



# Applied Steel Detailing

Tekla Structures 11.0 Basic Training  
February 10, 2005

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# 1

# Applied Steel Detailing

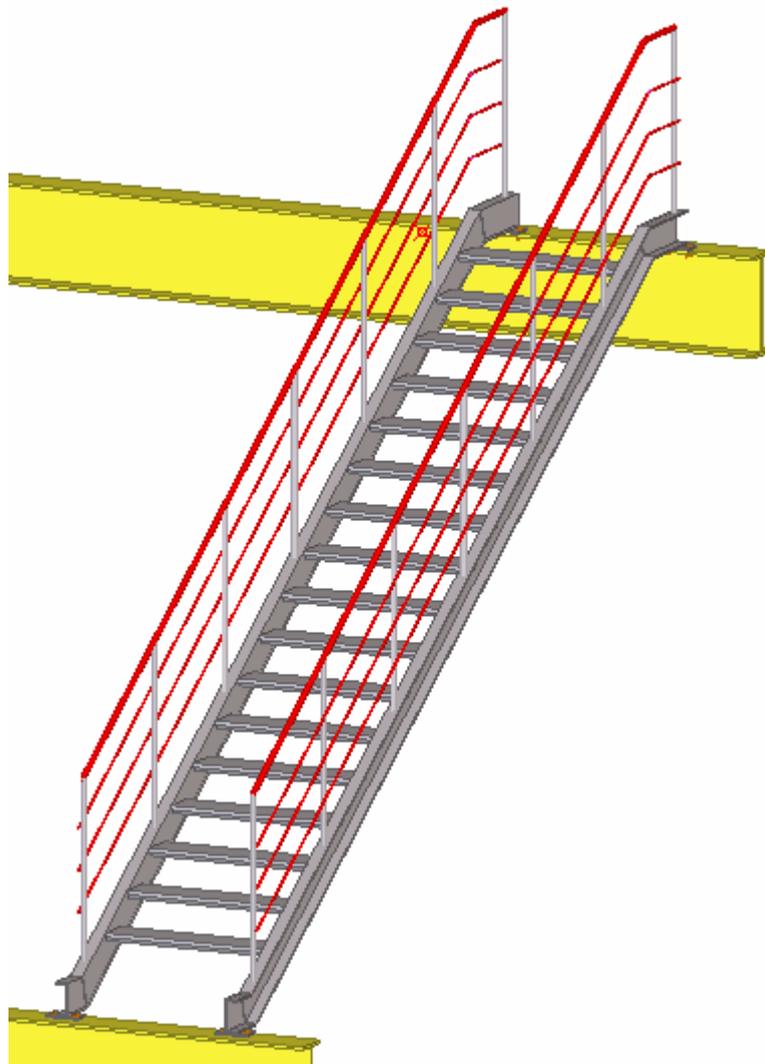
## In this lesson

In this chapter we will first create connections by using default AutoConnection / AutoDefault rules. We will get acquainted with the logic that defines how certain connections are created to certain positions according to the AutoConnection rules.

We will then create new AutoConnection rules for this project, remove the existing connections and replace them using a new AutoConnection rule group.

We will also study how AutoConnections react to changes in the model.

We will then create steel stairs.



# 1.1 AutoConnections

You can create connections either manually (as we did in lesson 2) or by using AutoConnections.

**Help: Getting started > Using components > Creating components**

**Help: Getting started > AutoConnection > Using AutoConnection**

We recommend you to use AutoConnections for creating connections. When you use AutoConnection, Tekla Structures automatically creates connections using a predefined set of rules, or rule group.

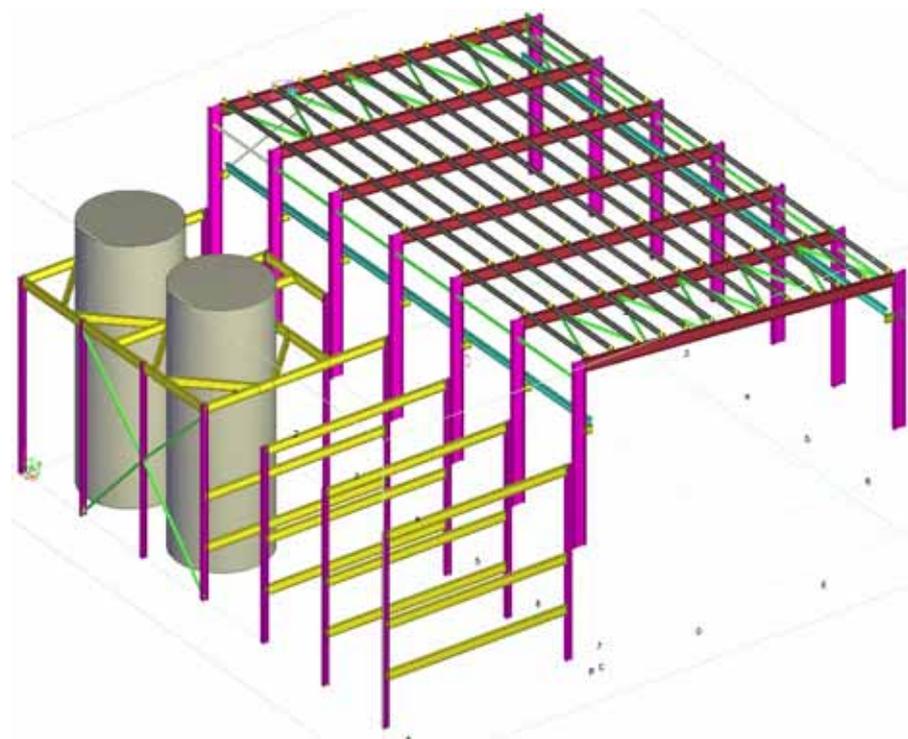
With AutoConnection, Tekla Structures automatically creates similar connections for similar framing conditions.

When you are creating AutoConnections you can also choose which connection properties you want to use (AutoDefaults).

## Run default AutoConnections

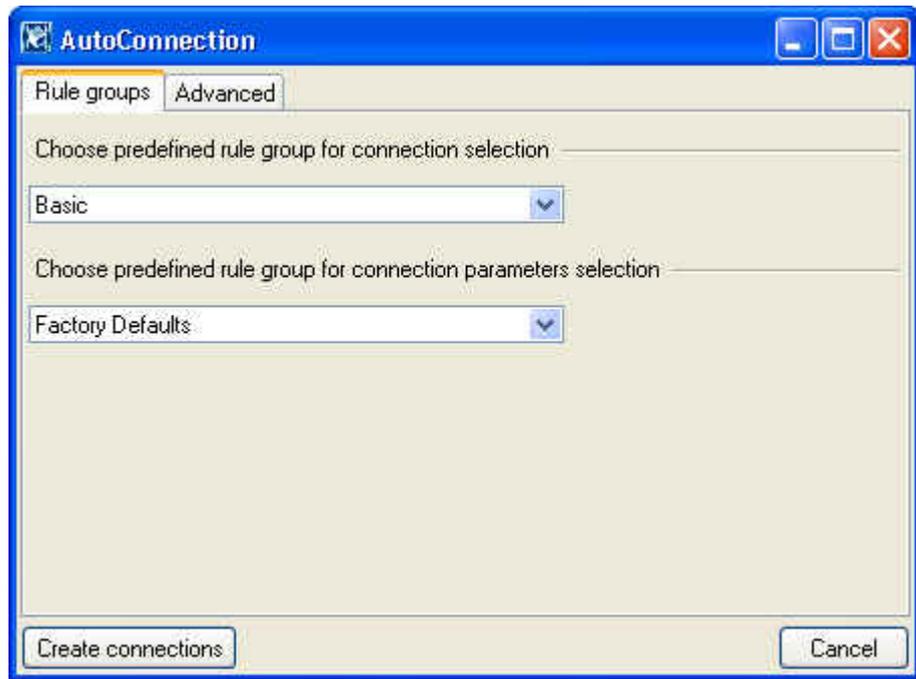
### Delete connections

1. Create or open a pre-defined view where only steel members are visible.
2. Select all the connections and delete them.



### Create auto-connections

1. Select all the visible parts in the model.
2. Select **Detailing > AutoConnection...** to display the **AutoConnection** dialog box.
3. Select a default rule group **Basic** for AutoConnection.
4. Select a default rule group **Factory defaults** for AutoDefaults.
5. Click the **Create connections** button.



The connections are created.

## 1.2 General about the Criteria for Creating Connections

The AutoConnection setup is a tree structure containing rules.

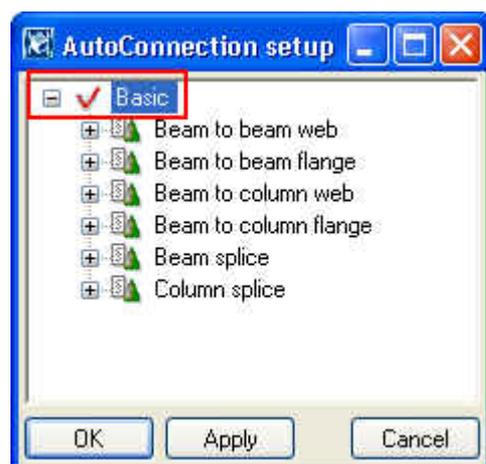
To apply a particular connection, the conditions within the model have to match all the rules in the branch containing the connection.

The order of the rules in the tree is important. Tekla Structures uses the first rule that matches the conditions within the model.

### Rule group

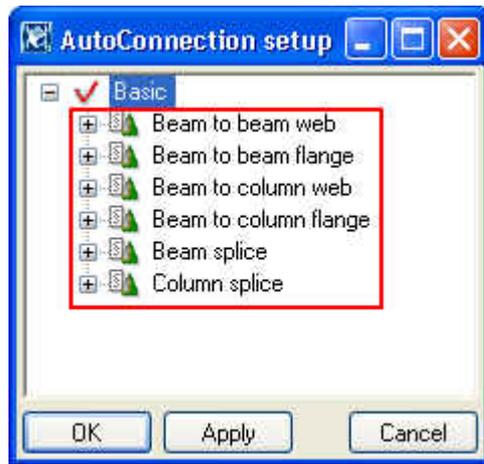
The first level in the tree is the rule group: a user-defined group of rules for different standards, projects, manufacturers or models.

You can create connections using the predefined rule group in the **AutoConnection setup** dialog box (as we did above). The dialog opens when you select **Setup > AutoConnection...** on the menu.



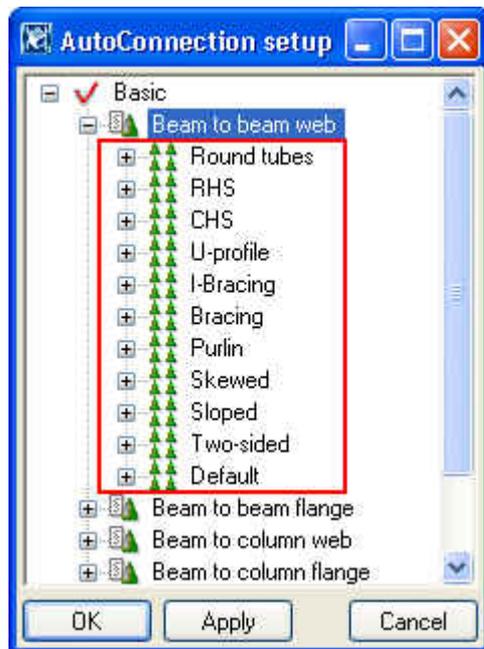
### Framing conditions

The second level shows the six different predefined framing conditions in AutoConnection setup which you cannot change.

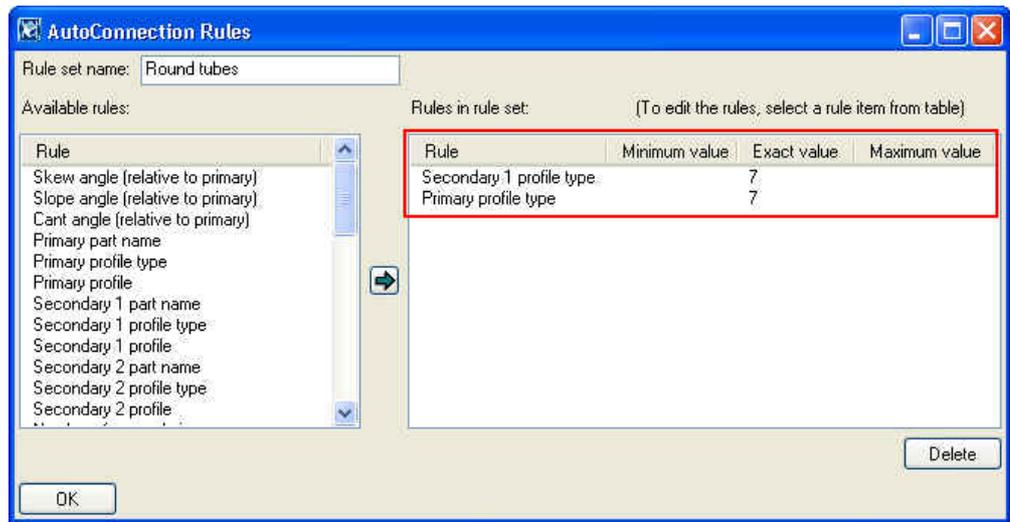


## Rule sets

Under each framing condition you can create rule sets to specify which connection to use for specific conditions within the model.



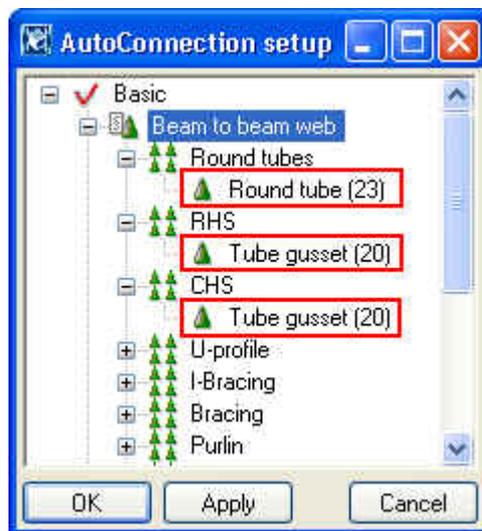
Each rule set can include several single rules to filter the cases.



The name of the rule set is just a descriptive name that is displayed in the tree structure. The actual filtering is done according to criteria set in the rules.

