【SAP2000与结构力学】系列课程

SAP2000 API 开发

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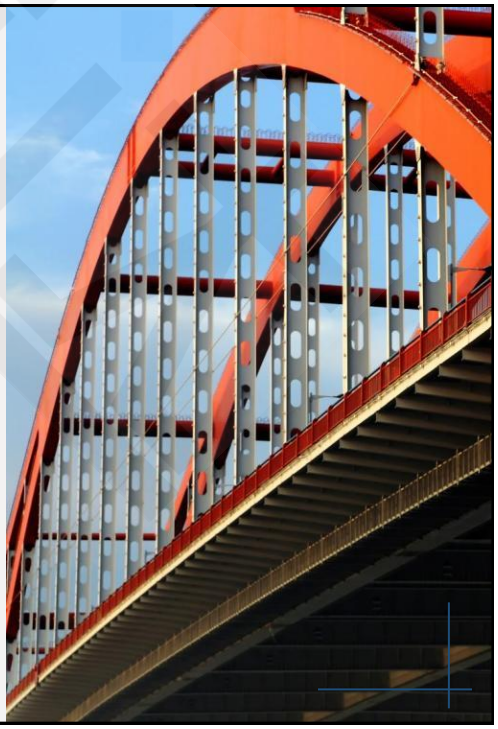
2024年5月22日

目录



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SAP2000 API 功能简介

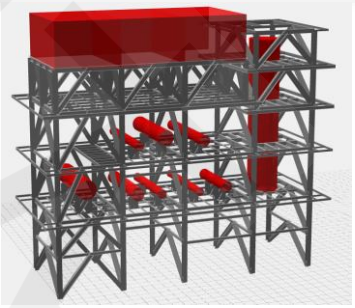
SAP2000 API 功能简介

❖ **API**（**A**pplication **P**rogramming **I**nterface）

- 应用程序编程接口：一组预定义的**函数**
- 辅助开发人员**访问**应用程序，但无法访问底层代码。

❖ **SAP2000 API**（全面开放的二次开发功能）

- 参数化的几何建模
- 定制化的计算报告
- 独立的应用程序
- ……



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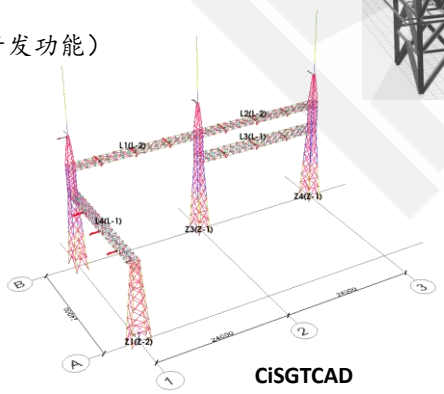

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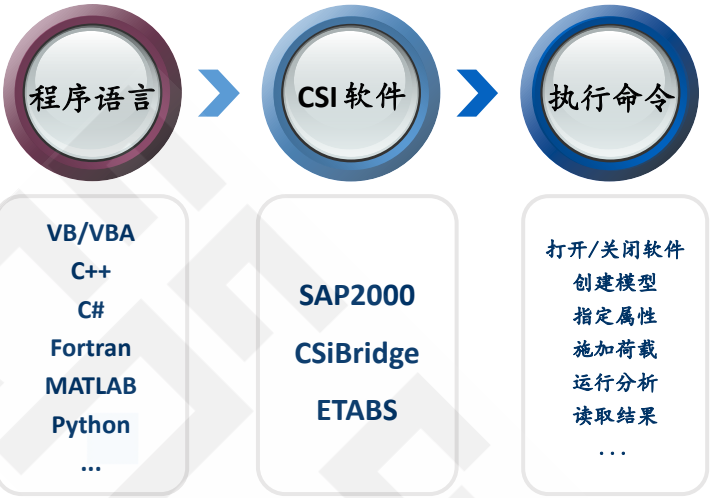
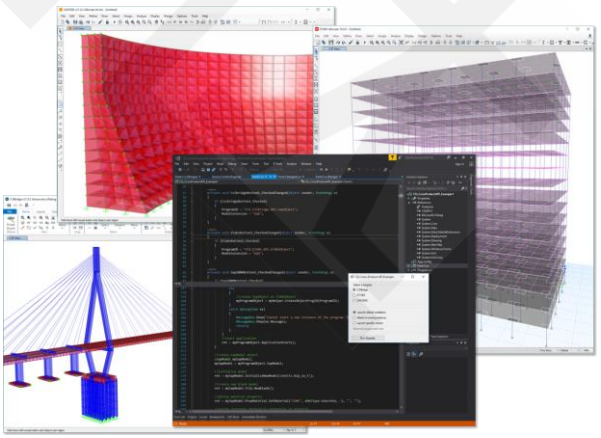


