
24/F	C60	1100	500	600	800	800
21/F-23/F	C60	1100	600	700	800	800
20/F	C60	1100	600	800	800	900
14/F-19/F	C60	1100	600	800	900	900
B1/F-13/F	C60	1300	600	900	900	900
B4/F-B2/F	C60	1400	600	900	900	900
层号	混凝土等级	W1	W2	W3	W4	W6

(1) 结构重量 18kN/m<sup>2</sup>

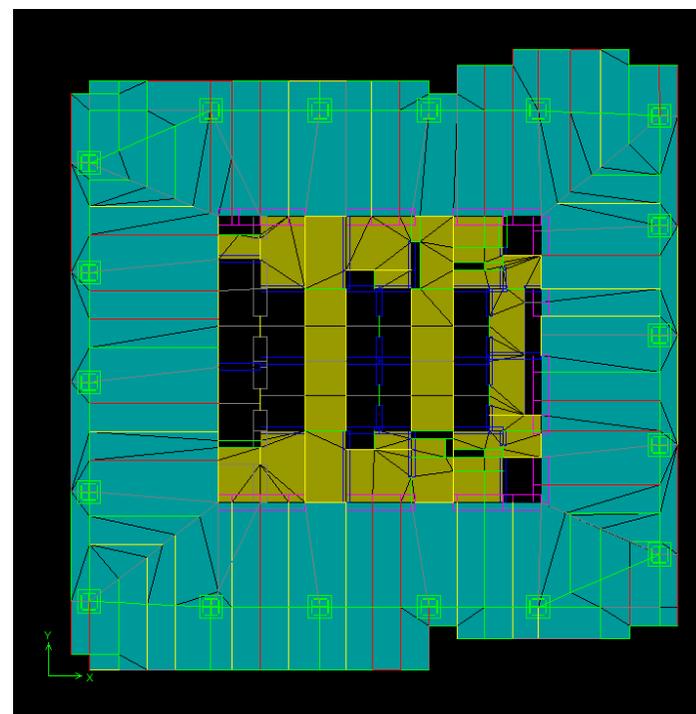
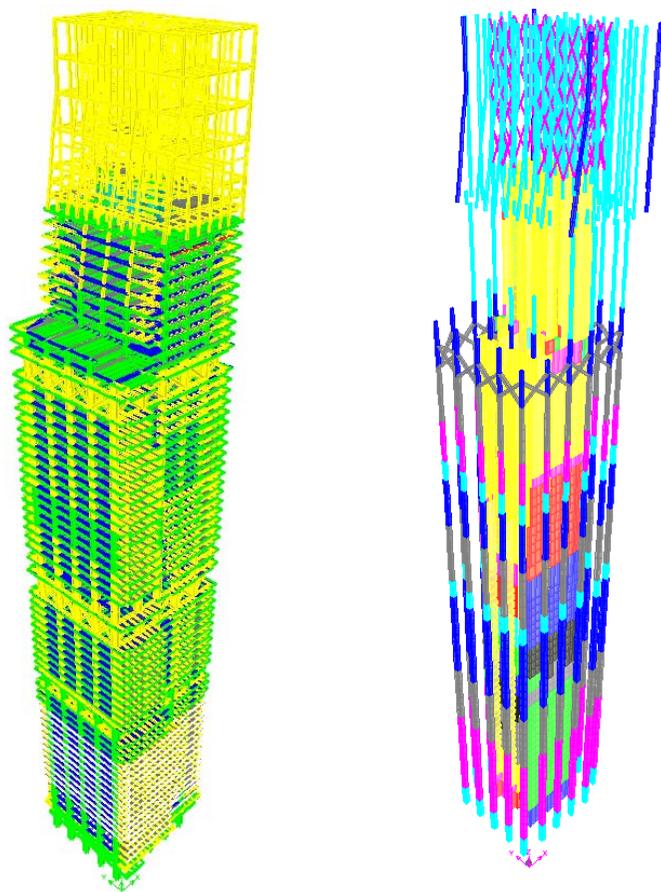
(2) 型钢混凝土钢骨控制在 4%~5%

(3) 10层以下采用钢骨剪力墙构件

(4) 无加强层，满足层间位移角要求

## (2) 优化设计的工程应用

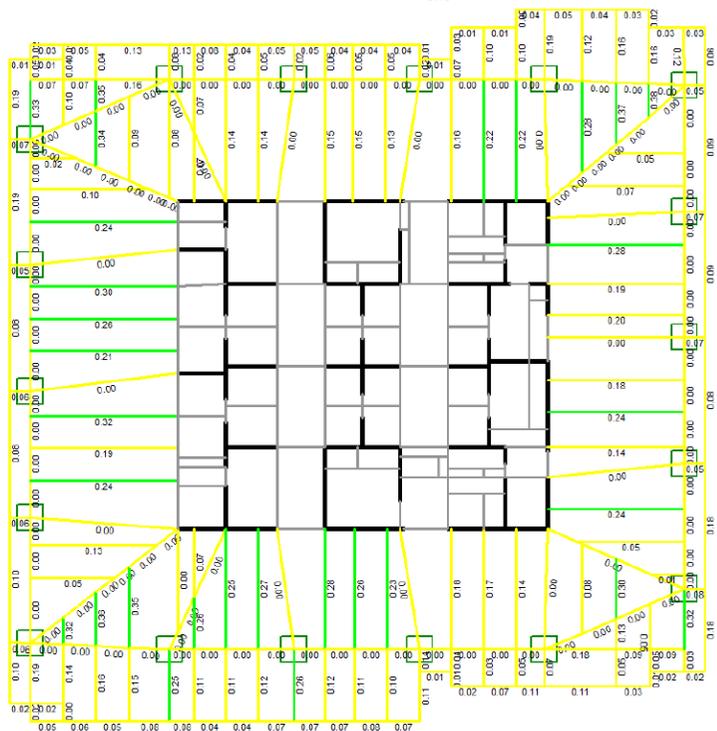
➤ 某项目结构优化工程（8度区），钢结构楼板系统楼面钢梁优化



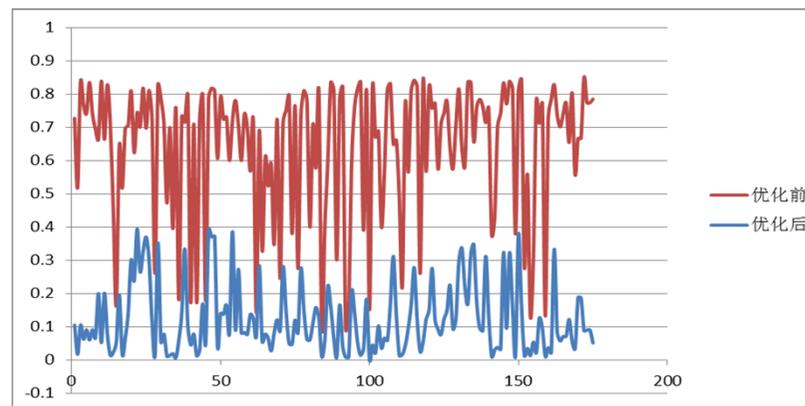
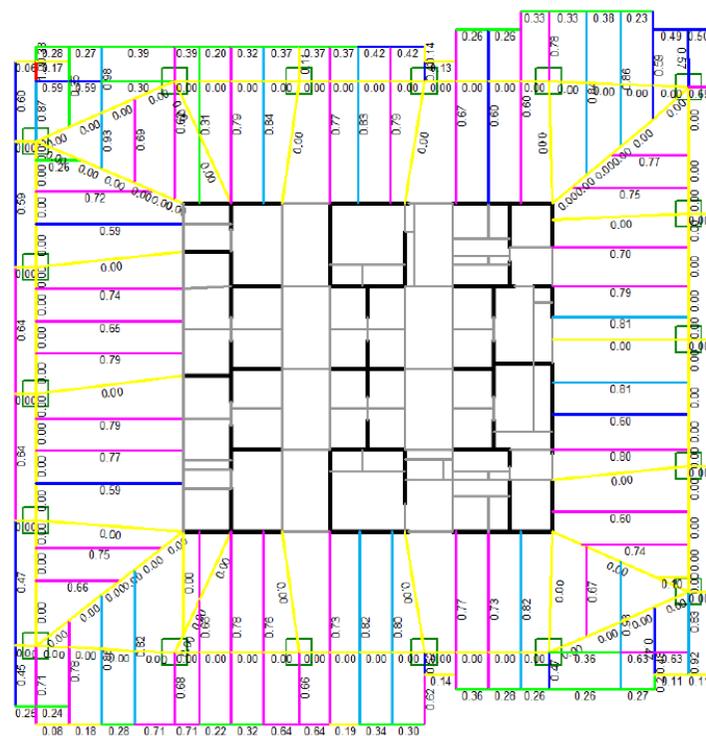
标准层平面