## Connections

Under each rule set you can select the connection to apply if the rule set criteria is met. It is also possible to define that in a certain case no connection is to be created.



The order of the rules in the tree is important. Tekla Structures uses the first rule that matches the conditions within the model, so you should place the most limiting rule highest in the tree, and the most generic, lowest.



You can change the priority of a rule set by right-clicking on the rule set and selecting **Move Up** or **Move Down**.

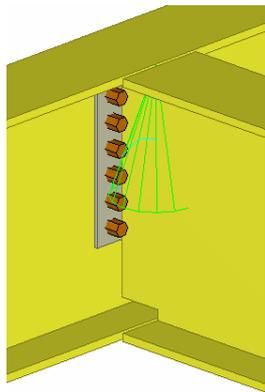
## 1.3 Study the Connections Created

We will now study two "beam to beam web" connections created by the default rule group **Basic**.

### End plate

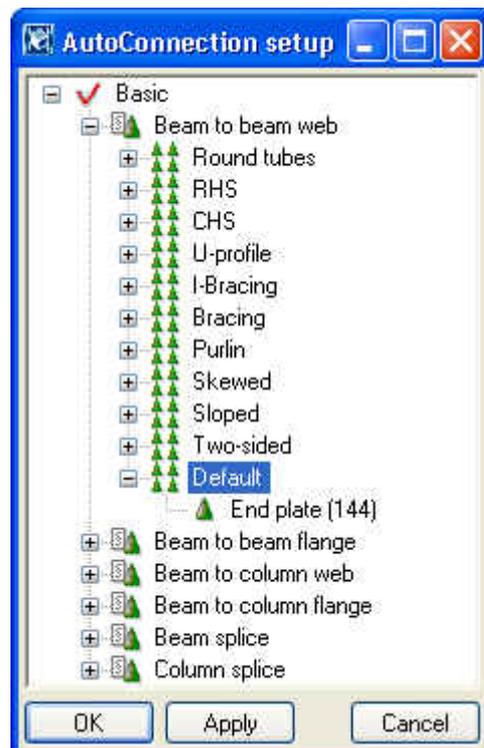
Check rule set used

1. Double-click on one of the straight beam to beam web connections around the silos.  
It appears to be **End plate (144)**.

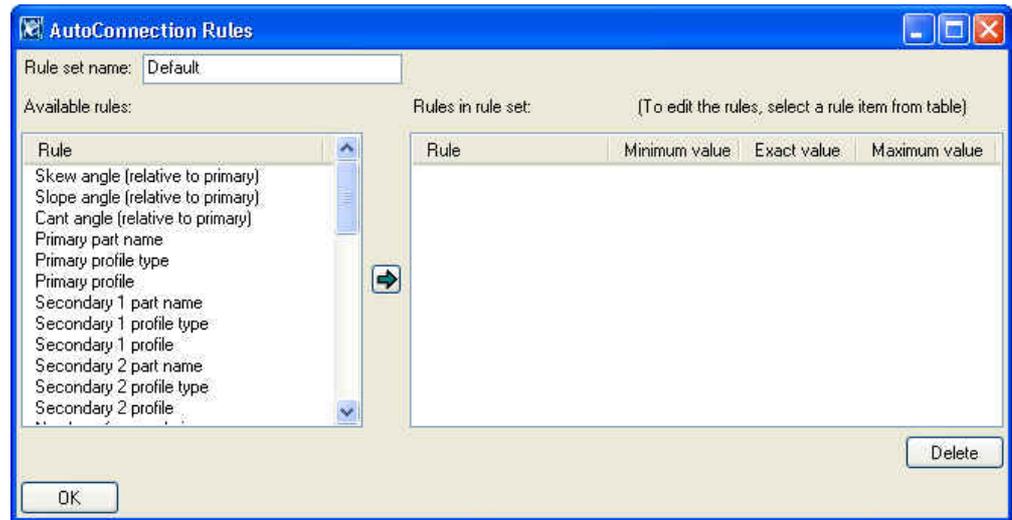


2. From the **Beam to beam web** framing condition in the **AutoConnection setup**, check the names of the rule sets.

No other rule set name (Round tube, RHS, CHS, Bracing) seems to match with the conditions in the model but the **Default**.



- Right-click on the **Default** rule set and select **Edit rule set...** to open the **AutoConnection Rules** dialog box.



You can see that there are no rules defined in the right pane under **Rules in rule set**.

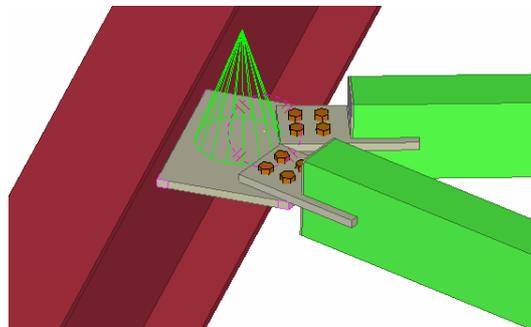
Since the **Default** rule set does not have any rules defined, all the **Beam to beam web** framing conditions that don't match with any other rule sets will match with the **Default** rule set.

This is also the case with our example.

## Tube gusset

### Check rule set used

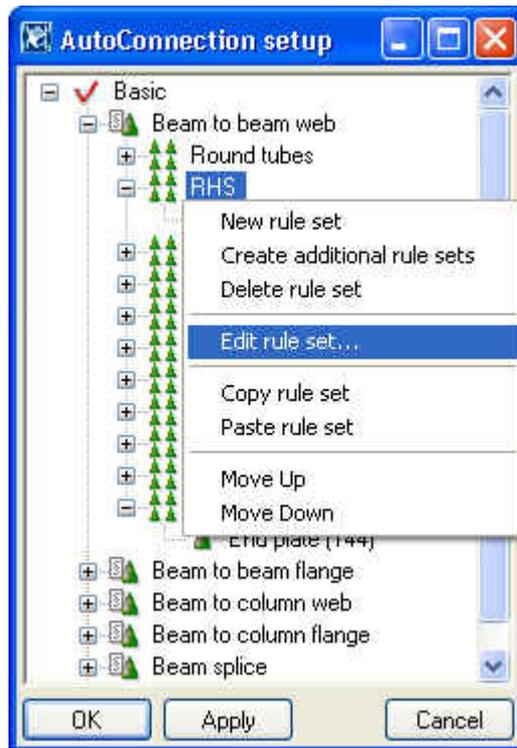
- Double-click on one of the horizontal brazing connections on the gridline 1.



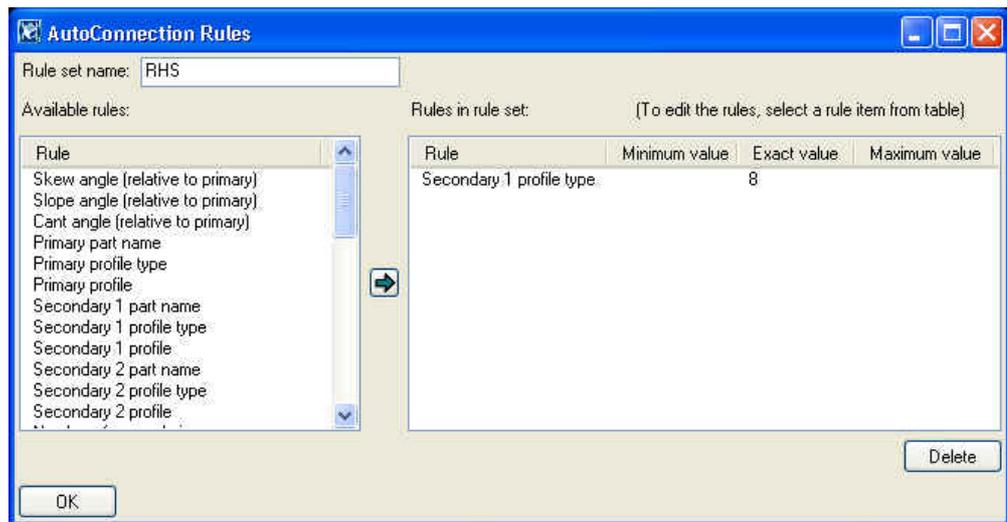
It appears to be a **Tube gusset (20)** connection.

- From the **Beam to beam web** framing condition in the **AutoConnection setup**, check the names of the rule sets.

In the tree we can see that the first rule set name that matches our example conditions is **RHS**.



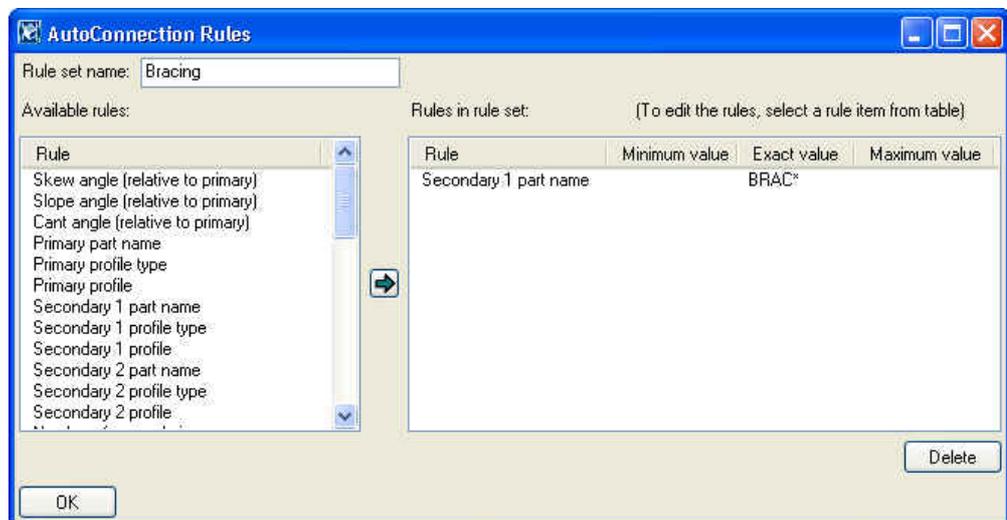
3. Right-click on the **RHS** rule set and Select **Edit rule set...**



The only rule it contains is **Secondary 1 profile type = 8** (square pipe, see the table below). So the rules match and the connection **Tube gusset (20)** is created.

Profile type	Number
I	1
L	2
Z	3
U	4
Plate	5
Round bar	6
Pipe	7
Square pipe	8
C	9
T	10
ZZ	15
CC	16
CW	17
Polygon plate	51

- Close the **AutoConnection Rules** dialog box.  
We will also study the next rule set that could have matched the conditions.
- Right-click on the **Bracing rule set** and select **Edit rule set....**



We can see that the only rule is **Secondary 1 Part name = BRAC\***. So also the **Bracing** rule set matches the conditions in our example. However, since the **RHS** rule set comes before the **Bracing** rule set, **RHS** is used and connection **20** is created instead of connection **11**.

#### Study other connections

Study some more connections in the model.

#### Delete the connections

Finally, delete all the connections from the model.

## 1.4 Create a New AutoConnection Rule Group

We will now create a new AutoConnection rule group for this project.

We will create a rule group that automatically creates the connections created manually in Lesson 2, and, in addition, some connections needed for the Model2.

In this exercise we will create the following rules for framing conditions:

Framing condition	Rule set name	Rules in rule set	Connection
Beam to beam web	Purlin	Secondary1 part name = PURLIN	Cold rolled overlap (1)
	Bracing	Secondary1 profile type = 8	Tube gusset (20)
	Default	No rule	Shear plate simple (146)
Beam to column web	Two sided	Number of secondaries = 2 Secondary1 part name = BEAM Secondary2 part name = BEAM	Two sided end plate (142)
	Bracing	Secondary1 profile type = 8	Tube gusset (20)
	Default	No rule	End plate (144)
Beam to column flange	Crane support	Secondary1 profile = IPE450	Welded Column with stiffeners (128)
	Default	No rule	End plate (144)

We will define rule sets for the following framing conditions:

- Beam to beam flange
- Beam splices
- Column splices

since we do not have those connections in our model.

### Create rule group "Industrial building connections"

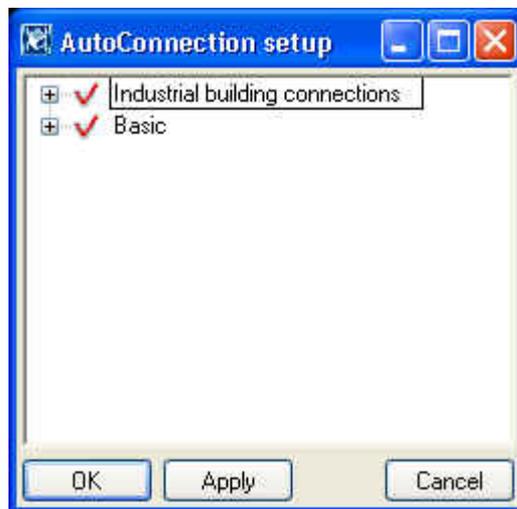
#### Create new rule group

1. Click **Setup >AutoConnection...** to open the **AutoConnection setup** dialog box.
2. Right-click on the **Basic** rule group and select **New rule group**.



A new rule group named **New** appears.