SAP2000 API 功能简介

❖ CSI 跨产品 API 开发

SAP2000® ETABS®
CSiBRIDGE®



SAP2000 API 功能简介

❖ CSI_OAPI_Documentation.chm

位于SAP2000安装目录下

- **Release Notes** explain recent changes in the API, and include instructions for users on how to update their client applications.
- **Getting Started** briefly explains how to use the CSi API and how the CSi API functions are documented.
- **CSI API Functions** identifies each function available in the API and provides an example of how the function might be called using Visual Basic for Applications (VBA).
- **Example Code** provides programming examples using the CSI API. These examples are more extensive than those included with the documentation of each function.
- **Obsolete Functions** are the result of changes to the software or the API. These obsolete functions have been superseded, but continue to be included to accommodate backwards compatibility.
- **Breaking Changes Between v16 and v17** lists functions and enumerations that have been renamed in SAP2000v17.

SAP2000 API 功能简介

❖ CSI_OAPI_Documentation.chm

Syntax

SapObject.SapModel.FrameObj.AddByCoord 根据节点坐标创建框架对象

VB6 Procedure

Function AddByCoord(ByVal xi As Double, ByVal yi As Double, ByVal zi As Double, ByVal xj As Double, ByVal yj As Double, ByVal zj As Double, ByRef Name As String, Optional ByVal PropName As String = "Default", Optional ByVal UserName As String = "", Optional ByVal CSys As String = "Global") As Long

Parameters

xi, yi, zi 起始节点

The coordinates of the I-End of the added frame object. The coordinates are in the coordinate system defined by the CSys item.

xj, yj, zj 终止节点

The coordinates of the J-End of the added

Name 框架标签

This is the name that the program ultimate
a UserName is specified and that name is
name is assigned to the frame object.

```
'基于坐标添加框架对象
Dim FrameName(2) As String
ret = mySapModel.FrameObj.AddByCoord(0, 0, 0, 0, 0, 10, FrameName(0), "R1", "1")
ret = mySapModel.FrameObj.AddByCoord(0, 0, 10, 8, 0, 16, FrameName(1), "R1", "2")
ret = mySapModel.FrameObj.AddByCoord(-4, 0, 10, 0, 0, 10, FrameName(2), "R1", "3")
```

PropName 框架截面属性

This is Default, None, or the name of a defined frame section property.

If it is Default, the program assigns a default section property to the frame object. If it is None, no section property is assigned to the frame object. If it is the name of a defined frame section property, that property is assigned to the frame object.

UserName 自定义框架标签

This is an optional user specified name for the frame object. If a UserName is specified and that name is already used for another frame object, the program ignores the UserName.

CSys 节点的参考坐标系

The name of the coordinate system in which the frame object end point coordinates are defined.

SAP2000 API 功能简介

❖ CSI_OAPI_Documentation.chm

Syntax

SapObject.SapModel.FrameObj.GetPoints 获取某框架对象的节点标签

VB6 Procedure

Function GetPoints(ByVal Name As String, ByRef Point1 As String, ByRef Point2 As String) As Long

Parameters

Name 框架标签
The name of a defined frame object.