#### 深圳某超高层办公楼 (T1 300m)

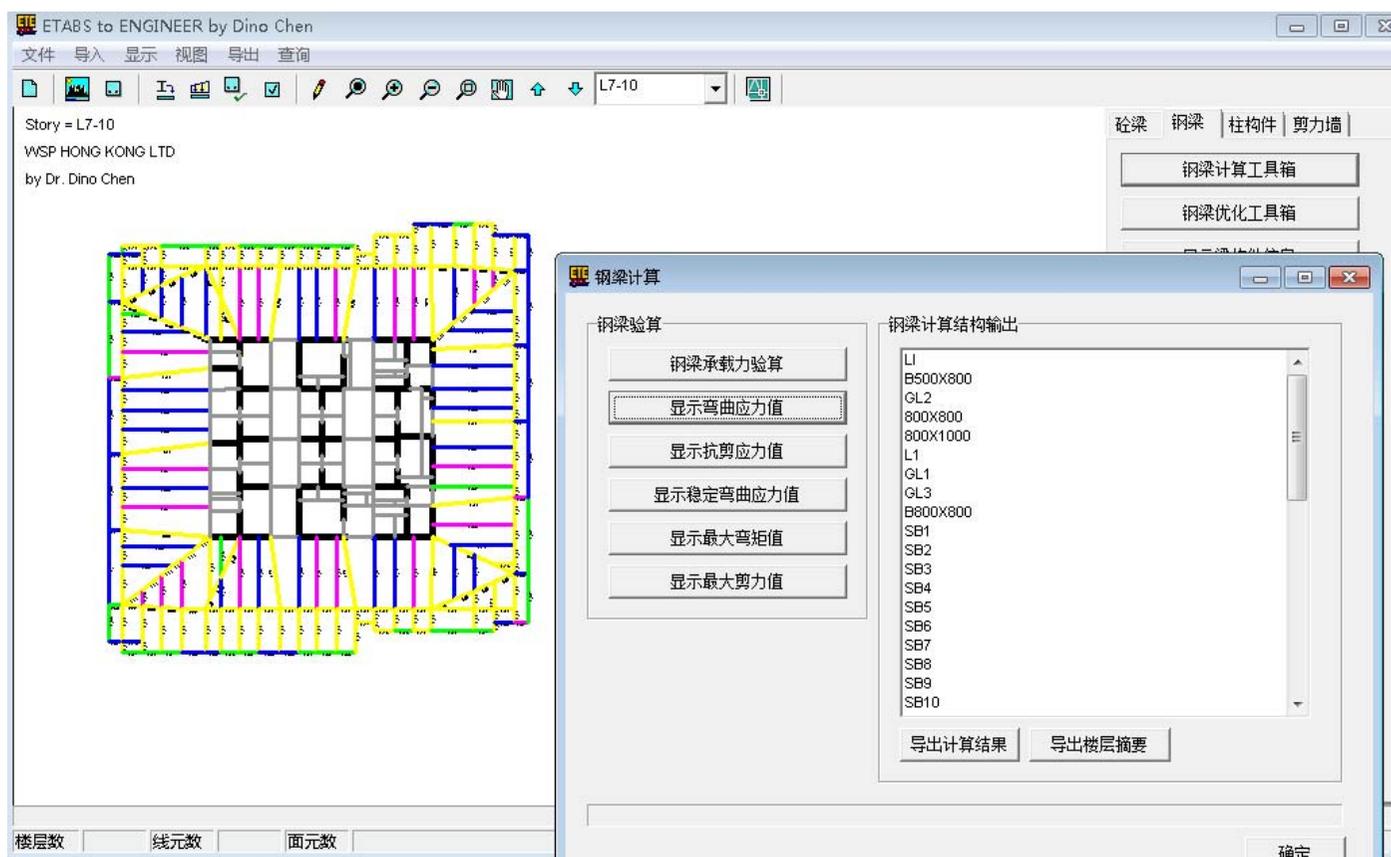
楼面钢梁：弯曲应力控制



优化前



## (2) 优化设计的工程应用



钢梁承载力验算（抗弯，抗剪，弯曲稳定）

## (3) 优化设计的工程应用



ETABS to ENGINEER by Dino Chen

文件 导入 显示 视图 导出 查询

Story = L7-10  
WSP HONG KONG LTD  
by Dr. Dino Chen

自动配置钢梁截面

需要优化的截面标识字符 SB

NUM	SEC NAME	Moment(kNm)
1	SB1	61.8
2	SB2	65.3
3	SB3	80.9
4	SB4	85.1
5	SB5	104.8
6	SB6	110.2
7	SB7	132.6
8	SB8	139.5
9	SB9	180.6
10	SB10	189.6
11	SB11	198.5
12	SB12	228.8
13	SB13	240.1

弯矩值统计  
最大弯矩 5305.04  
统计弯矩

截面优化操作  
显示优化截面  
输出优化截面文本E2K

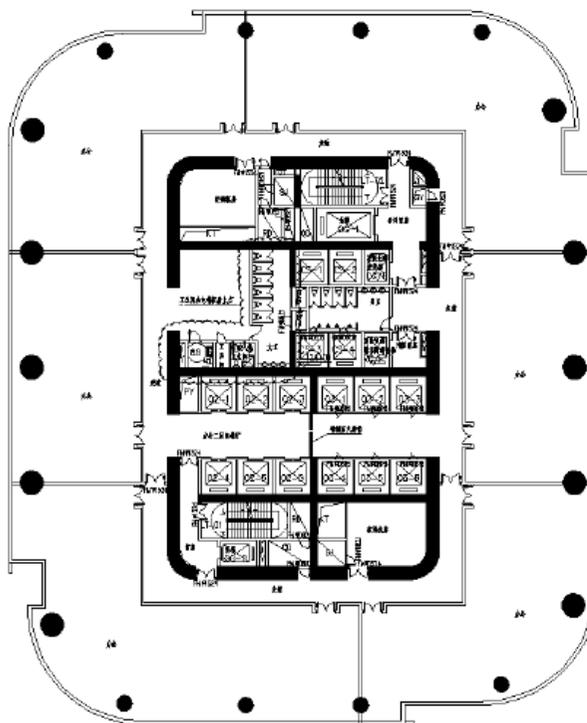
读取钢梁截面库 自动截面

楼层数 线元数 面元数

钢梁验算后进行截面配对

## (3) 优化设计的工程应用

► 深圳某超高层综合楼 (h= 380m)

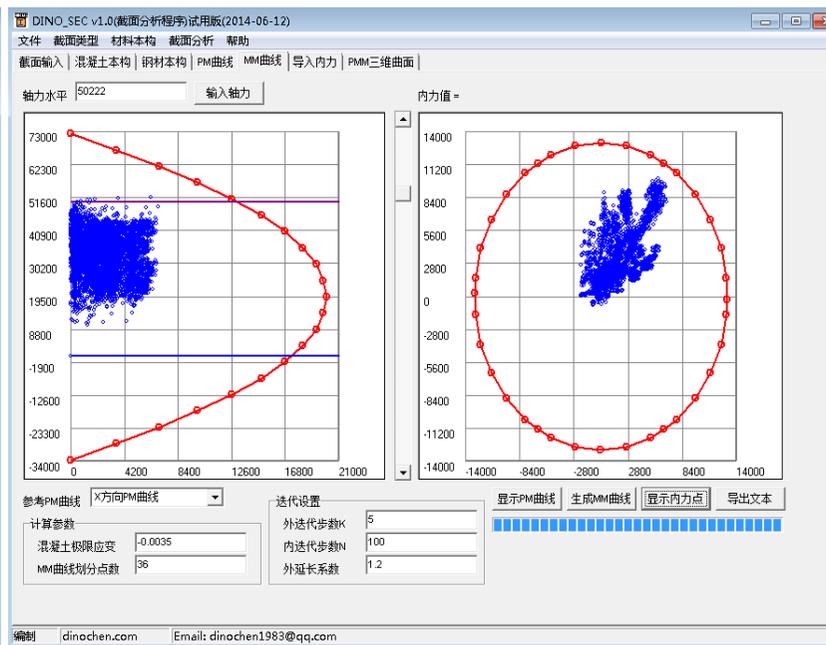
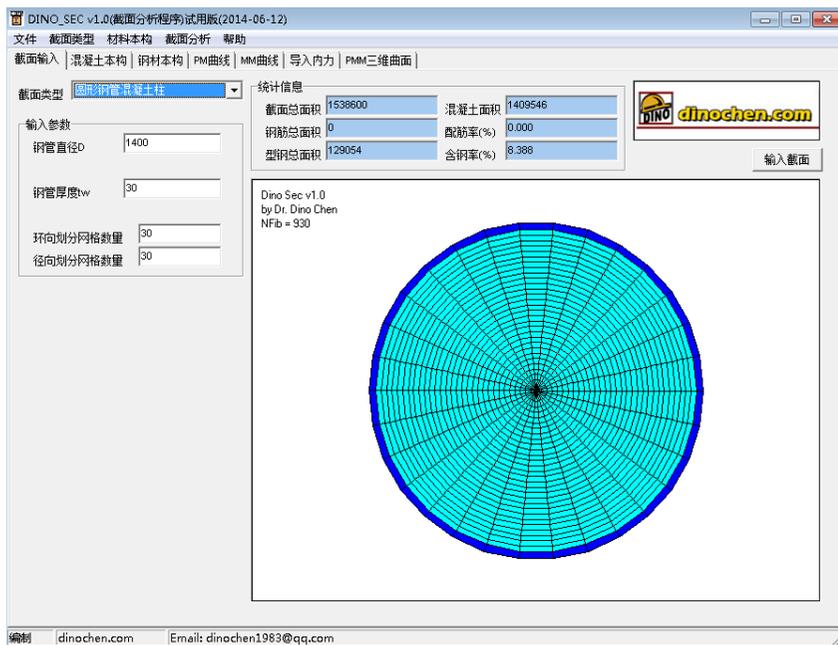


低区标准层平面图



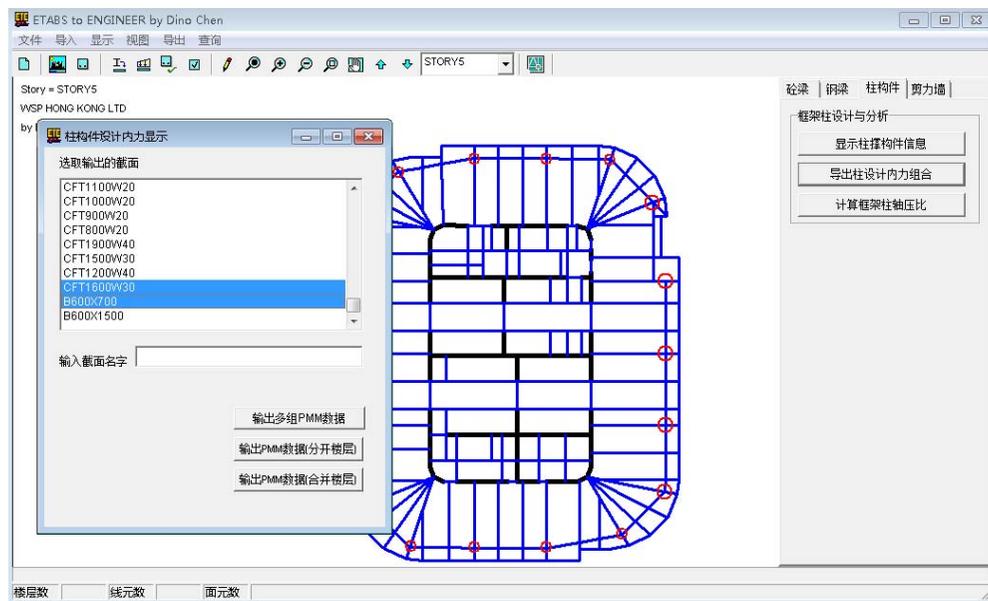
## (3) 优化设计的工程应用

快速PMM验算与外框柱设计



## (3) 优化设计的工程应用

### 快速PMM验算与外框柱设计



CFT850W15C50.TXT - 记事本

文件(F)	编辑(E)	格式(O)	查看(V)	帮助(H)
STORY 57, D173, COMB117, -4829.9, 623.0, 67.6,				
STORY 57, D173, COMB118, -4774.5, 732.4, 87.8,				
STORY 57, D173, COMB119, -4387.7, 645.0, 69.5,				
STORY 57, D173, COMB120, -4572.6, 853.1, 90.8,				
STORY 57, D173, COMB121, -4589.7, 524.3, 66.5,				
STORY 57, D173, COMB122, -4566.5, 836.9, 89.6,				
STORY 57, D173, COMB123, -4595.7, 540.5, 67.7,				
STORY 57, D173, COMB124, -6053.1, 754.4, 89.8,				
STORY 57, D173, COMB125, -6550.6, 623.0, 67.6,				
STORY 57, D173, COMB126, -6495.3, 732.4, 87.8,				
STORY 57, D173, COMB127, -6108.4, 645.0, 69.5,				
STORY 57, D173, COMB128, -6293.3, 853.1, 90.8,				
STORY 57, D173, COMB129, -6310.4, 524.3, 66.5,				
STORY 57, D173, COMB130, -6287.3, 836.9, 89.6,				
STORY 57, D173, COMB131, -6316.5, 540.5, 67.7,				
STORY 57, D4541, COMB1, -11033.6, 303.7, 195.1,				
STORY 57, D4541, COMB2, -10927.6, 288.8, 193.7,				
STORY 57, D4541, COMB3, -9600.5, 249.0, 170.4,				
STORY 57, D4541, COMB4, -9403.4, 577.4, 367.4,				
STORY 57, D4541, COMB5, -6522.3, -99.7, -87.4,				
STORY 57, D4541, COMB6, -6872.9, 376.8, 309.8,				
STORY 57, D4541, COMB7, -9052.8, 100.8, -29.8,				
STORY 57, D4541, COMB8, -7935.1, 708.2, 166.7,				
STORY 57, D4541, COMB9, -7990.6, -230.6, 113.3,				
STORY 57, D4541, COMB10, -8167.6, 841.5, 184.1,				
STORY 57, D4541, COMB11, -7758.1, -363.9, 95.8,				
STORY 57, D4541, COMB12, -8076.2, 537.6, 344.0,				
STORY 57, D4541, COMB13, -5195.2, -139.5, -110.7,				
STORY 57, D4541, COMB14, -5545.8, 337.0, 286.5,				
STORY 57, D4541, COMB15, -7725.7, 61.0, -53.2,				
STORY 57, D4541, COMB16, -6608.0, 668.4, 143.3,				
STORY 57, D4541, COMB17, -6663.5, -270.4, 90.0,				
STORY 57, D4541, COMB18, -6840.5, 801.7, 160.8,				
STORY 57, D4541, COMB19, -6431.0, -403.7, 72.5,				
STORY 57, D4541, COMB20, -11791.9, 492.0, 330.2,				
STORY 57, D4541, COMB21, -10063.3, 85.7, 57.3,				
STORY 57, D4541, COMB22, -10273.6, 371.7, 295.6,				