3. Select the **New** rule group, press the **F2** key and edit the name to **Industrial building connections**.

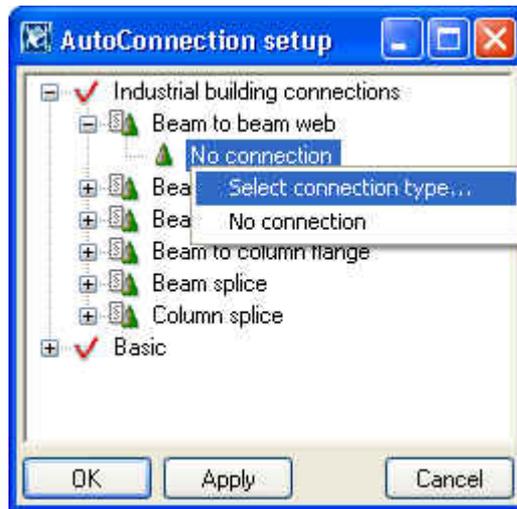


## Beam to beam web

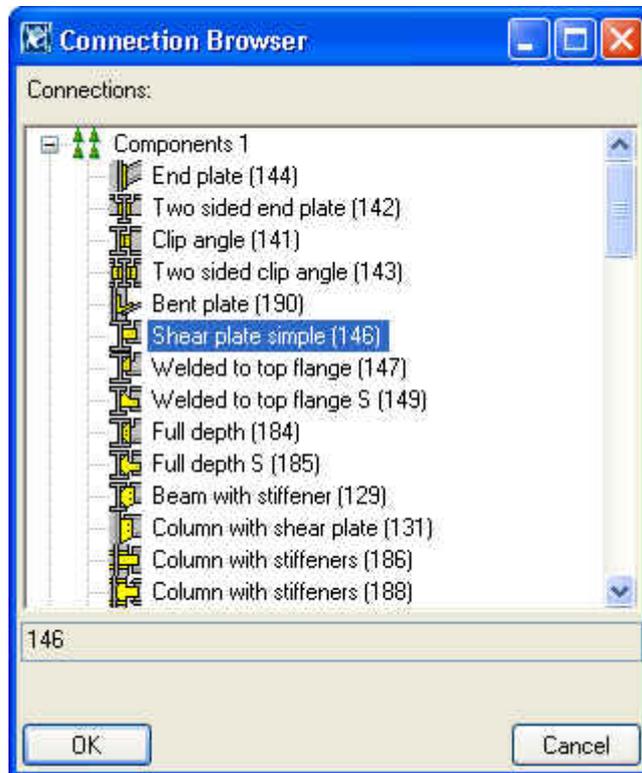
We will start creating rule sets for the **Beam to beam web** framing condition. By default, the framing conditions do not have any rule sets defined, only the connection type **No connection**.

### Create Default connection

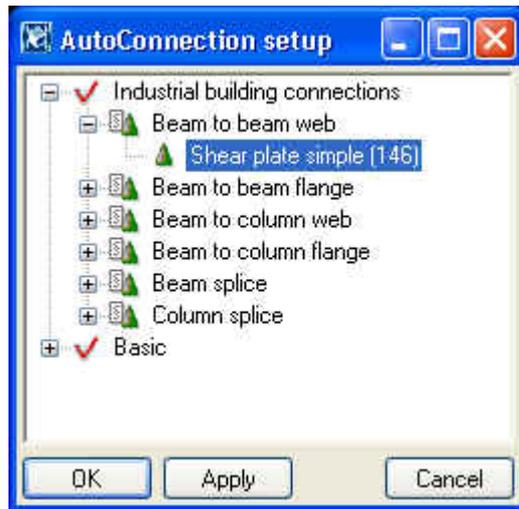
1. Right-click on a connection **No connection** in the **AutoConnection setup** tree.
2. **Select connection type...** to open the **Connection Browser** dialog box.



3. Select **Shear plate simple (146)** and click **OK** to update the tree.



The tree is updated.

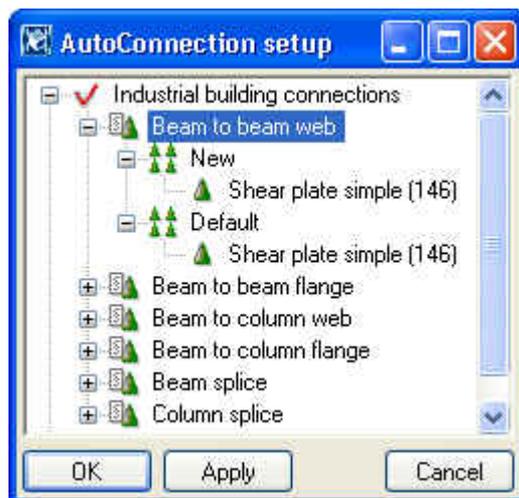


### Rule for "Purlin" connections

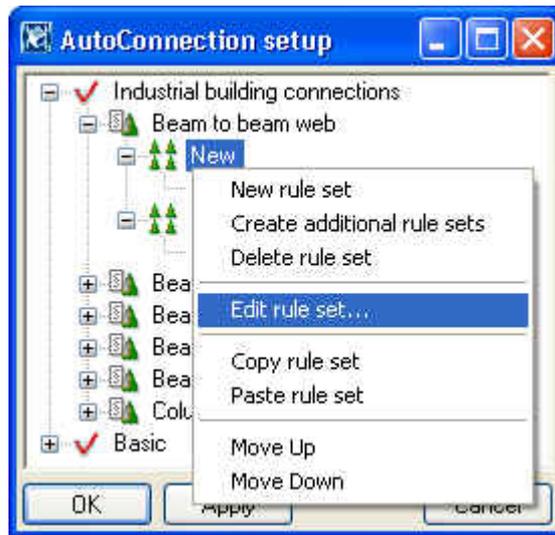
We will now create additional rule sets to the **Beam to beam web** framing.

1. Right-click on **Beam to beam web** framing condition and select **Create additional rule sets**.

Two rule sets, **New** and **Default**, appear. The connection we chose now appears under both rule sets **New** and **Default**.

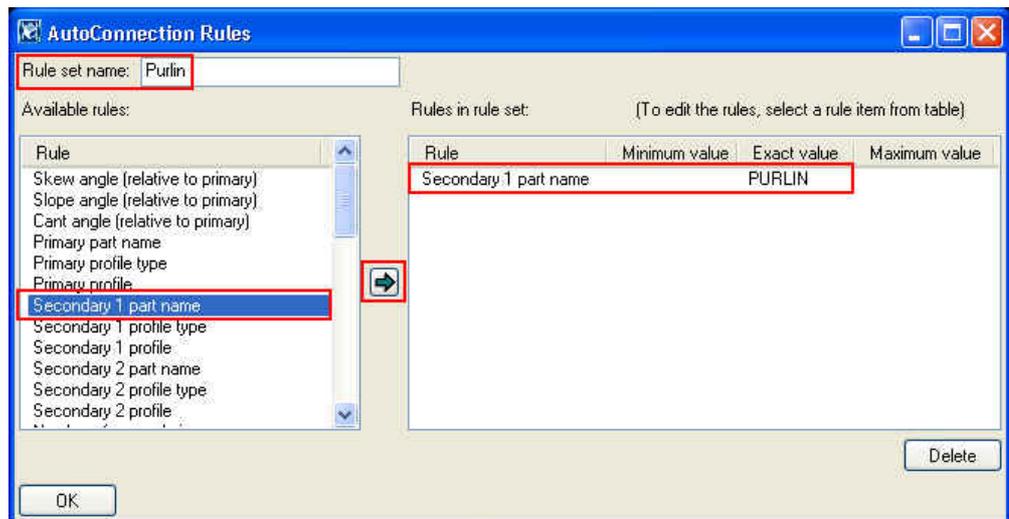


2. Right-click on the rule set **New** and select **Edit rule set...**

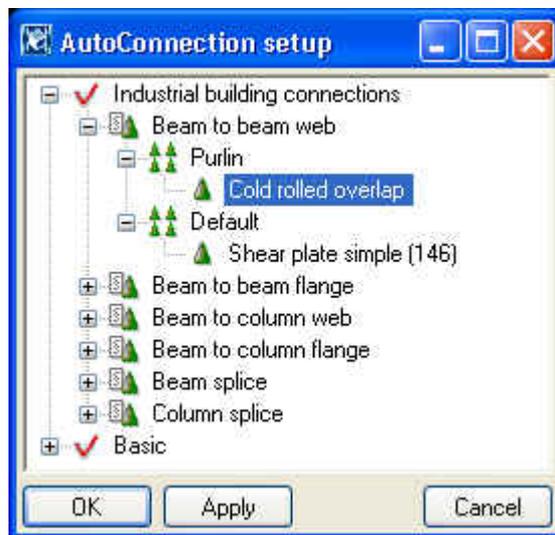
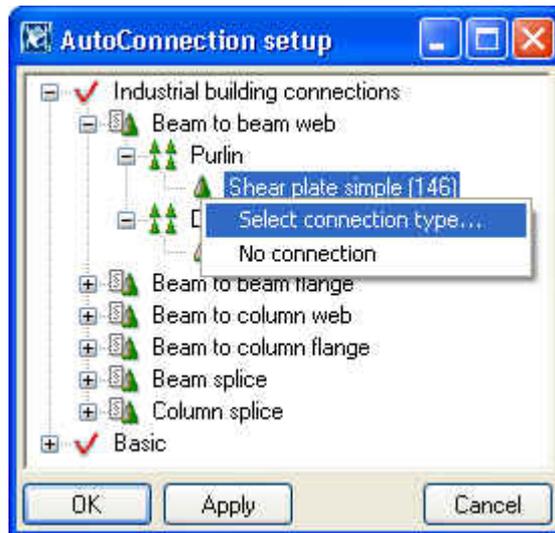


The **AutoConnection Rules** dialog box opens.

3. Select a rule **Secondary 1 part name** from the **Available rules** list.
4. Click on the right arrow button to move the selected rule into the list **Rules in rule set**.
5. Write **PURLIN** as the **Exact** value for the rule.
6. Define **Purlin** as the name for the rule set.
7. Click **OK** and the tree is updated.

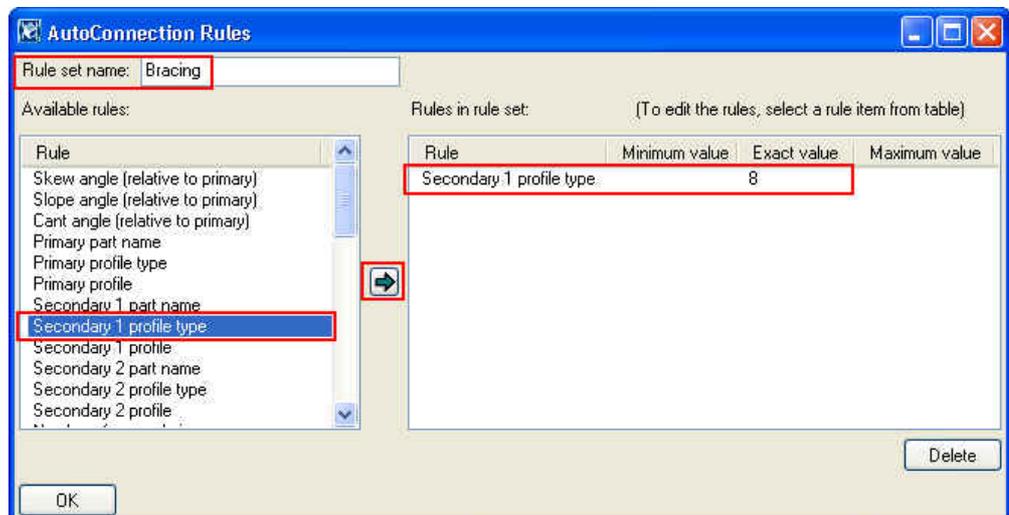


8. Select the **Cold rolled overlap** connection for the **Purlin** rule set.

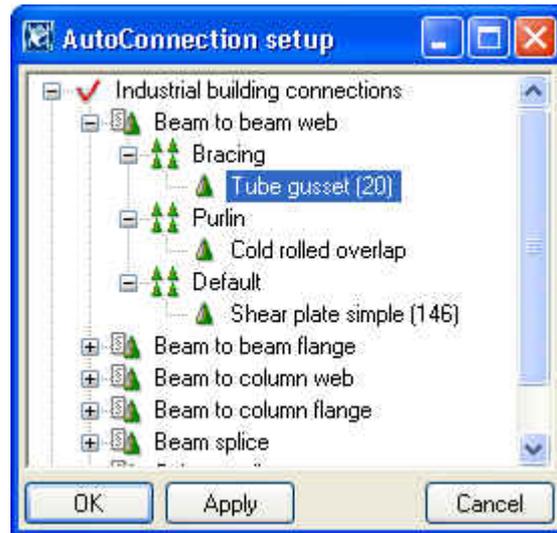


**Rule for "Bracing" connections**

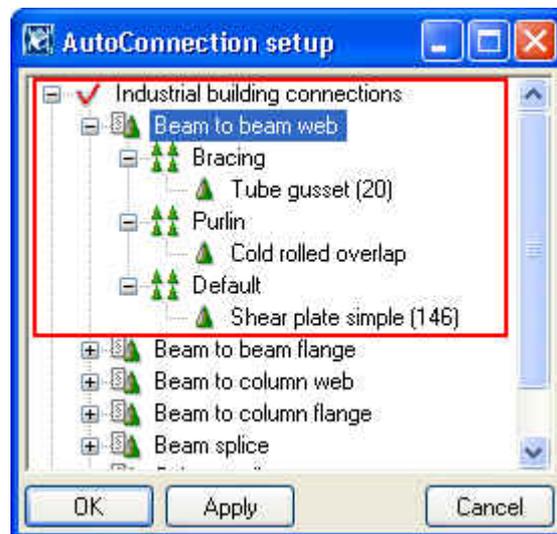
1. Create an additional rule set to the **Beam to beam web** framing.
2. Right-click on the **New** rule set created and select **Edit rule set...**
3. Add 8 as the value for the rule **Secondary 1 profile type** and name the rule **Bracing**, click **OK**.



4. Select the connection **Tube gusset (20)** for the **Bracing** rule.



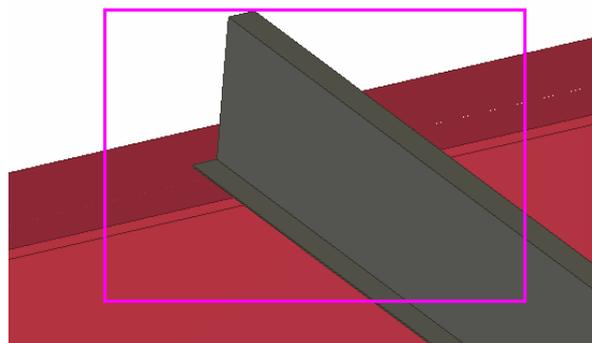
5. Click **Apply** in the **AutoConnection setup** dialog box to save the editing so far.

