



Interactive Steel Detailing

Tekla Structures 12.0 Basic Training
September 21, 2006

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Contents

Contents..... i

3 Interactive Steel Detailing 3

 3.1 Create Gusset Plate with Stiffeners Interactively..... 3

 3.2 Create an End Plate Connection from Scratch 10

 3.3 Create Cuts Interactively 24

3

Interactive Steel Detailing

In this lesson

Tekla Structures system components cover a great variety of the components used in most projects. However, you may come across situations where it's not possible to make the necessary connections in your model using the system components.

In this chapter we will take advantage of the Tekla Structures tube gusset connection by using it as a base for a connection. We will explode the system component, modify the ungrouped objects and then add objects to the connection using a system component detail.

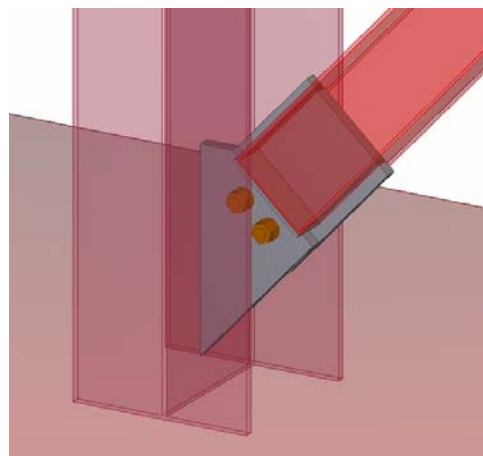
We will also create a whole new connection (i.e. all connection objects: parts, welds, bolts and cuts) interactively from scratch without using any system components.

3.1 Create Gusset Plate with Stiffeners Interactively

In Tekla Structures there is no gusset plate system component available in which you can get the stiffeners included in the connection. You can, however, create the stiffeners separately by using a system component detail.

We will explode an existing tube gusset connection, modify the gusset plate shape and then create stiffeners in the connection using a system component detail.

Near the bottom end of the column at grid A-2 is a **Tube Gusset (20)** connection.



In the figure on the left we see the connection before the stiffeners have been added. In the figure on the right we see how the connection will look after the stiffeners have been added.

Create component basic views

Select the component symbol, right-click and select **Create view > Component basic views**.

Explode gusset plate connection

Inside of the system connection we are not able to reshape the gusset plate the way it is shown in the figure above.

In situations where the connection parameters do not contain a particular option, we must edit the parts outside of the connection.

In order to modify connection objects outside the connection, we need to explode the connection. Exploding ungroups the objects in a connection. Modifications when done outside of the connection dialog without first exploding the connection will result in the changes being overwritten if the connection were to get updated.



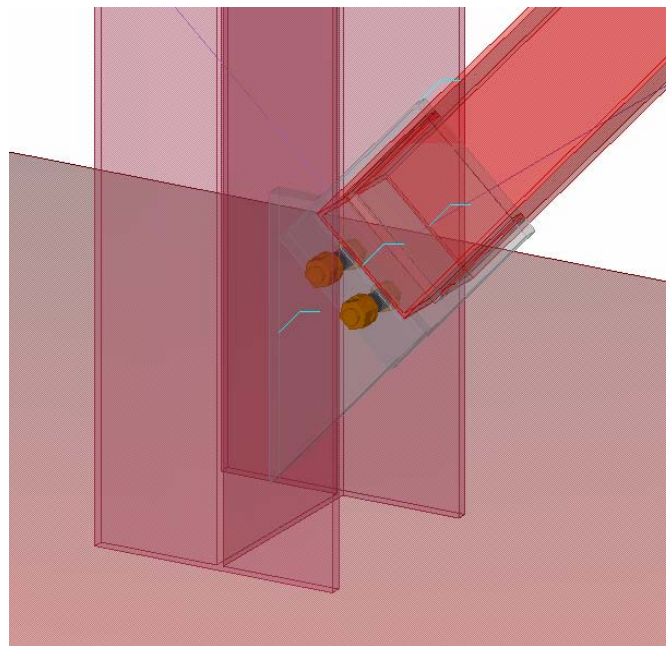
Before exploding the connection you should take advantage of the connection to get as close to the desired result as possible since editing connection macros is faster and easier than editing objects outside the connection.

Explode connection

To explode the connection:

Select gusset plate's connection symbol, right-click and select **Explode component**.

All connection objects (even if they are set to "not visible" in the view properties) will become visible. Now all of these objects have lost intelligence and association to the connection dialog.



Reshape the gusset plate

We will now reshape the gusset plate as shown in the figure below by editing the polygon plate using the **Edit polygon shape** command.

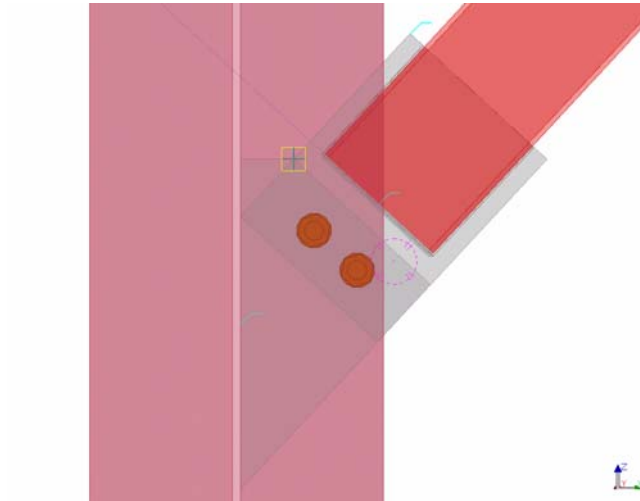
Create a construction line

We will first create a temporary construction line to help to locate the bottom right corner of the gusset plate.

1. Click the **Create construction line** icon.

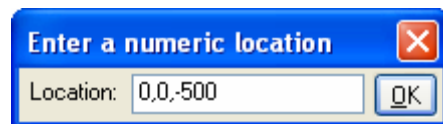


2. Pick the top right corner of the gusset plate as the starting point of the line.

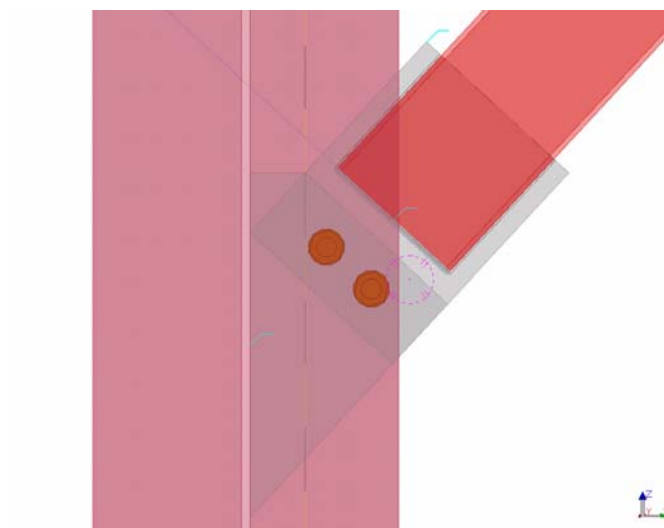


3. Type **0,0,-500** to define the end point of the construction line (-500 mm in the z direction from the last picked point).

