

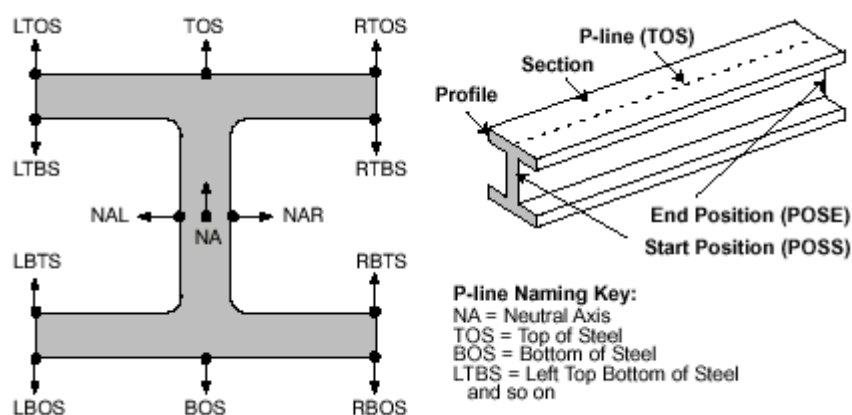
## 结构建模

### 程序组成

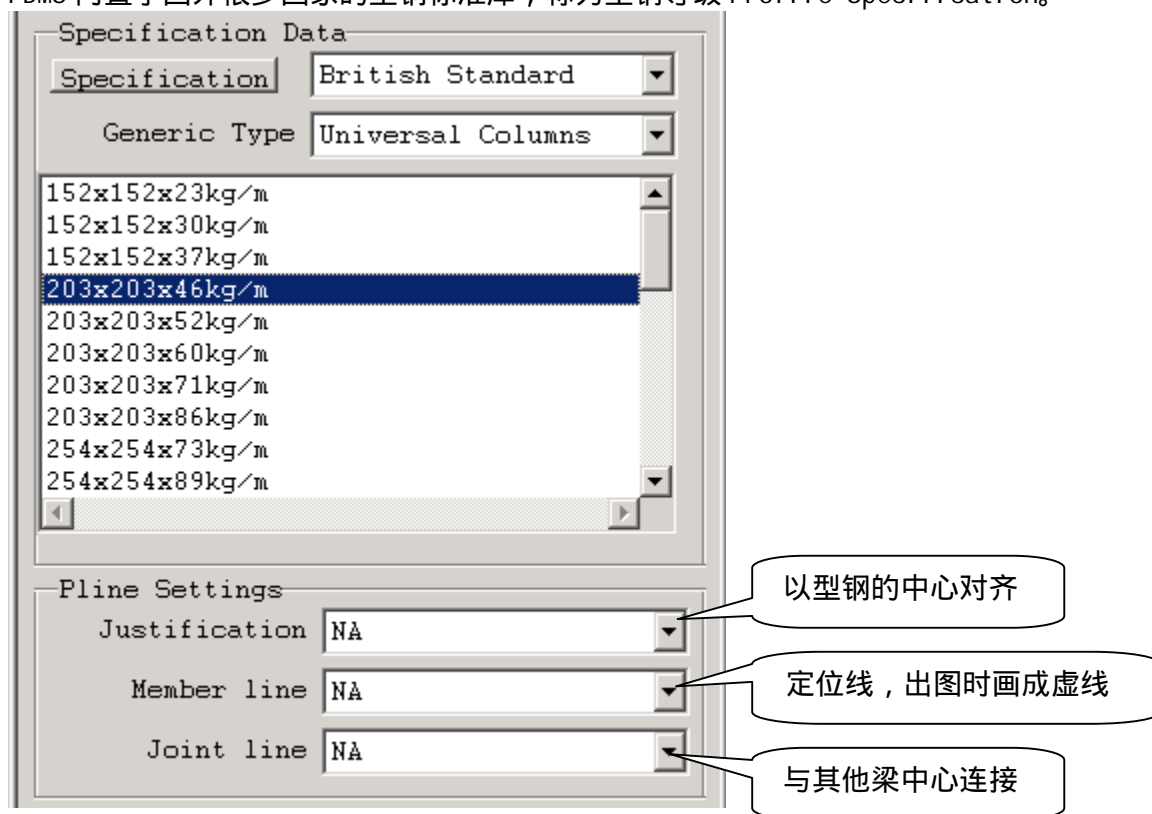
结构建模分为四部分程序：

- 1 . Beams & Columns
- 2 . Panels & Plates
- 3 . ASL Modeller (Access, Stairs and Ladders)
- 4 . Walls & Floors

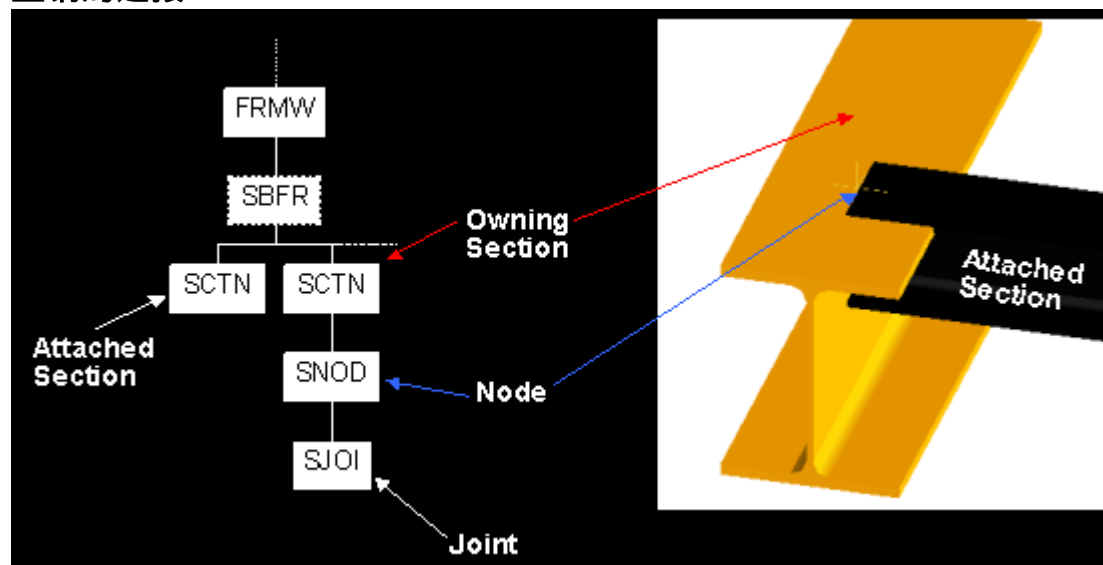
### 型钢及型钢等级



PDMS 内置了国外很多国家的型钢标准库，称为型钢等级 Profile Specification。



## 型钢的连接

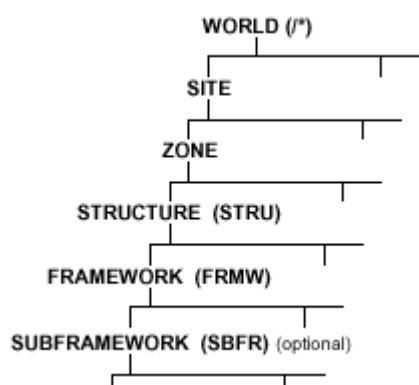


两个型钢的连接会产生一个 SJOI (Secondary joint)，而 SJOI 从属于 SNOD (Secondary Nodes)。

## 练习一：生成项目管理层

1. Creat>Site, 命名为 STABILIZER。Position>Explicitly 修改 SITE 的标高为 UP 100000mm。
2. Creat>Zone, 生成以下四个层次，注意它们是同一层次。  
 ZONE /EQUIP.ZONE  
 ZONE /PIPE.ZONE  
 ZONE /STEEL.ZONE  
 ZONE /CIVIL.ZONE