## (3) 优化设计的工程应用

### 快速PMM验算与外框柱设计

DINO\_SEC v1.0(截面分析程序)试用版(2014-06-12)

文件 截面类型 材料本构 截面分析 帮助

截面输入 | 混凝土本构 | 钢材本构 | PM曲线 | MM曲线 | 导入内力 | PMM三维曲面

内力放大系数

轴力P	读取列数	放大倍数
4		1.0
5		1.0
6		1.0

输入参数

Case	P	Mx	My
Nj,max	36548	954	652
Nj,min	0	0	0
Mx,max	21101	5219	1428
Mx,min	17532	3160	2633

统计内力数据

导入内力组合的总数量 = 23580

STORY	COL_MARK	LOOMB	P	M2	M3
STORY21	D54	COMB1	-25824.8	278.6	69.4
STORY21	D54	COMB2	-24804.7	276.9	65.5
STORY21	D54	COMB3	-21486.5	243.6	56.3
STORY21	D54	COMB4	-13247.1	856.0	168.4
STORY21	D54	COMB5	-26571.5	-457.1	-57.8
STORY21	D54	COMB6	-24752.5	646.9	136.4
STORY21	D54	COMB7	-15066.1	-247.9	-25.8
STORY21	D54	COMB8	-18737.8	1849.2	65.5
STORY21	D54	COMB9	-21080.8	-1450.2	45.1
STORY21	D54	COMB10	-20376.0	1716.9	78.0
STORY21	D54	COMB11	-19442.6	-1317.9	32.6
STORY21	D54	COMB12	-9928.9	822.8	159.2
STORY21	D54	COMB13	-23253.3	-490.3	-67.0
STORY21	D54	COMB14	-21434.3	613.6	127.2
STORY21	D54	COMB15	-11747.9	-281.2	-35.0

编制 dinochen.com Email: dinochen1983@qq.com

DINO\_SEC v1.0(截面分析程序)试用版(2014-06-12)

文件 截面类型 材料本构 截面分析 帮助

截面输入 | 混凝土本构 | 钢材本构 | PM曲线 | MM曲线 | 导入内力 | PMM三维曲面

X方向PM曲线(角度=0度) P = -10274, MX = 11667

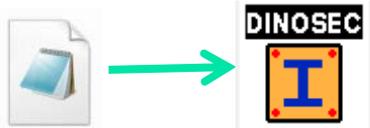
Y方向PM曲线(角度=90度) P = 8564, MY = 2257

计算参数

混凝土极限应变	-0.0035	迭代设置	外迭代步数K	5
轴力划分点数	10	内迭代步数N	100	
		外延长系数	1.2	

绘制PM 显示内力点 导出文本

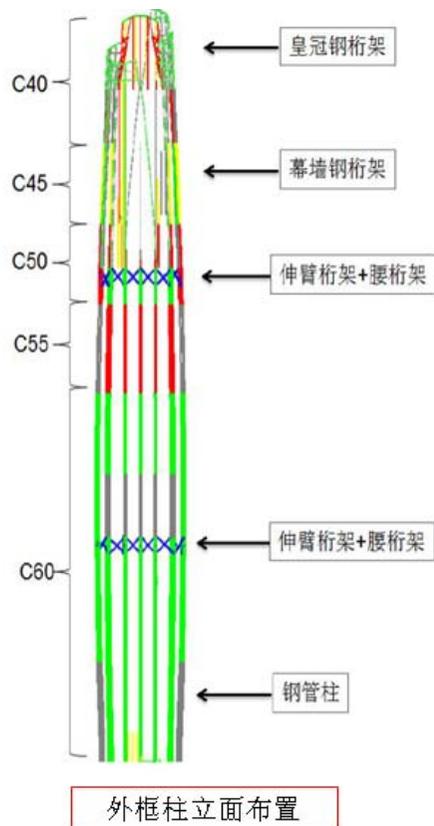
编制 dinochen.com Email: dinochen1983@qq.com



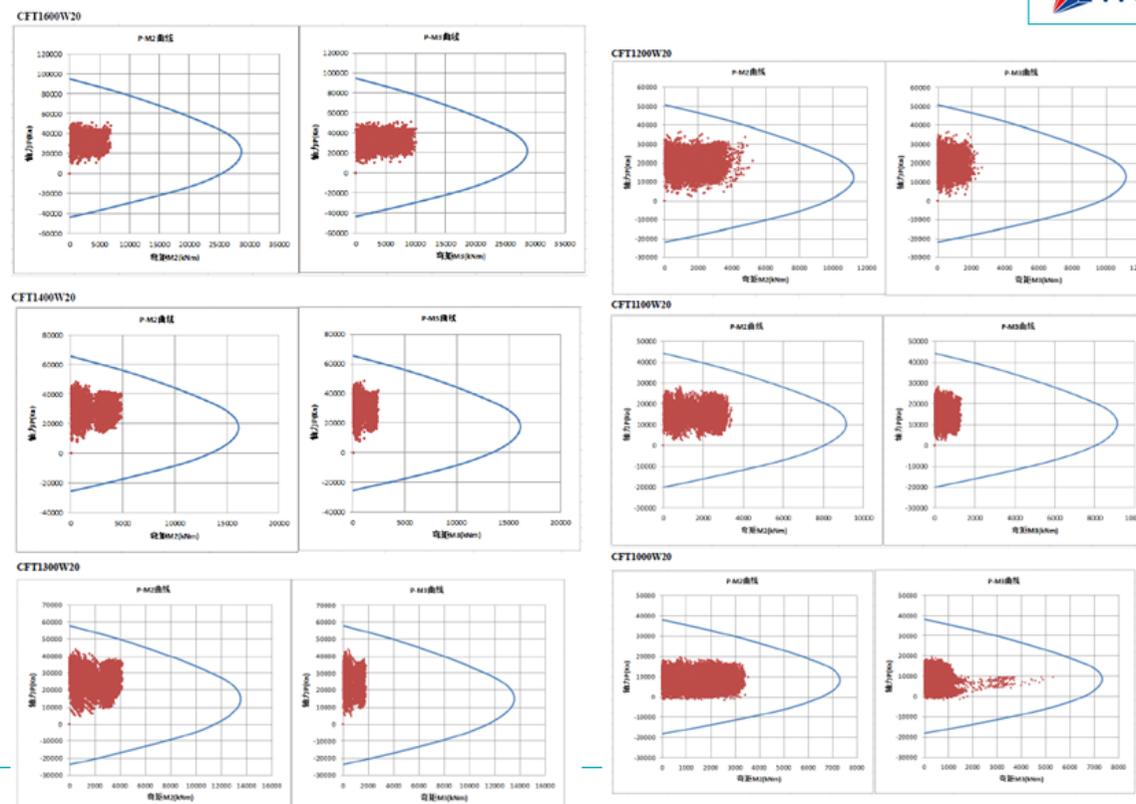
## (3) 优化设计的工程应用

快速PMM验算与外框柱设计

### 柱验算 Column PMM Checking



(D). X方向外框柱抗弯验算



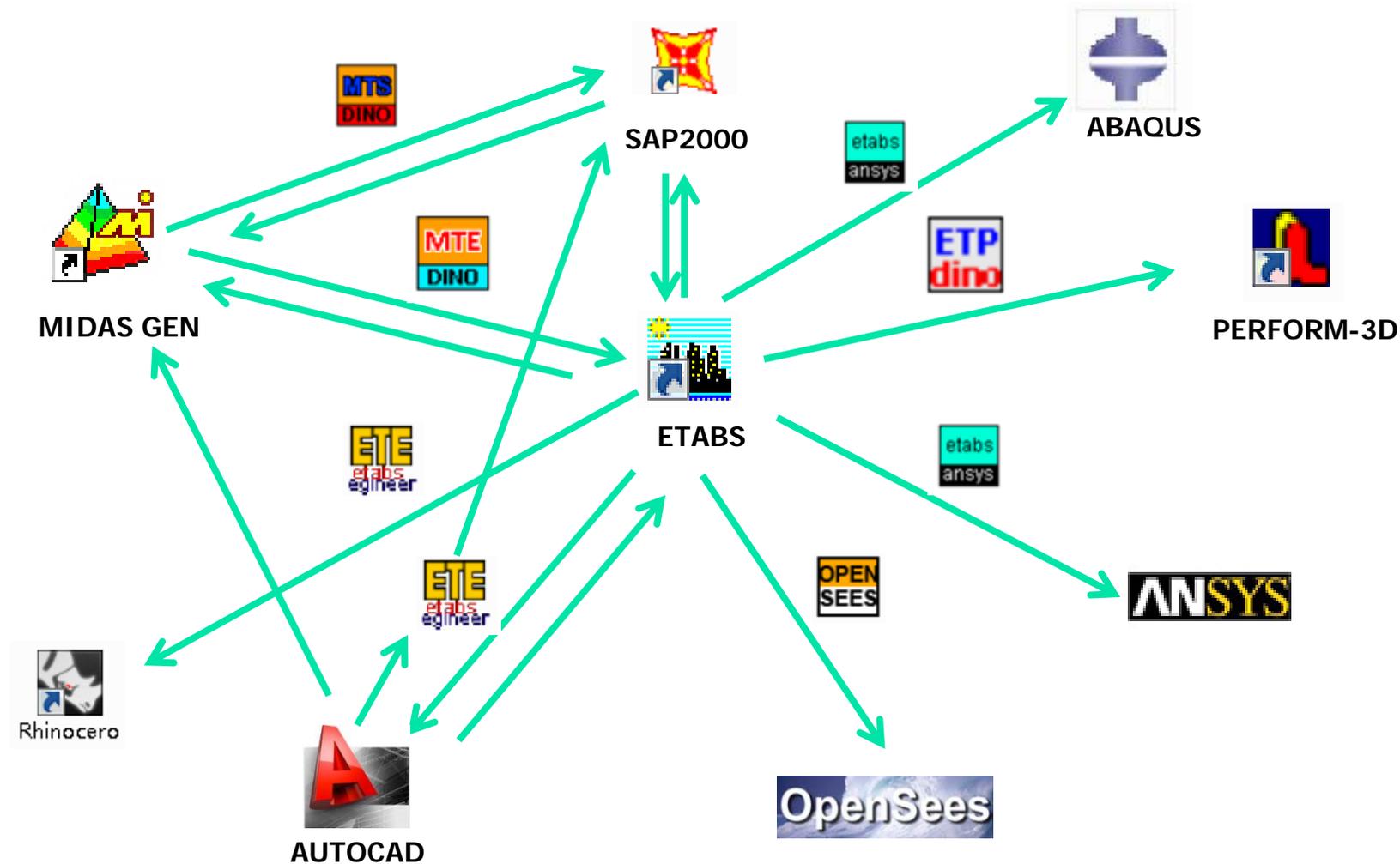
## (4)CSI 软件二次开发成果介绍(DINOBOX)