As you type, the **Enter a numeric location** dialog box is automatically displayed.



4. Press **Enter** and the construction line is created



Instead of recreating the polygon plate we will now reshape the existing plate by using the **Create line cut** command.

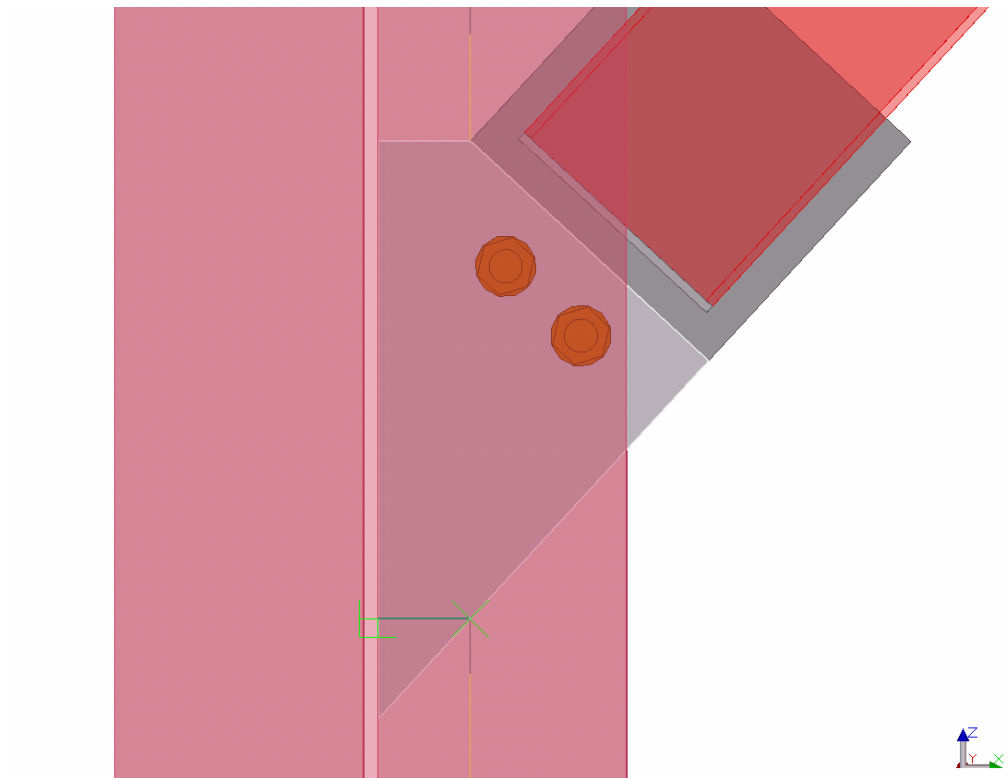
Edit polygon shape



1. Select the **Create line cut** icon and follow the instructions on the command line.



2. Pick the gusset plate as the part to be cut.
3. Pick the intersection of the gusset plate edge and the construction line.
4. Snap to the perpendicular point on the gusset plate edge and pick point. (Make sure you pick the plate edge and not the gridline).
5. Pick the bottom corner as the side to be removed. The plate is now reshaped.



The construction line is no longer needed and you can delete it.

Add stiffeners

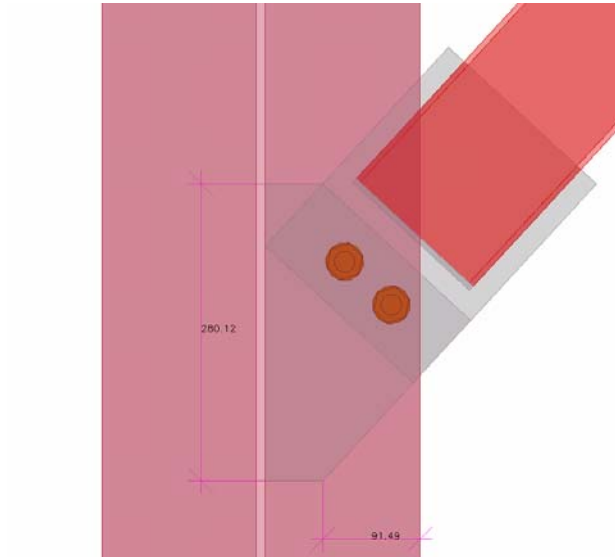
We will now add stiffeners to our connection using the **Multiple Stiffeners (1064)** detail. When we open the detail's dialog box we can see which options are available to us for creating the stiffeners. In this case we are interested in setting the stiffener spacing and the edge distance from the edge of the stiffener to the edge of the column. We can then measure the column to get the parameters exactly as desired.

Measure dimensions

1. Take the following measurements in the model: Click the **Create X measure** icon, pick the points and a place for the dimension as shown below:



2. Click the **Create Y measure** icon, pick the points and a place for the dimension as shown below:



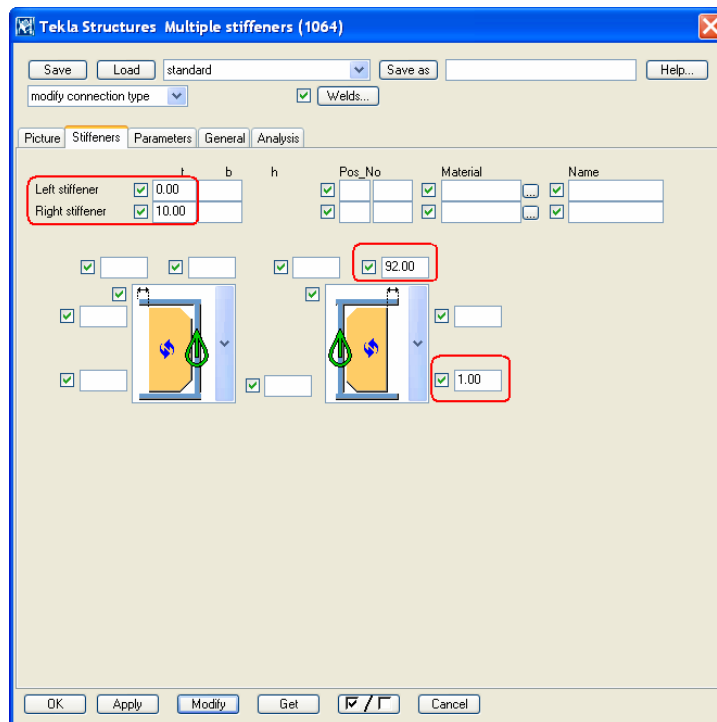
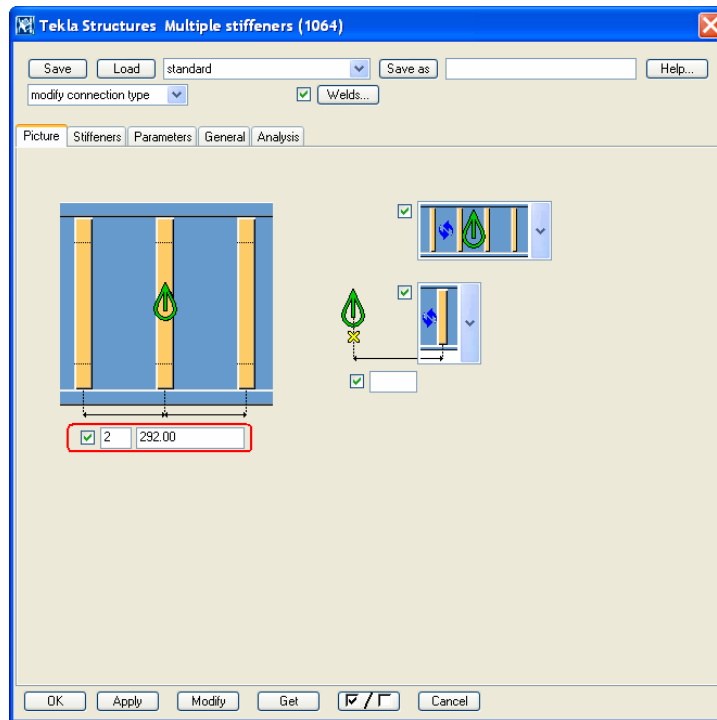
Create stiffeners using macro

