



Tekla Structures Basic Training

Tekla Structures 10.0

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2 Creating System Connections

In this lesson

This lesson introduces the basics of creating system connections in Tekla Structures.

You will learn how to:

- Create connections
- Work with connection properties
- Save the properties for later use
- Work with AutoDefaults, i.e. create rules to apply pre-defined connection properties automatically

2.1 About System Connections

You can model connections quickly with the Tekla Structures system connections.

The greatest benefits of using system connections are:

- The connection properties can be saved with a particular name so that they can be used later. These properties can then be used for all projects.
- When you modify a main objects profile in the model all of the connections to the object are automatically modified at the same time.
- If you select options such as edit, copy, or mirror, all connections are automatically included. The connections that are copied or mirrored are exactly the same as the originals. The same applies to plates and bolts.
- With AutoDefaults you can create rules defining when to use different connection properties.

All available system connections are located on the connection toolbars, which can be found at the right of the main window.

When applying a connection that you are unfamiliar with, accept the default properties and create the connection. Then look to see what needs to be modified. This is usually quicker than trying to set the values for the connection before seeing what the connection actually creates.

[Help: Modeling > Detailing > Getting started > Using connections > Creating connections](#)

[Help: Modeling > Detailing > Getting started > Basics > connection concepts](#)

[Help: Modeling > Detailing > Getting started > Basics > Picking order](#)

Check Clashing of Steel Structures

In Chapter 1 we created a model of a small industrial structure. To complete the model we will need to connect the parts. Before creating the connections usually all of the members in the model collide with other members.

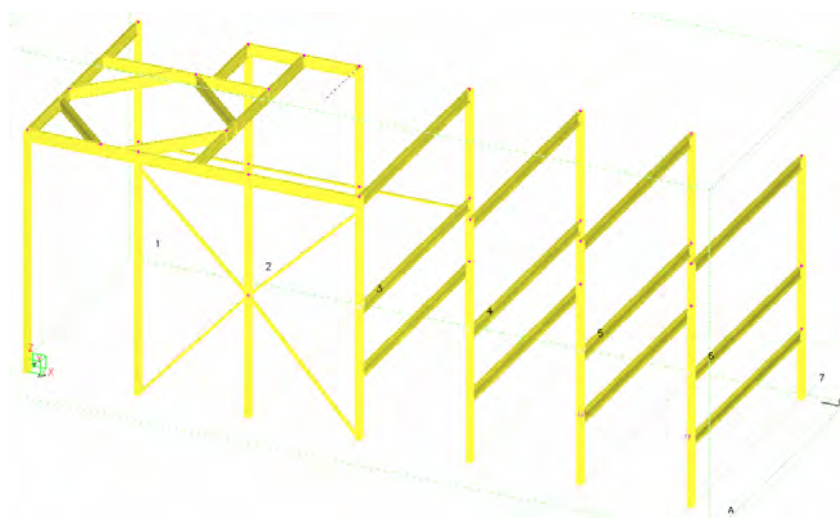
By using the **Clash check** command we can check which parts in the model collide. We will run a clash check now and then again after the connections have been applied.

Help: Modeling > Settings and tools > Querying objects > Clash check

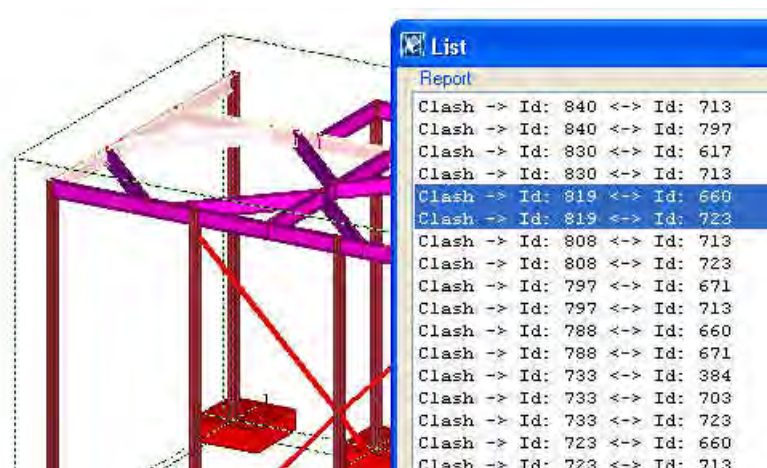
Check clashing

1. Select all of the parts of the model by dragging an area select around the whole model.
2. Right-click and select **Clash check**.

Tekla Structures highlights the colliding parts in yellow and displays the clash check log in the **List** dialog box. You can see that all of the parts in the model collide.



Select any clashing parts from the list and Tekla Structures highlights them in the model.



2.2 Column Base Plates

The first system connections that we will add are the column base plate details.

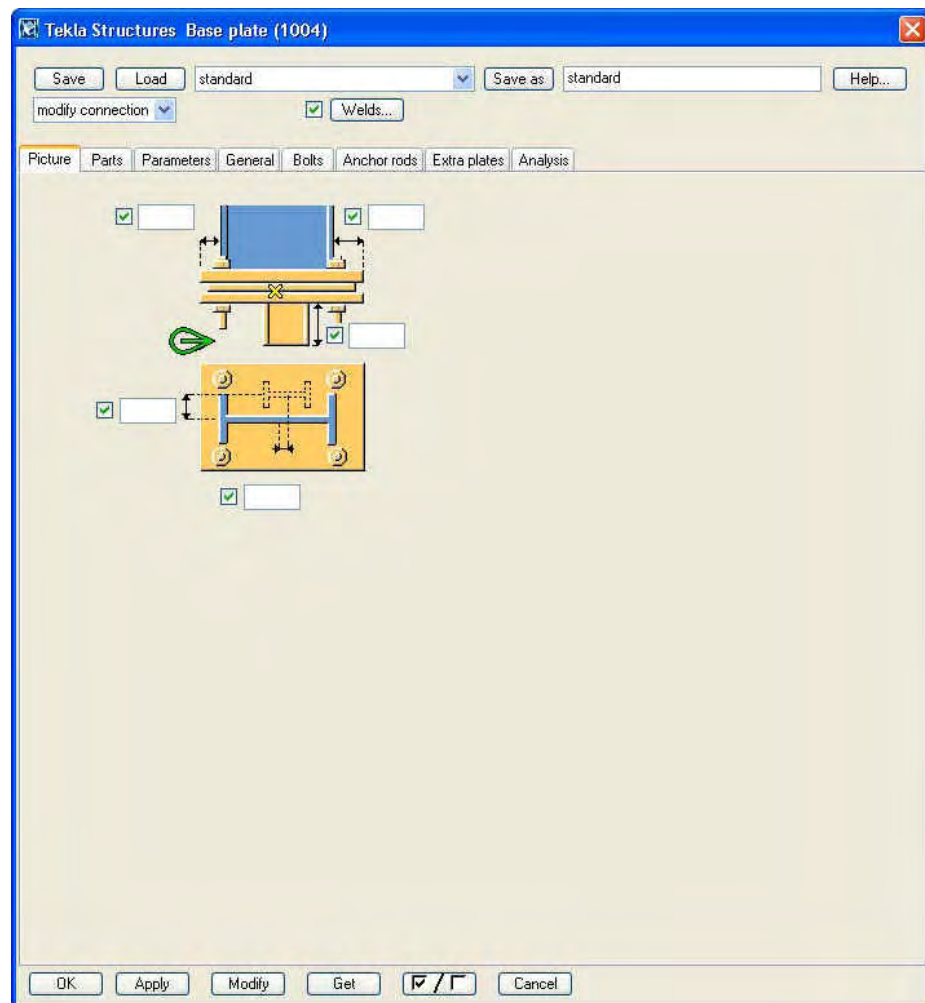
First we will create a base plate using the default values. We will then modify the properties of the base plate and finally create the rest of the base plates with the new properties.