博主 主页 笔记 日志 研究 论文 编程 工程 共享 OpenSEES **DinoBox**

since 2007 **dinochen.com** 陈学伟的博客

	ETABS TO PERFORM-3D Author: dinochen1983 Time: 2023-12-31		DinoETE_Etabs后处理 Author: dinochen1983 Time: 2023-12-27		DinoMTS,Midas to Sap2k转换程序 Author: dinochen1983 Time: 2023-12-08
	Midas Gen to Etabs Author: dinochen1983 Time: 2023-10-17		DinoSEC截面分析程序 Author: dinochen1983 Time: 2014-06-13		DinoBox_钢柱轴压计算 Author: dinochen1983 Time: 2014-03-28
	ETO_OpenSEES前后处理程序 Author: dinochen1983 Time: 2014-03-26		DinoBox_组合楼板设计 Author: dinochen1983 Time: 2014-03-26		Dino_Etabs to ansys转换程序 Author: dinochen1983 Time: 2014-01-21
	DinoBox_钢梁受弯计算 Author: dinochen1983 Time: 2014-01-05		DinoBox_钢柱脚节点 Author: dinochen1983 Time: 2014-01-04		WindHist_风振时程 Author: dinochen1983 Time: 2013-12-26
	PKPM to SAFE Author: dinochen1983 Time: 2013-10-19		DinoSap2D结构力学求解器 Author: dinochen1983 Time: 2013-10-12		DinoBox_地下室侧壁 Author: dinochen1983 Time: 2013-10-11
	IDARC-2D 前后处理系统 v1.0 Author: dinochen1983 Time: 2009-07-15		DinoBox_Bmp2Data_带回曲线工具 Author: dinochen1983 Time: 2013-12-29		DinoBox_钢骨梁承载力 Author: dinochen1983 Time: 2013-10-22
	DinoBox_简支组合梁 Author: dinochen1983 Time: 2013-10-16				