1. Open the component catalog (Ctrl+F) and find the **Multiple stiffeners (1064)** component. Double-click on the component icon.

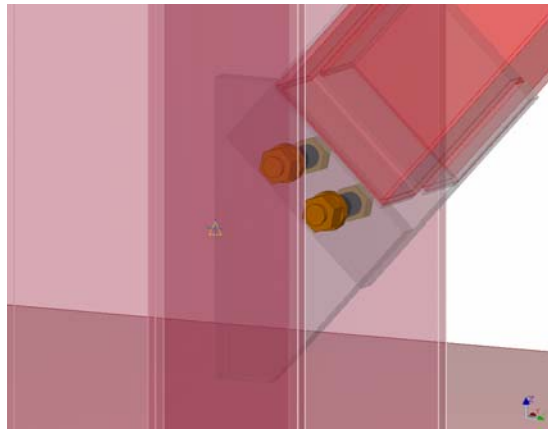


Multiple Stiffeners (1064)

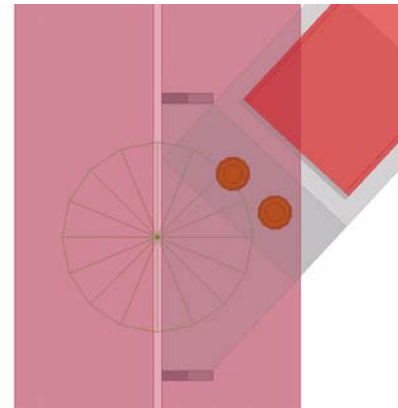
2. Edit the fields shown highlighted on each of the tab pages below and click **Apply** (study the association with the dimensions taken in the model and note the tolerances).



3. Pick the column.
4. Pick the midpoint of the gusset plate, and the stiffeners are created.



You can see the final result in the figures below.

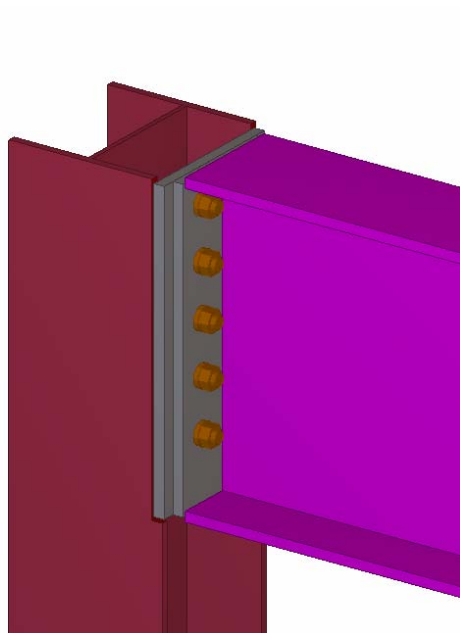


We could now explode the stiffener detail but since we have not edited the connection objects except for the detail we can also just leave it.

In the next lesson, Lesson 4: Custom element, you will learn to group objects in your own user-defined connections.

3.2 Create an End Plate Connection from Scratch

Sometimes you may need to create all the objects for a connection interactively from scratch. As an example we will now create plates, a polygon cut, a fitting, a bolt group and welds interactively in order to create the connection shown below.



Create plate and fitting for the beam

At grid intersection B-3 at level 13400:

Create connection basic views and delete the connection

1. Select the existing end plate connection, right-click and select **Create view > Component basic views**.
2. Delete the existing connection.

Create end plate for the beam

We will now use the beam command to create the end plate for the beam.

1. Start the beam command and **Apply** the properties for the end plate shown in the dialog box below.

Beam properties

Save Load standard Save as standard

Start releases End releases Design Deforming
 Attributes Position Analysis Loading Composite

Numbering series

Prefix: Start number:

Part P 1

Assembly A 1

Attributes

Name: BEAM

Profile: PL20*230 Select...

Material: S235JR Select...

Finish:

Class: 99

User-defined attributes...

OK Apply Modify Get ✓ / Γ Cancel

Beam properties

Save Load standard Save as standard

Start releases End releases Design Deforming
 Attributes Position Analysis Loading Composite

Position

On plane: Middle 0.00

Rotation: Front 0.0

At depth: Front 0.00

End offset

Start: End:

Dx 0.00 0.00

Dy 0.00 0.00

Dz 0.00 0.00

Curved beam

Radius: XY plane 0.00

Number of segments: 1

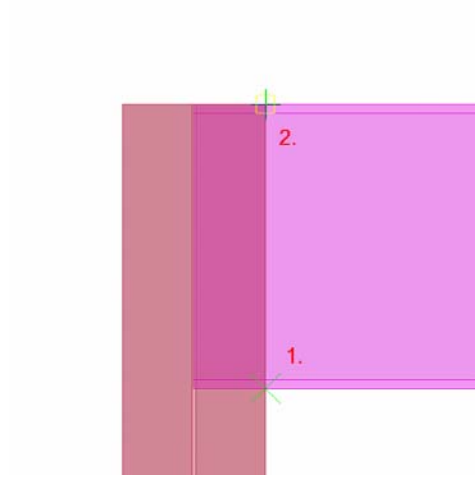
OK Apply Modify Get ✓ / Γ Cancel



It is possible to create plates by using either the beam or the contour plate command.

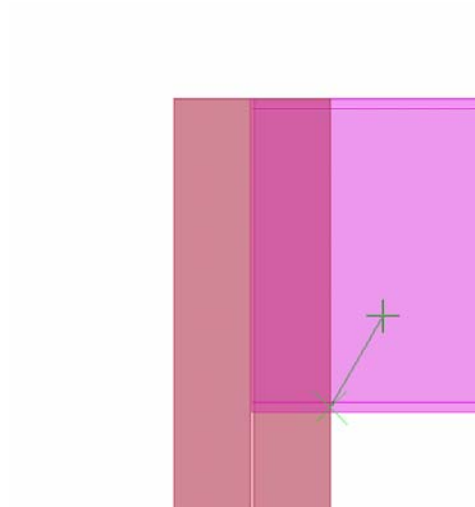
In the **Component front view**:

2. Hold down the **Ctrl** key and pick the intersection of the beam lower flange and the column flange (1) to set the “From” location coordinates.
3. Then use the cursor to snap (do not pick!) at the top right corner of the column (2) to set the correct direction.