Create base plate to one column

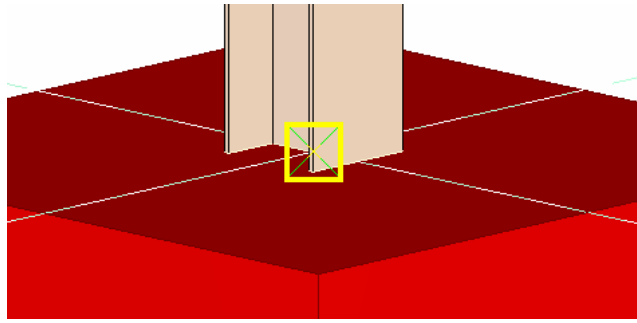
1. From the page 5 connection toolbar, double-click the **Base plate (1004)** icon.



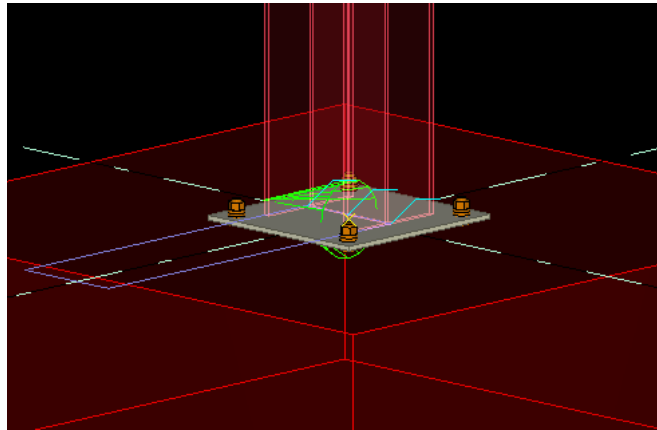
2. Following dialog appears:



3. Click **OK** to accept the default values.
4. Pick any column.
5. When prompted, pick the bottom endpoint of the column as the position and the base plate will be created.



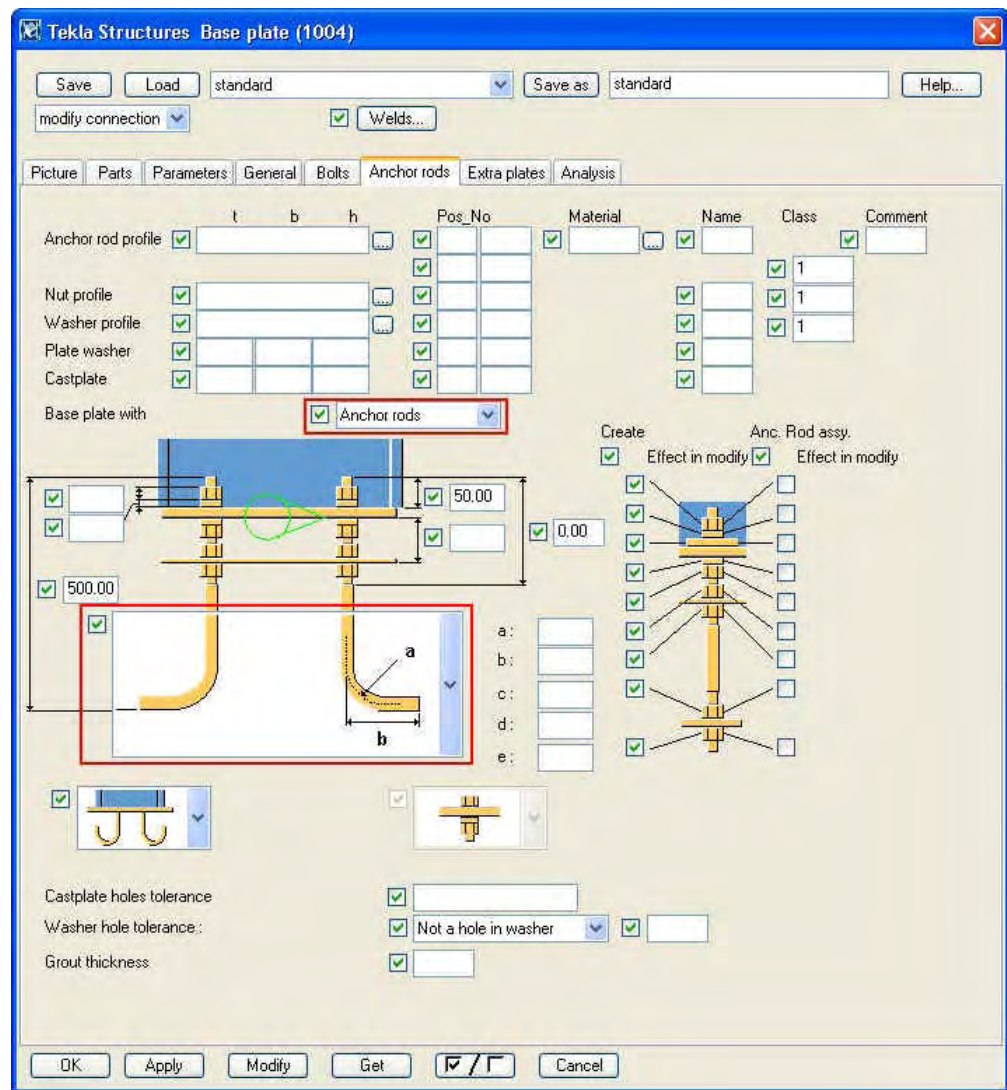
6. Use the shortcut **Ctrl+2** to set the parts displayed in shaded wire frame. You can see that the anchor bolts were created just as ordinary bolts.



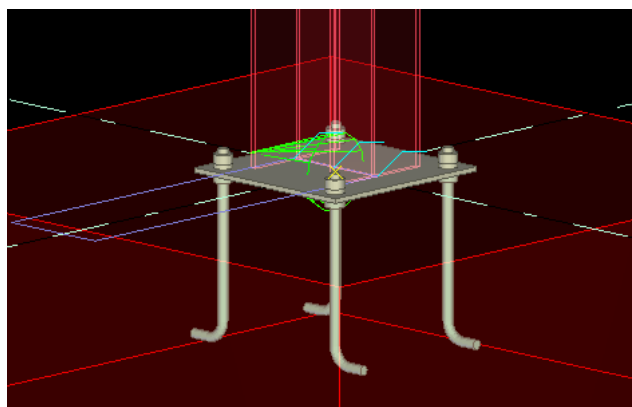
Add anchor rods to base plates

We will change the bolts in the base plate to anchor rods by modifying the connection properties.

1. Double-click the green connection symbol; the **Base plate** dialog box will reopen.
2. Select the **Anchor rods** page in the dialog box.
3. Edit the values in the fields shown highlighted in the figure below.



4. Click **Modify** and the bolts become anchor bars.
5. Click **OK** to accept the properties for use later.



Create base plates to rest of the columns

1. Press the **Enter** key to start the base plate command again.



To repeat the last command, do one of the following:

- Click **Edit -> Repeat last command**

Press **Enter**

2. Create the rest of the base plates by picking each column and then the position for the base plate.

2.3 Beam to Beam Web

Shear Plates

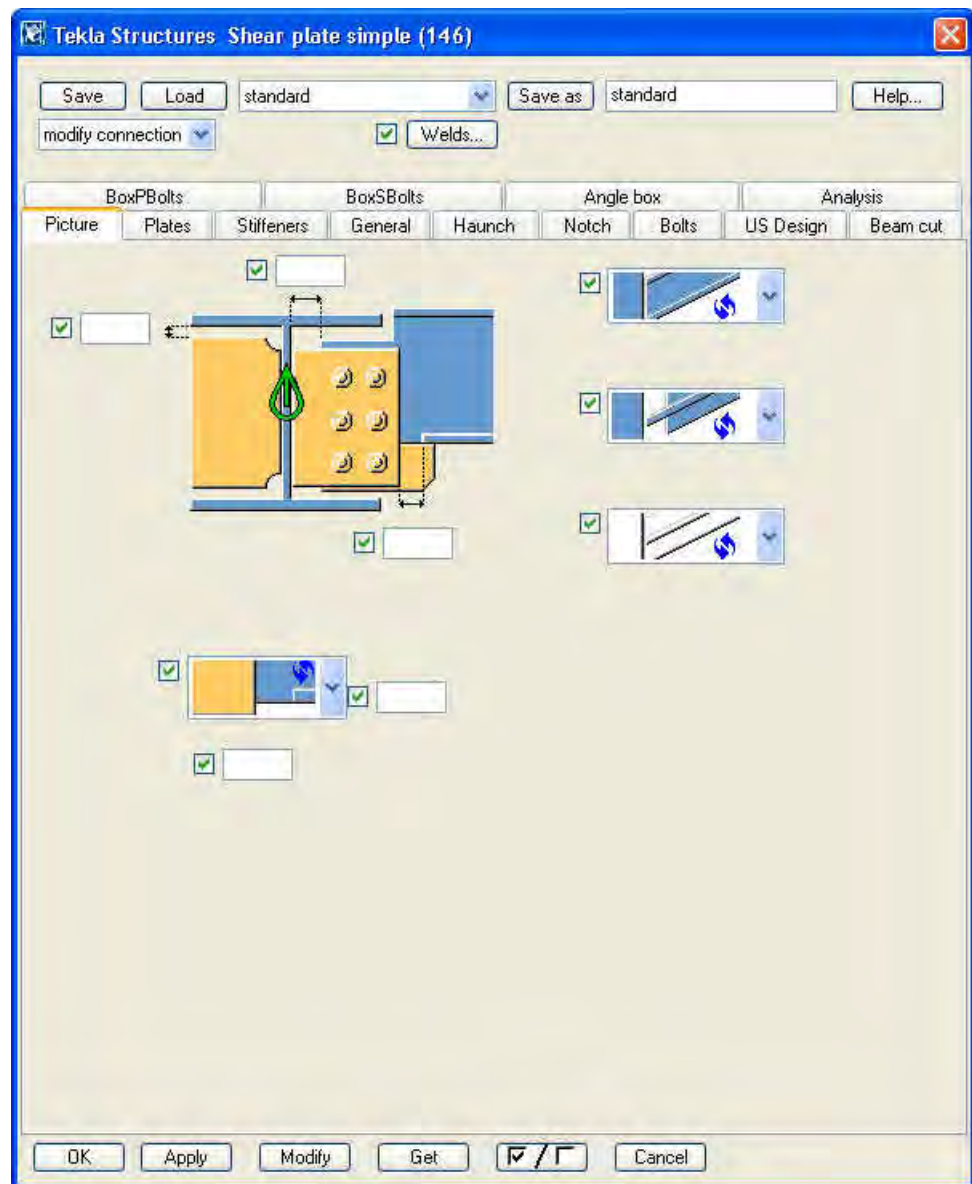
We will use the **Shear plate simple (146)** connection to make the beam to beam web connections. The shear plate will be welded to the primary beam web and bolted to the secondary beam web. We will use the connection both when the secondary beam is perpendicular to the main member or at a skewed angle to the main member.

Create one shear plate connection

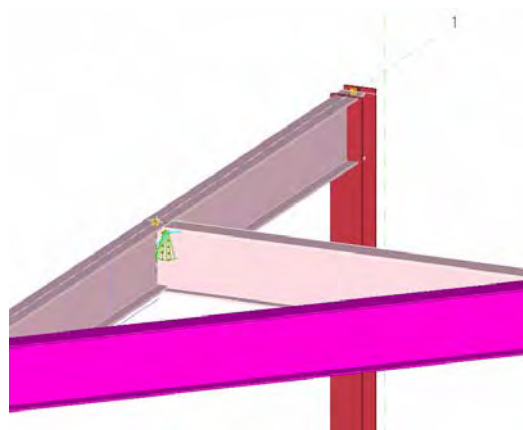
1. From the page 1 connection toolbar, double-click the **Shear plate simple (146)** icon.



Following dialog appears:



2. Pick the beam on grid line 1 as the main part of the connection.
3. Pick the beam perpendicular to the main part to be the secondary part and the connection will be created.



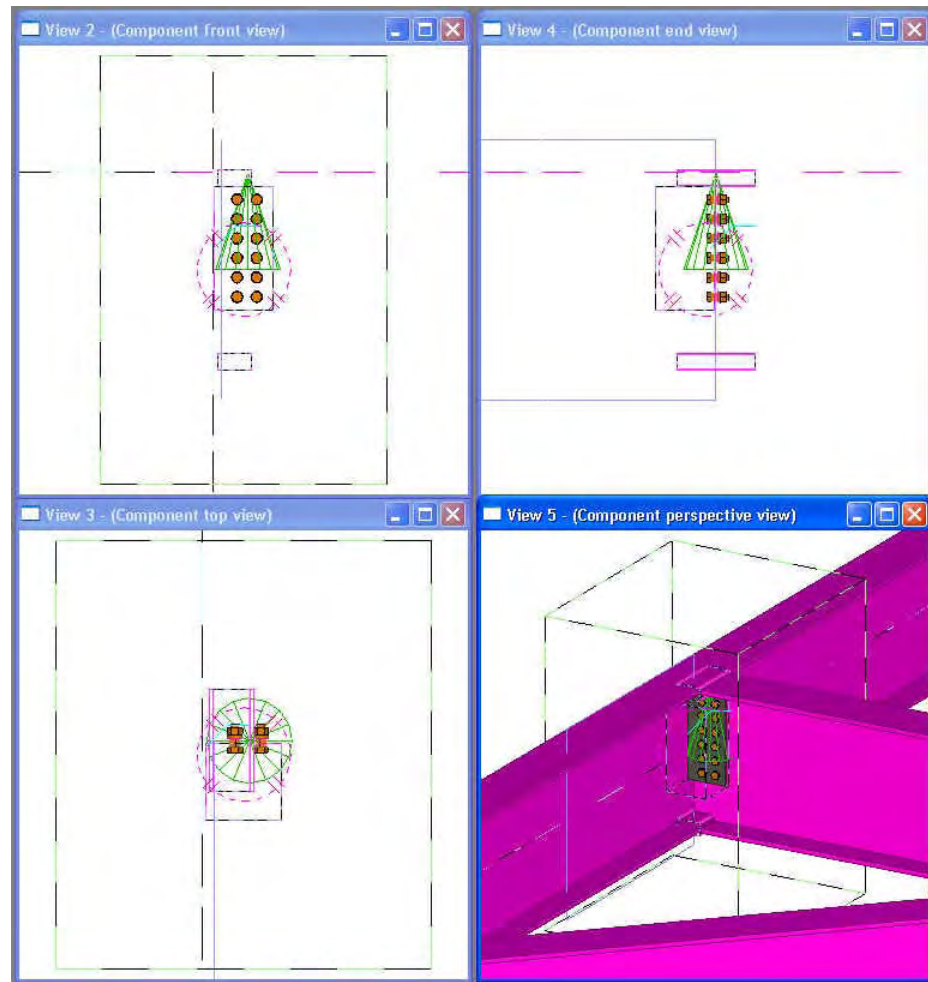
Check the Connection

To make it easier to check the connection you created you can create views from different sides of a selected connection. In the view the work area is closely fitted around the connection.

Create connection basic views

To create component basic views:

1. Select the connection symbol.
2. Right-click and select **Create view > Component basic views**, four basic views (front, top end and perspective) appear.



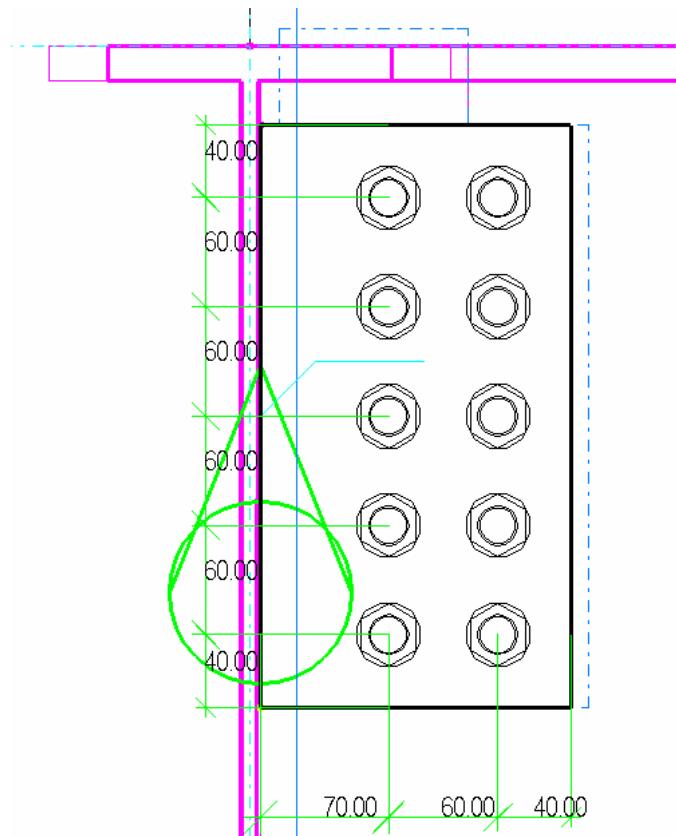
3. Keep the **Component front view** open and close the other component basic views.