## 结构模型的层次及层次设置



练习中的用到的层次设置：

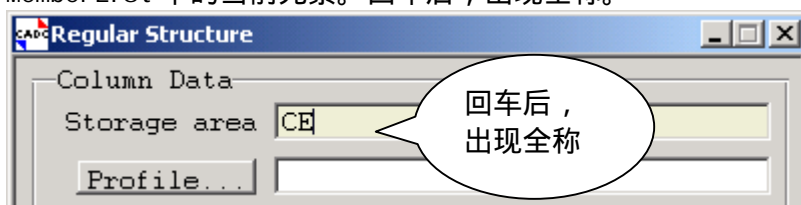
ZONE	STEEL.ZONE		
STRU	EQUI PRACK		
FRMW	EQUI PRACK/MAIN		设备框架 主框架
SBFR	EQUI PRACK/MAIN/COLUMNS		
SBFR	EQUI PRACK/MAIN/BEAMS		
SBFR	EQUI PRACK/ACCESS/BEAMS		挑梁

STRU	PIPEWORK	管廊
FRMW	PIPEWORK/MAIN	
SBFR	PIPEWORK/MAIN/COLUMNS	
SBFR	PIPEWORK/MAIN/BEAMS	
FRMW	BRACING-NORTH	斜撑
SBFR	BRACING-N	
FRMW	BRACING-SOUTH	
SBFR	BRACING-S	
ZONE	EQUIPRACK/ACCESS	设备框架附件
STRU	EQRACK/7M-STAIR	上层斜梯
STRU	EQRACK/5M-STAIR	下层斜梯
STRU	EQRACK/7M-FLOOR	上层平台
STRU	EQRACK/5M-FLOOR	下层平台

## 练习二：生成设备框架

框架的数据和型钢的大小请参考图集。

1. 选择梁柱模块 Design>Structure>Beams & column.
2. 确认在结构分区 STEEL.ZONE 下面。
3. Creat>Structure...命名为 EQUIPRACK.
4. Creat>Framework...命名为 EQUIPRACK/MAIN。是设备主框架。
5. Creat>SubFrame 命名为 EQUIPRACK/MAIN/COLUMNS。用于存放主框架的柱子。
6. Creat>SubFrame 命名为 EQUIPRACK/MAIN/BEAMS。存放主框架的横梁。
7. Creat>Section>Specials 在 Section Creation 列表中选择 2.Regular Structure.
8. 在弹出的对话框中首先要确定柱子 (COLUMN) 的存放位置。在 Member List 中定位在 SBFR EQUIPRACK/MAIN/COLUMN, 在对话框的 Storage area 栏中键入 CE, 表示在 MemberList 中的当前元素。回车后, 出现全称。



9. 点取 Profile 按钮, 选择柱子使用的型材。
10. 设置框架梁的存放位置及使用的型材。注意：梁的对齐方式为顶对齐 TOS。
11. 框架的西南角起点坐标为 W314200 N292990 U0。
12. 填入东 (EAST) 方向的起点坐标和跨距。
13. 填入北 (NORTH) 方向的起点坐标和跨距。
14. 填入两层框架的绝对标高。
15. 选择 Trim sections to plines. 修剪两柱的连接处

**Regular Structure**

**Column Data**

Storage area: /EQUIPRACK/MAIN/COLUMNS

Profile...: /BS-SPEC/203x203x46kg/m

Justification NA

Member Line NA

Joint Line NA

**Beam Data**

Storage area: /EQUIPRACK/MAIN/BEAMS

Profile...: /BS-SPEC/203x133x25kg/m

Justification TOS

Member Line NA

Joint Line NA

**Grid Origin**

Datum: /STABILIZER

Underside of Base-Plate: 0

SITE 的标高为 100000 米

框架的西南角起点坐标为 W314200 N292990 U0

East Spacings	North Spacings	Elevation
-314200	292990	4880
3660	2540	7930
	2870	
	2740	

其余的输入跨距

☒ Trim sections to Plines

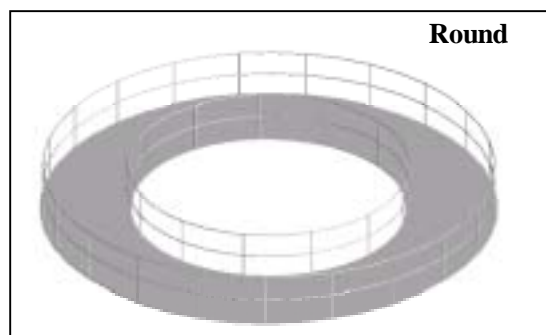
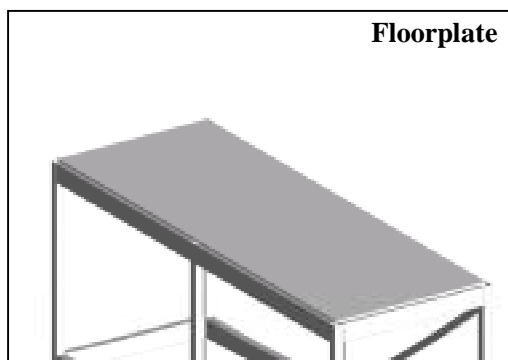
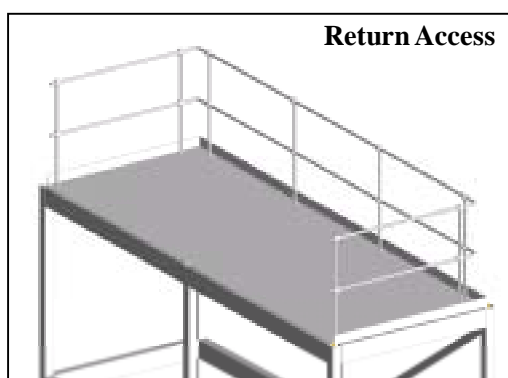
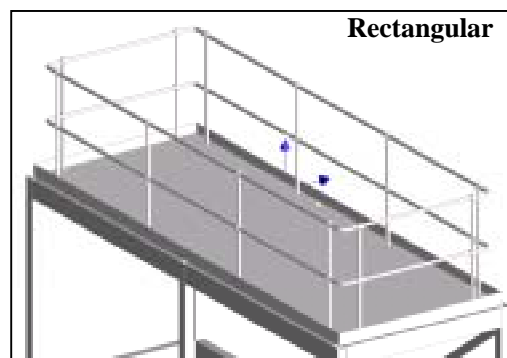
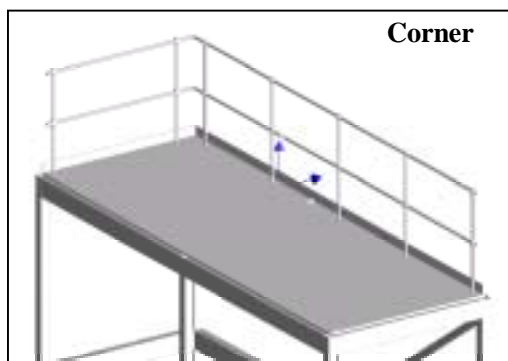
Preview

Apply Dismiss

16. 填完的对话框如图。Preview 预览没问题后 Apply，生成框架。Limits>drawlist 可以看到全部。

## 平台

平台包括以下几种类型



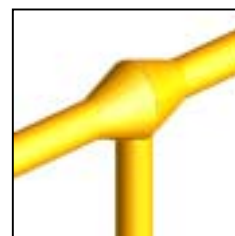
### 护栏连接形式



Ball Joint (Default)



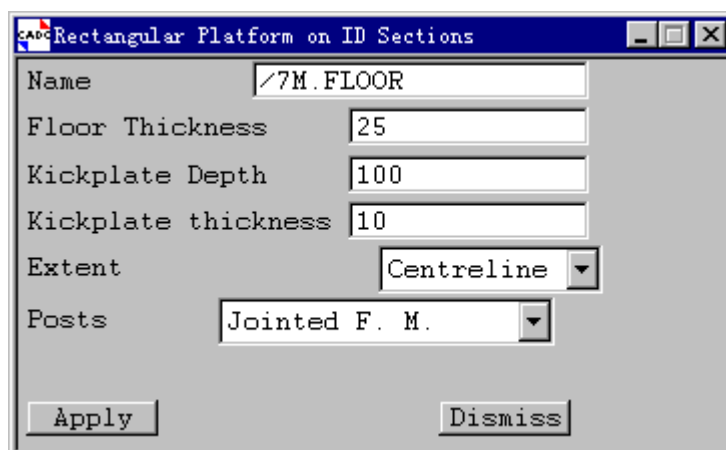
Tee Joint



Cone Joint

### 练习三：生成框架平台

1. 选择梯子平台模块 Design>Structure>ASL Modeller...
2. 生成梯子平台管理层 ZONE /EQUIPRACK/ACCESS。
3. Creat>Platform>Rectangular>On ID section。生成 7M 平台。