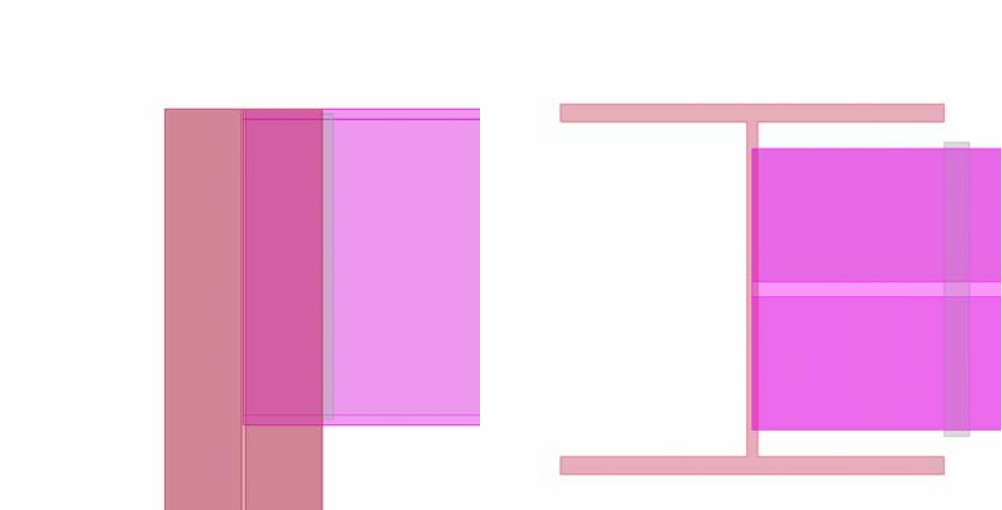


4. Type **10** for the numeric location (the **Enter a numeric location** dialog box will open automatically) and press **Enter**.

The cursor picks to the desired start position (which equals 10 mm from point 1 in the direction of point 2).



5. To pick the end position, hold down the **Ctrl** key and pick position (2). Then use the cursor to snap to position (1). Type **10** for the numeric location and press **Enter** (which equals 10 mm from point 2 in the direction of point 1).



Fit the end of a beam

The plate then appears.

We will use the **Fitting** command to trim the end of the beam at the end plate.

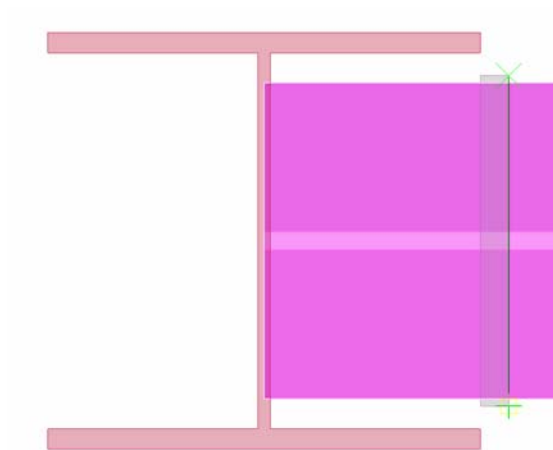
The **Fitting** tool will trim the end of the beam on a plane perpendicular to the view plane, which is defined by picking two points on a line.

Help: Modeling > Detailing > Fine-tuning part shape > Fitting

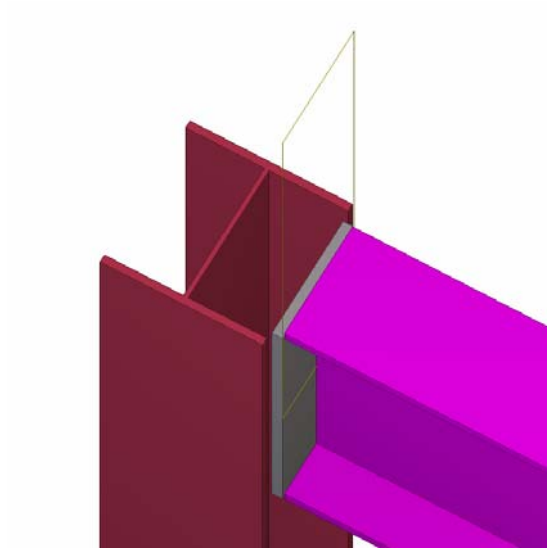
1. Click on the **Create fitting** icon.



2. Select the beam as the part to be fitted.
3. Pick the points on the end plate corners to set the cut line for the fitting.



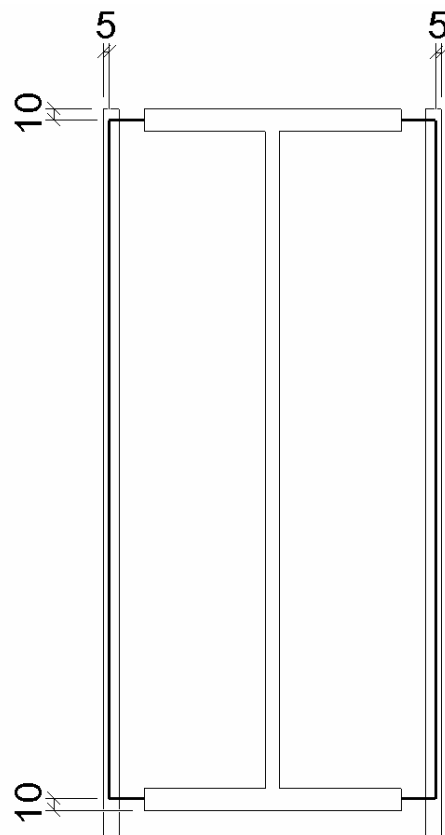
Tekla Structures displays the fitting in the model using a blue fitting symbol.



Create a plate for the column

We will now use the **Create contour plate** command to create a plate for the column. We will use the **Component end view** for ease of picking points to place the plate. We will then move the plate to the correct depth.

[Help: Modeling > Parts > Steel parts commands > Contour plate](#)



Create column plate

1. Start the **Create contour plate** command.



2. **Apply** the properties for the plate as shown below:

Contour plate properties

Save Load standard Save as standard

Attributes Analysis Spanning Loading Design

Numbering series

	Prefix:	Start number:
<input checked="" type="checkbox"/> Part		1001
<input checked="" type="checkbox"/> Assembly	A	1

Attributes

<input checked="" type="checkbox"/> Name:	PLATE
<input checked="" type="checkbox"/> Profile:	PL10
<input checked="" type="checkbox"/> Material:	S235JR Select...
<input checked="" type="checkbox"/> Finish:	
<input checked="" type="checkbox"/> Class:	99
<input checked="" type="checkbox"/> User-defined attributes...	