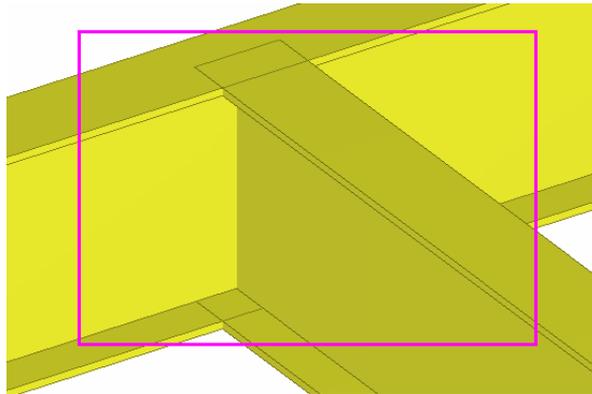
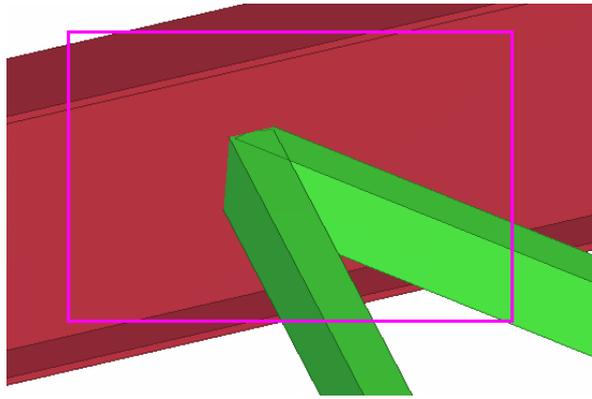


### Test the rules

We will now do a simple test to make sure our new rule group works.

1. Select the parts of each conditions we have defined rules for (by using **Ctrl**).





2. Select **Detailing > AutoConnection...**
3. Select the **Industrial building connections** rule group.
4. Select **Industrial building rules** for connection parameters (the AutoDefaults file we created in lesson 2).
5. Click **Create connections**.

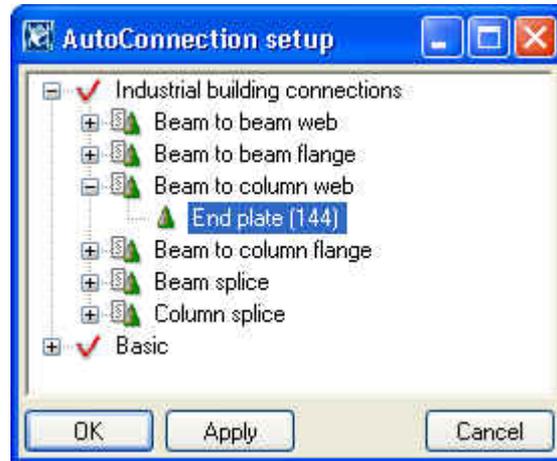


6. Check that a correct connection was created to each condition.

## Beam to column web

### Default connection

Set **End plate (144)** as the default connection for the **Beam to column web** framing condition.

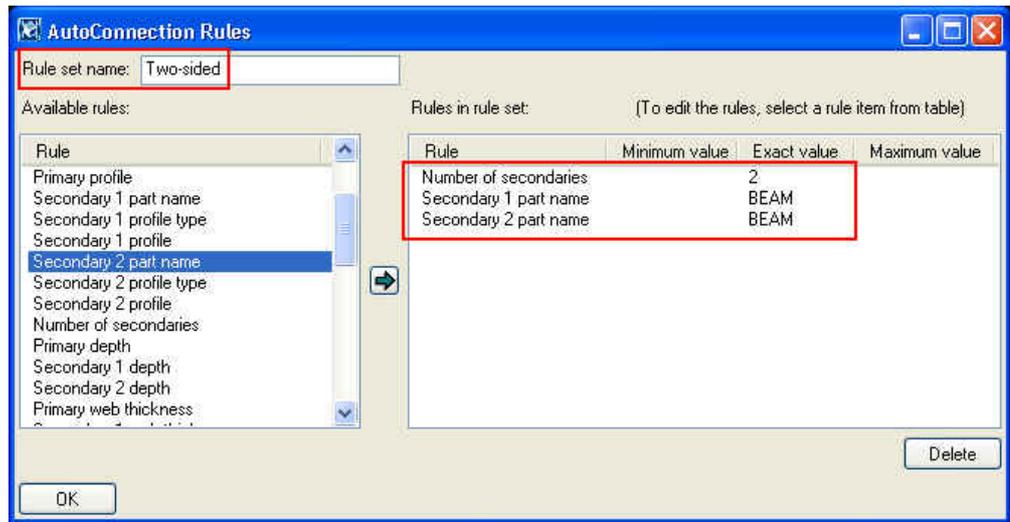


### Two-sided end plate

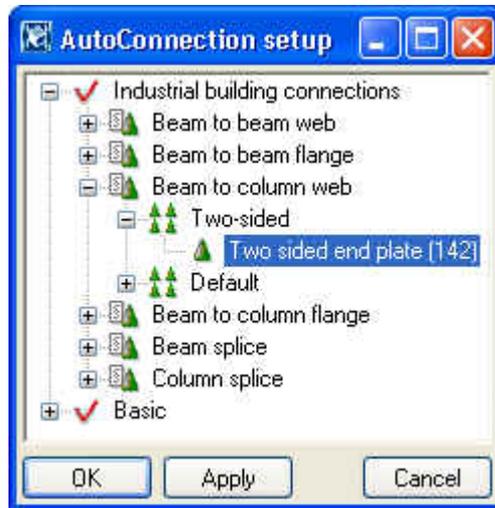
1. Right-click on the **Beam to column web** framing condition and select **Create additional rule sets**.
2. Right-click on the **New Rule set** and select **Edit rule set...**



3. Edit the rule set to have the following rules:
4. Number of secondaries: 2
5. Secondary 1 part name: BEAM
6. Secondary 2 part name: BEAM
7. Name the rule set **Two-sided** and click **OK**.



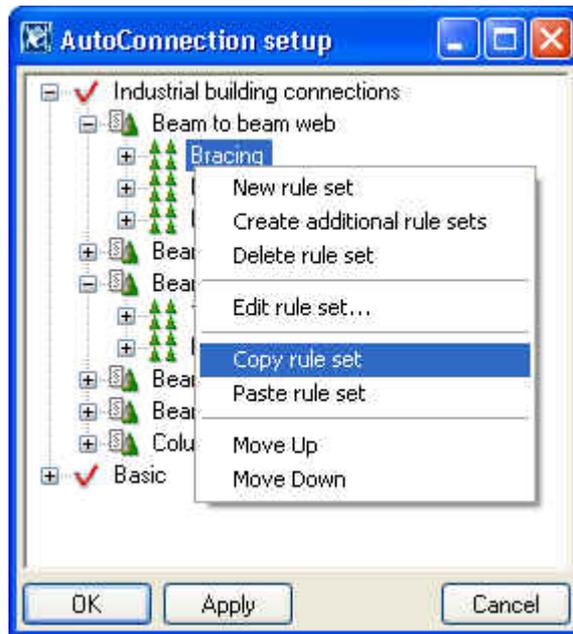
8. Select **Two sided end plate (142)** as the connection for the rule **Two-sided**.



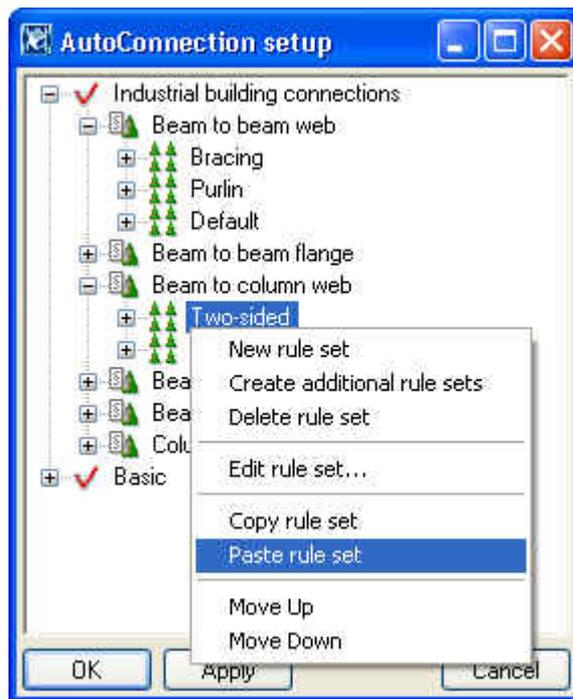
## Bracing

Instead of creating a new rule for bracing, we will now copy the existing **Bracing** rule from the **Beam to beam web** framing condition.

1. Copy the rule **Bracing** from the **Beam to beam web** framing.



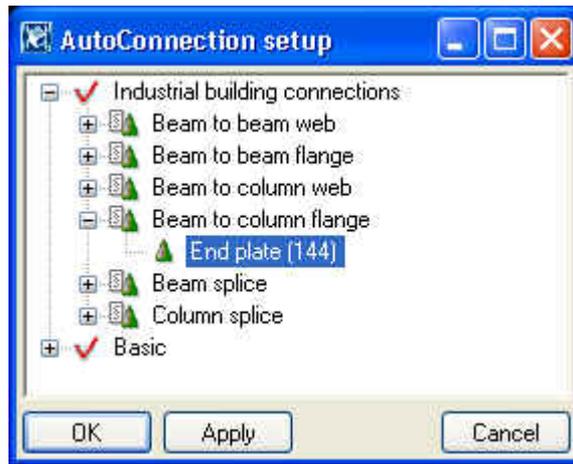
2. Right-click on the first rule (**Two-sided**) in the **Beam to column web** framing condition and select **Paste rule set**.



## Beam to column flange

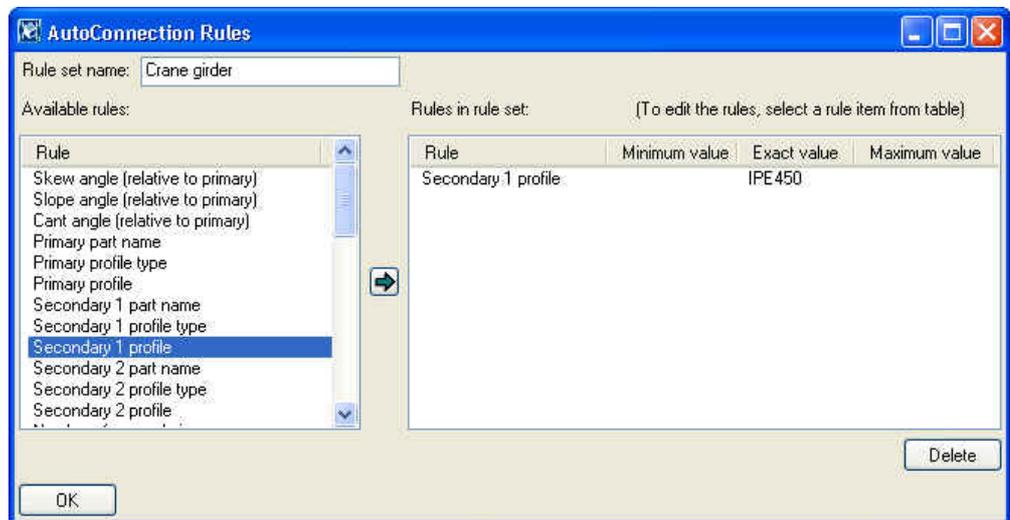
### Default connection

Set **End plate (144)** as the default connection for the **Beam to column flange** framing condition.

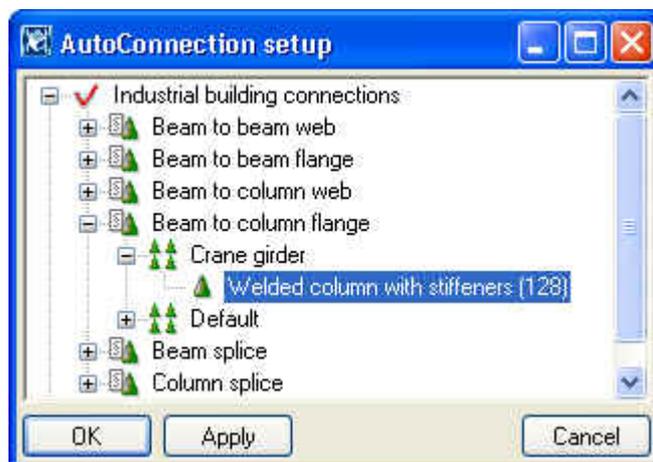


### Crane support

1. Create additional rule sets.
2. Right-click on the **New** rule set and select **Edit rule set**.
3. Edit the rule set to have the rules **Secondary 1 profile = IPE450**.



4. Select **Welded column with stiffener (128)** as the connection for the rule **Crane girder**.

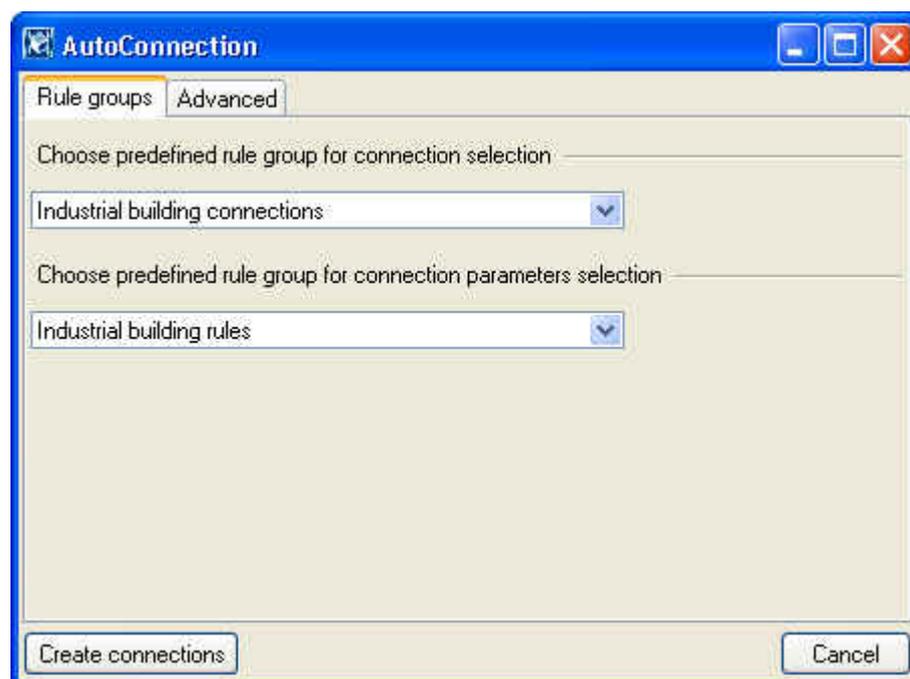


5. Click **OK** in the **AutoConnection setup** dialog box.

## 1.5 Run AutoConnection

### Create connections

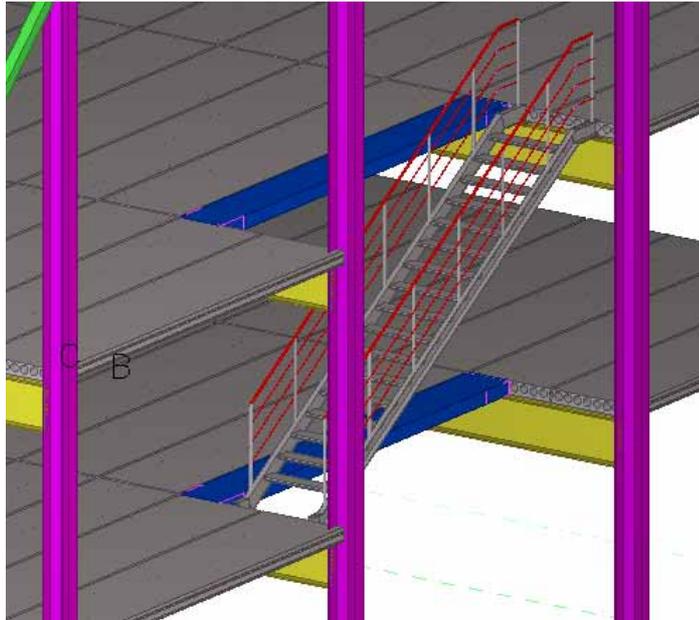
1. Select the whole model.
2. Select **Detailing > AutoConnection...**
3. Select the **Industrial building connections** rule group.
4. Select **Industrial building rules** for connection parameters (the AutoDefaults file we created in lesson 2).
5. Click **Create connections**.