### (4)CSI 软件二次开发成果介绍(DINOBOX)



## (4) 二次开发程序

### ➤ 结构弹塑性分析接口程序ETP

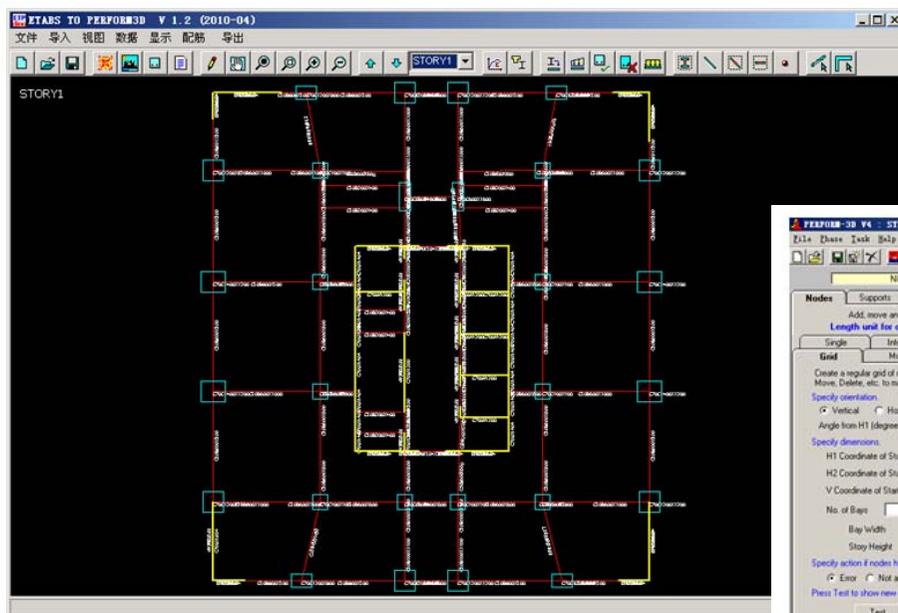


图 9-13 ETP 程序主界面

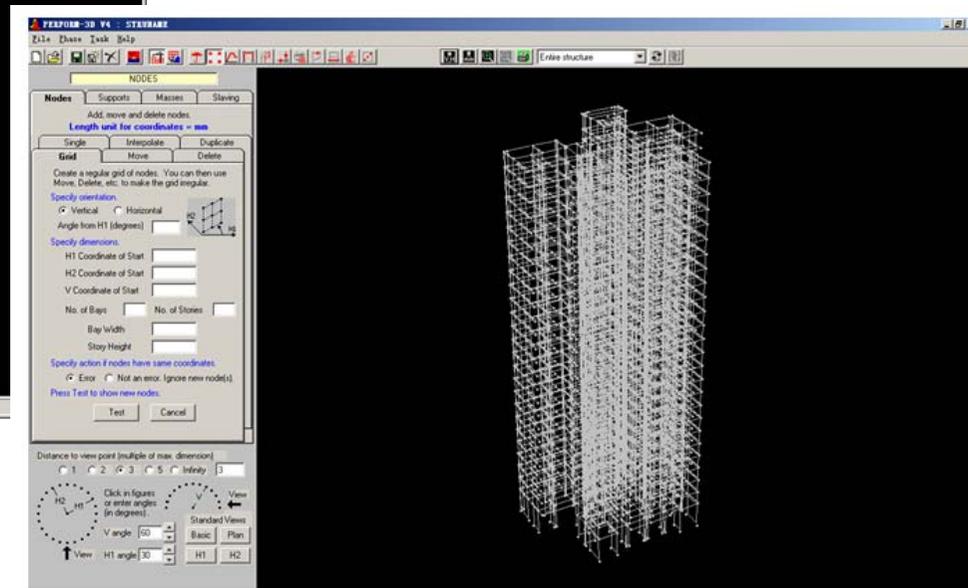


图 10-14 Perform-3D 模型图

## (4) 二次开发程序

### ➤ 结构弹塑性分析接口程序ETP

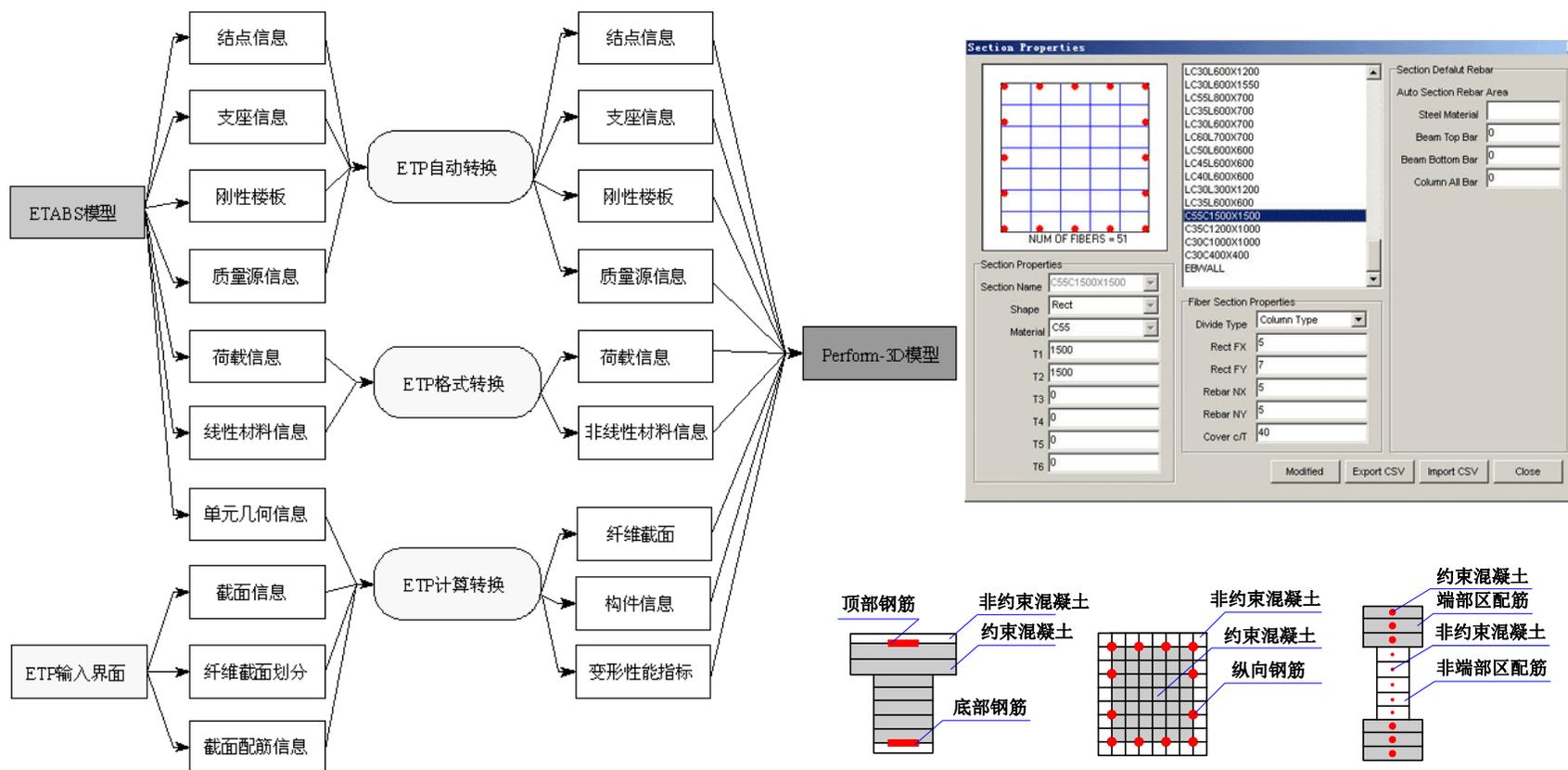


图 9-16 ETP 程序工作流程图



## (4) 二次开发程序

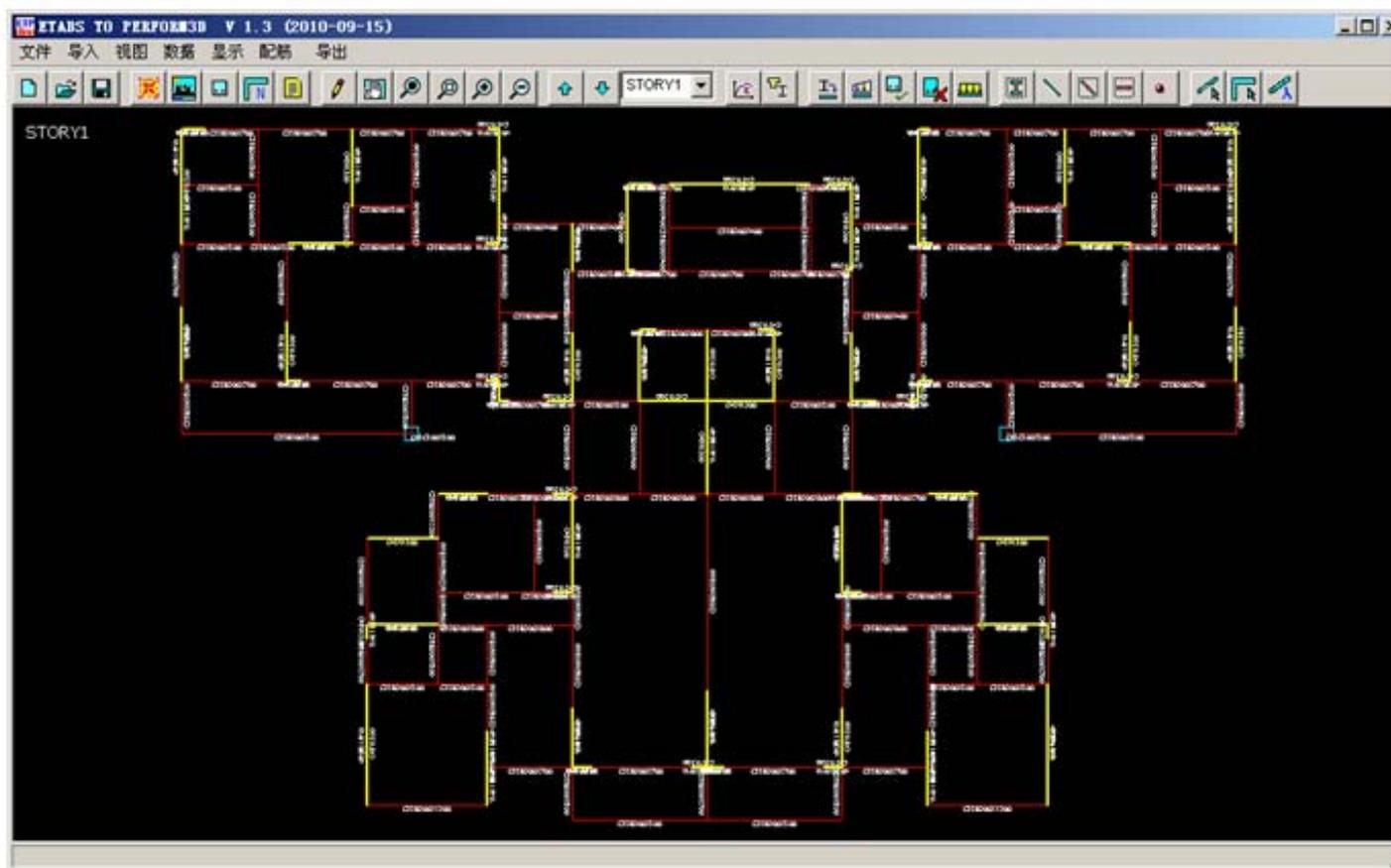


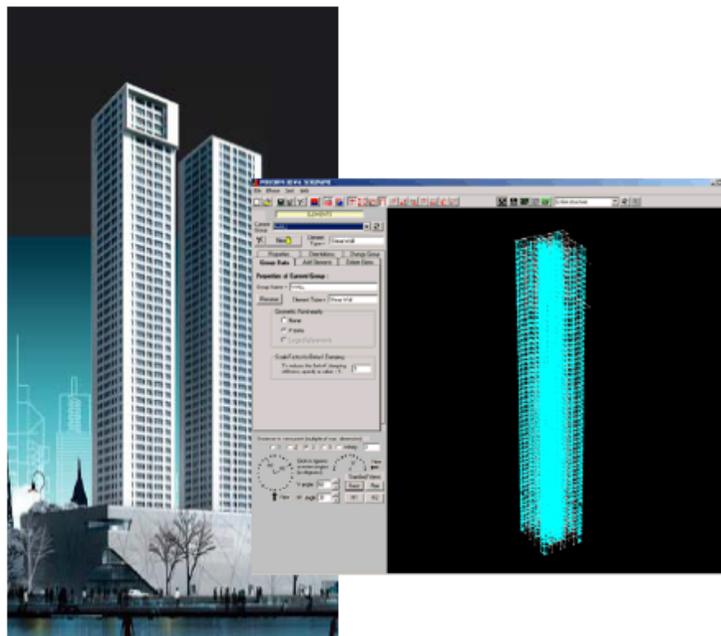
图 10-12 ETP 主界面图

## (4)二次开发应用程序的工程实例

### ➤ETABS TO PERFORM-3D的工程实例

#### PERFORM-3D工程应用

全纤维单元截面，全采用人工输入配筋  
采用ETP生成模型，基本不需后期修改

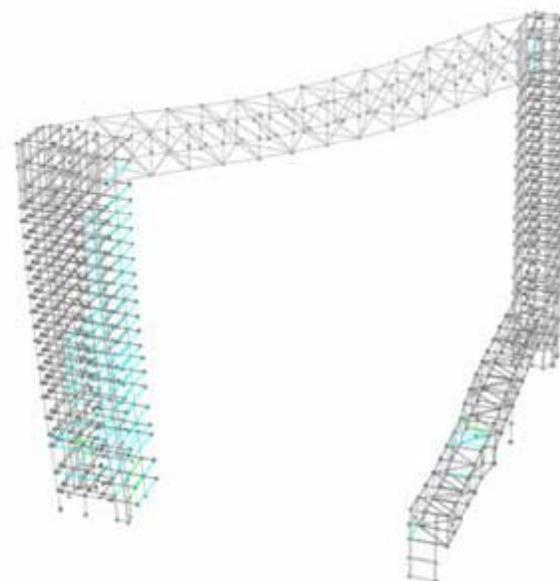


## (4)二次开发应用程序的工程实例

### ➤ETABS TO PERFORM-3D的工程实例



增加采用弹性楼板，型钢混凝土构件，  
剪力墙测应变，钢-混凝土共同弹塑性分析  
带阻尼器弹塑性分析



(c) 框架梁和钢梁变形性能状态



## (3)二次开发应用程序的工程实例

### ➤ETABS TO PERFORM-3D的工程实例

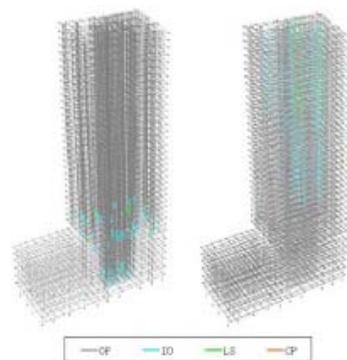


图 10 GM4 地震波工况下构件变形性能图