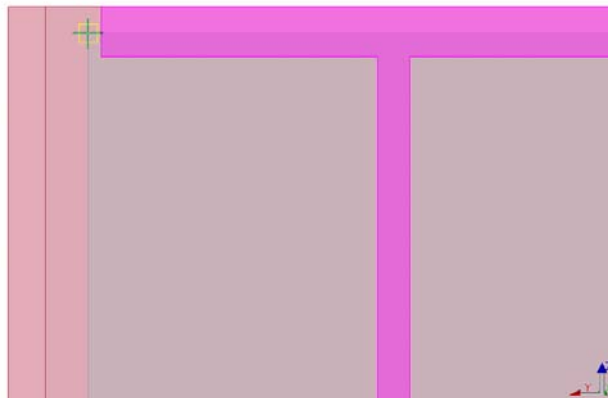
Position

<input checked="" type="checkbox"/> At depth:	Middle	0.00
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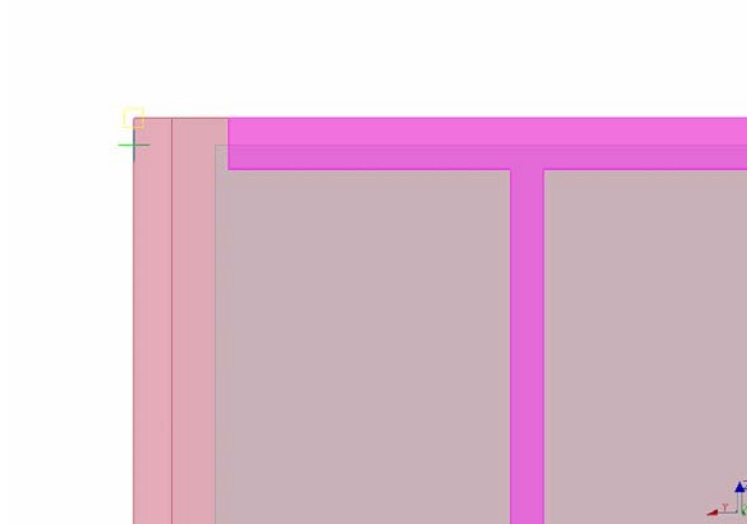
OK Apply Modify Get / Cancel

In the **Component end view**:

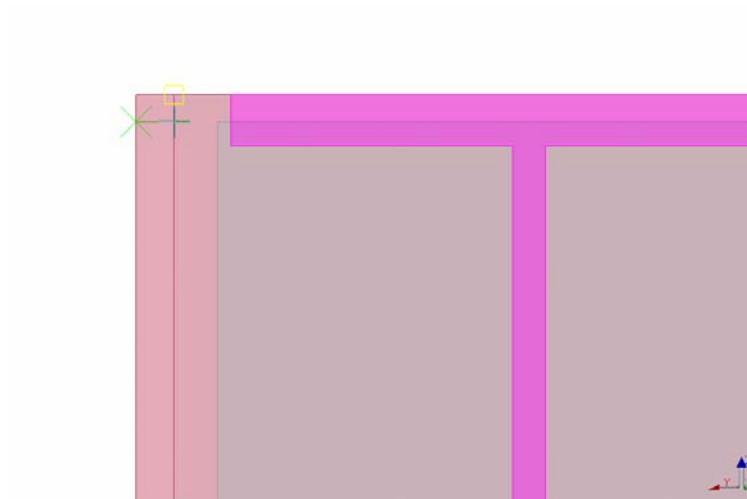
3. Let the cursor snap to the top left corner of the end plate and type **z** to lock the z coordinate.



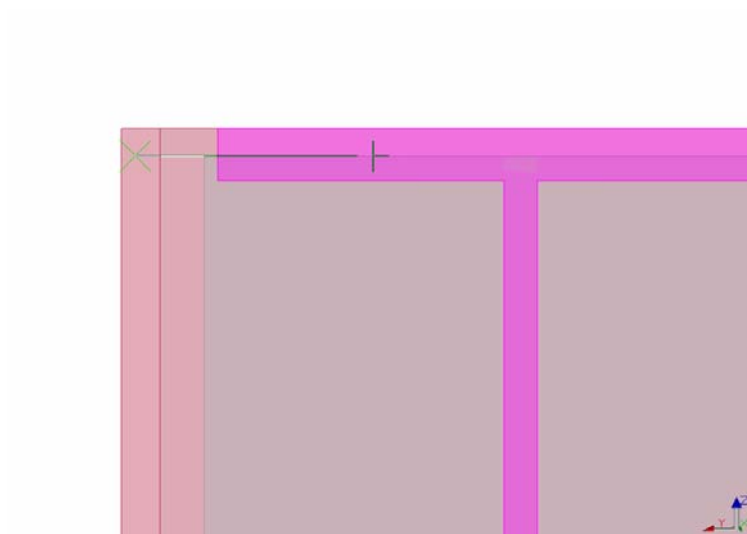
4. Hold down the **Ctrl** key and pick the top left corner of the column to set the “From” location coordinates.



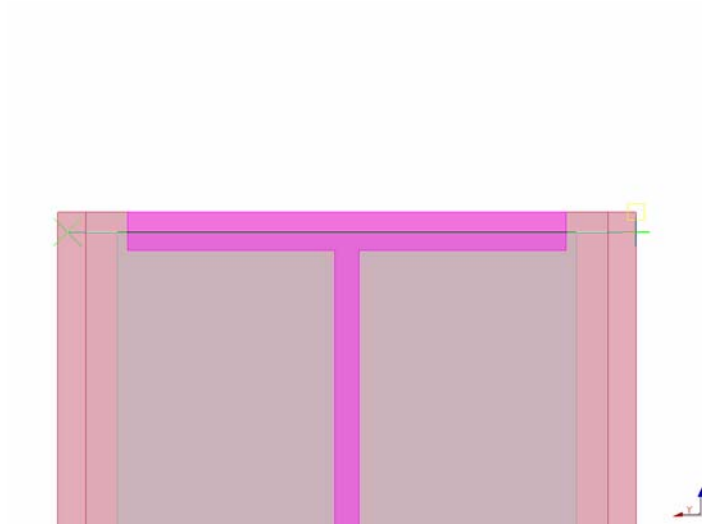
5. Let the cursor snap to the inner side of the flange shown, type **5** and press **Enter**.



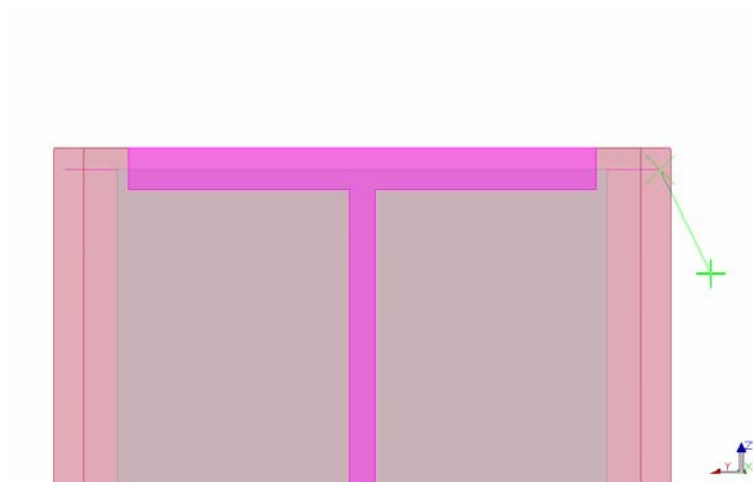
The first point for the plate is now picked.