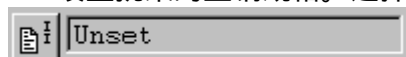


4. apply 后，根据提示依次选择北，南，东，西方向的横梁。

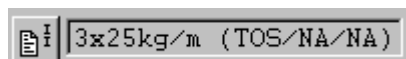
## 练习四：生成 5M 平台

## 练习五：生成顶部平台挑梁

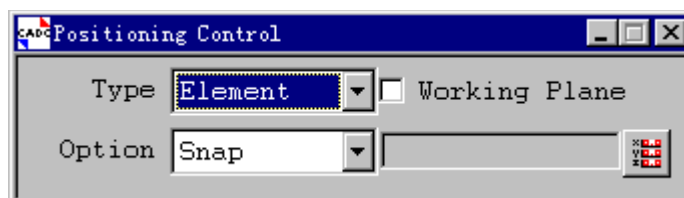
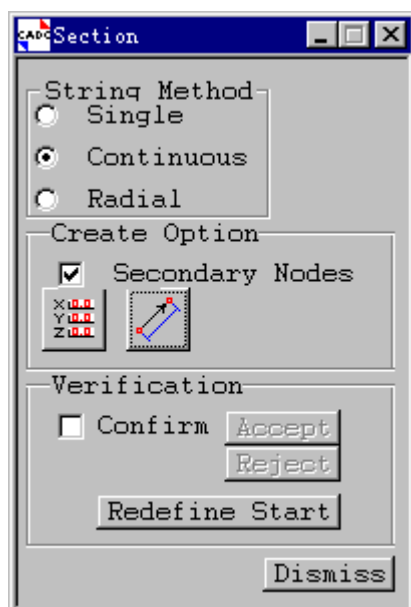
1. 返回到 Structure>Beams & column.
2. 设置挑梁的型钢规格。选择左面的图标。



设置挑梁的型钢规格与框架的横梁规格一致，顶对齐。完成后如下图：



2. 确认在 FRMW EQUIPRACK/MAIN 这一级。Creat>Sub frame...生成一个子集。  
SBFR EQUIPRACK/ACCESS/BEAMS
3. Creat>Section>straight...在 Section string method 中选择 Continuous.



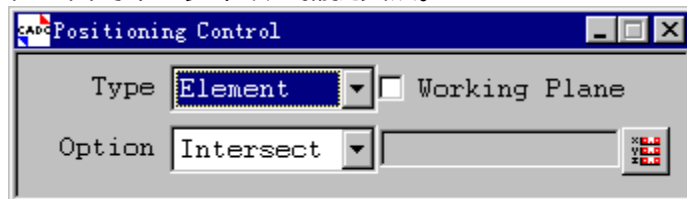
4. 在 positioning control type 中选择 Element。选择框架柱子的上端，自动会捕捉到柱子的端点，并在端点处提示 start 点。
5. 第二点采用极坐标方法生成，在 Creat Option 中选择按钮



输入终点方向和距离，自动生成一段梁。可以连续生成。

### 练习六：生成中间回廊挑梁

在上面的第 4 步中设置捕捉交点。



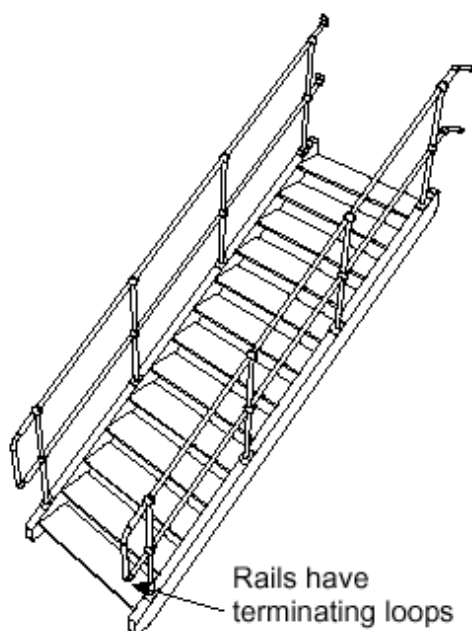
然后选择柱子和横梁，它们的交点自动成为起点。

### 练习七：生成回廊平台

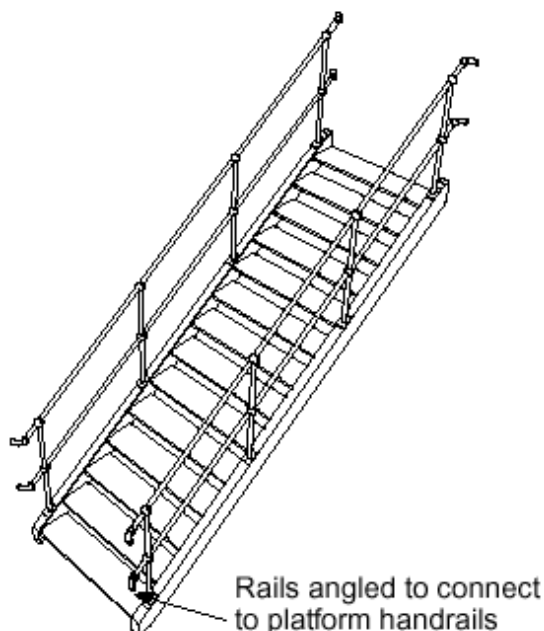
护栏的修剪方法见《Accessways, Stairs&Ladders Application User Guide》第 7 节

### 斜梯

有两种类型的斜梯，缺省的参数设置见 Setting>Default。



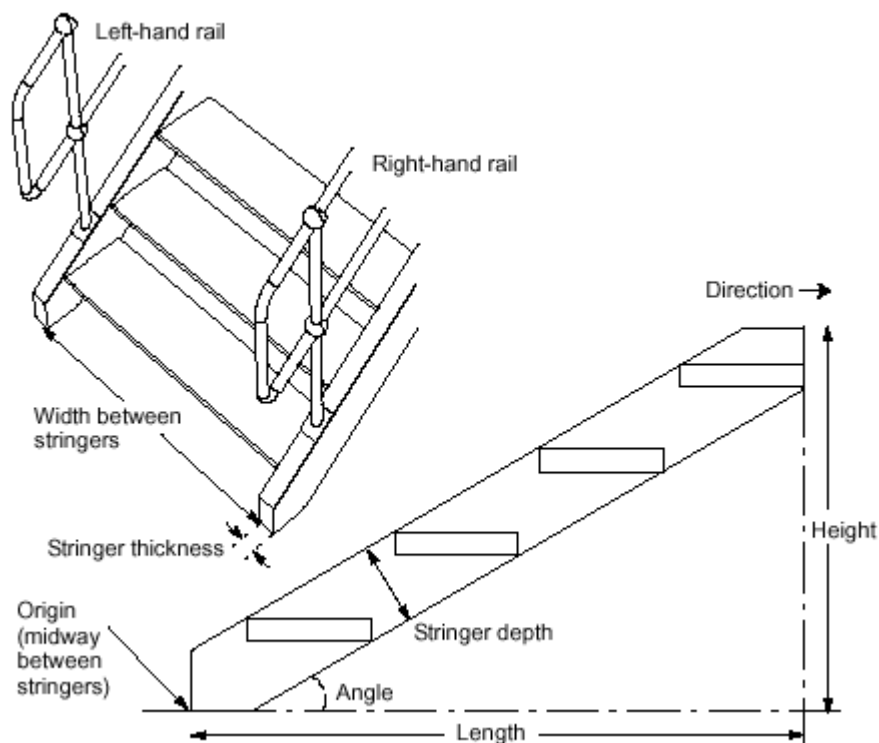
**Bottom Flight**



**Top Flight**

### 练习八：生成 5-7M 斜梯

1. 选择梯子平台模块 Design>Structure>ASL Modeller....
2. 确认当前元素是 ZONE EQUIPRACK/ACCESS。
3. Creat>stair>bottom flight>height&length. 命名为 5-7M.STAIR，方向为 N。不用给出精确坐标，通过参考点可以定位。