6. Check that a correct connection was created to each condition.

## 1.6 Create Steel Stairs

We will now create steel stairs from level 3850 to level 7350 in the location where we left out the hollow-core slabs in lesson 1. We will create the stairs by using the **U pan (S71)** component.



You can also create steel stairs with component **Stairs (S82)**. The advantage of **U Pan (S71)** is the ability to use library profiles, parametric profiles and custom parts to create steps. Also the positioning of bolts is easier.

### Create stairs with default properties

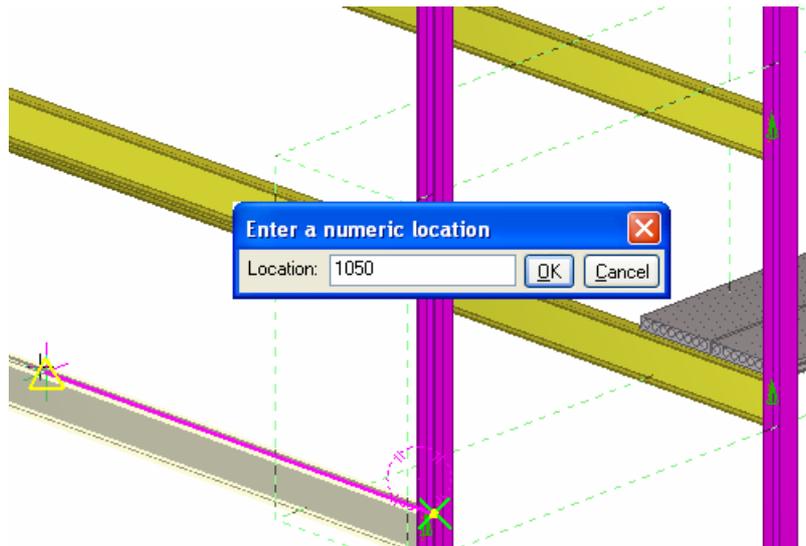
Hide or filter out unnecessary parts to make the view easier to work in. You will need to see only the level 3850 beam on gridline 5 and the level 7350 beam on gridline 6.

1. Double-click on the **U Pan (S71)** component.

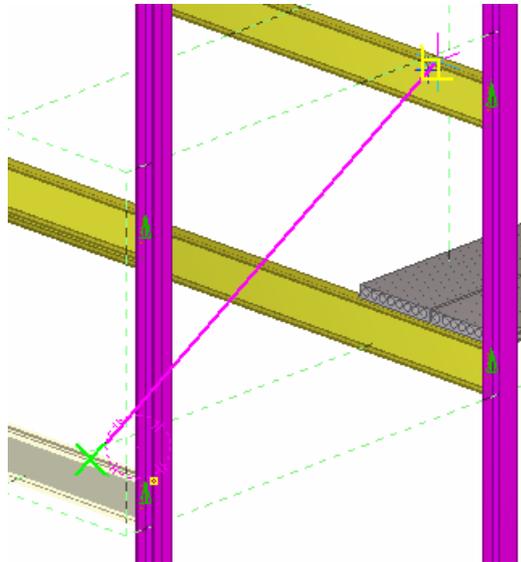


U pan (S71)

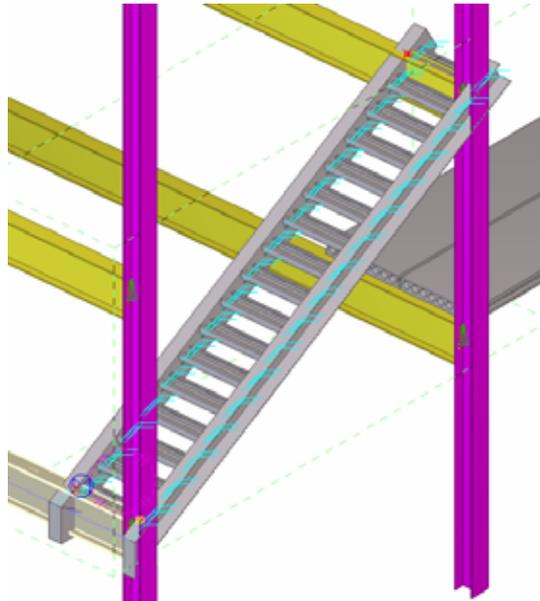
2. Pick the first point on the reference axis of the gridline 5 beam 1050 mm from the end point.



3. Pick the second point (using ortho snap) on the reference axis of the gridline 6 beam.



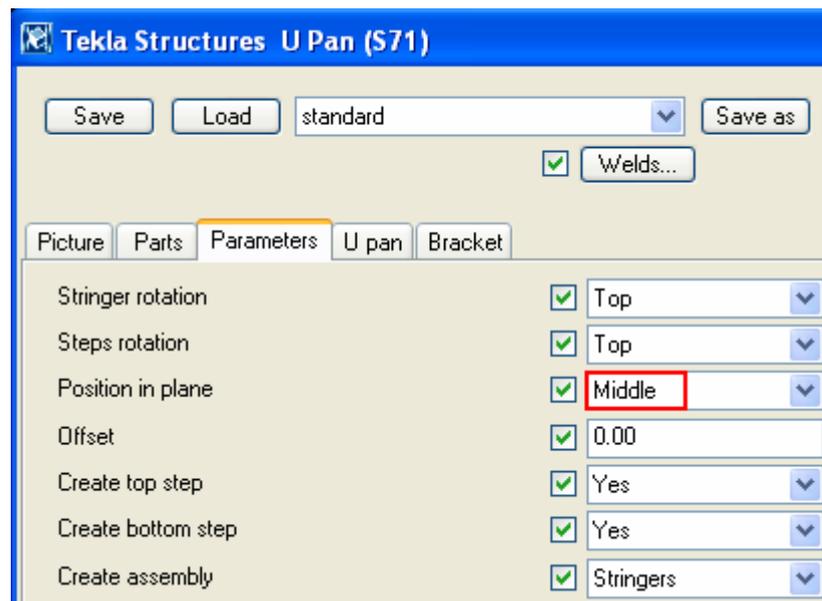
The stairs appear, with default properties.



4. Create component basic views of the stairs.

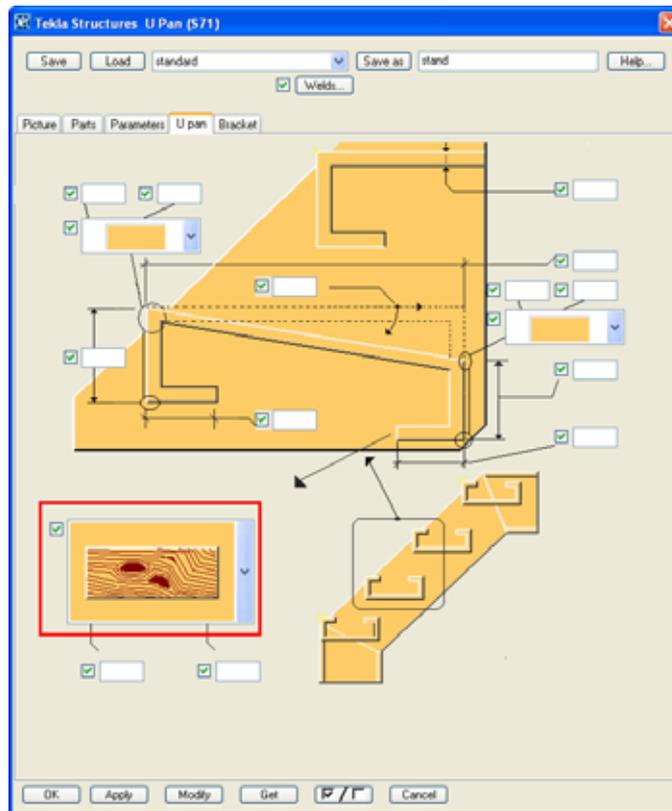
### Position the stairs

On the **Parameters** tab page, change the **Position in plane** to **Middle**.



### Define the stringers and the steps

1. On the **U pan** tab page, choose the custom option shown in the figure. This enables the options to use any step profiles you want on the **Parts** tab page.



2. On the **Parts** tab page, find the parametric profile shown below for the steps and edit the parameters as shown.

Profile name: RECTCB50\*200-25\*25

Profile type:

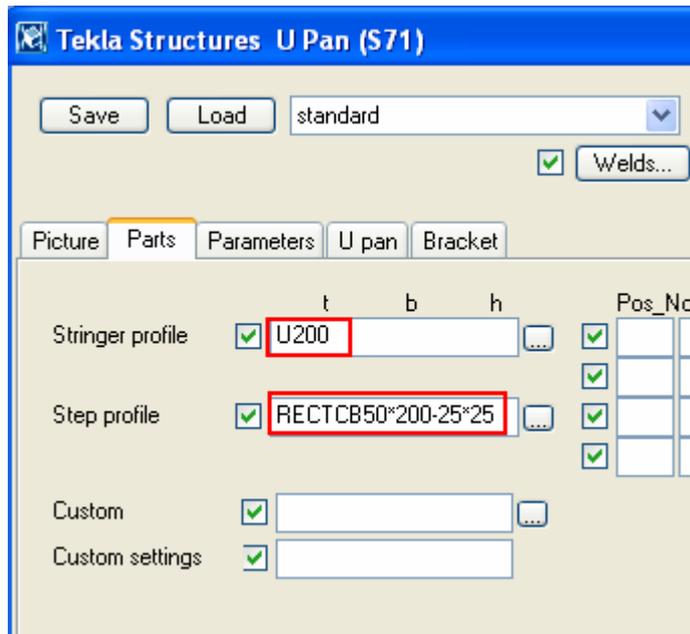
Profile subtype:

Prefix:

Picture

Property	S...	Value	Unit
Height	h	50	mm
Width	b	200	mm
Chamfer horizontal	ch	25	mm
Chamfer vertical	cv	25	mm

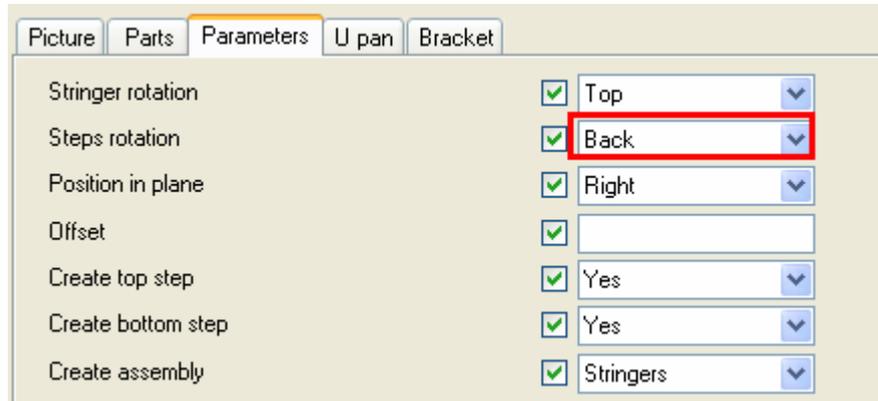
3. Edit **U200** for the stringer profiles.

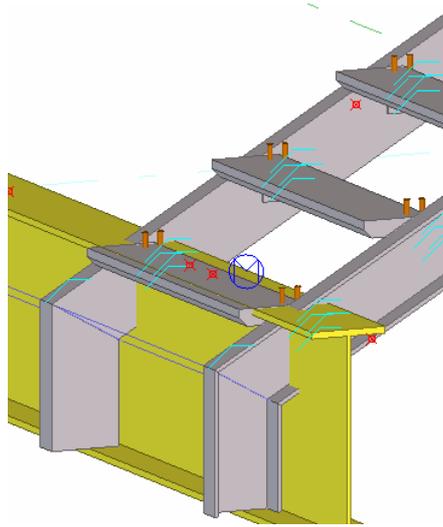


The **U Pan (S71)** component can create steps from library profiles, parametric profiles or custom parts.