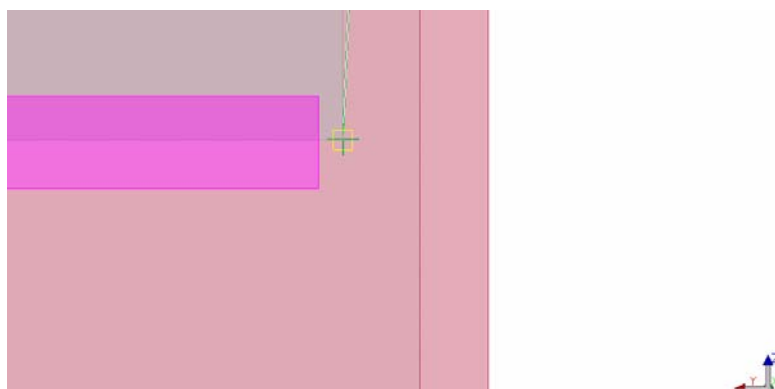
6. Hold down the **Ctrl** key and pick the top right corner of the column to set the “From” location coordinates.



7. Let the cursor snap to the inner side of the flange, type **5** and press **Enter**.
8. The second point is now picked.
9. Press **z** to release the coordinate lock.



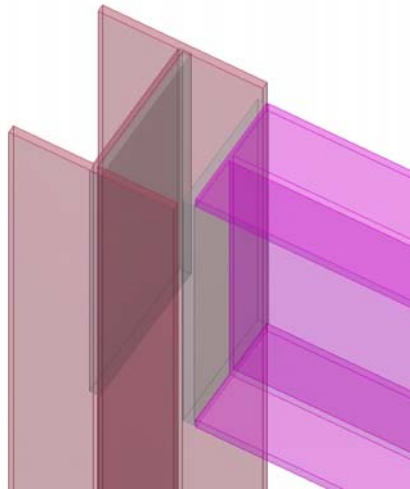
10. Let the cursor snap to the bottom right corner of the end plate and type **z** to lock the z coordinate.



11. Repeat steps 4 and 5 to pick the third point for the plate.
12. Repeat steps 6 and 7 to pick the last position for the plate.
13. Press **z** to release the coordinate.

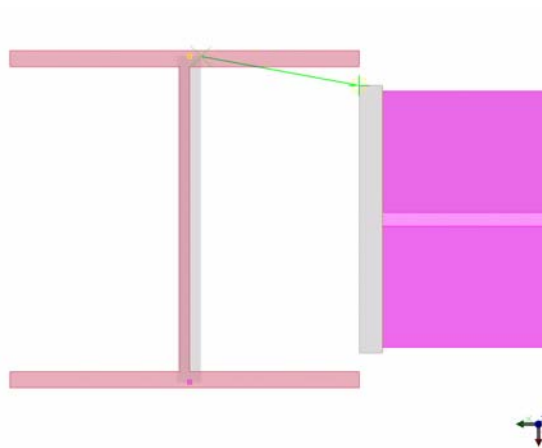
14. Press the middle button to create the plate.

The plate is created in the view plane of the **Component end view**.



Move the plate

1. Select the column connection plate, right-click and select **Move > Translate...**
2. Move the plate in the x direction (and only x) so that it is next to the end plate.



Fitting the column

The column connection plate is now in the correct position but it collides with the column flanges. We will use the **Create part cut** command to cut the column with the plate. We will then enlarge the antimatter cut to add some clearance between the plate and the column flanges.

Help: Modeling > Detailing > Detailing commands > Detailing>Part cut

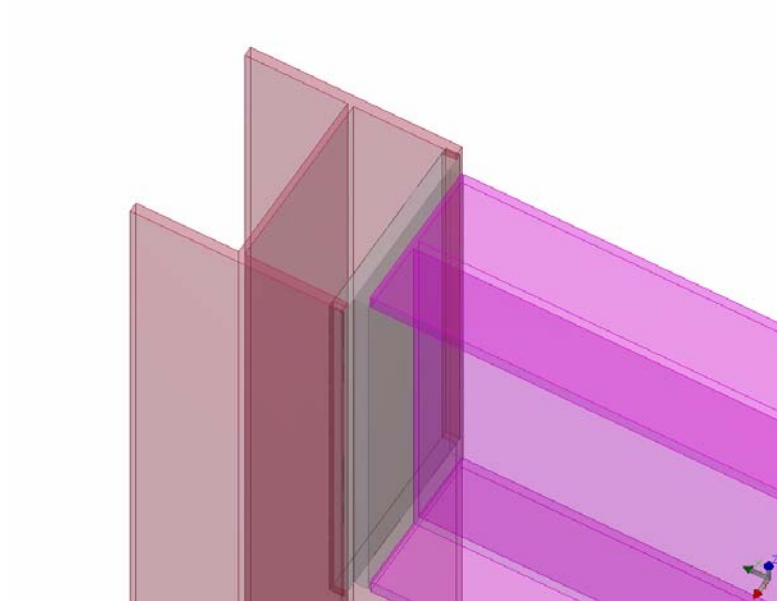
Create part cut for the column

1. Click the **Create part cut** icon.



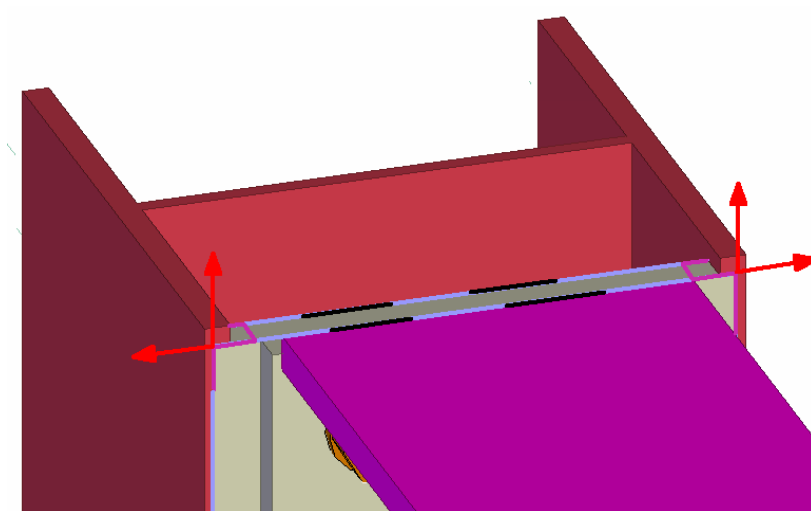
2. Pick the column as the part to be cut.
3. Pick the plate as the cutting part.

The column is now cut exactly along the edges of the connection plate.



We will next enlarge the antimatter cut.

Since the column connection plate and the part cut are now in exactly the same space, it would be hard to select the correct chamfers to modify.



That's why we will temporarily hide the column connection plate and then move the cut chamfers.