定位点(Origin)在斜梯底端。但为了定位方便，程序在斜梯顶端通过计算得到一个参考点 Reference point，可以通过参考点定位

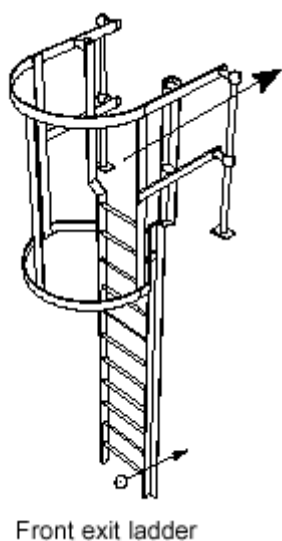
4. Connect>Reference point。选择 BOX 侧面的 Ppoint 作为定位点。

### 练习九：生成 0-5M 斜梯

国外的设计规范中，斜体的踏步不允许超过 18 级，0-5 米的斜梯时 21 级台阶，所以要修改缺省的参数设置 Setting>Default。

### 练习十：生成直梯

1. Creat>Ladder>FrontExit。其他类型的直梯见参考手册。



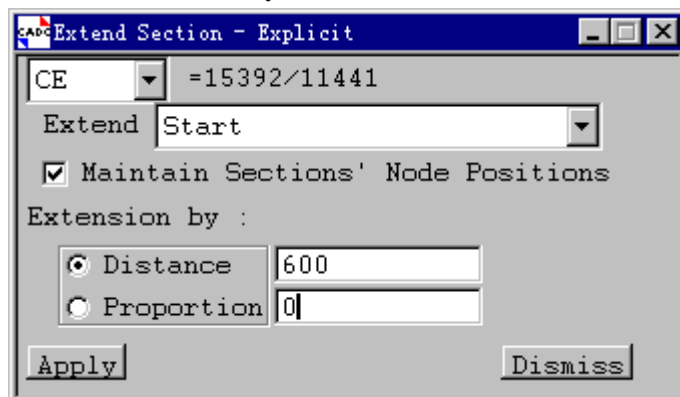
### 练习十一：管廊



1. 生成管廊数据库层次。
2. 生成 3 层管廊。

## 练习十二：延伸 Extend

1. 选择要延伸的柱子。
2. Position>Extend>By...。选择柱子的延伸点（Start 还是 End）和延伸距离。

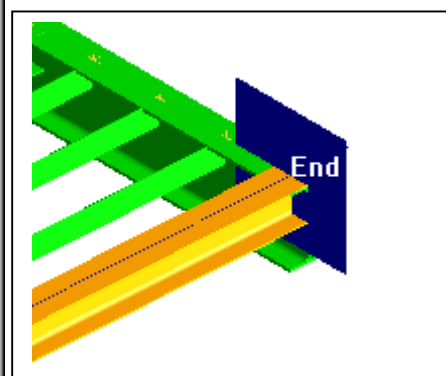


## 练习十三：生成及拷贝管廊挑梁

1. 生成一个挑梁
2. 拷贝生成。Creat>Copy>Offset.
3. 选择菜单 Offset>From Element>To Element。自动测量出偏移的距离。
4. 重复上一步，共生成 4 个挑梁。

## 练习十四：延伸与修剪

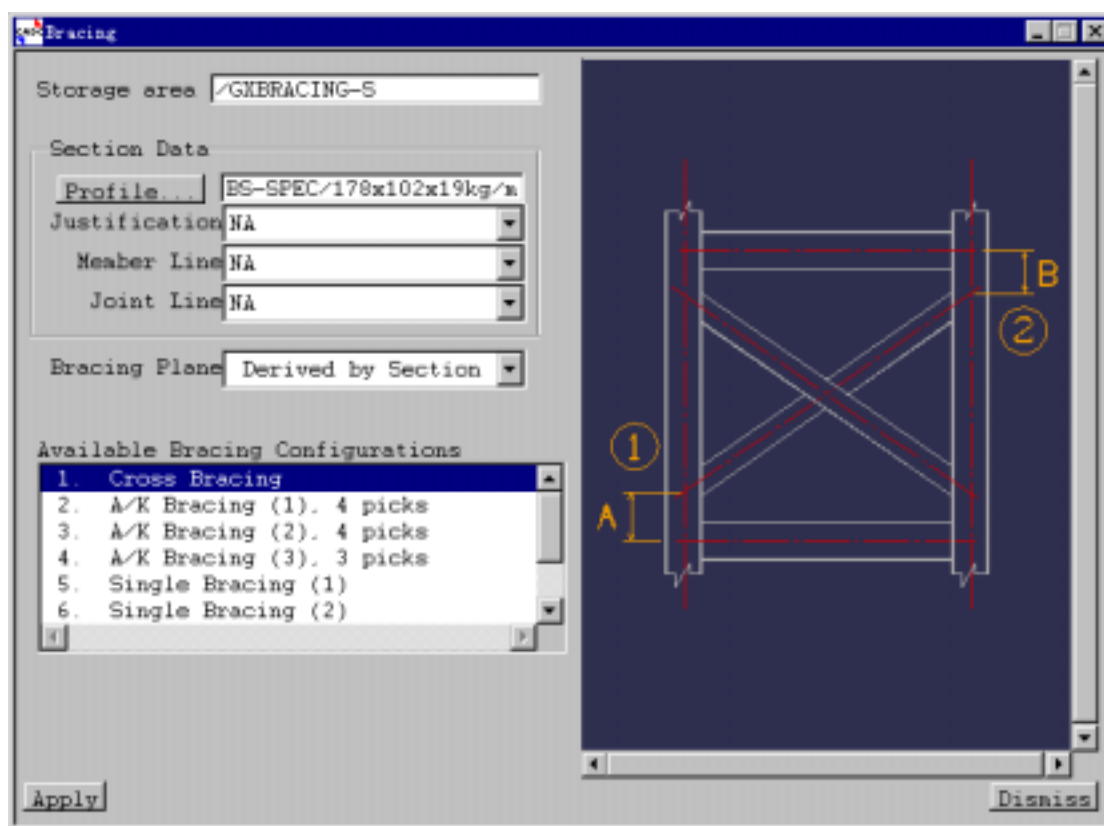
1. 选择要延伸的柱子。
2. Position>Extend>Through....