Check bolt dimensions

We will now check the bolt location distances and bolt edge distances between bolts and the shear plate.

Help: Modeling > Settings and tools > Querying objects > Measure

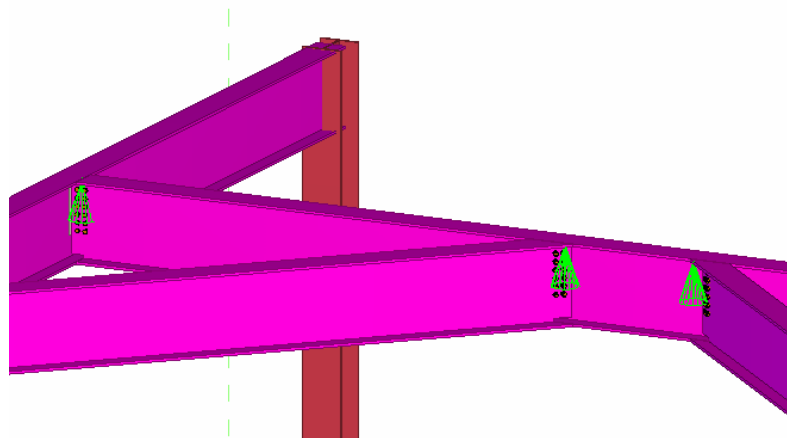
1. Click **Tools > Measure > Bolt measure**.
2. Pick the bolt group.
3. Pick the shear plate and the temporary dimensions are shown in the view.



Create the rest of the shear plates

Now we will accept the created connection's with the default properties.

With the connection's applied properties, create shear plate connections to all of the rest of the beam to beam conditions.



2.4 Beam to Column Web

We will use the **End plate (144)** connection to make the beam to column web connections.

For the double sided beam to column web connections we will use the **Two sided end plate (142)** connection. That connection uses only one bolt group to go through all three parts.

We will then make the wall brace to column connections with **Tube gusset (20)**. The connection uses a gusset plate to connect the beam to the column. Connection plates welded to the end of the braces will be bolted to gusset plate.

End Plate

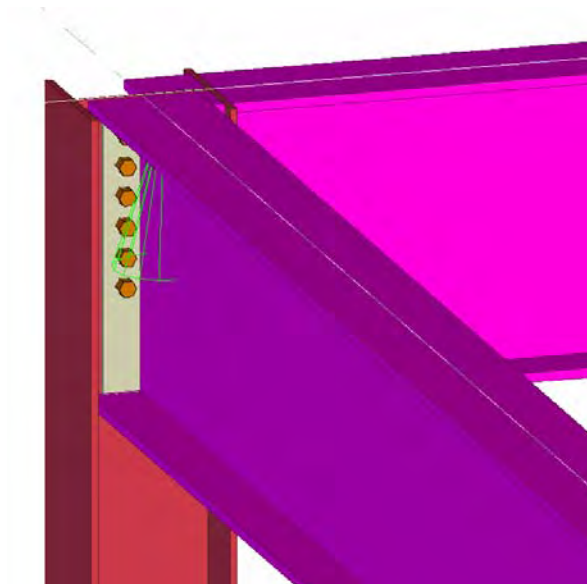
We will now use the **End plate (144)** connection to make all of the beam to column web connections using the default connection properties. We will modify the properties later with AutoDefaults.

Create end plates

1. On the page 1 connection toolbar, double-click the **End plate (144)** icon.



2. Make an end plate connection at every beam to column web condition where there is only one secondary beam coming to the column web.



Two Sided End Plate

Create the two sided end plate connection to all the double sided beam to column web condition to connect beams to both sides of the column web:

Create two sided end plates

1. Double-click the **Two sided end plate (142)** icon.

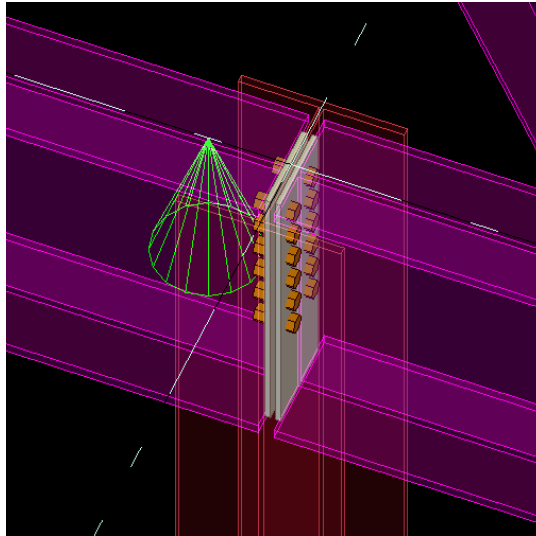


2. When prompted, pick the column as the main part.
3. Pick each beam as a secondary part.
4. Click the middle mouse button to complete the connection.



When there are multiple secondaries you need to click the middle mouse button to complete the selection.

Help: Modeling > Detailing > Getting started > Basics > Picking order



Wall Bracing –Tube Gusset

We will connect all the wall braces to columns using **Tube gusset (20)** connections and after that modify their properties all at once.

Create tube gusset to intersection of braces

1. From the page 4 connection toolbar, double-click the **Tube gusset (20)** icon.

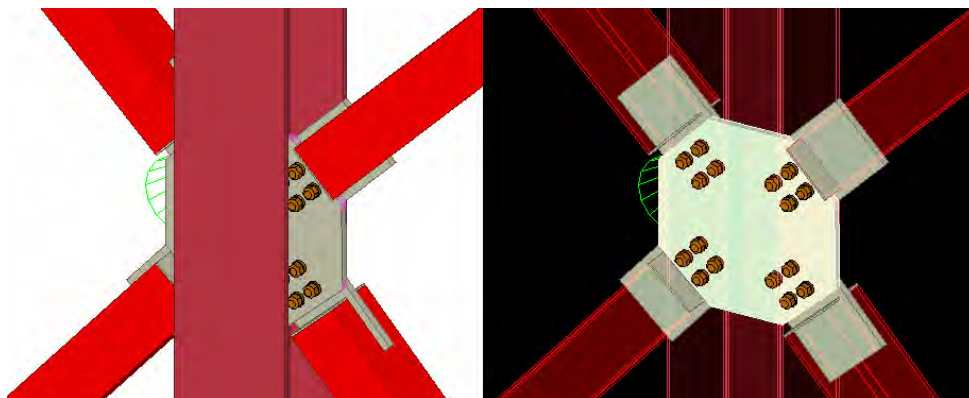


2. Pick the column on the grid intersection A-3 as the main part.
3. Pick the four braces one by one as secondaries.
4. Click middle mouse button to create the connection.

Now we can see that the connection created has only one gusset plate which goes through the column.



We could have created a separate gusset plate at each side of the column by creating two separate connections.



Create the rest of the tube gussets

While still in the command, create the connections to the other ends of the braces by doing the following:

1. Pick the column.
2. Pick the brace.
3. Click middle mouse button to create the connection.

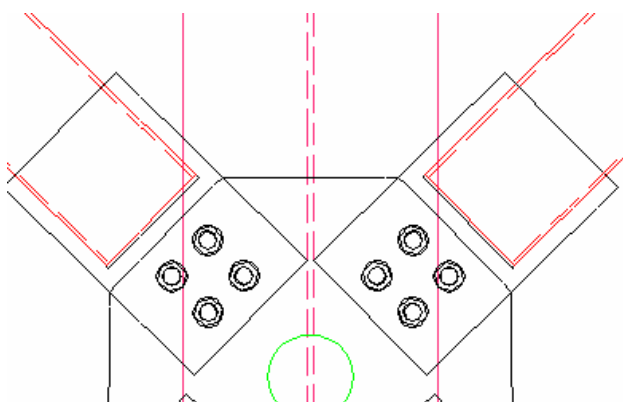
Check one tube gusset connection

Create **Component basic views** of the tube gusset connection connecting the four braces.