Point1 起始节点
The name of the point object at the I-End of the specified frame object.

Point2 终止节点
The name of the point object at the J-End of the specified frame object.

长度	48.
线对象类型	直杆架
起点(I)	4
坐标系	GLOBAL
X	-48.
Y	0.
Z	120.
终点(J)	2
坐标系	GLOBAL
X	0.
Y	0.
Z	120.

SAP2000 API 功能简介

❖ CSI_OAPI_Documentation.chm

Syntax

SapObject.SapModel.PointObj.SetRestraint 指定节点支座

VB6 Procedure

Function SetRestraint(ByVal Name As String, ByRef Value() As Boolean, Optional ByVal ItemType As eItemType = object) As Long

Parameters

Name 节点标签或对象组名称
The name of an existing point object or group depending on the value of the ItemType item.

Value 支座条件（六个自由度）节点
This is an array of six restraint values.

Value(0) = U1
Value(1) = U2
Value(2) = U3
Value(3) = R1
Value(4) = R2
Value(5) = R3

```
Dim Value() As Boolean
Redim Value(5)
For i = 0 to 5
    Value(i) = True
Next i
ret = SapModel.PointObj.setRestraint("1", Value)
```

固定支座

ItemType
This is one of the following items in the eItemType enumeration:

Object = 0
Group = 1
SelectedObjects = 2

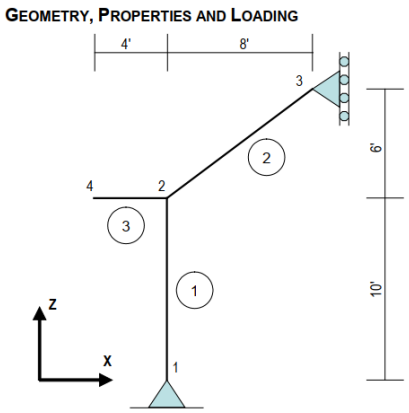
2

在 Excel 中调用 SAP2000

筑信达

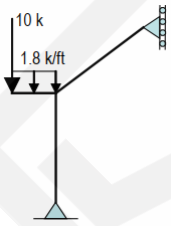
在 Excel 中调用 SAP2000

❖ 平面刚架

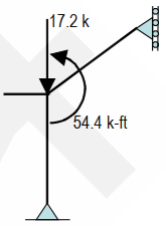


Material Properties
E = 3,600 k/in²
Unit weight = 0.15 k/ft³

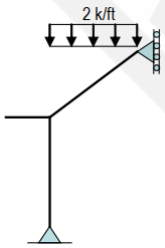
Section Properties
A = 144 in²
I = 1,728 in⁴