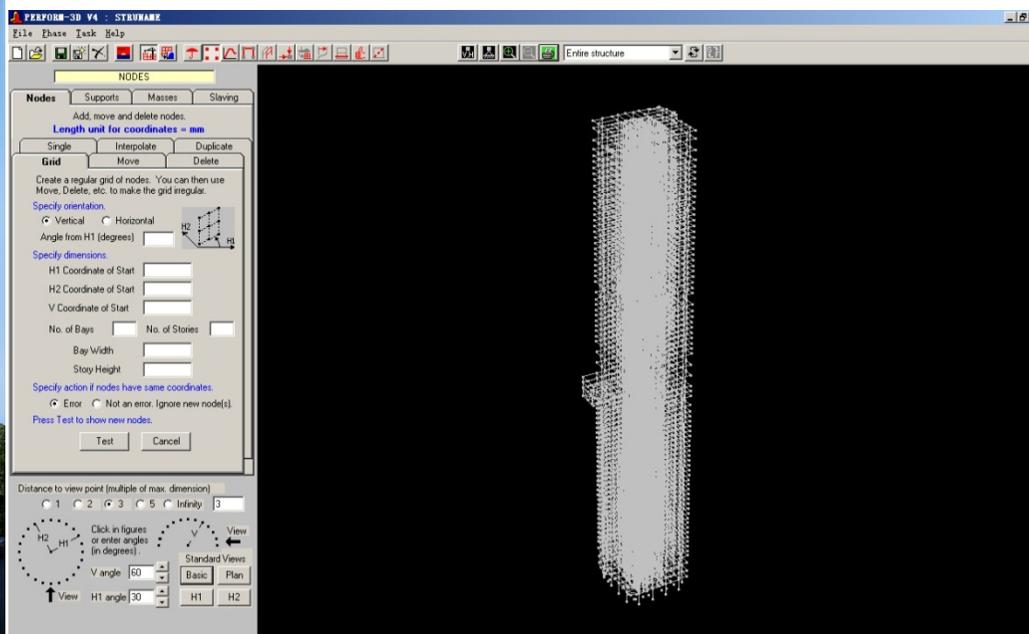


开始采用塑性铰单元来模拟梁单元  
柱墙采用纤维单元,导入ETABS配筋数据  
监测纤维应变

## (4)二次开发应用程序的工程实例

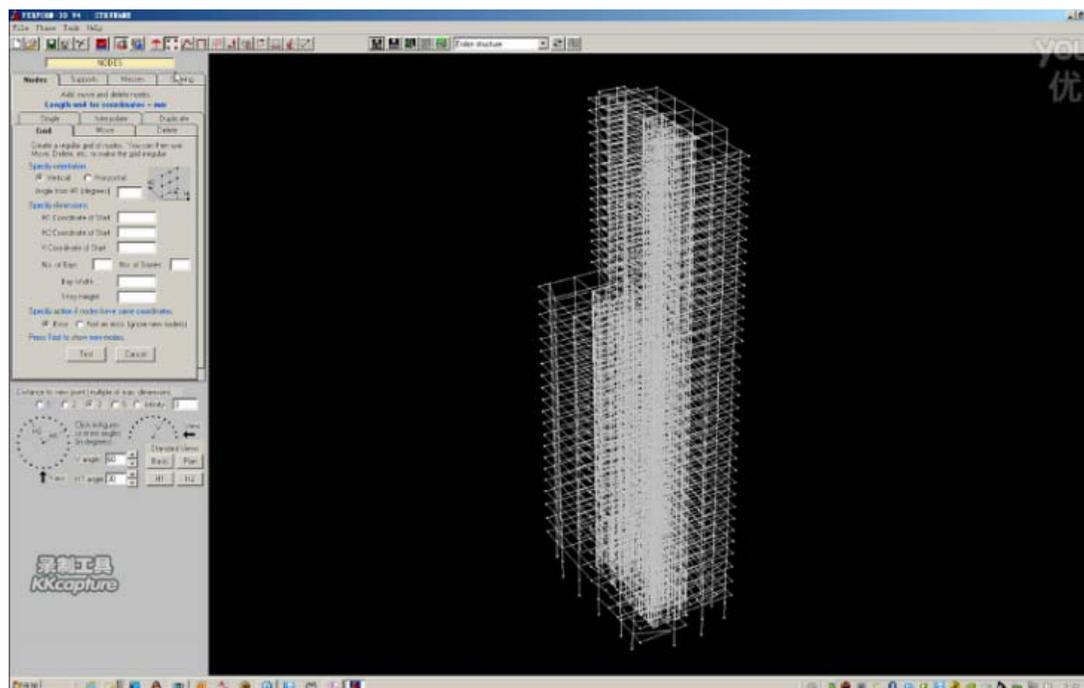
### ➤ETABS TO PERFORM-3D的工程实例

#### 大连300米超高层



## (4)二次开发应用程序的工程实例

- ETABS TO PERFORM-3D的工程实例  
苏州170米超高层

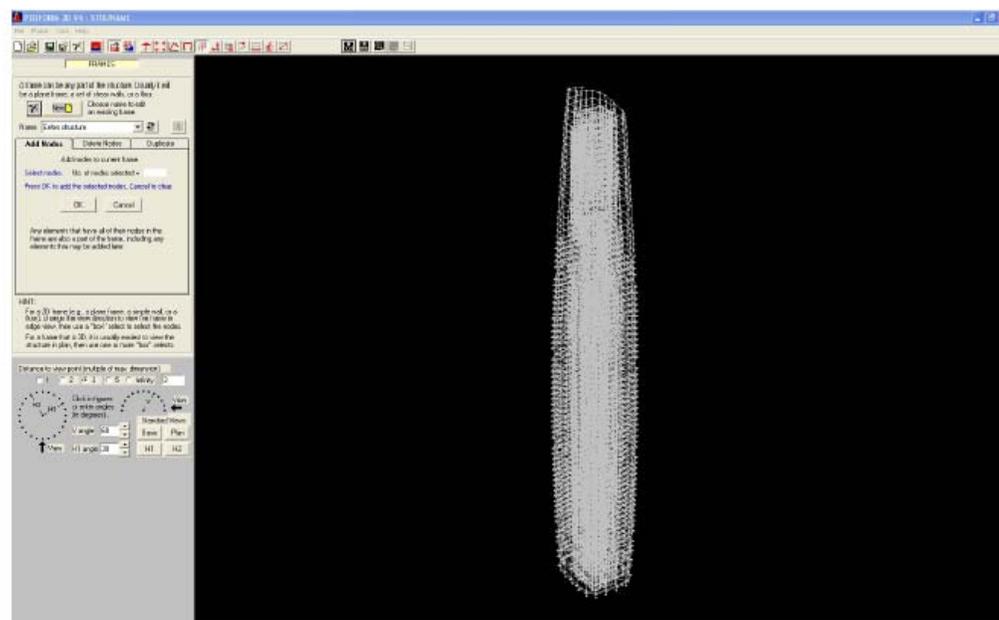


## (4)二次开发应用程序的工程实例

### ➤ETABS TO PERFORM-3D的工程实例



深圳项目380m

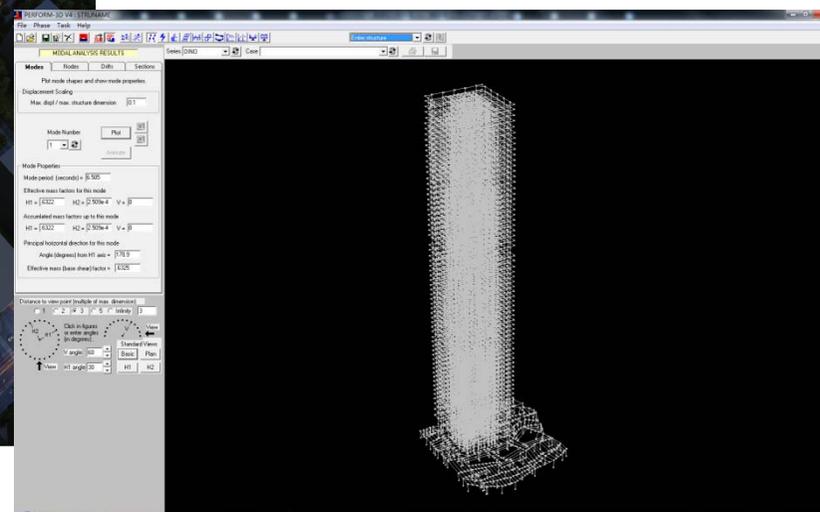


## (4)二次开发应用程序的工程实例

### ➤ETABS TO PERFORM-3D的工程实例



深圳项目300m

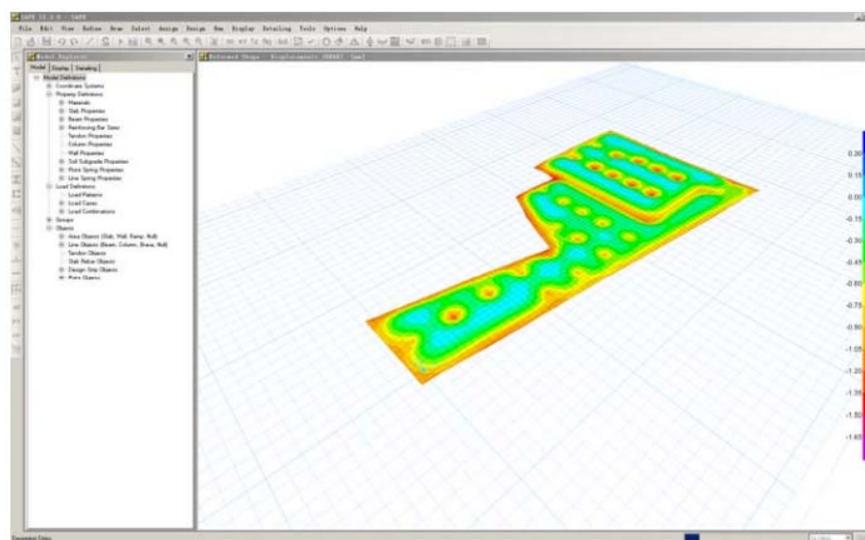
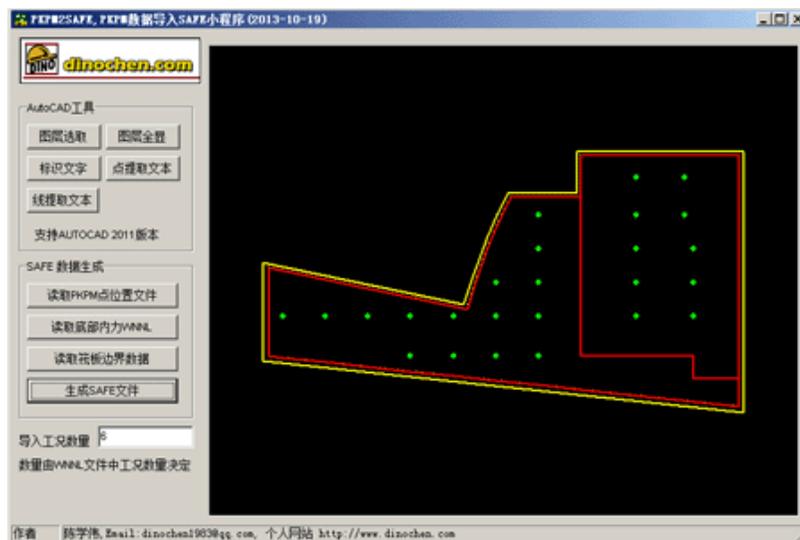




Upgrade!

## (2) 新研发二次开发程序

- 基于CSI的二次开发的工程小程序：  
PKPM TO SAFE



**Upgrade!**

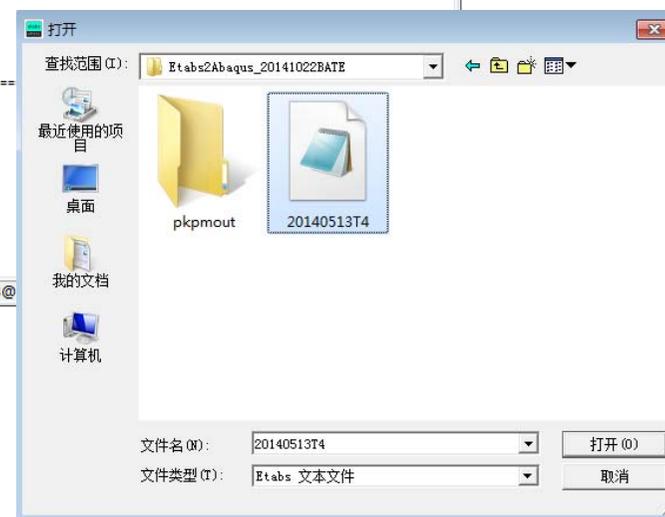
## (3) 新研发二次开发程序

➤ 基于CSI的二次开发的工程小程序：  
ETABS TO ABAQUS

➤ 转换类型：显示分析

➤ 特色：

- 读取PKPM.OUT文件配筋
- 程序自动处理剪力墙网格划分
- 组合截面、层间梁准确识别
- 程序自动导荷生产集中质量点
- 仅需e2k，无需第三方软件或s2k
- 操作更加便捷，仅需三步