In the **Component front view** you can see that there is no clearance from the gusset plates to the column web.



To see the column web in the connection front view you can change the view type in the view properties dialog to rendered.

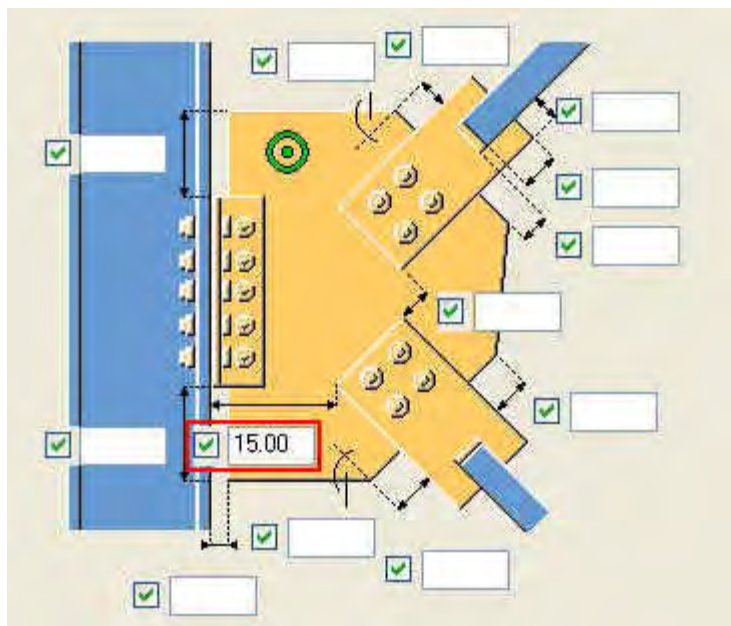


Modify the Connection

We will modify the connection by adding 15 mm clearance between the gusset plates and the column. We will also change the number of vertical bolt rows from 2 to 1.

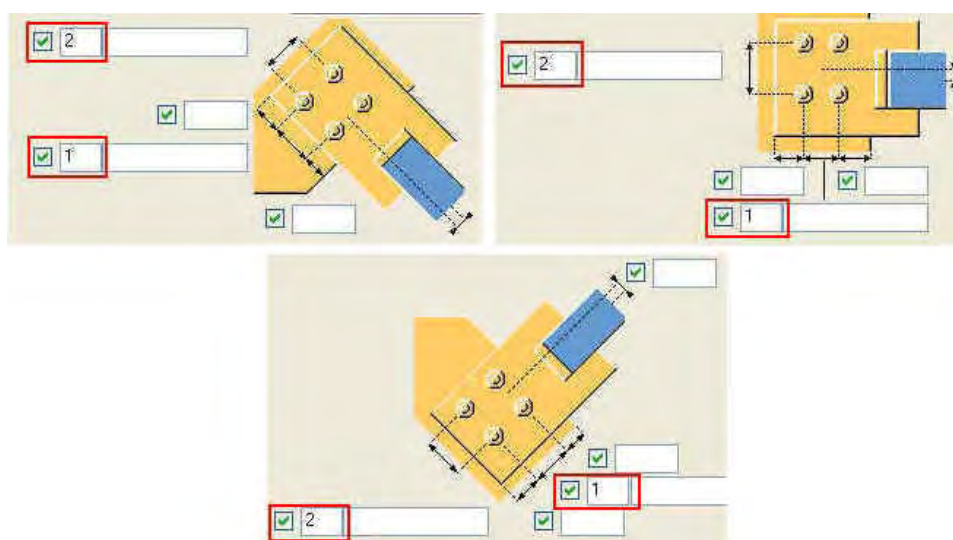
Add clearance between the gusset plate and the column

1. Double-click the connection symbol.
2. On the **Picture** tab type 15 in the field defining the clearance between gusset plate and the column.



Edit the number of bolt rows

3. In the **TubeBolts1**, **TubeBolts2** and **TubeBolts3** tab pages edit the number of horizontal and vertical bolt rows as shown in the figures below.



4. Click **Modify** and then **Apply**.



The TubeBolts1 tab effects the first picked brace, TubeBolts2 tab the second pick and TubeBolts3 picks 3-9.

Check the changes

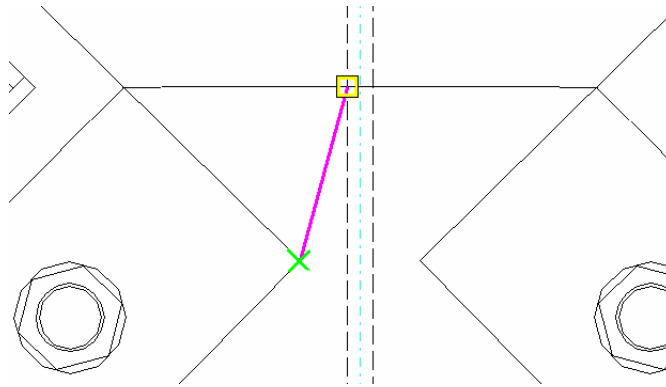
Check that the number of bolt rows was changed and that the clearance is correct.

To check the clearance:

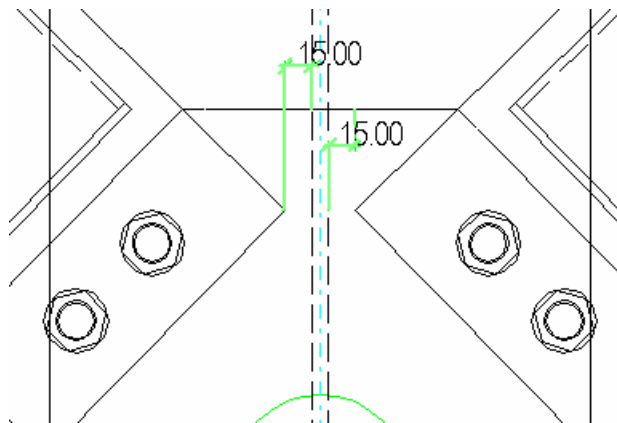
1. Click the **Create X measure** icon.



2. Pick the starting and end points as shown:



3. Pick a point to locate the dimension.
4. Repeat for the other dimensions you want to check.



Now we will also modify the other tube gusset connections with the new properties we applied.

Modify all the tube gusset connections at once

We can easily modify only connections of the same type shown in the connection dialog box by selecting **Ignore other types** in the connection dialog box.

1. Check that the **Ignore other types** is selected in the connection dialog box.

Help: Modifying connections



2. Select all the connections in the model by using the **Select component** select switch shown below and dragging a window around the whole model.



3. Click **Modify**.

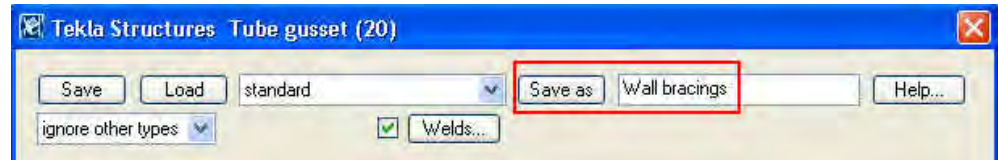
We will now save the edited properties for later use.



By saving the properties with a descriptive name you can easily use them later. You can also get AutoDefaults to automatically use the saved properties in desired cases by setting up AutoDefaults rules.

Save the properties

4. Type **Wall bracings** in the **Save as** field in the dialog box.
5. Click the **Save as** button.



2.5 Beam to Column Flange

We will now create **End plate (144)** connections to all of the beam to column flange conditions by using the default properties.

Then we will edit one of the connection's properties. Instead of modifying the rest of the connections with the new properties, in the next section, we will create AutoDefaults rules to define when certain properties will be used.