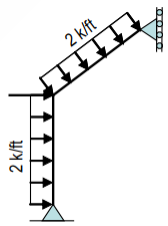
节点集中荷载+跨间均布荷载



节点集中荷载（力+力矩）



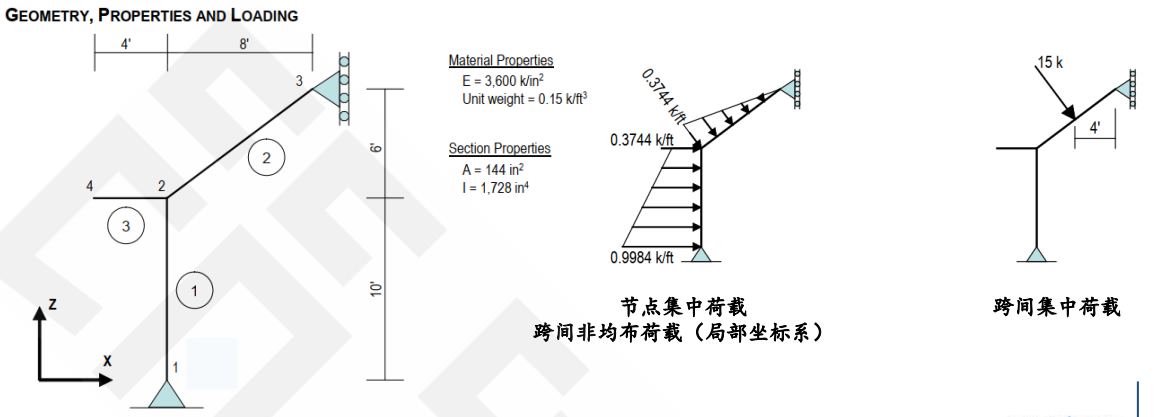
跨间均布投影荷载



节点集中荷载
跨间均布荷载（局部坐标系）

在Excel中调用SAP2000

❖ 平面刚架

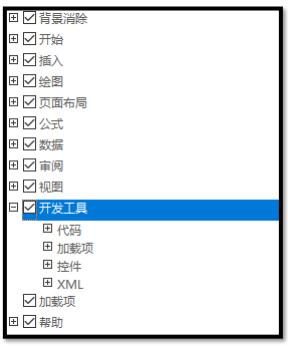


节点集中荷载
跨间非均布荷载（局部坐标系）

跨间集中荷载

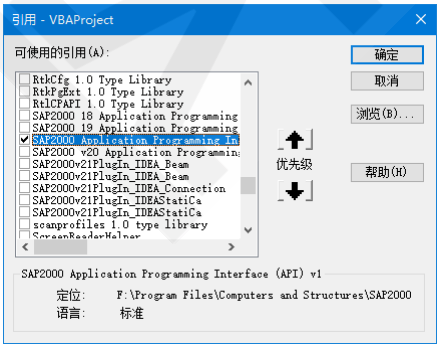
在Excel中调用SAP2000

❖ Excel开发设置



Excel自定义功能区

引用SAP2000 API



在 Excel 中调用 SAP2000

❖ VBA 源代码

```
'开始建模
ret = mySapModel.InitializeNewModel
ret = mySapModel.File.NewBlank
'材料和截面属性
ret = mySapModel.PropMaterial.SetMaterial("CONC", eMatType_Concrete)
ret = mySapModel.PropMaterial.SetMPIsotropic("CONC", 3600, 0.2, 0.0000055)
ret = mySapModel.PropFrame.SetRectangle("R1", "CONC", 12, 12)
'属性修正系数
Dim i As Long
Dim ModValue() As Double
ReDim ModValue(7)
For i = 0 To 7
    ModValue(i) = 1
Next i
ModValue(0) = 1000
ModValue(1) = 0
ModValue(2) = 0
ret = mySapModel.PropFrame.SetModifiers("R1", ModValue)
'切换单位制
ret = mySapModel.SetPresentUnits(eUnits_kip_ft_F)
'基于坐标添加框架对象
Dim FrameName(2) As String
ret = mySapModel.FrameObj.AddByCoord(0, 0, 0, 0, 0, 10, FrameName(0), "R1", "1")
ret = mySapModel.FrameObj.AddByCoord(0, 0, 10, 8, 0, 16, FrameName(1), "R1", "2")
ret = mySapModel.FrameObj.AddByCoord(-4, 0, 10, 0, 0, 10, FrameName(2), "R1", "3")
```

筑信达

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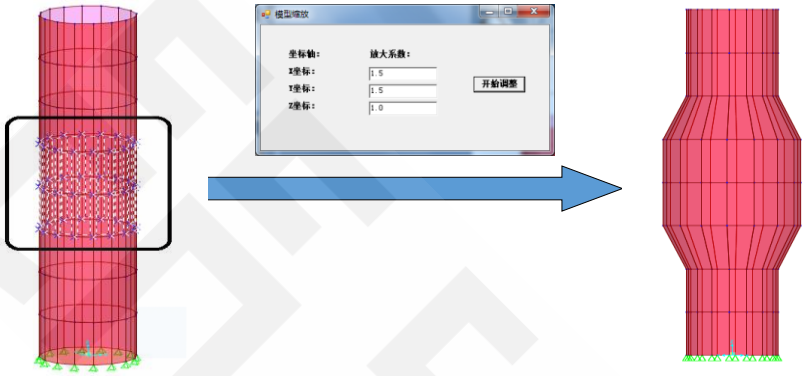
在 SAP2000 中开发内部插件