3. Cursor>Element。选择延伸面。Plane Direction 是法线方向。
4. 修剪。Connect>Trim to Section>Pick。选择需要修剪的梁，然后按 Esc 键。

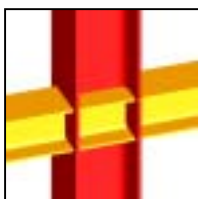
## 练习十五：斜撑 Bracing

1. Creat>Section>Bracing configuration. 选择保存区域，型钢规格及斜撑类型。

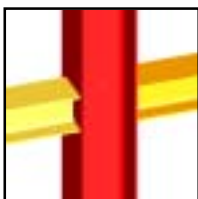


## 分割 Splitting sections

分割有三个选项：

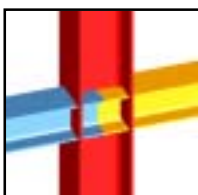


**初始状态**  
一个连续的梁穿过柱子



### 1. 修剪分割 Trimmed split sections

这种情况下一般的选择是修剪（trimmed），梁的端点在柱子最外侧的 p-line 上。自动生成连接关系。



### 2. 点分割 Nodes split sections

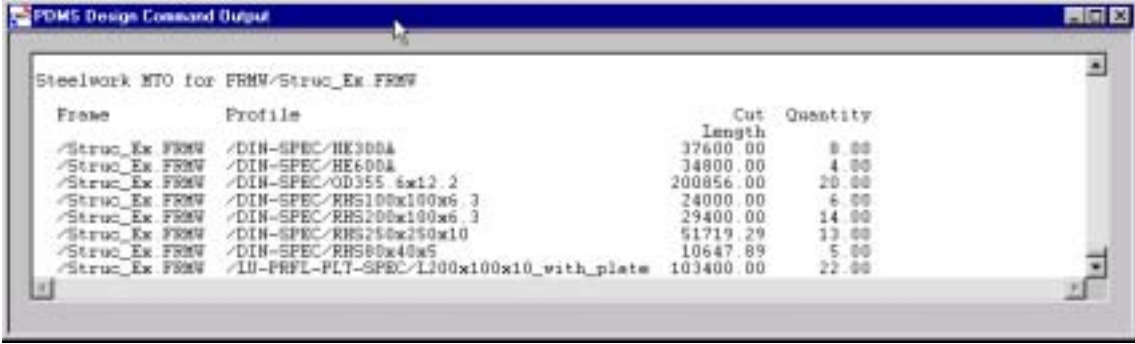
在 node 点上分割横梁，自动生成连接关系。

### 3. None

类似于第二个选项，在 node 点上分割横梁，自动生成连接关系。

## 生成报告

Utilities>Reports>Run 选择 steel\_mto.tmp

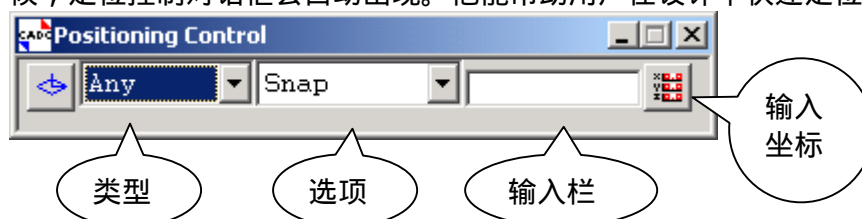


Frame	Profile	Length	Quantity
/Struc_Ex FRMW	/DIN-SPEC/HE300A	37600.00	8.00
/Struc_Ex FRMW	/DIN-SPEC/HE600A	34800.00	4.00
/Struc_Ex FRMW	/DIN-SPEC/OD355 6x12.2	200856.00	20.00
/Struc_Ex FRMW	/DIN-SPEC/RHS100x100x6.3	24000.00	6.00
/Struc_Ex FRMW	/DIN-SPEC/RHS200x100x6.3	29400.00	14.00
/Struc_Ex FRMW	/DIN-SPEC/RHS250x150x10	51719.29	33.00
/Struc_Ex FRMW	/DIN-SPEC/RHS60x40x5	10647.89	5.00
/Struc_Ex FRMW	/LU-PHFL-PLT-SPEC/L200x100x10_with_plate	103400.00	22.00

## 定位控制 Positioning Control

### 用途

在事件驱动图形模式下（event-driven graphics mode）当你需要选取一个定位点的时候，定位控制对话框会自动出现。他能帮助用户在设计中快速定位。



### 类型：

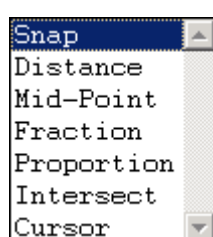
在光标选择时，控制那一类的元素响应光标的选择。同时被选中的元素在图形中高亮显示，在状态行中显示详细信息。

类型中的选项包括：

Any	任意的元素，aid，pline 或是 p-point。
Element	元素的定位点，对于型钢来说，是 start 和 end 点。
Aid	辅助线。
Pline	型钢的 plines 线。
Ppoint	P-points 或者 panel 的定位点（vertices）。
Screen	屏幕中的任意一点，在图中得到的是二维点，纵深点来源于当前的工作平面。
Graphics	任意的图形元素。

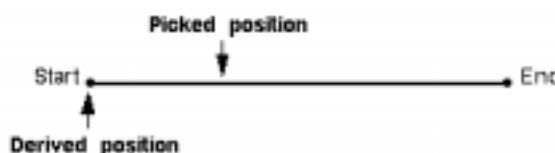
### 选项

决定了在光标选择了元素后定位点如何确定。



**Snap** 捕捉到靠近拾取点的最近点。对于型钢来说，意味着最近的 start 或 end 点。

#### The Snap pick option



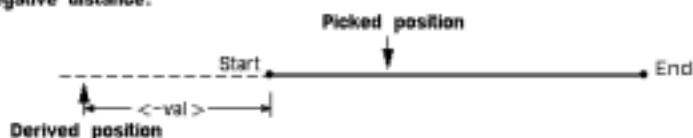
**Distance** 在输入栏中输入数值，光标能拾取到距最近捕捉点给定距离的点。负值则向相反方向。

### The Distance <val> pick option

Positive distance:

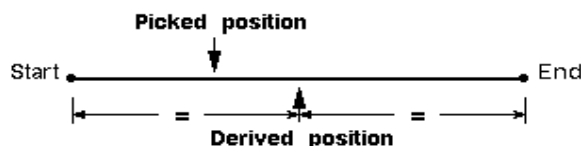


Negative distance:



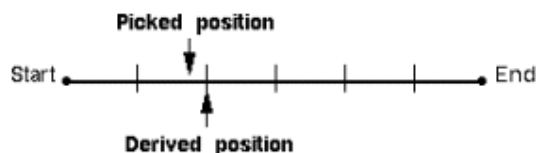
**Mid-Point** 光标拾取到中心点。

### The Mid-Point pick option



**Fraction** 在输入栏中输入分割份数，光标捕捉到最近的分割点。

### The Fraction <val> pick option



**Proportion** 在输入栏中输入分割比例，光标捕捉到最近的分割点。例如 0.25。

### The Proportion <val> pick option



**NOTE:** <val> is expressed here as a proportion of the distance from Start to End.

**Intersect** 两个元素的交点。

### The Intersect pick option

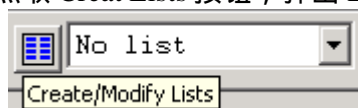


**NOTE:** Linear items picked here do not intersect. Derived position is at projected intersection of second picked item onto first picked item, so order of picking is significant.

**Cursor** 光标在元素上拾取的任意一点。

## 练习十七：组 LIST

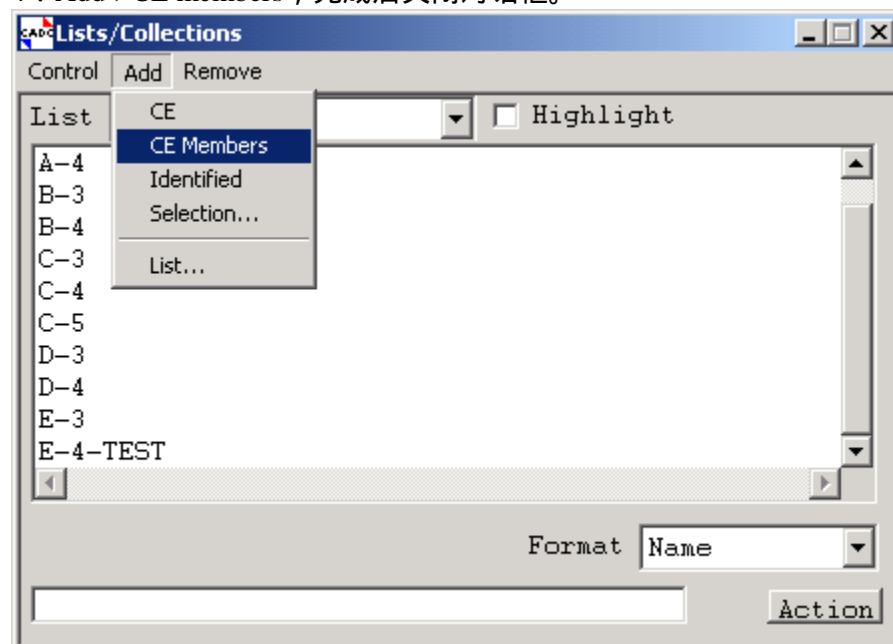
1. 点取 Creat Lists 按钮，弹出 List/Collections 对话框。