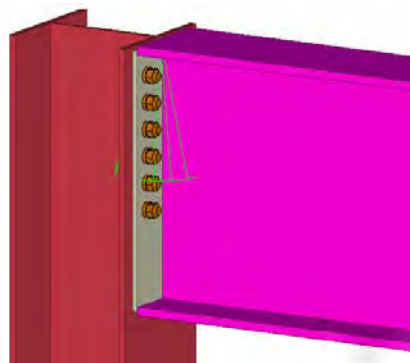
End Plate

Create end plates

1. Double-click the **End plate (144)** icon.



2. Create connections at all of the beam to column flange framing conditions.



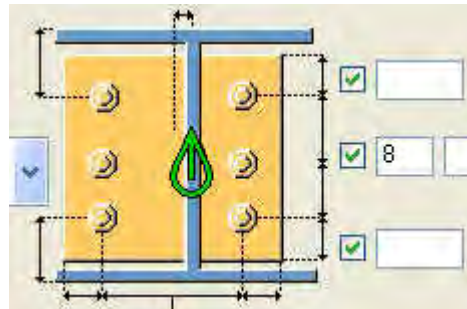
Change the Number of Bolt Rows and Save the Properties

We will now change the number of bolt rows to eight when the secondary beam is IPE600. We will then save the new properties with a specific name so that we will be able to use them in AutoDefaults.

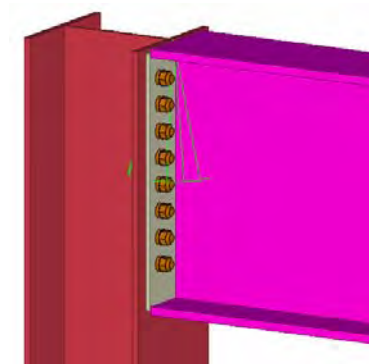
8 bolt rows to IPE600

We will also save properties with seven bolt rows for later use with IPE500 beams.

1. Double-click one of the connections we just created to open the connection dialog box.
2. On the **Bolts** tab input **8** as the number of bolt rows.



3. Click **Modify**.



4. Type **8_bolt_rows** in the **Save as** field in the dialog box and click **Save as**.



7 bolt rows to IPE500

5. On the **Bolts** page input **7** as the number of bolt rows.
6. Use **Save as** to save the properties as **7_bolt_rows**.

2.6 Create AutoDefaults Rules

With AutoDefaults you can create rules defining when to use different pre-defined connection properties. When the connections need to be modified (for example changing the beam size), Tekla Structures automatically redefines the connection properties using AutoDefaults rules defined by you.

New Rule Group: Industrial Building Rules

We will now create a new AutoDefaults rule group named **Industrial building rules**.

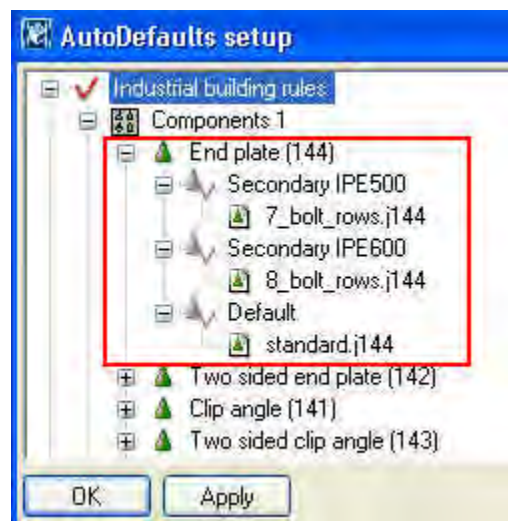
This rule group could include all the rules needed to define when to use certain pre-defined connection properties for the entire project.

Help: System > AutoConnection > AutoDefaults setup > AutoDefaults setup

We will now define two simple rules for the **End plate (144)** connection.

1. When the secondary is an IPE500, the end plate connection will have 7 bolt rows.
2. When secondary is an IPE600, the end plate connection will have 8 bolt rows.

When the secondary is neither of the above (IPE500 or IPE600) the default rule will be met and the standard properties will be used.

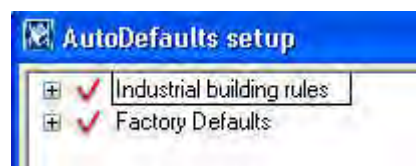


Create new rule group: Industrial building rules

1. Click **Setup > AutoDefaults...** to open **AutoDefaults setup** dialog box.
2. Right-click in the dialog and select **New rule group**, a rule group named **New** appears.



3. Select the **New rule group**, press the **F2** key and type: **Industrial building rules**.

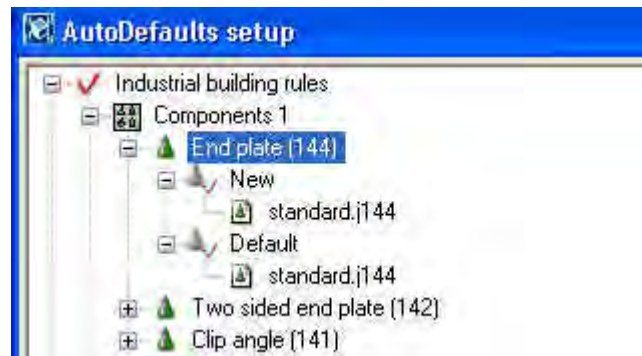


Create new rule sets for end plate

4. Browse to **Industrial building rules > Components 1 > End plate (144)**.
5. Right-click the connection **Endplate (144)** and select **Create additional rule sets**.



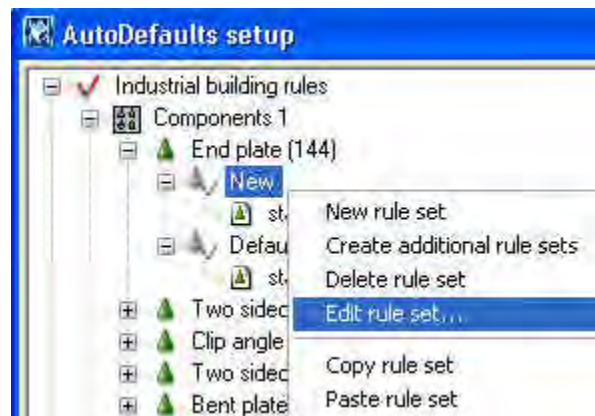
- Two rule sets: **New** and **Default** appear in the tree. By default, both rule sets have standard connection properties selected.



IPE 600 Rule Set

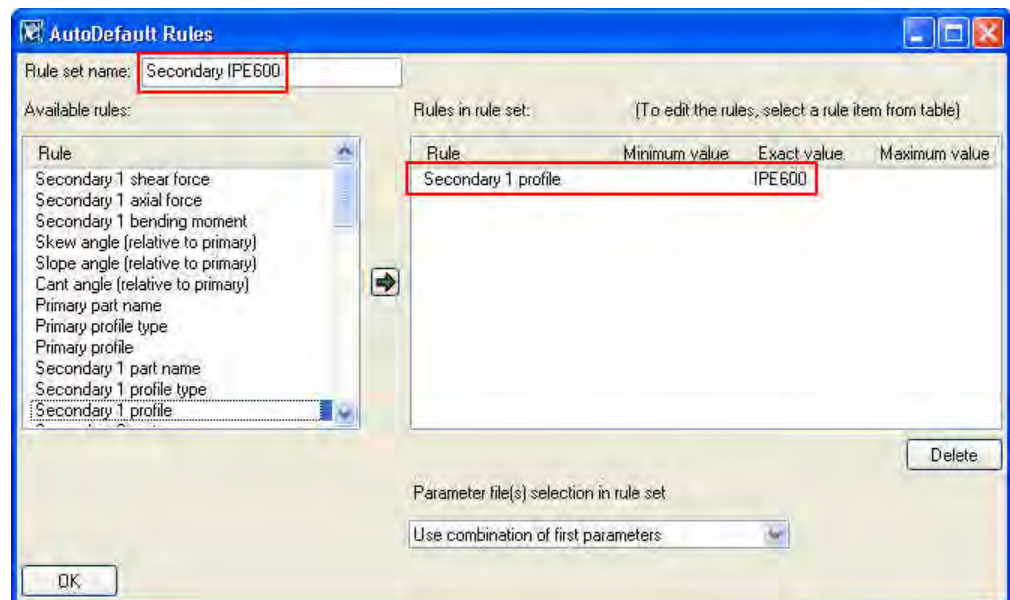
Add rule to rule set New

- Right-click the rule set **New** and select **Edit rule set...** to open the **AutoDefault Rules** dialog box.