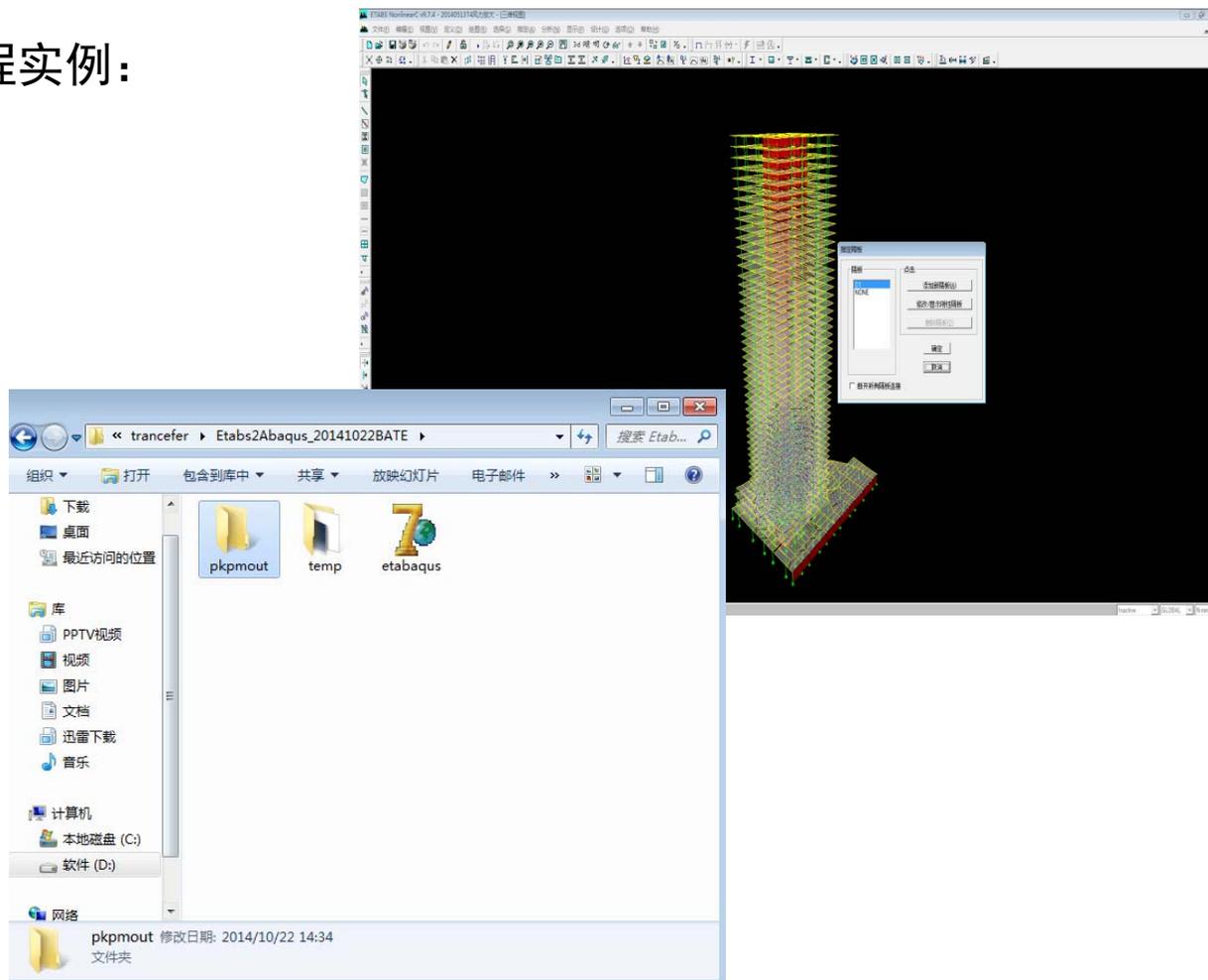


Upgrade!

## (3) 新研发二次开发程序

### ➤ ETABS TO ABAQUS工程实例： 深圳项目188米塔楼

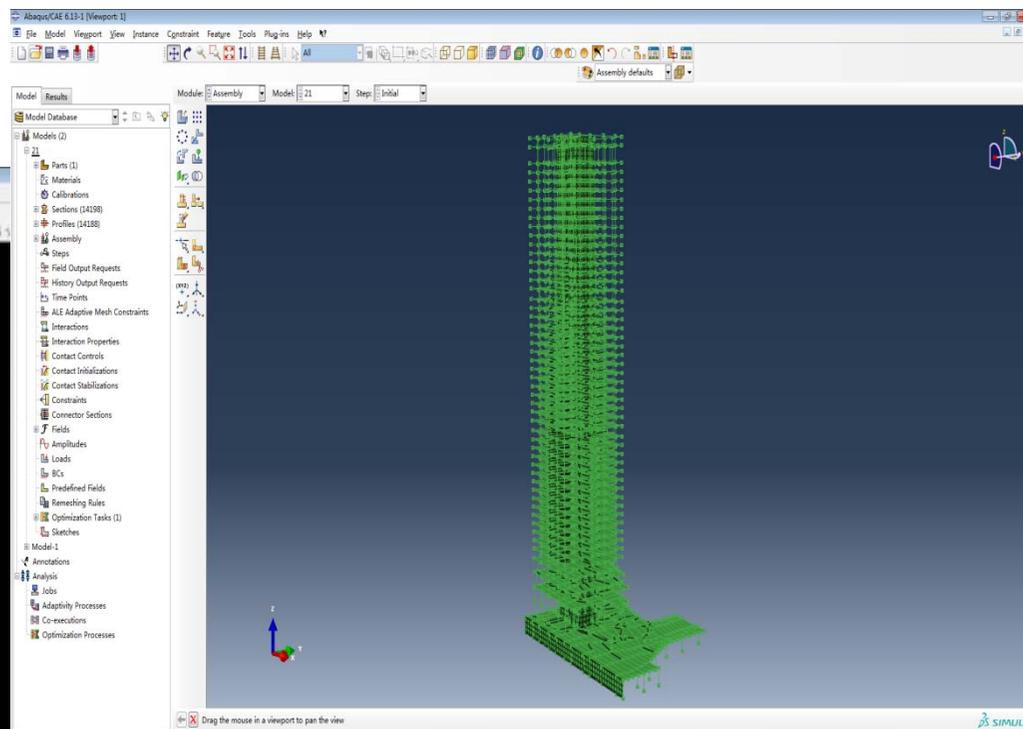
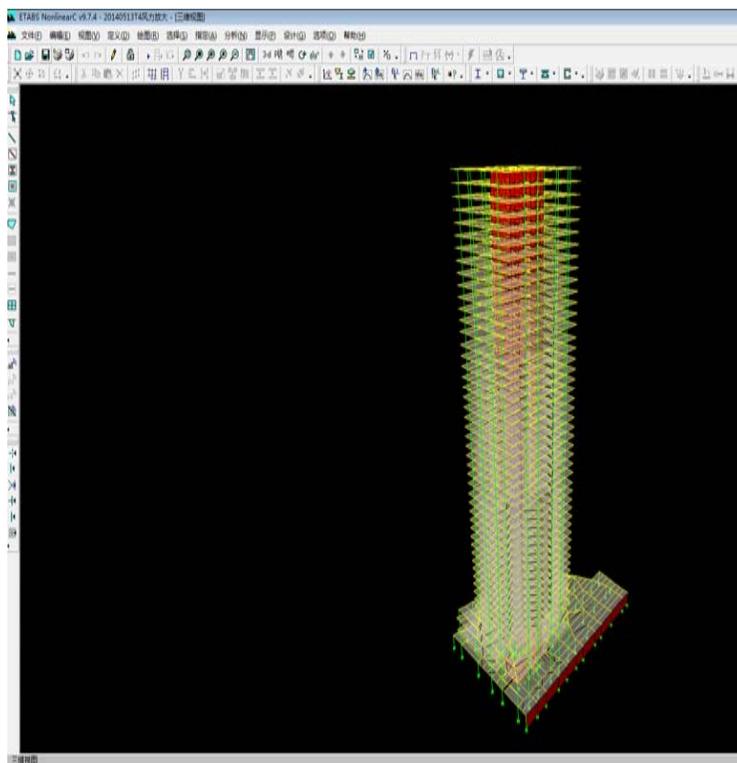
- Step-1:  
所有点指定刚性楼板  
导出为.e2k (单位N.m)
- Step-2:  
将PKPM计算结果文件  
wpj.out、wmass.out拷贝  
到pkpmout文件夹中
- Step-3:  
运行ETA导模型



## (3) 新研发二次开发程序

Upgrade!

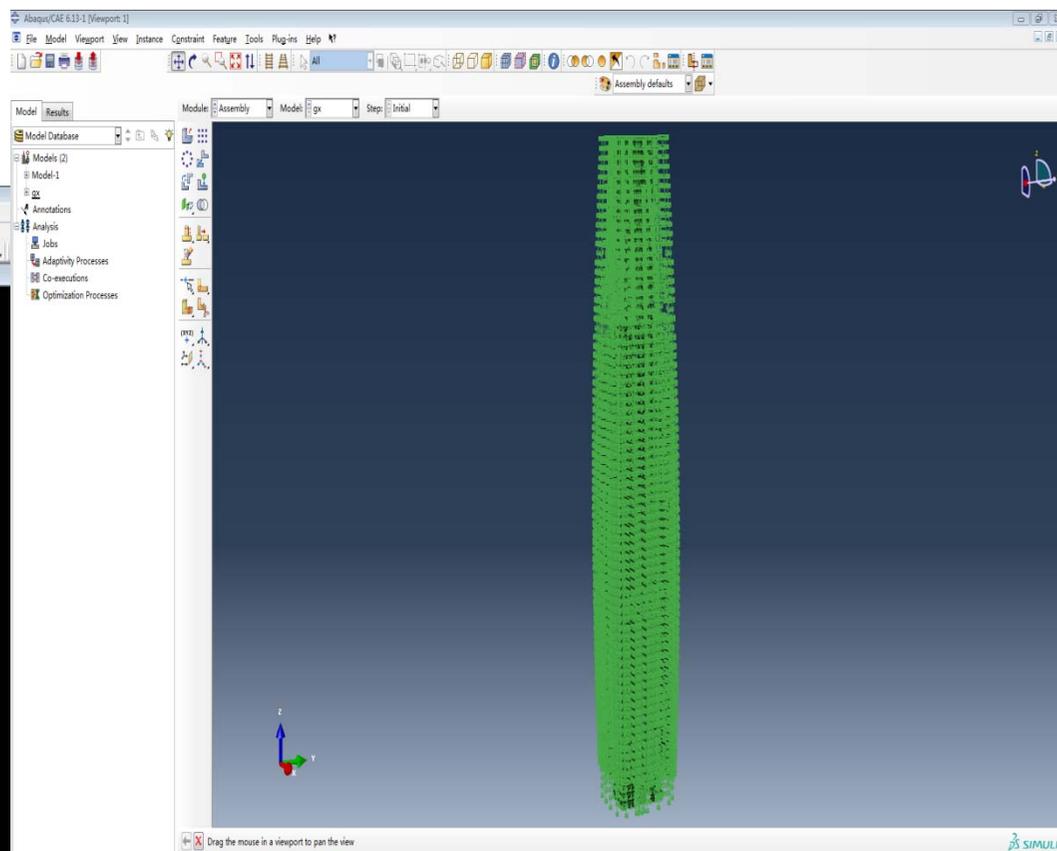
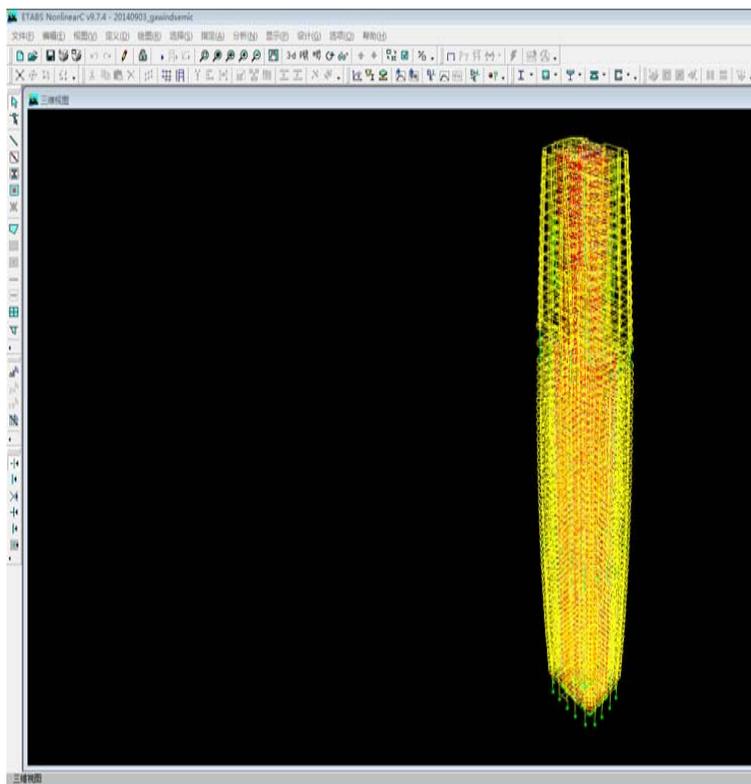
➤ ETABS TO ABAQUS工程实例：  
深圳项目188米塔楼



## (3) 新研发二次开发程序

Upgrade!