Move the cut chamfers

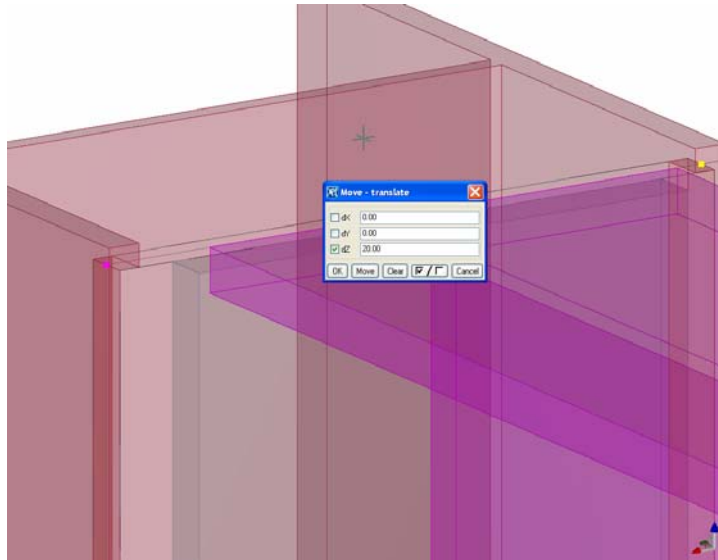
1. Select the column connection plate (only the plate, using select switch **Select parts** shown below), right-click and select **Hide**.



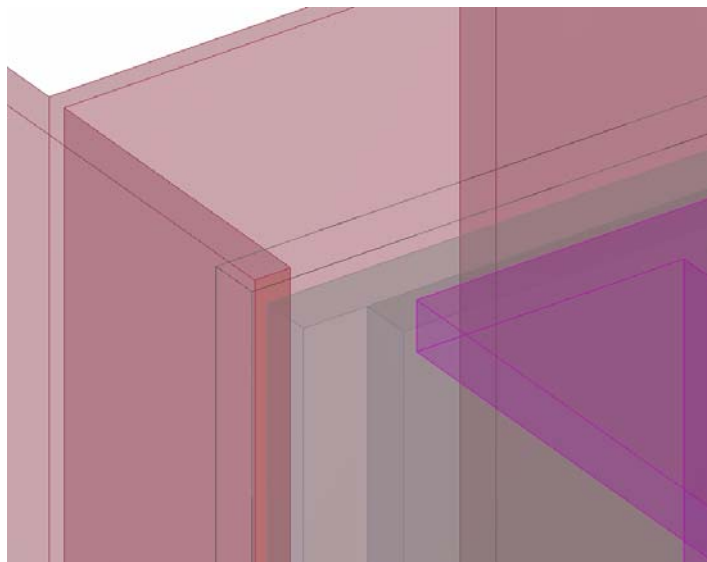
2. Turn the **Select all** select switch back on. Select both upper chamfers (using **Ctrl**).



3. Move the chamfers 20 mm upwards.



4. Select the lower chamfers and move them 5 mm downwards.
5. Select the right side chamfers and move them 20 mm right.
6. Select the left side chamfers, move them 20 mm left.



Create welds

Next we will weld the end plate to the beam and the column connection plate to the column. This will also add the plates to the beam and column assemblies.

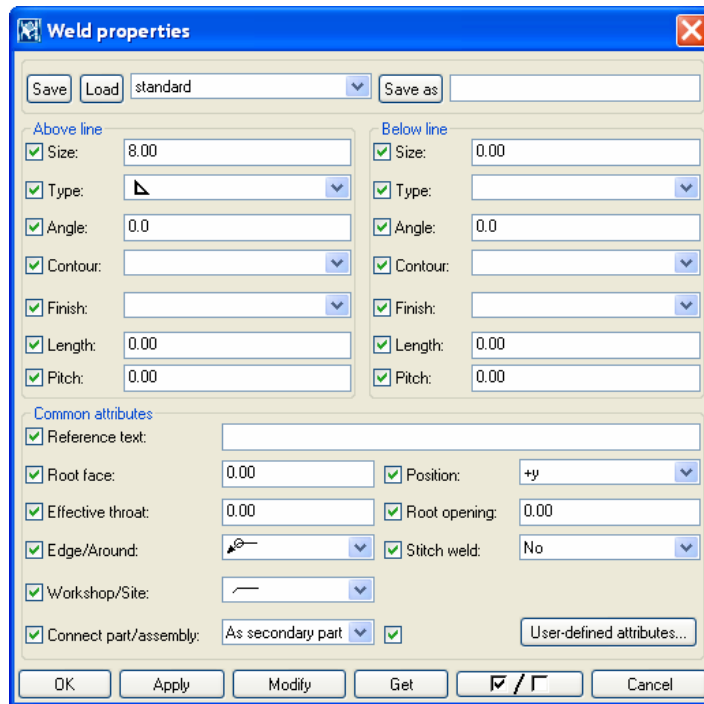
Help: Modeling > Detailing > Detailing commands > Weld

Weld column plate to the beam

1. Double-click on the **Create weld** icon.



2. Edit the **Weld properties** dialog as shown below and click **OK**.



3. Select the beam as the part to weld to (the primary part for workshop welds).
4. Select the end plate as the part to be welded (the secondary part for workshop welds).



It is very important to enter the welding order correctly. Tekla Structures uses the welding order to determine the primary and secondary parts of the assembly. This affects the position of the parts in the drawings.

Inquire assembly

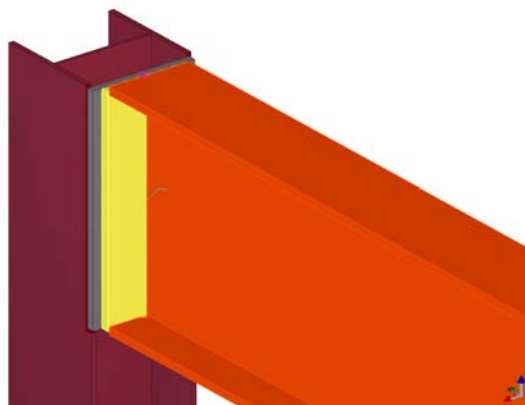
You can check assemblies using the command **Inquire Assembly**.

1. Pick the beam (or any part of the assembly).
2. Right-click and select **Inquire > Assembly**.

The main part of the assembly will appear red and other parts will appear yellow.



To select the entire assembly: press the **Alt** key while clicking a part in the assembly.





If your weld was not automatically placed in the desired position, you can manually affect the location by setting the desired position for the weld in the **Weld properties** dialog box.

Weld connection plate to the column

By using the applied weld properties, weld the connection plate to the column.

Create bolt group

Next we will create a bolt group to connect the beam to the column. We will use the bolts to bolt the beam's end plate to the column's connection plate.

For information on bolt group dimensions see:

[Help: Modeling > Detailing > Bolts > Creating a bolt group](#)

Create bolts

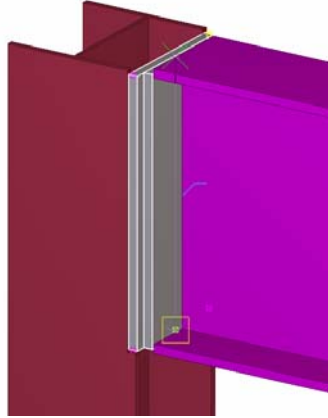
1. Double-click on the **Create bolts** icon.