Enter name for rule set

- Select the rule **Secondary 1 profile** from the **Available rules** list.
- Click the right arrow button to move the selected rule into the list of rules in the rule set.
- In the right pane under **Exact value**, fill in **IPE600**.
- Enter a name for the rule set: **Secondary IPE600**.
- Click **OK**.

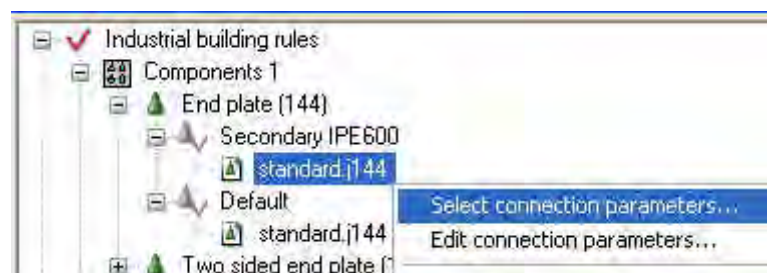


We have used the **End plate (144)** connection both in beam to column web and beam to column flange cases so the rule will now be used in both cases.

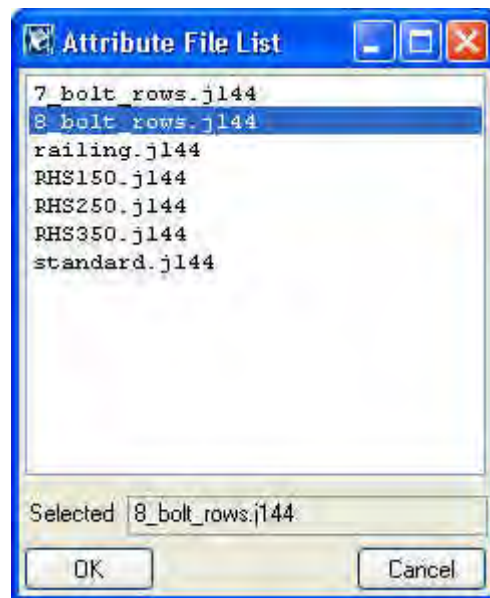
We could make this rule to work only in beam to beam flange cases by setting another rule: Secondary beam to beam flange TRUE.

Select connection parameters

7. Select the **standard.j144** parameters, right-click and pick **Select connection parameters...**



8. This opens **Attribute file list** in which all the saved properties for connection 144 are listed.
9. Select the **8_bolt_rows** properties and click **OK**.



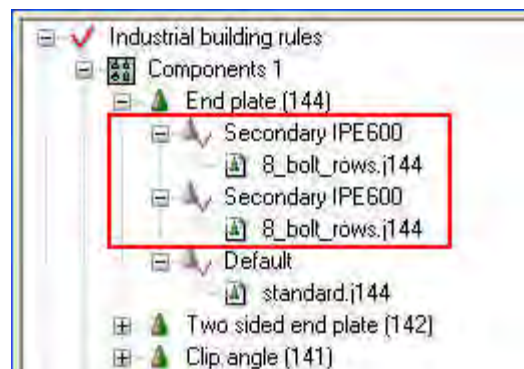
IPE 500 Rule Set

We will now create another rule set for IPE500 taking advantage of the **IPE600** rule set we just created.

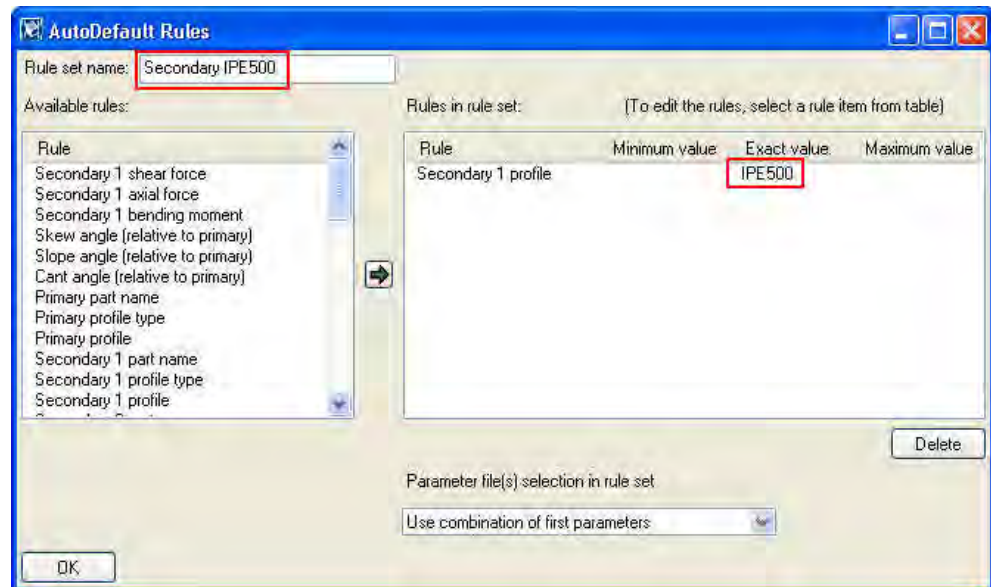
Copy and modify rule set

1. Select the rules set **Secondary IPE600**, right-click and select **Copy rule set**.
2. While the rule set **Secondary IPE600** is still selected, right-click again and select **Paste rule set**.

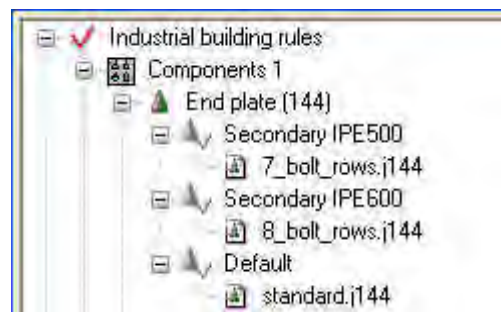
We now have two identical rule sets.



3. Select the upper **Secondary IPE600** rule set, right-click and select **Edit rule set...**
4. Modify the value in the rule to **IPE500** and the **Rule set name** to **Secondary IPE500** and click **OK**.



5. Select the properties **8_bolt_rows** under the rule set **Secondary IPE500**, right-click and pick **Select connection parameters...**
6. Select the parameters: **7_bolt_rows** and click **OK**.