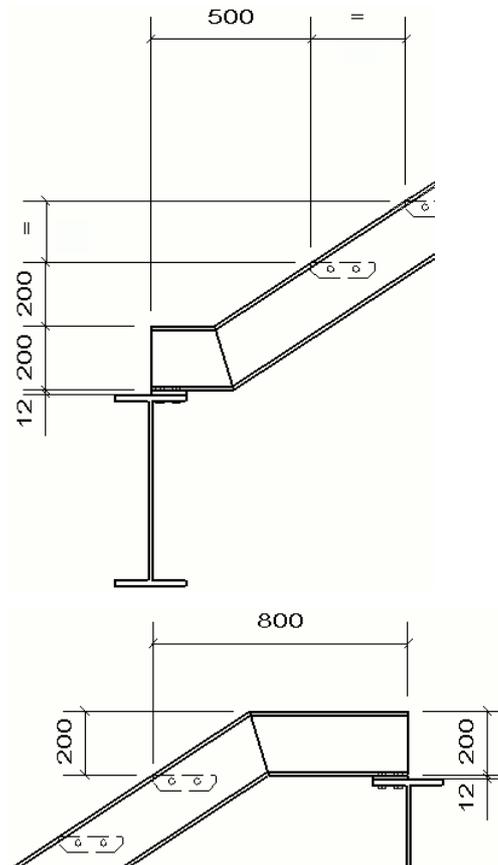
### Set steps rotation

On the **Parameters** tab page, change the **Steps rotation** to **Back**.





## Position stairs according to steps and define landings



The definition points of the stairs refer to treads instead of stringers.

We will now move the definition points of the stairs to position the steps according to the drawing details above.

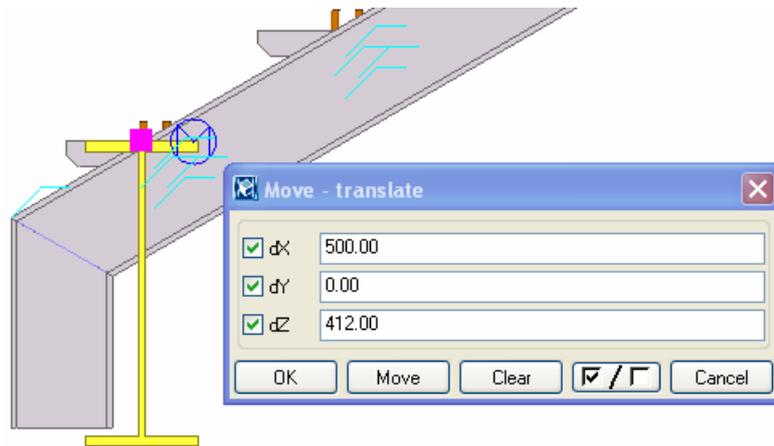
### Position the stairs according to first and last steps

1. Select the stairs and then its lower handle.

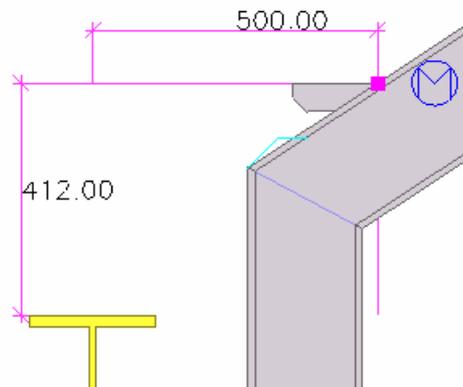
2. Move the handle according to the detail shown above.



You can either create the stairs directly in the correct position or create them between two points and then adjust these definition points of the stairs later.



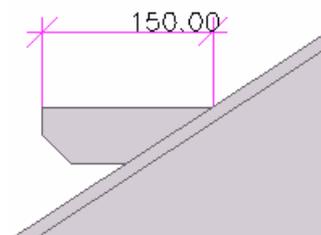
3. Check the dimensions by using the measure tool in the front view.



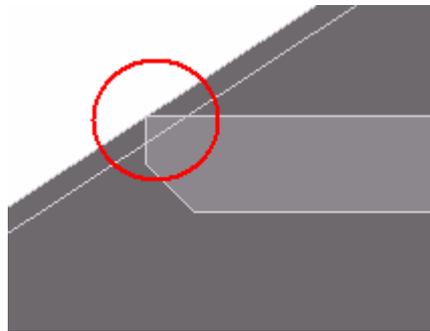
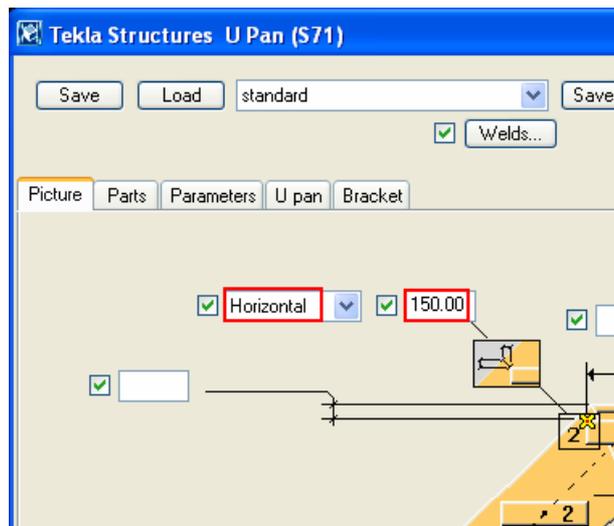
4. Move the upper handle according to the drawing detail in the same way.

### Set nosing to zero

1. In the component front view, measure the nosing distance.



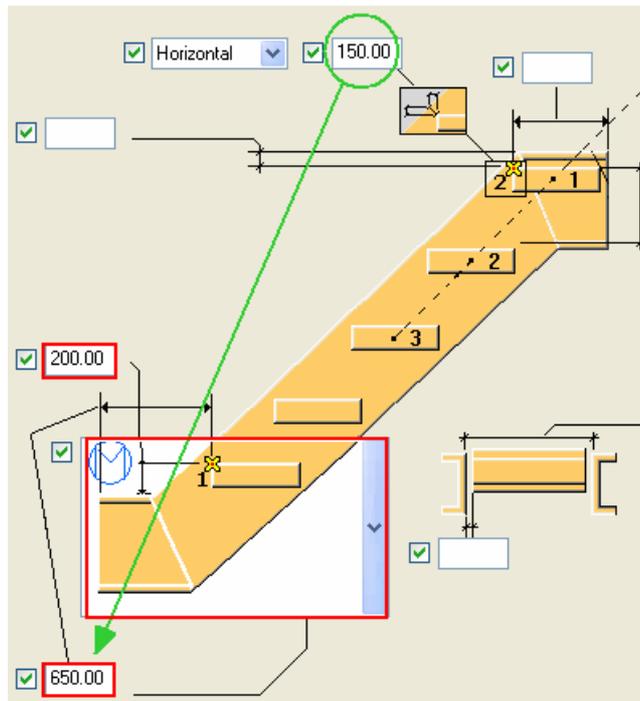
2. On the **Picture** tab page, edit the **Nosing** distance as shown to set the nosing to zero.



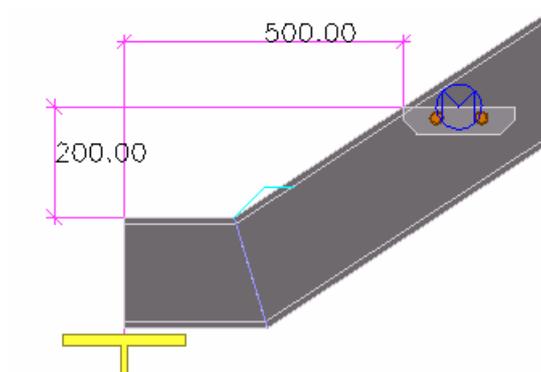
Now the steps are positioned the way we wanted.

### Define the landings

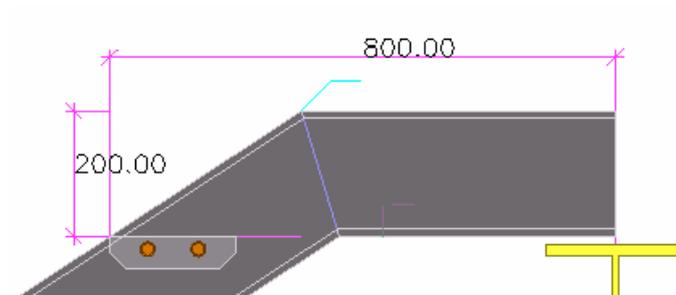
1. Select the bottom landing type shown in the figure below.
2. Edit the bottom flooring thickness to **200** according the detail drawing above.
3. Edit the bottom landing length to **650** (the nosing distance 150 taken into account) according to the detail drawing above.



4. Check the dimensions in the model with the measure tool.

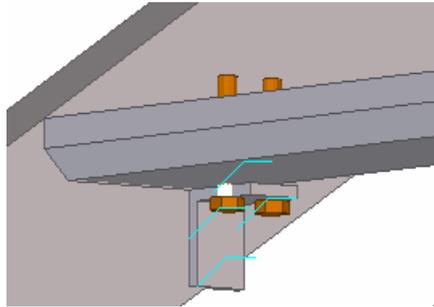


5. Edit, in the same way, the top flooring thickness and top landing length. The result should be as shown below.

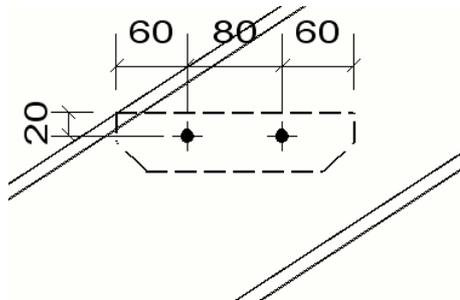


## Remove brackets, create and position the bolts

The **U Pan (S71)** component, by default, creates and connects supporting L profile brackets underneath the treads.

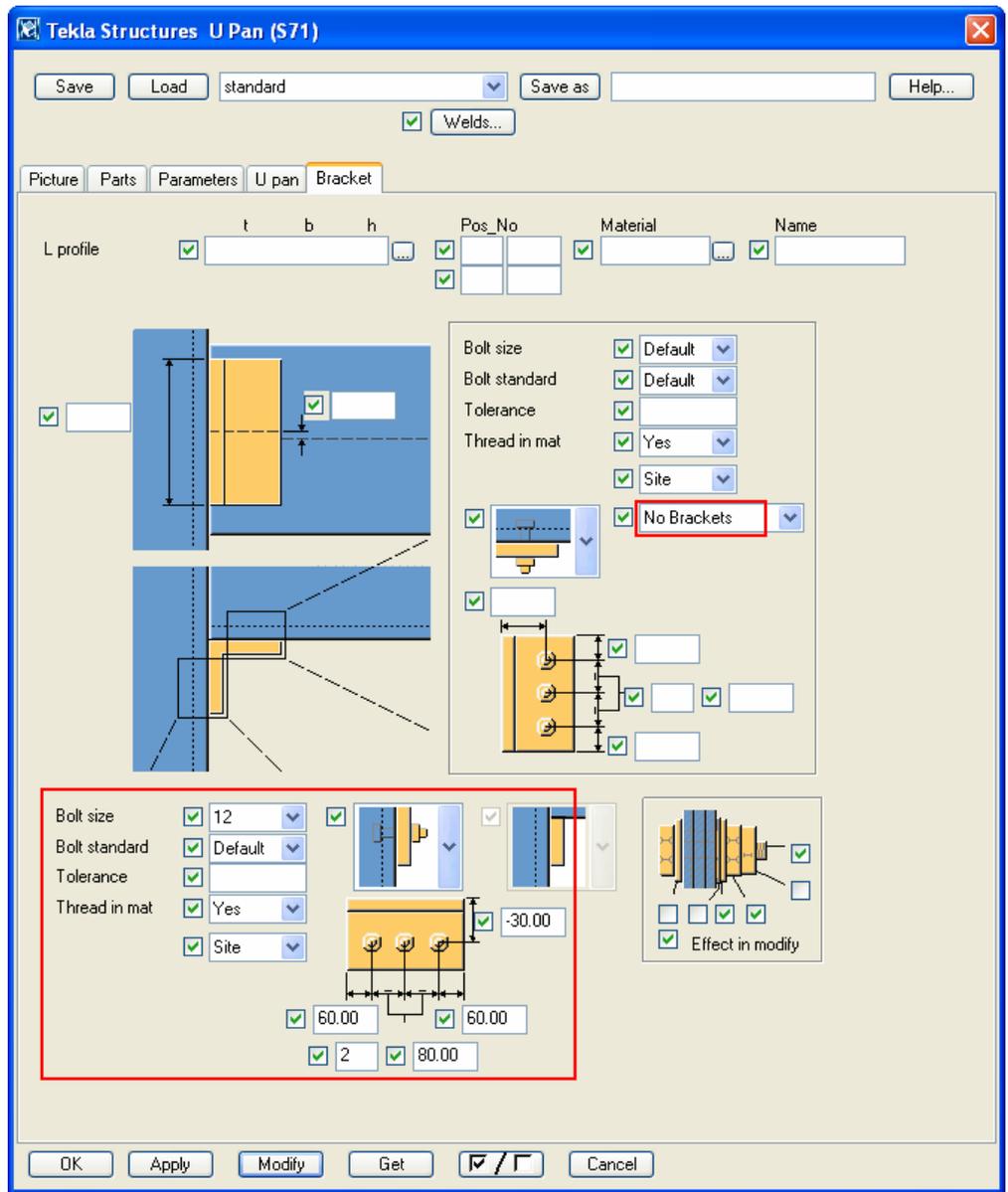


We will now remove the L-profile brackets and position the bolts straight to the step profile.

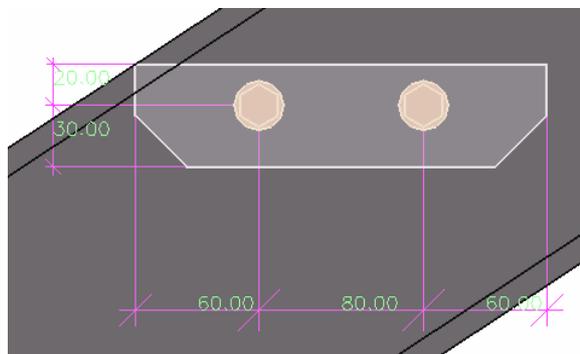


### Remove brackets and position the bolts

1. On the **Bracket** tab page, select the option **No Brackets**.
2. Edit the horizontal bolt size to 12.
3. Edit the bolt distances to position the bolts according to the drawing detail above.