筑信达

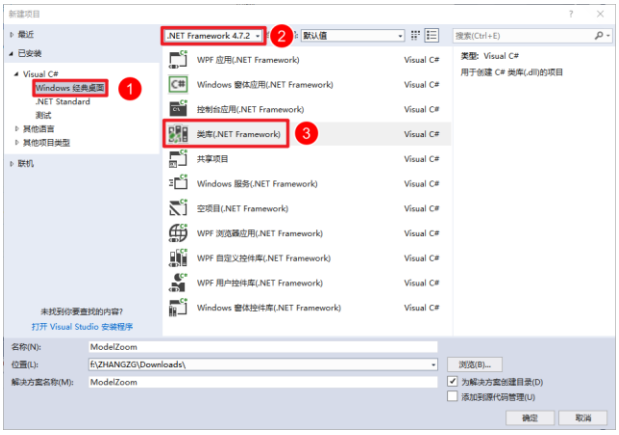
在SAP2000中开发内部插件

❖ 缩放节点坐标值



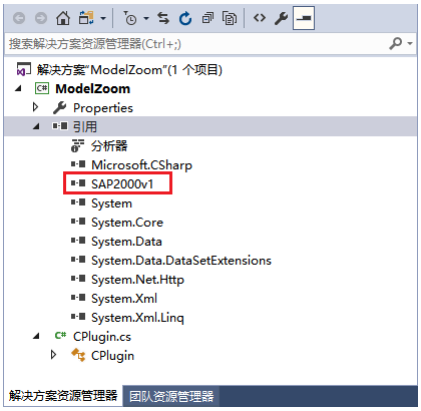
在SAP2000中开发内部插件

❖ Visual Studio开发设置



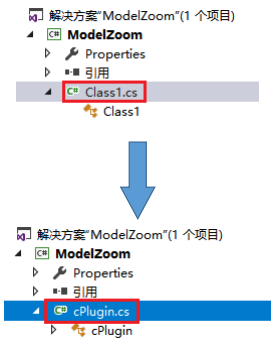
在SAP2000中开发内部插件

❖ Visual Studio开发设置



在SAP2000中开发内部插件

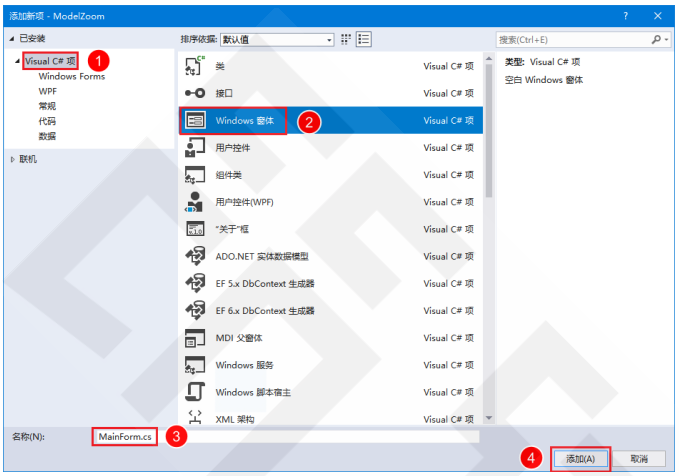
❖ cPlugin类及其入口函数

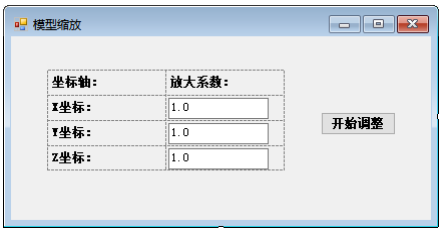



```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using SAP2000v1; SAP2000 命名空间

namespace ModelZoom
{
    public class cPlugin                    引用类型的参数
    {
        public void Main(ref cSapModel SapModel, ref cPluginCallback ISapPlugin)
        {

            ISapPlugin.Finish(0); 结束插件的运行
        }
    }
}
```