2. Add->List，键入描述为 A。

3. 在 Member List 中定位到设备框架柱子  
SBFR EQUIPRACK/MAIN/COLUMNS。

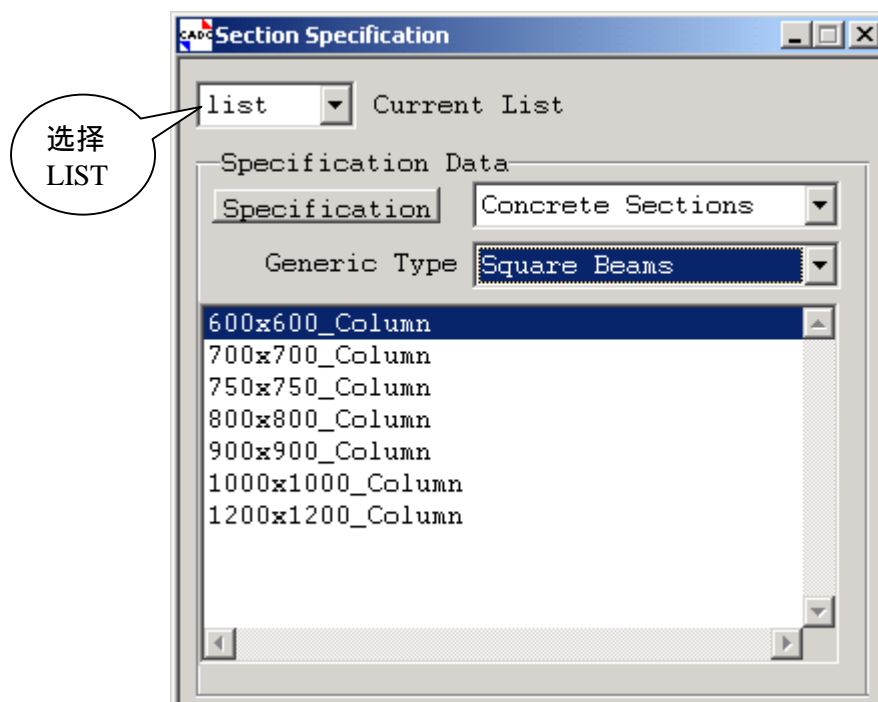
4. Add->CE members，完成后关闭对话框。



## 练习十八：修改型钢截面形式

将设备框架柱子截面形式改成混凝土形式。

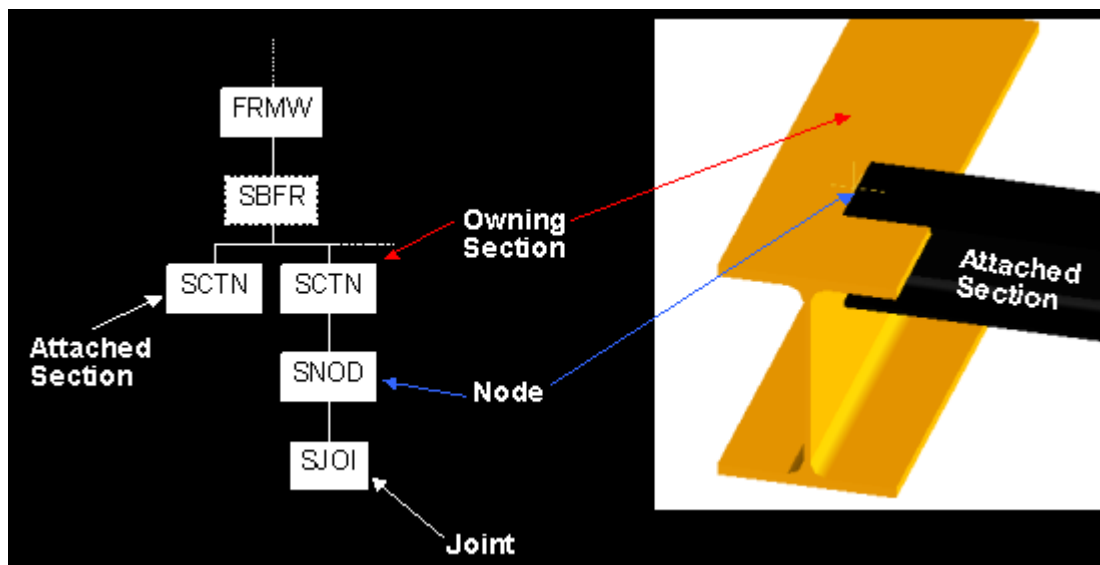
1. Modify->Sections->Specification...,在屏幕中选择一个柱子，弹出对话框。



2. 选择 LIST，然后将型钢截面改成混凝土形式 Concrete Sections。

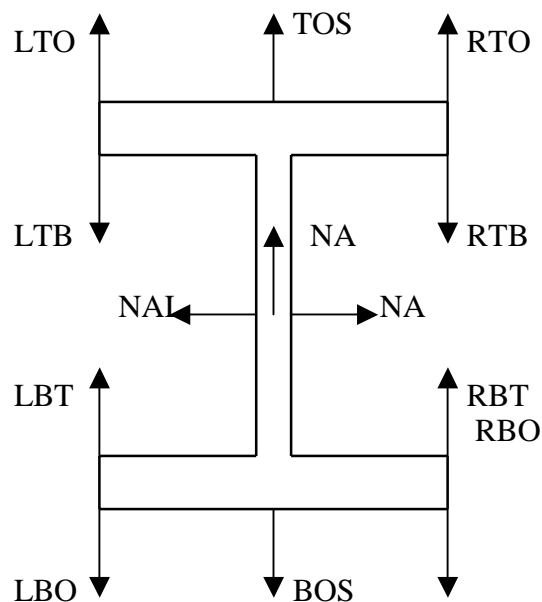
## 练习十九：板 Panel

1. 切换模块 Design->Structures->Panels&Plates。
2. 在导航器中定位在 SBFR
3. Creat->Panels。



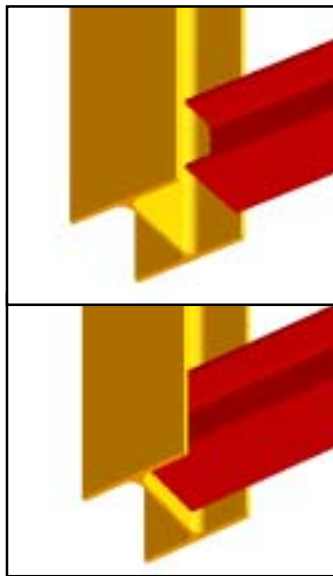
## P-line Rules

Pline rules describe how two sections are to be connected together. They also decide which P-lines will be visible and available for positioning of fittings, penetrations etc.



The most commonly used P-line rule is: **pkey eq 'NA' or CCON eq 'ANY'** The rule makes P-line 'NA' and all the P-lines with the CCON attribute set to 'ANY' feasible for connections and snapping. According to the figure above: TOS, BOS, NAL and NAR have CCON set to 'ANY'. This rule is provided as a standard rule, but needs to be set.

From the main menu: **Settings>Pick Filters>Plines... Define Rule....**Select Rule 'Normal' and press OK.