➤ ETABS TO ABAQUS工程实例：  
深圳项目350米塔楼



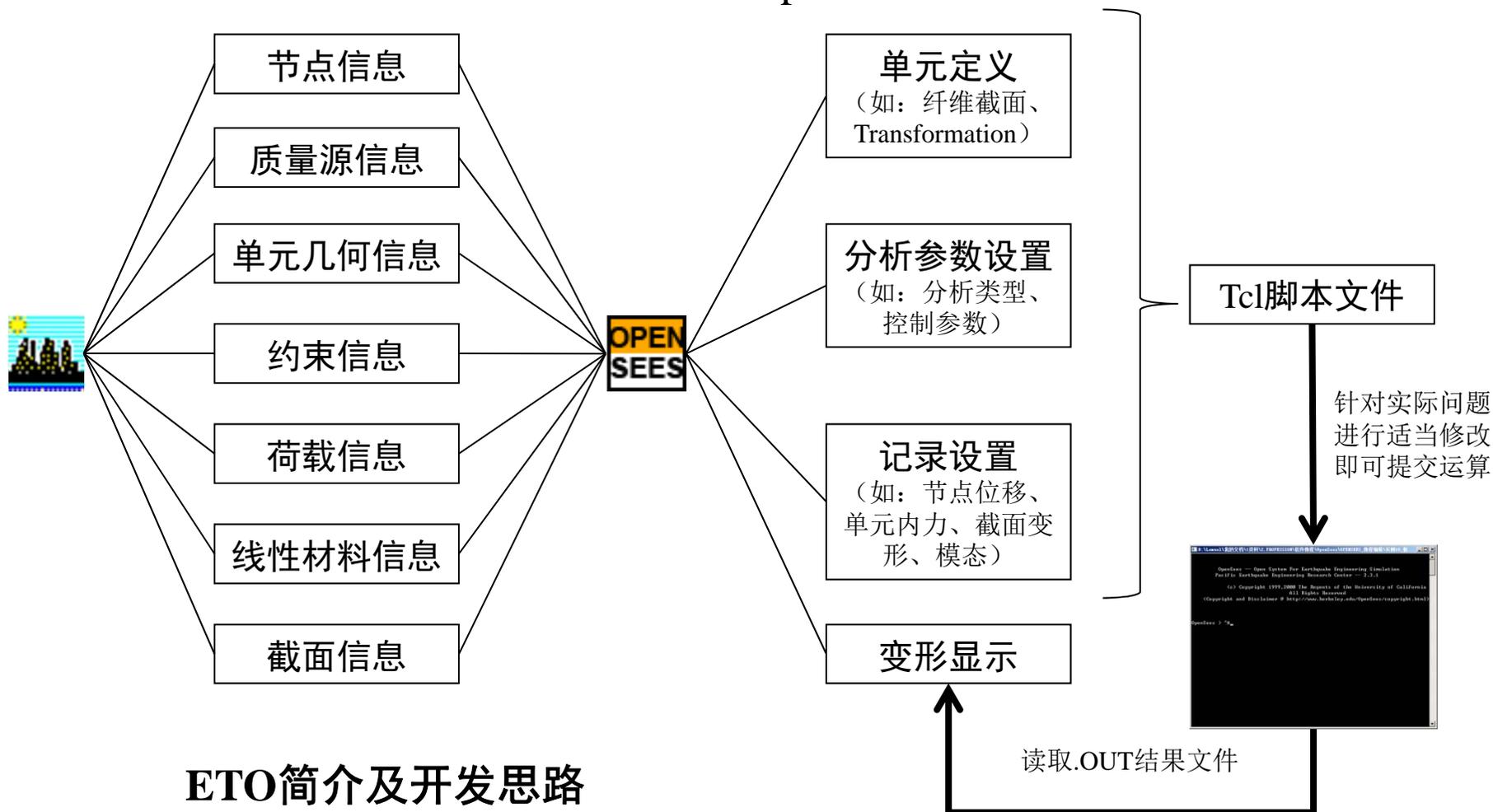
Upgrade!

### (3) 新研发二次开发程序

➤ETABS TO ABAQUS未来更新:

- 开发隐式分析模块
- 增加类似ETP交互截面，配筋更加多元人性化
- 增加更多功能项：短梁判断、运动耦合方式刚性隔板、B31细分、剪力墙约束边缘构件分离式配筋、三维梁单元规范本构子程序、模型检查.....
- 开发基于odb计算结果的处理
- 接力ETE优化配筋结果

ETO是一款具有与ETABS交互接口的OpenSees前后处理程序。



ETO简介及开发思路

## OpenSEES实例教程 即将出版

since 2007 [dinochen.com](http://dinochen.com)

结构弹塑性分析程序 OpenSEES 原理与实例

**Structural Nonlinear Analysis Program  
OpenSEES Theory and Tutorial**

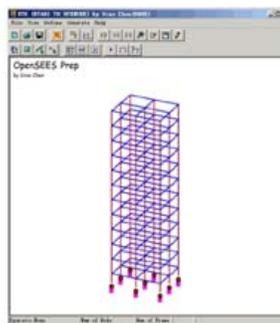
结构弹塑性分析程序  
OpenSEES 原理与实例

中国建筑工业出版社

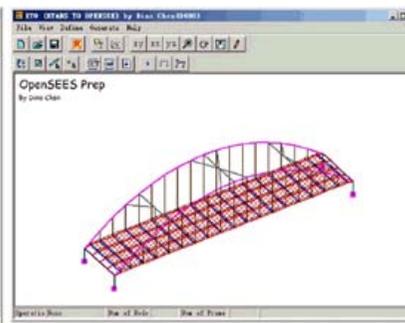
陈学伟 林哲 编著

中国建筑工业出版社

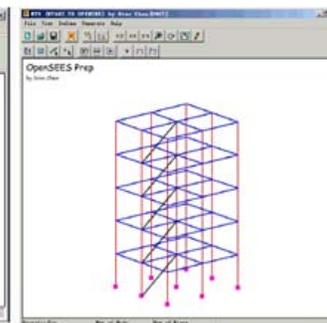
@DinoChen陈学伟  
weibo.com/u/2012935115



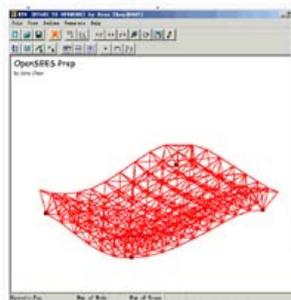
隔震结构弹塑性分析



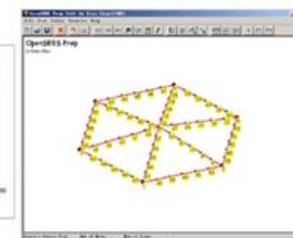
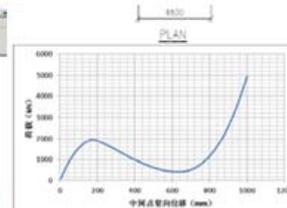
桥梁的多点激励



带阻尼器结构的分析

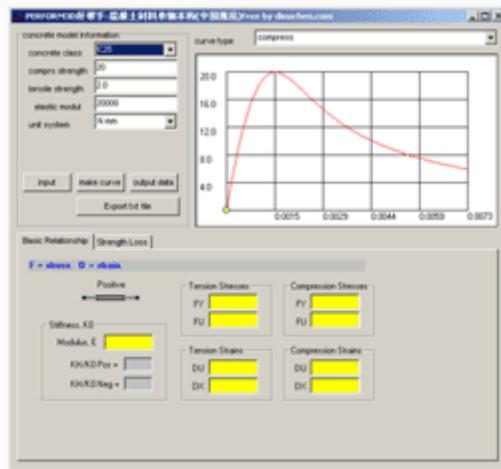


网架结构的弹塑性分析

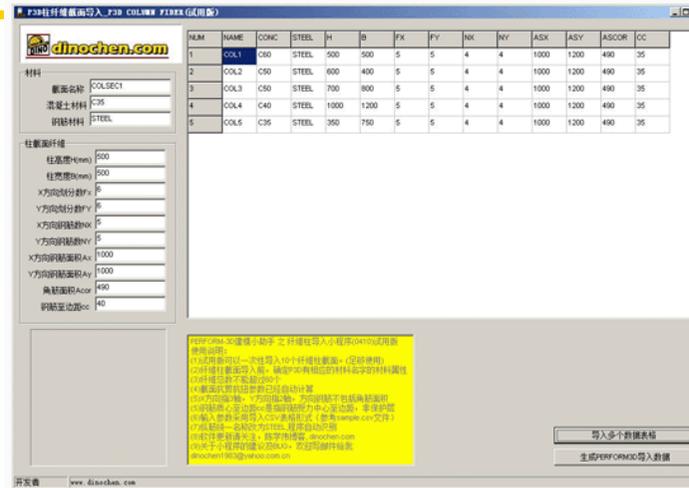


网壳几何非线性

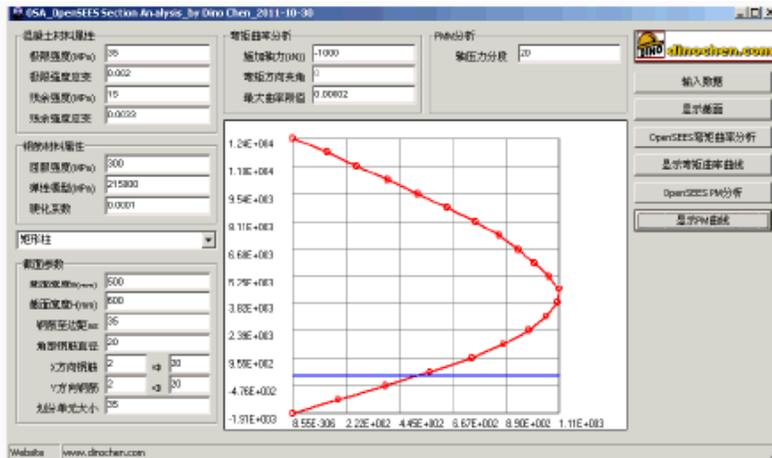
## PERFORM-3D的二次开发及学习资源可供下载



混凝土本构参数小工具



导入柱截面纤维小程序



通过OPENSEES二次开发实现截面分析，可以得到截面PMM曲线及M-Fai曲线可供PERFORM-3D输入

**谢谢聆听**  
**Thanks for Your Attention**

**WSP HONG KONG LTD.**  
**Associate (Civil and Structural)**  
**Dr. Dino Chen Xuewei**