在SAP2000中开发内部插件

❖ Windows窗体





在SAP2000中开发内部插件

❖ Windows窗体

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using SAP2000v1;

namespace ModelZoom
{
    public class cPlugin
    {
        public void Main(ref cSapModel SapModel, ref cPluginCallback ISapPlugin)
        {
            MainForm tF = new MainForm(ref SapModel);
            tF.ShowDialog();

            ISapPlugin.Finish(0);
        }
    }
}
```

定义和显示窗体

在SAP2000中开发内部插件

❖ Windows窗体代码

```
int ret = 0;
int NumberItems = 0;
int[] ObjectType_int = new int[0];
string[] ObjectName_str = new string[0];
ret = m_SapModel.SelectObj.GetSelected(ref NumberItems, ref Ob

for (int i = 0; i < NumberItems; i++)
{
    if ((int)ObjectType_int.GetValue(i) == 1)
    {
        double x = 0.0, y = 0.0, z = 0.0;
        ret = m_SapModel.PointObj.GetCoordCartesian((string)Ob
        ret = m_SapModel.EditPoint.ChangeCoordinates_1((string
    }
}
m_SapModel.View.RefreshView(0, false);
```

1、获取选择的对象

SapObject.SapModel.SelectObj.GetSelected

2、获取点对象的坐标值

SapObject.SapModel.PointObj.GetCoordCartesian

3、编辑点对象的坐标值

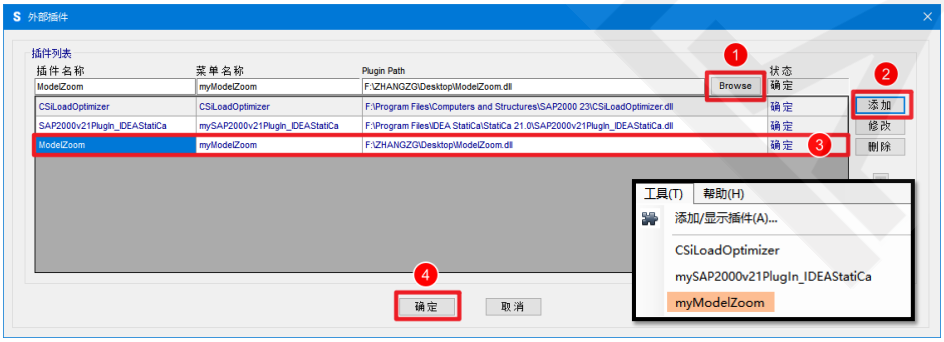
SapObject.SapModel.EditPoint.ChangeCoordinates_1

4、刷新视图

SapObject.SapModel.View.RefreshView

在SAP2000中开发内部插件

❖ SAP2000插件



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筑信达

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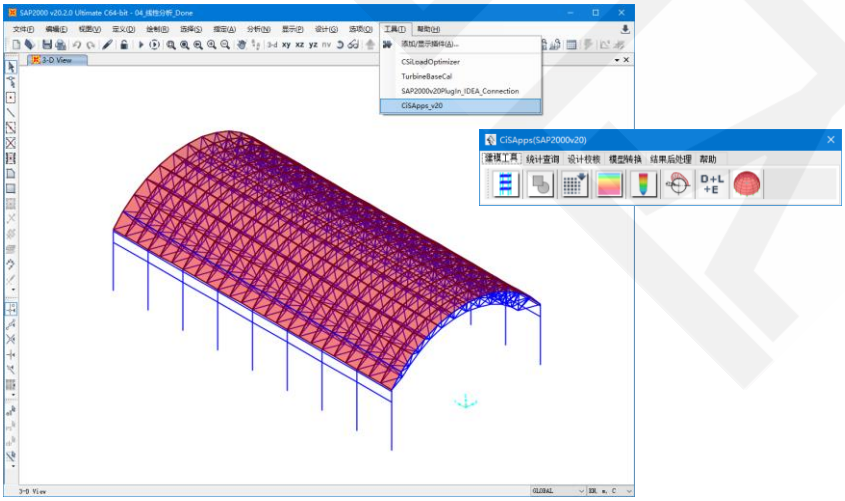

免费下载地址：http://www.cisec.cn

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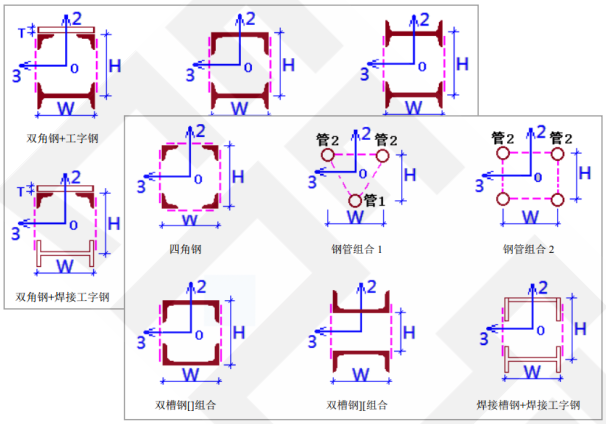

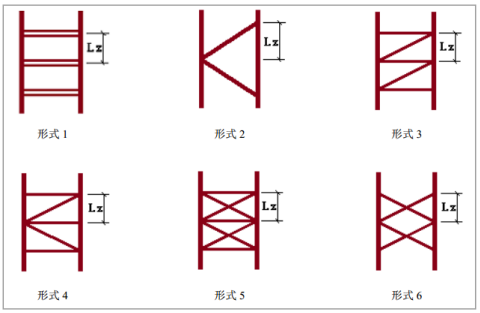

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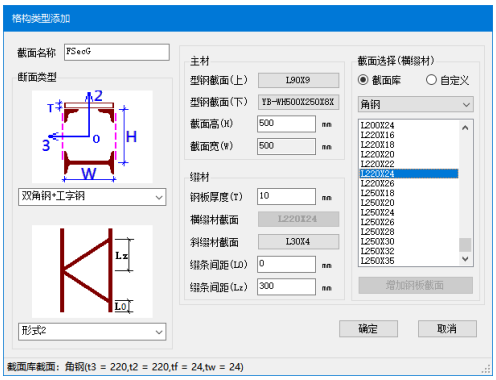

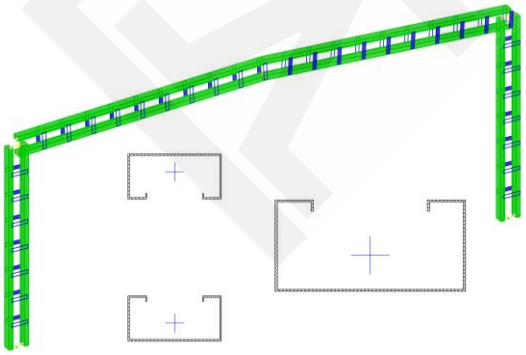

门式刚架

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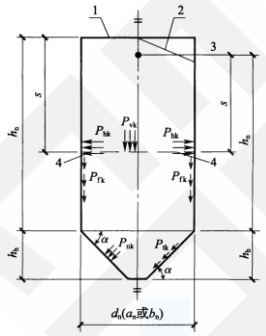
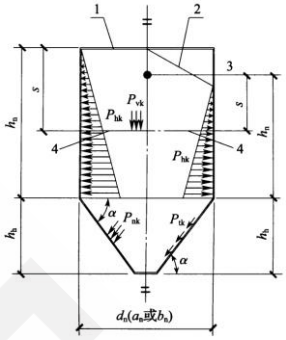


$$p_h = C_h \gamma \rho (1 - e^{-\mu k s/\rho}) / \mu$$

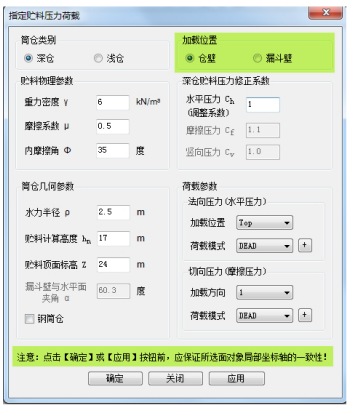