Connection with no rule set:

Connection with “normal” rule:

**pkey eq 'NA' or CCON eq ANY'**

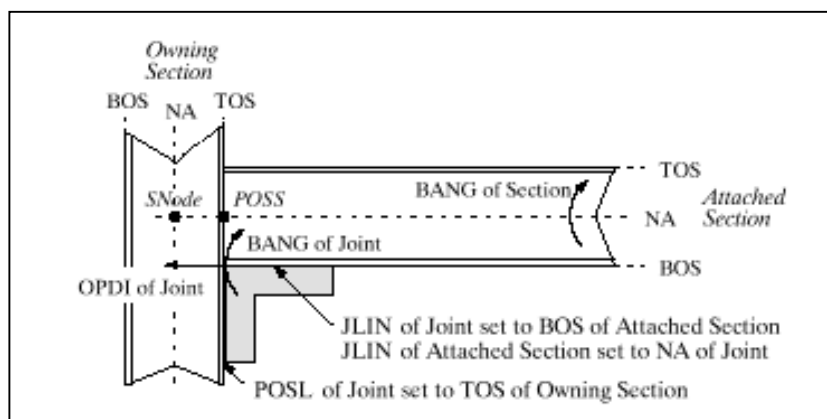
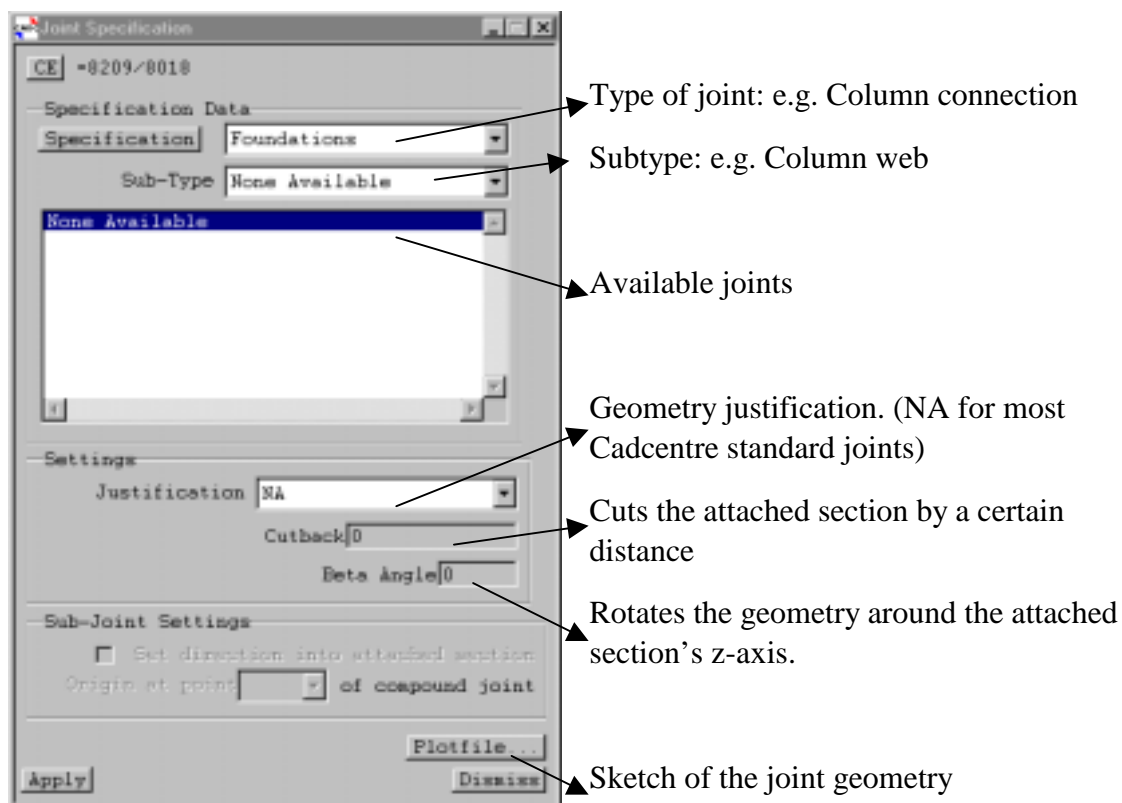
Cadcentre supplies a set of standard details in the catalogues, which can be used for detailing. It is however important that each company build their own standard details in the catalogues.

### Secondary Joints

The secondary joints can have an associated geometry, which is stored in a catalogue. The shape of the joint geometry can be parameterised to suit more than one specific occurrence.

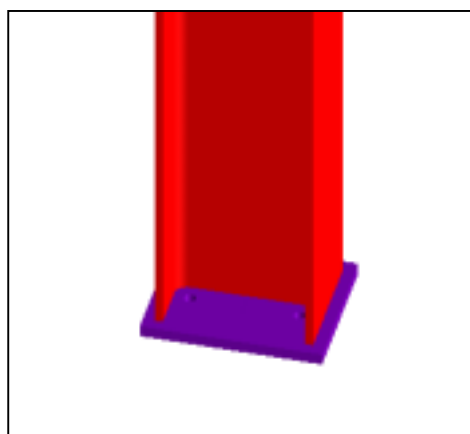
**Modify>Joints> Specification** → ‘Select a connected section end’ - Will bring up the following menu:





## Primary Joints

The geometry of a primary joint can be selected from a specification in a similar way to secondary joints. Typical catalogue geometry's for Primary Joints would be: Base plates, Foundations, Sealing plates etc

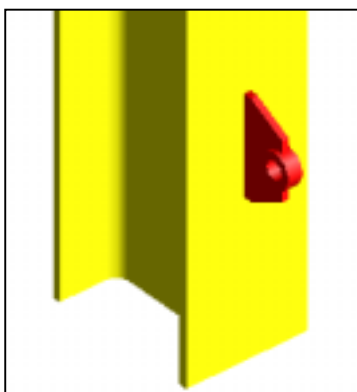
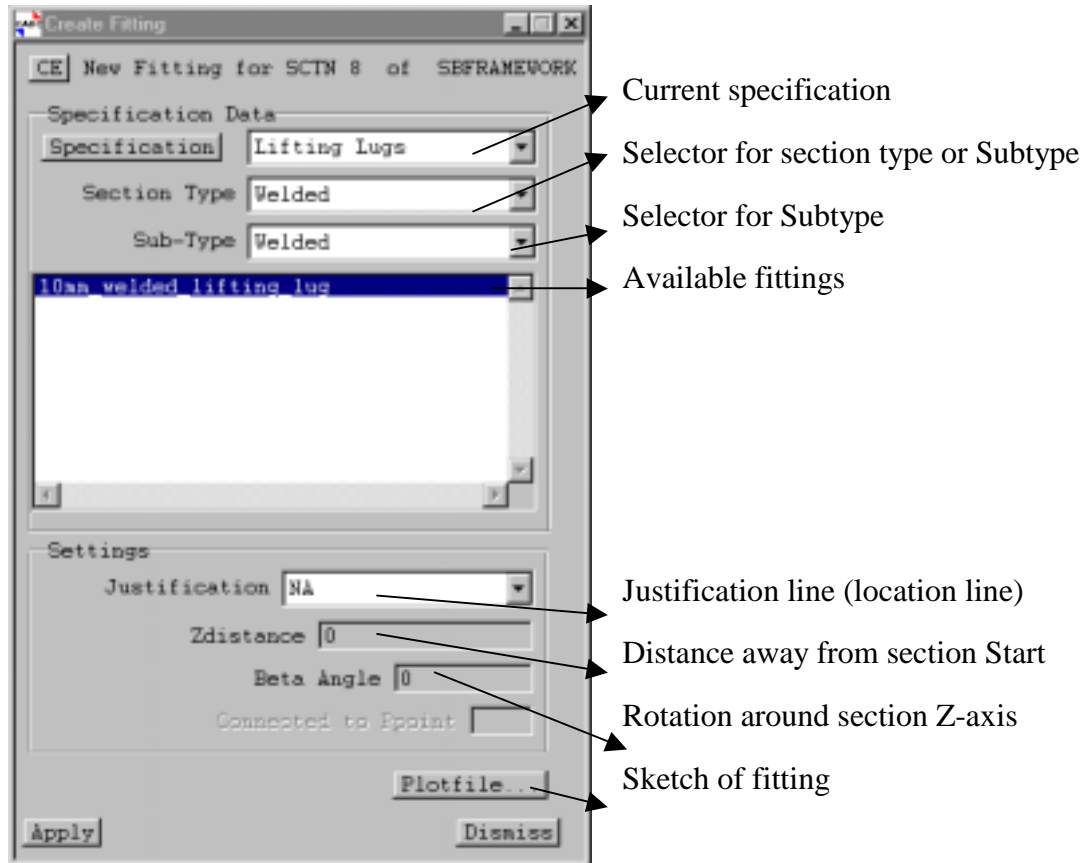


### **Joint Freedom**

When a connection is made between structural elements the joint can either be dominant or subordinate, by default it is subordinate. If a joint is subordinate then this means that if the owning section is moved then in response the attached sections will only extend or retract when the p-line rules are re-executed, in some situations this results in an unrealistic geometry with section end. When the joint is dominant the owning section doesn't only describe the cut-plane for the attached section with p-line rules, it also describes the end point of the section dragging the connected end of the attached section to the new position of the joint on the owning section.