7. Finally click **OK** in the **AutoDefaults setup** dialog box.

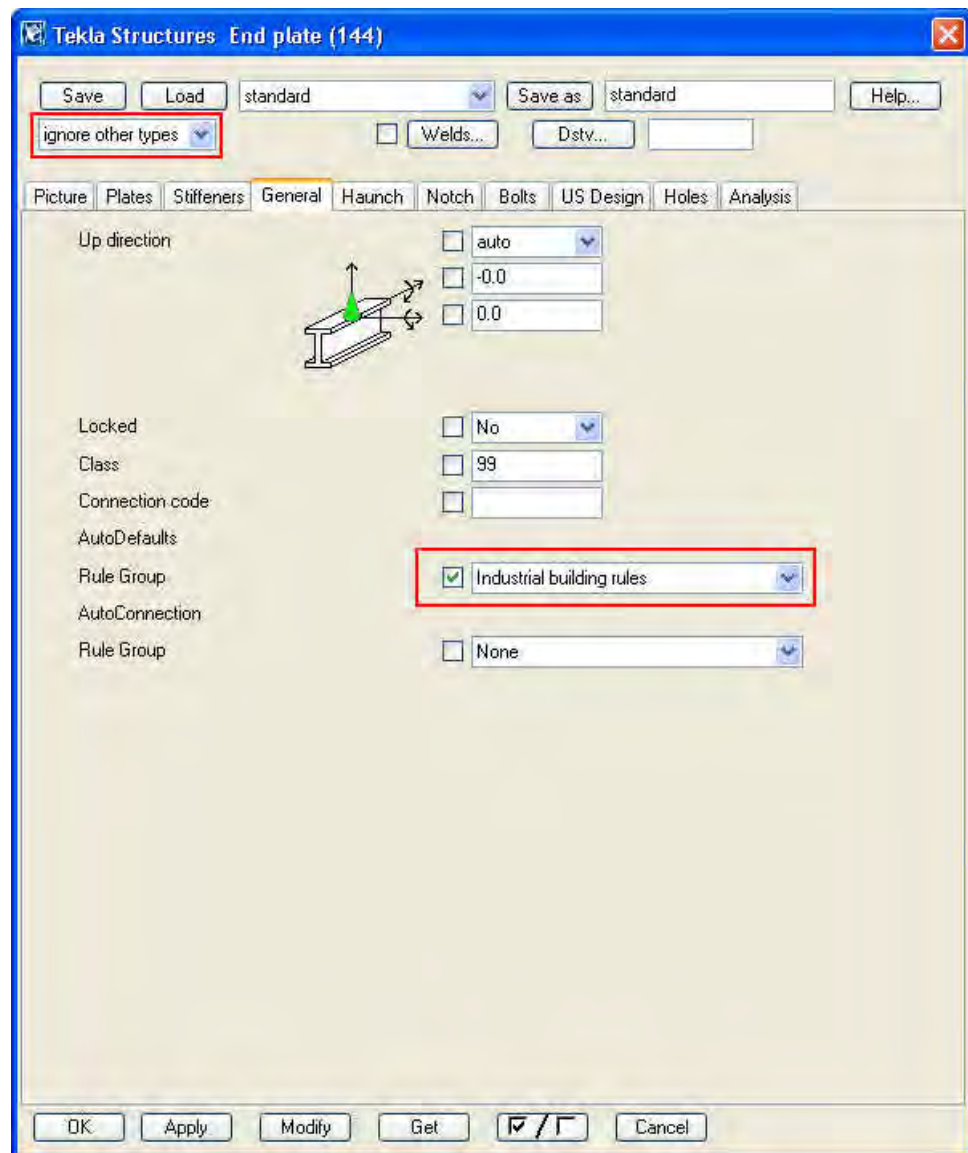
Now the new AutoDefaults rules are ready for use.

2.7 Use AutoDefaults Rules

We will now use the **Industrial building rules** created to automatically apply the correct properties to the existing **End plate (144)** connections.

Switch the AutoDefaults On in the End Plate Connections

1. Open the **End plate (144)** connection dialog box.
2. On the **General** tab select **Industrial building rules**.
3. Click the on/off button and tick only the **Rule Group** check box.
4. Check that the **Ignore other types** is selected.



5. Save as **ipe600**.
6. Select all of the connections in the model.
7. Click **Modify**.

Since all the secondaries in our end plate connection are IPE600, they all pass the **Secondary IPE 600** rule and result in having the same properties, **8_bolt_rows**.

Change profiles – AutoDefaults React

Let's now assume that first and second floor beams on gridlines 4 and 7 don't have as much load as others and we can change their profiles to IPE500.

Change the profiles

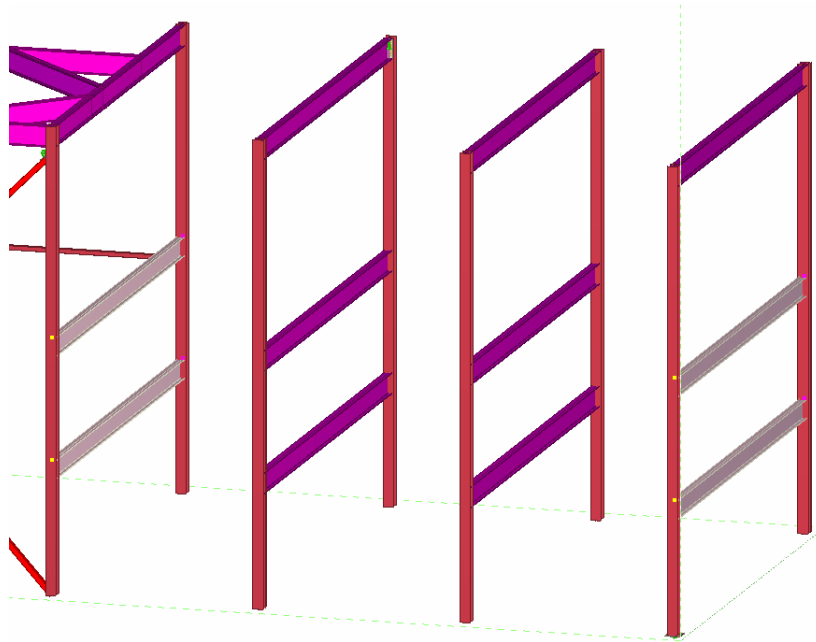
1. Double-click one of the beams selected in the figure below to open the beam properties dialog box.
2. Change the profile to **IPE500** and tick only the profile check box.

Attributes:

<input type="checkbox"/> Name:	BEAM	
<input checked="" type="checkbox"/> Profile:	IPE 500	Select...
<input type="checkbox"/> Material:	S355JR	Select...

3. Select the four beams shown highlighted in the figure below and click **Modify**.

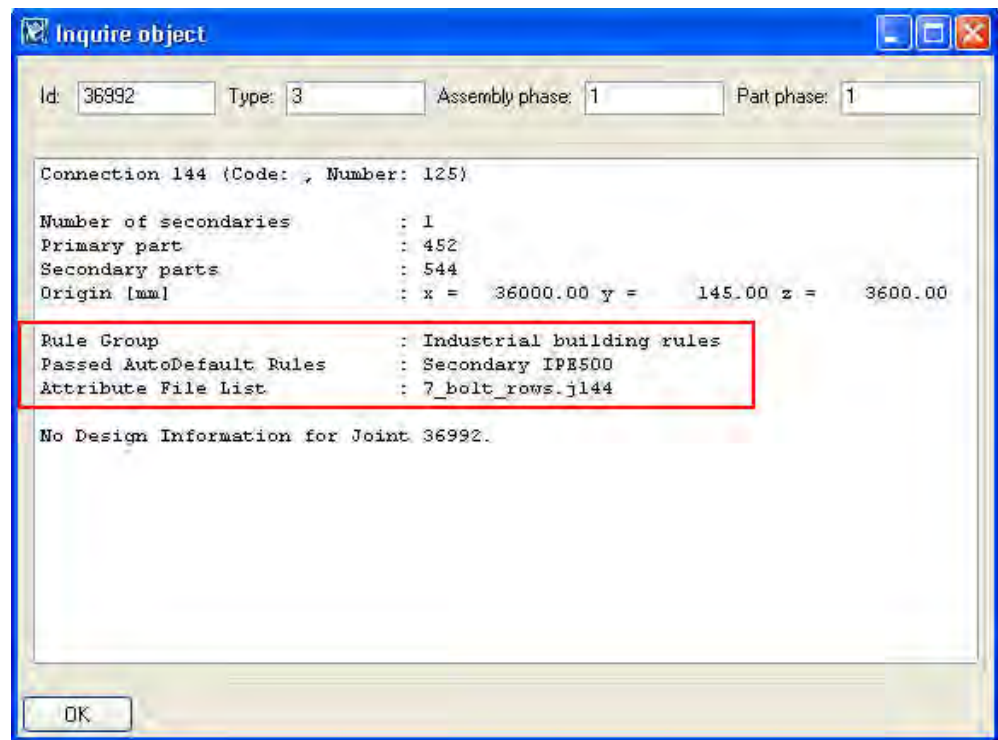
You can see that the connections in the modified beams were updated to have 7 rows of bolts.



Inquire the properties used

1. Select one of the connection symbols of the changed profiles.
2. Right-click and select **Inquire**.

From the inquire object dialog box you can check which rule group, particular rule and connection attributes were used.



Check Clashing Again

Now that we have connected all the steel parts in our model we will run the clash check again.

Check clashing

1. Select all of the parts by dragging an area select around the whole model.
2. Right-click and select **Clash check**.

To quickly locate and view colliding parts in the model, select a line containing the ID numbers of colliding parts from the list. Tekla Structures highlights the parts in the model.