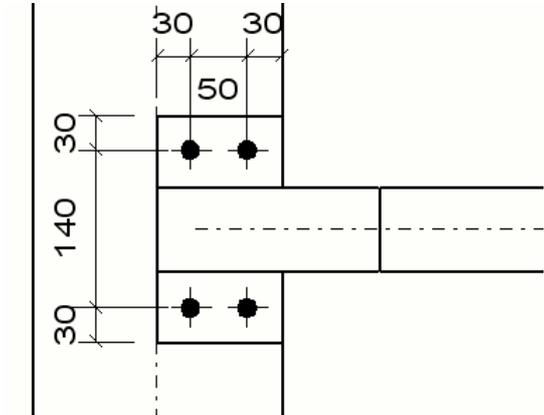


4. Check the dimension with the measure tool in the model.
5. Save the properties used.

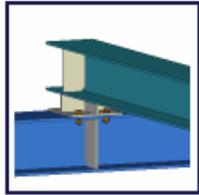


# Connect landings

We will now use the **Seating (30)** component to connect the landings to the beams with a plate welded to the landing and bolted to the beam.

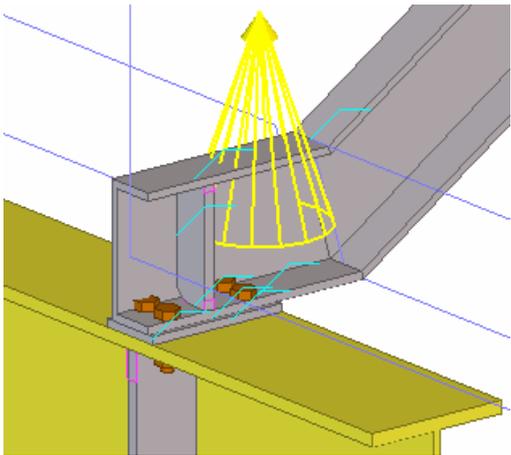


## Create seating connection

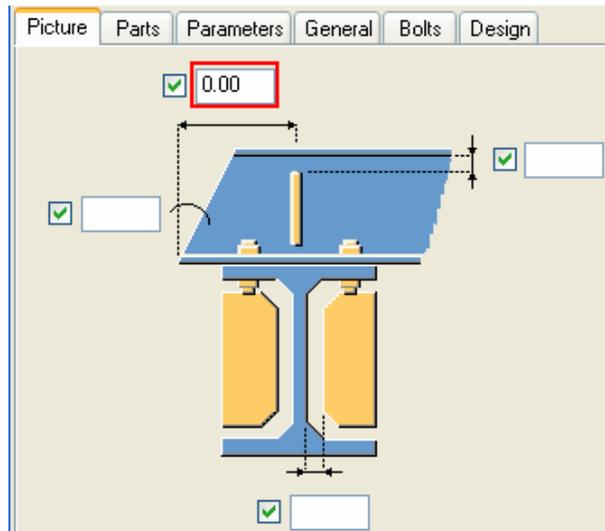


Seating (30)

1. Double-click on the component **Seating (30)** in the component catalog.
2. Pick a beam and then a landing to create a connection with default properties.

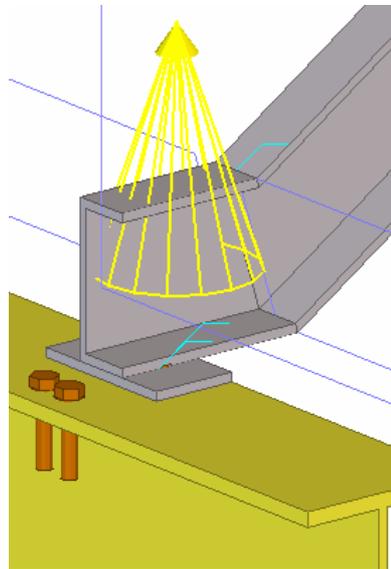


3. Edit the cut distance to 0.

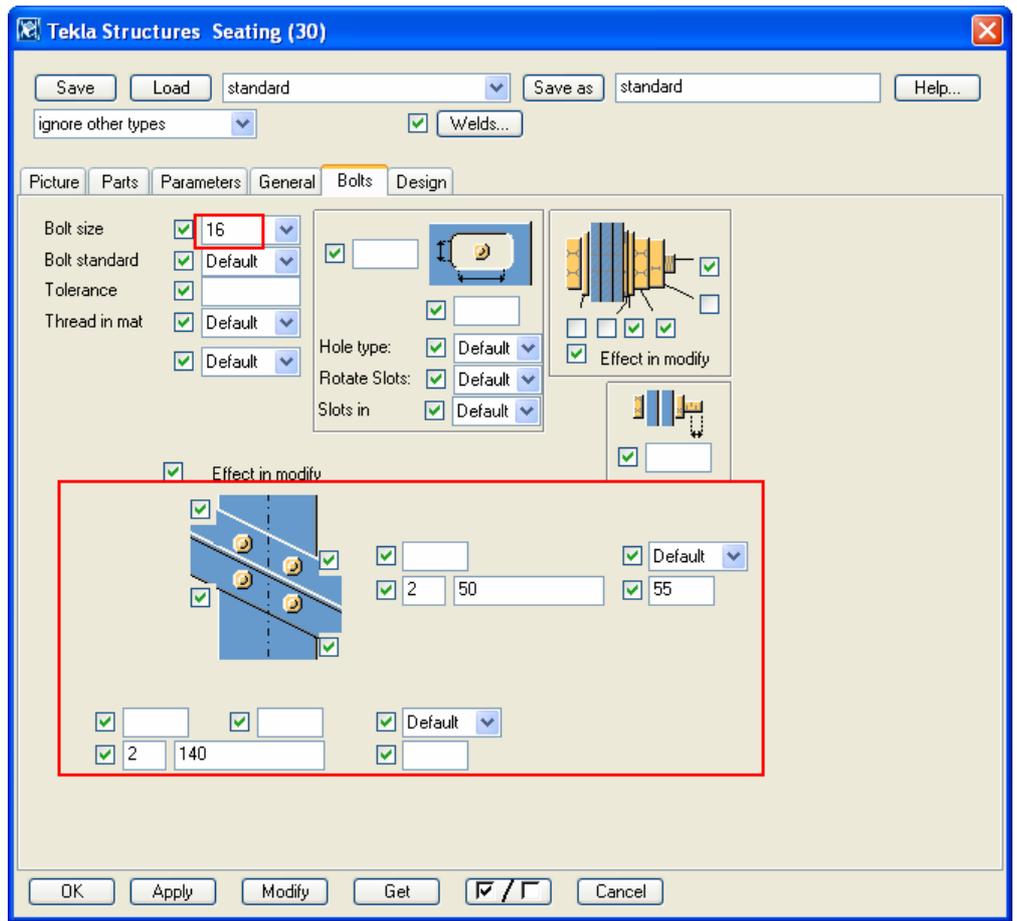


4. Edit the plate dimensions (width changes the value parallel to the main part).
5. Write zero (0) in the stiffeners thickness fields to delete the stiffeners.

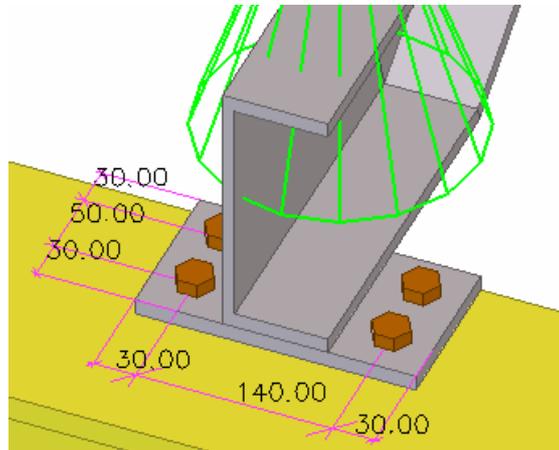
		t	b	h
Prim stiffeners	<input checked="" type="checkbox"/>	0		
Plate	<input checked="" type="checkbox"/>	12	200	110
Sec stiffeners	<input checked="" type="checkbox"/>	0		
Int stiffeners	<input checked="" type="checkbox"/>	0		



6. Edit the bolt positions.



Check the dimensions with the measure tool.  
 Save the properties used.



## 1.7 Create Stanchions

We are now going to create railings to our stairs. We will create stanchions separately on one stringer and the upper landing with the component **Stanchions (S76)** and then rails to the stanchions with the component **Railings (S77)**.

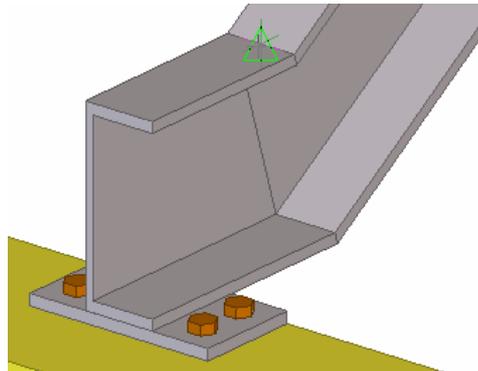
### Create stanchions

1. Double-click on the component **Stanchions (S76)** in the component catalog.

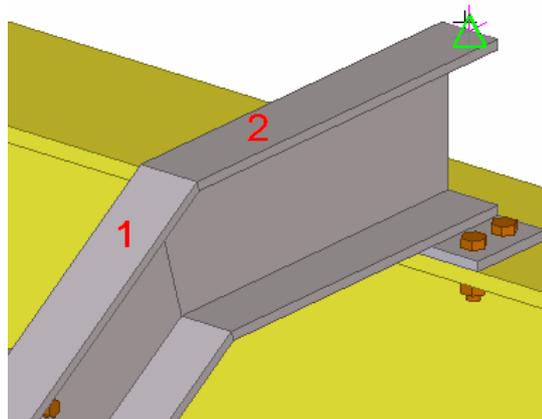


Stanchions (S76)

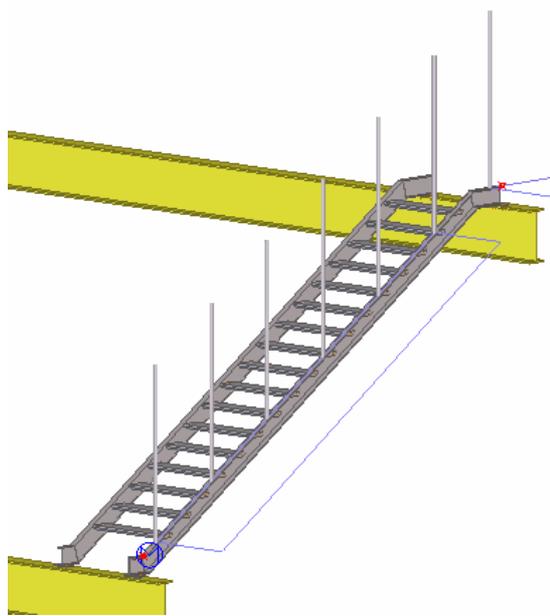
2. Pick the first position at the lower end of the stringer as shown.



3. Pick the second position at the end of the upper landing.
4. Pick the stringer (1) and then the upper landing (2) as objects.
5. Click the middle mouse button to end the command.

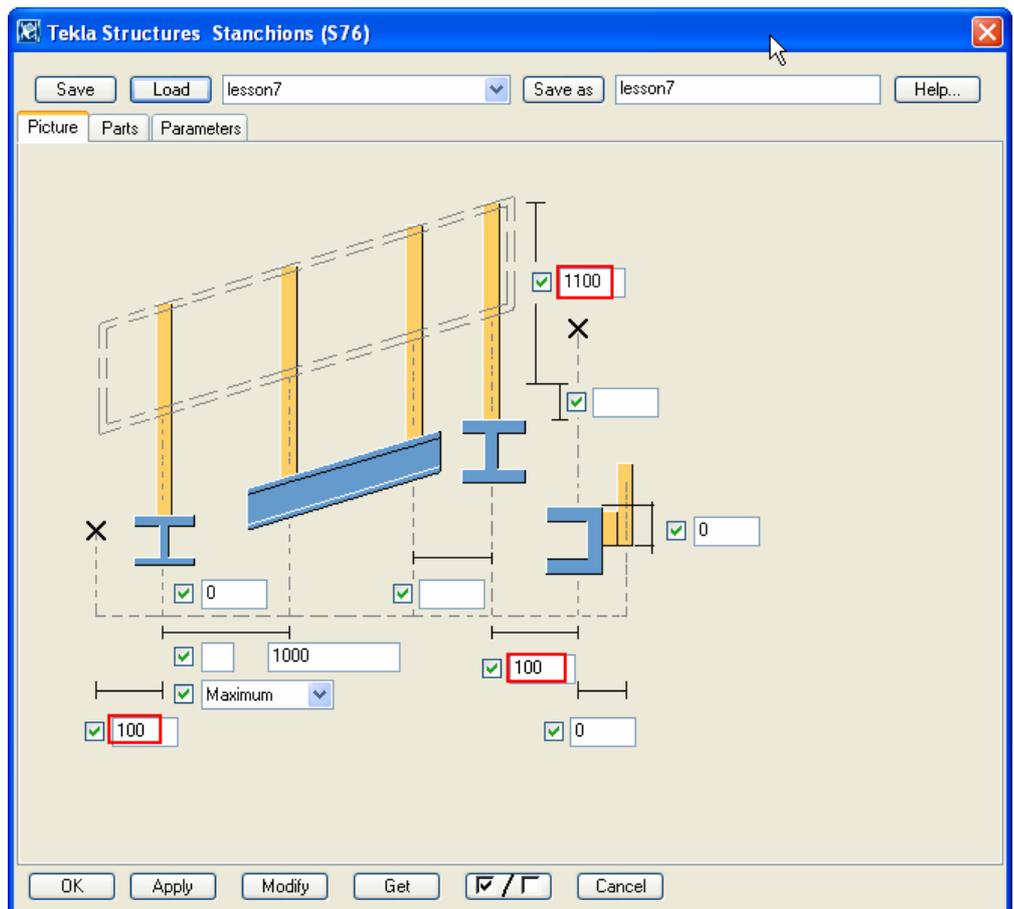


The stanchions are now created.



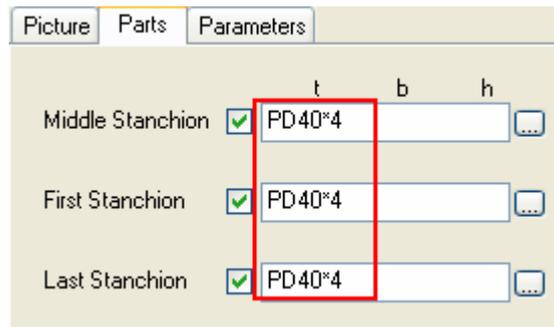
**Adjust position and height of stanchions**

1. Edit the stanchion height to 1100.
2. Edit the distance from the start point to the first stanchion to 100.
3. Edit the distance from the end point to the last stanchion to 100.