## Fittings


A Section fitting does not belong to joints or nodes and can therefore be located anywhere along a section. Various types of fitting are available in the standard catalogue, e.g. Web stiffeners, Lifting lugs, fire insulation, etc. From the main menu bar in the Beams & Columns application **Create>Fitting...**



Lifting lug located on TOS of HEA section

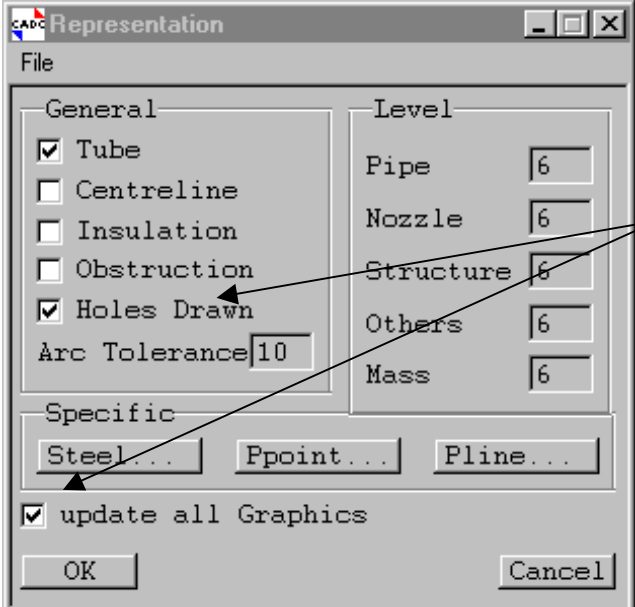
## Structural Exercise 4- Section Fittings and Joints

- Modify one of the Main girder to Main girder joints to look like the picture below.

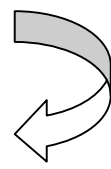
	<p><b>Modify&gt;Joints&gt;Specification...</b></p> <p>Identify end of section to be modified</p> <p>Select:End Preparations</p> <p>Simple Examples</p> <p>Flush_p_cutback_with_snipe</p> <p>Justification: NA</p> <p>Cutback: 0</p> <p>Beta angle: 0 or 180</p> <p>→ Apply</p> <p>Give a Rathole radius: 30</p>
---	---

If an error message occurs, check if the sections are connected, if they need connecting select **Connect>Connect** and connect them.

If the cutouts are displayed like black wireframe lines change your graphical representation mode: **Settings>Graphics>Representation...**



Toggle these buttons and press Apply.



- Copy the joint specification to the other side of the section using:  
**Modify>Joints>Joint Like>Maintain Pline**

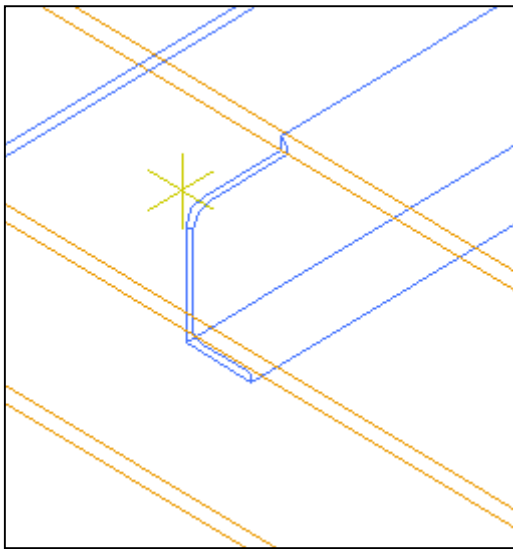
- Hit joint to be copied like and then joint to be modified.

The 'Maintain Pline' option is used for copying joints to the same section, while 'Use copied Pline' is used for adjacent sections.

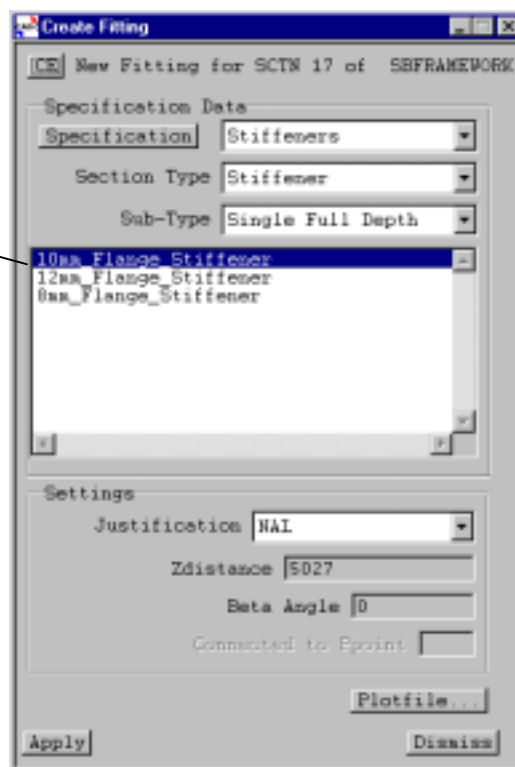
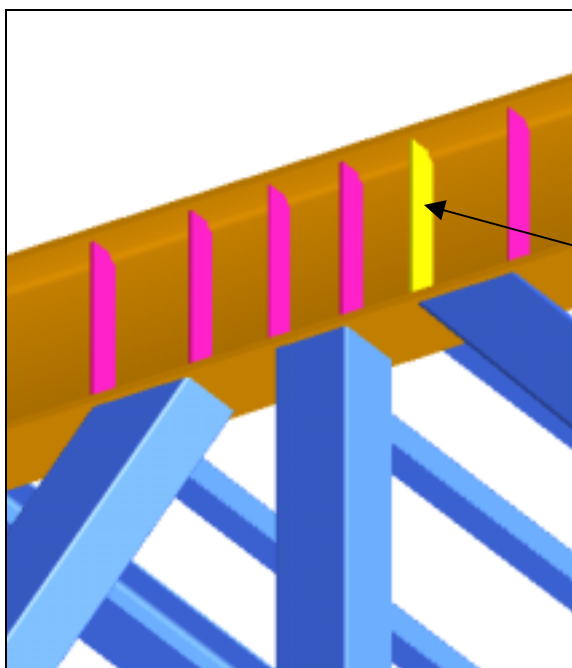
- Modify the Angle to Main Girder Joints to:


End Preparations, Simple Examples, Angle\_with\_plate, Rathole 0.

Switch to wireline representation if it is hard to see the joint (F8)



- Modify the tubular joints to: Tube Connections, Bracing Tube, TUBE/TUBE/CONNECT
- Add web stiffener brackets at the location of incoming bracing. See figure next page **Create>Fitting>Single...**



Use the measuring facility to find the position of the stiffeners 



1. Snap Pline on Column
2. Snap Pline on Bracing



## Copy Multiple Attached

There are often instances, as in the beginning of our example, where a section needs

to be copied several times at regular centres, this would happen for example in a floor deck or where a uniformly distributed load is being applied to a bay. Each copy needs to have connections to the same elements and the same joint preparation. (Multiple offset copy would produce the items but with no connectivity.)

Copy multiple attached automatically calculates how many sections at a given centres will fit in a bay, after the designer has selected the number of sections required they are produced complete with a copy of the connection details of the original. All the designer has to do is select the original as CE then select **Create>Sections>Multiple Attached....**