$$k = \tan^2(45° - \phi/2)$$

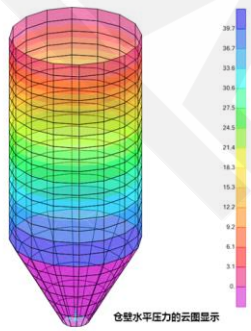


浅仓

筑信达

筑信达工具箱 CiSApps

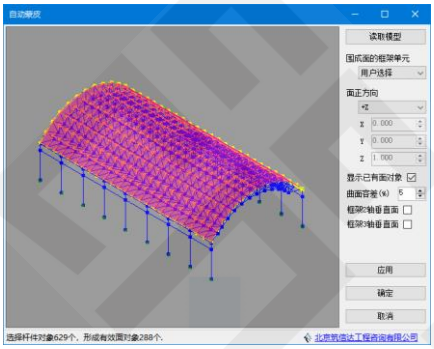


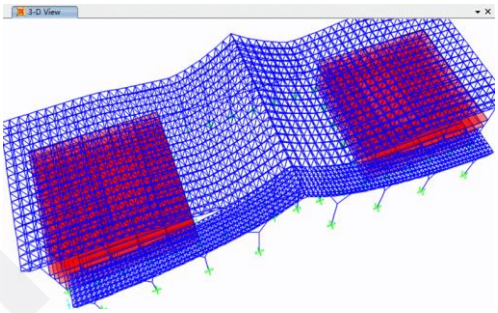


仓壁水平压力的云图显示

筑信达

筑信达工具箱 CiSApps





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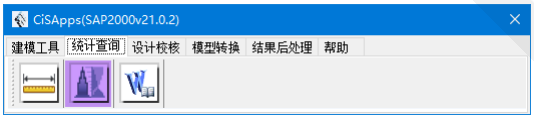

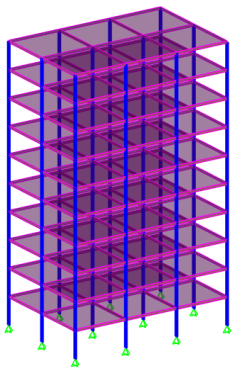

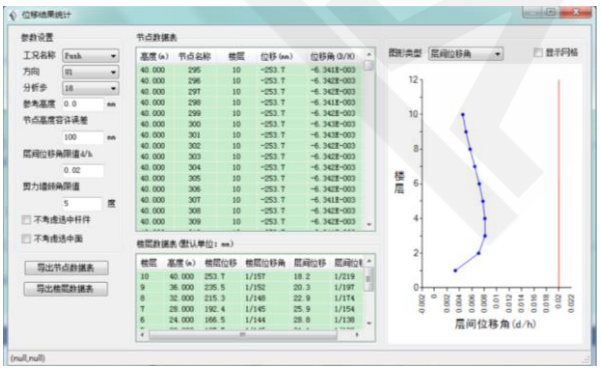

筑信达

谢 谢

“The idea that an expert-system computer program, with artificial intelligence, will replace a creative human is an insult to all structrual engineers.”

加州大学伯克利分校终身名誉教授 Edward L.Wilson（著名的结构分析设计软件 SAP 的创始人）在《Three Dimensional Static and Dynamic Analysis Of Structures》（http://www.edwilson.org/Book/book.htm#Personal ）一书中提到：

"Don't use a structural analysis program unless you fully understand the theory and approximations used within the program"

"Don't create a computer model until the loading， material properties and boundary conditions are clearly defined"