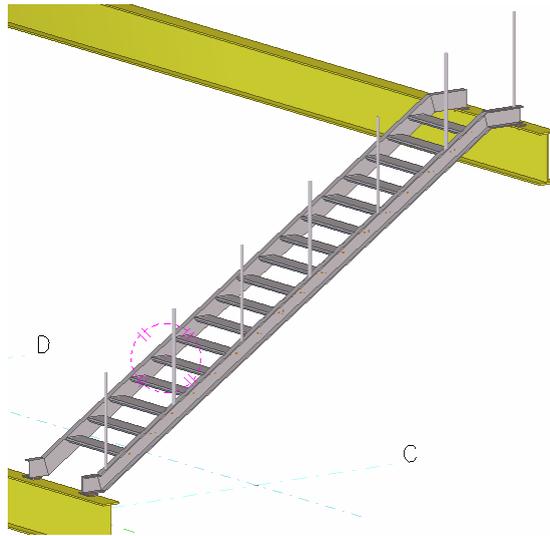


**Define stanchion profiles**

1. On the **Parts** tab page, edit all stanchion profiles to **PD40\*4**.



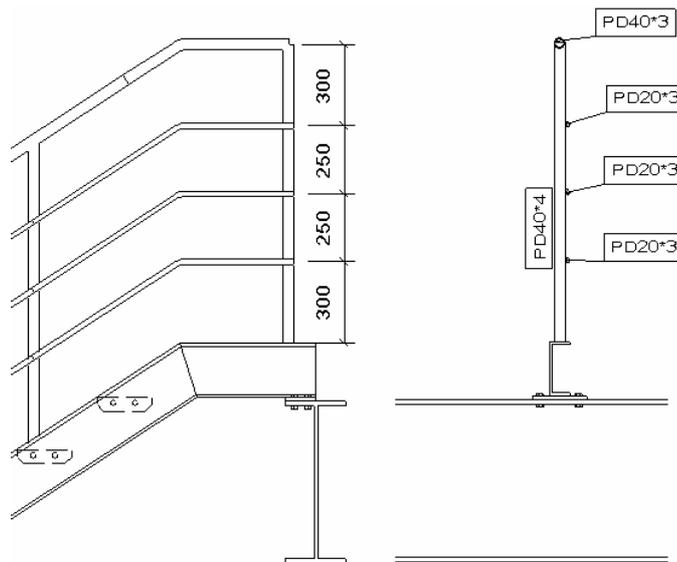
2. Save the properties used.



## 1.8 Create Railings

We will now create railings to the stanchions that we just created. For this, we will use the **Railings (S77)** component.

We will remove the closures that the component creates and instead simply weld the rail ends to the first and last stanchions.



### Create the railings

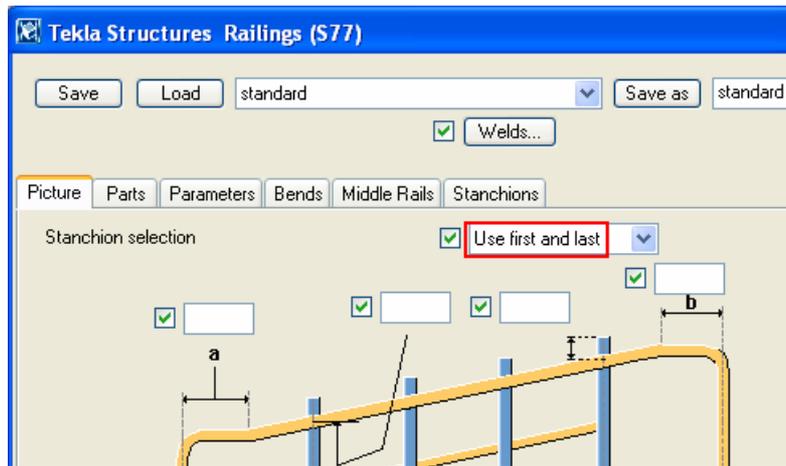
1. Double-click on the component **Railings (S77)** in the component catalog.



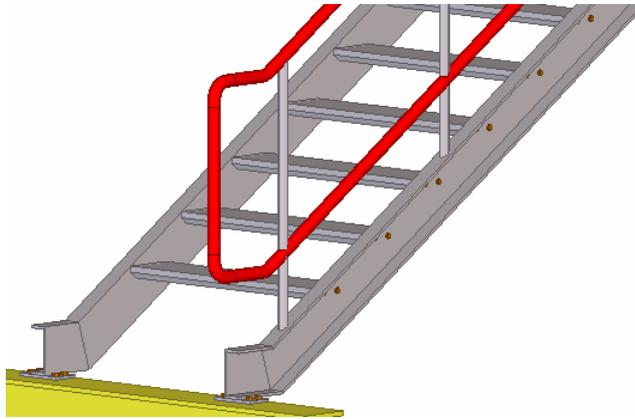
Railings (S77)

2. Select the stanchion option **Use first and last**.

This option allows you to select only one stanchion (instead of selecting each one by one).

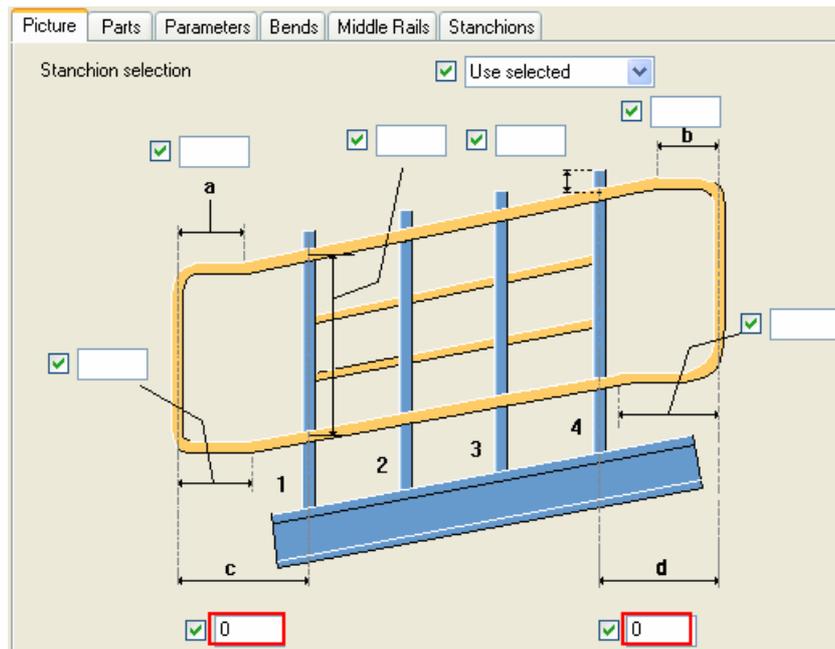


3. Select one of the stanchions.
4. Click the middle mouse button to create the railings.



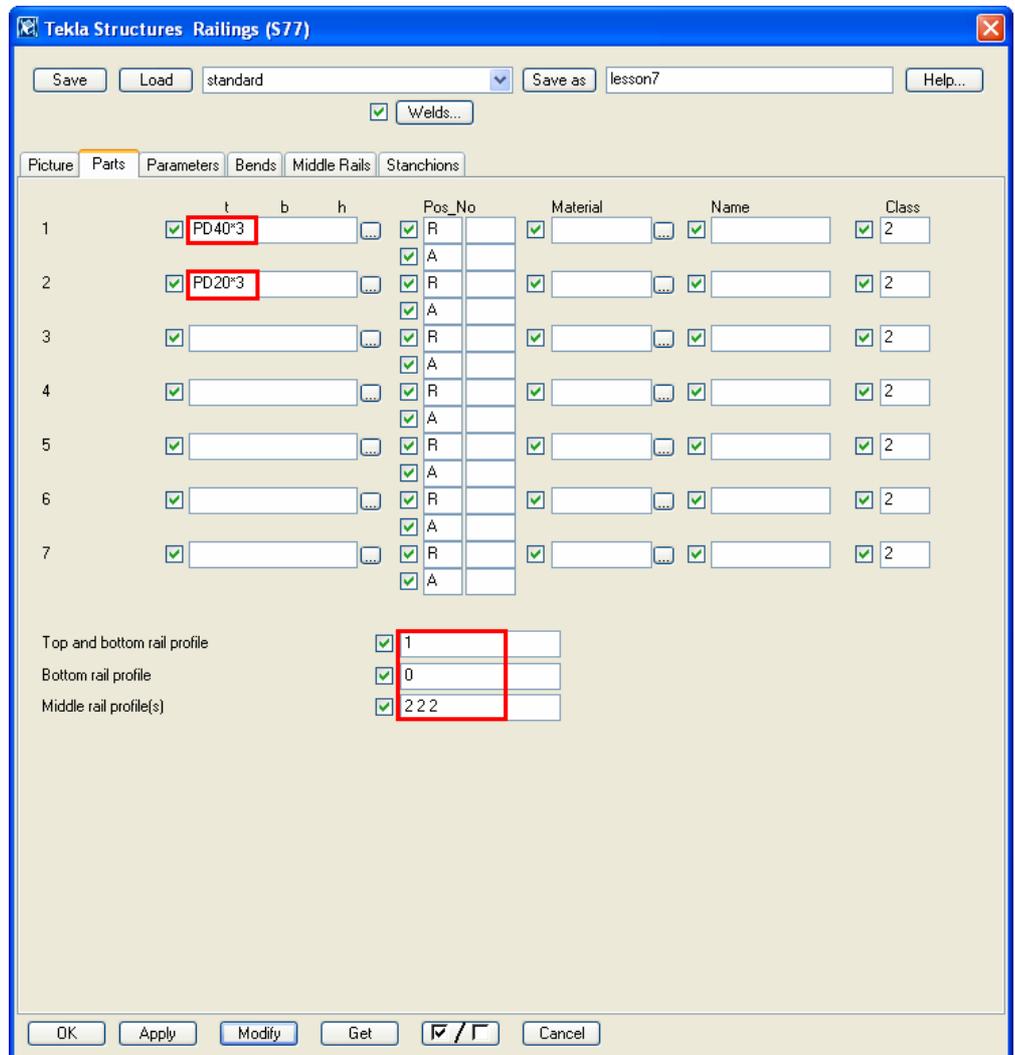
### Remove closures

On the **Picture** tab page, edit the distances from the closures to the nearest stanchion to 0.



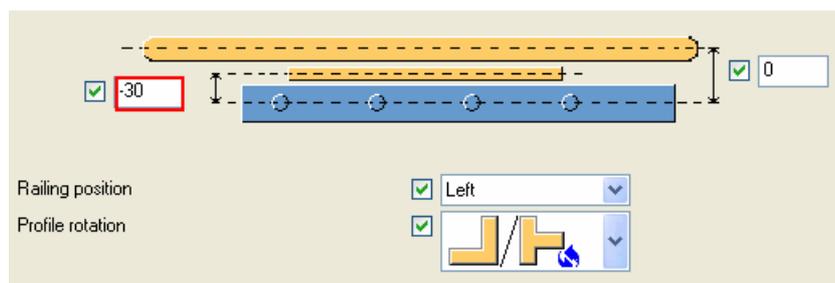
### Define rail profiles

1. Edit profile 1 to **PD40\*3** and profile 2 to **PD20\*3**.
2. Edit the top and bottom rail profile to 1 (number 1 refers to the profile defined in field 1).
3. Edit the bottom rail profile to 0 in order not create it at all.
4. Edit the middle rail profiles 2 2 2 in order to create three rails of profile 2.

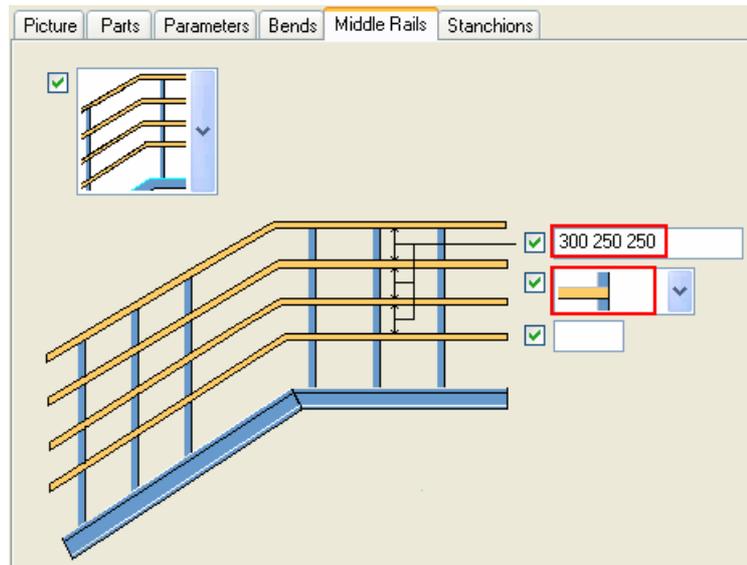


### Define middle rail distances

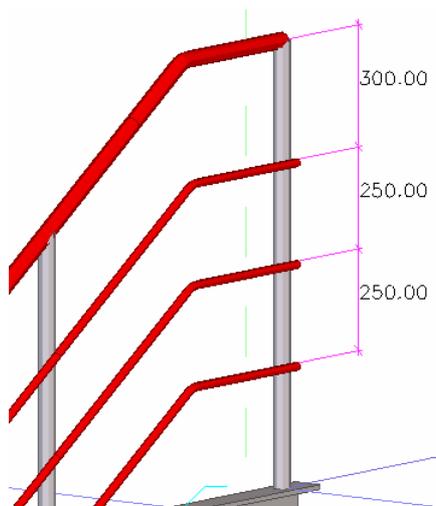
1. On the **Picture** tab page, edit the middle railing offset to -30.



2. On the **Middle Rails** tab page, edit the distances between the rails according to the above drawing.
3. Select the option to end the middle railings at the stanchion outer edge level.



4. Check the dimensions with the measure tool.



5. Save the properties used.

### Create railings to the other side

Using the saved properties, repeat the creation of the railings to the stringer and upper landing on the other side.

1. Create stanchions.
2. Create railings.
3. Edit the offset of the middle railings from -30 to 30.