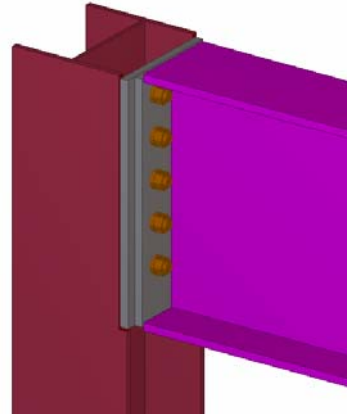
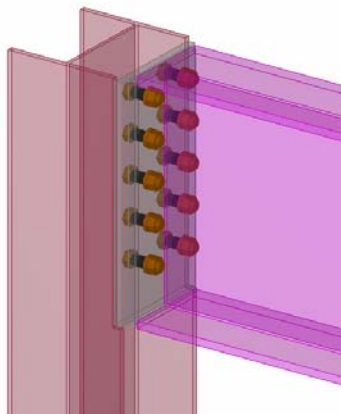
2. Define bolt group properties as shown in the picture below and **Apply**.

3. Pick the column connection plate as the part to bolt to.
4. Pick the end plate as the part to be bolted.

5. Click the middle mouse button to finish selecting parts.
6. Pick the end plate top point as the first point (this will be the bolt group origin).
7. Pick the end plate bottom point as the second point (this will indicate the bolt group's x direction).



The bolt group has now been created and the final connection looks like in the figures below.



3.3 Create Cuts Interactively

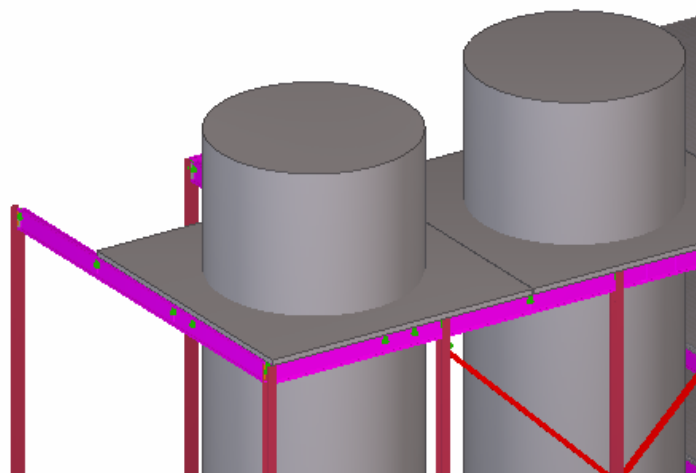
You can cut parts by various methods in Tekla Structures. The available cuts are:

- Line cut
- Polygon cut
- Part cut

There are numerous places in our model in which the parts are still colliding with each other, and the shape of the parts needs to be modified with the cutting tools.

We will use these cutting tools to cut the concrete slabs with the Silos (part cut) and then create a penetration for a column (polygon cut) through a hollow-core slab.

Create part cuts for silos

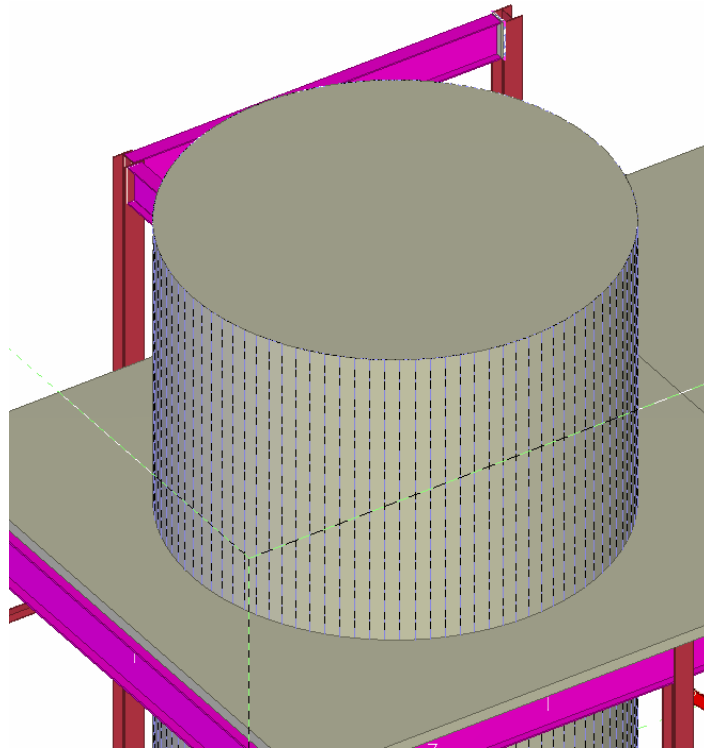


Create part cut

1. Click the **Create part cut** icon.



2. Pick one of the slabs as the part to be cut.
3. Pick the related silo as the cutting part. Click on the middle mouse button.
4. The slab is now cut. A blue antimatter part cut the same size as the silo appears.



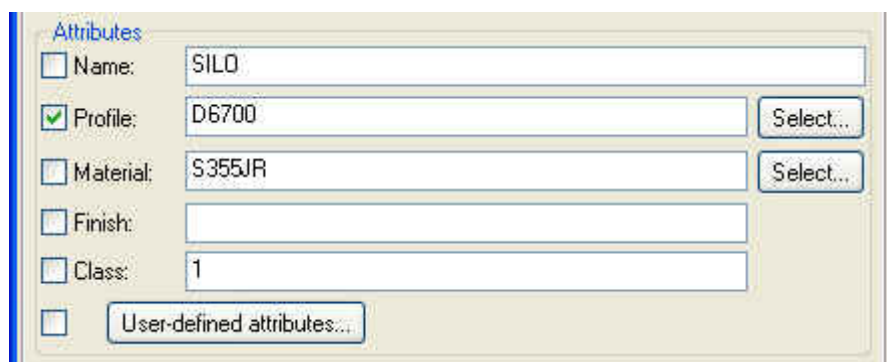
Change part cut profile

In order to have clearance between the concrete slab and the silo we will now modify the size of the profile used to make the part cut.

1. Disable all of the selection switches except for the **Select cuts** switch. This makes it easier to select the part cut.

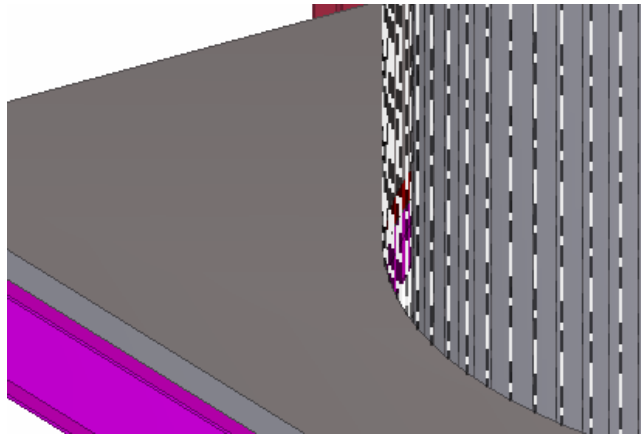


2. Double-click on the part cut.
3. The **Column properties** dialog box appears.
4. Uncheck all the modify check boxes and change only the profile as shown in the dialog below:



5. Click **Modify**.

This creates a 150 mm gap all the way around between the slab and the silo.



The part cut height is still equal to the height of the cutting part (= the silo). Sometimes it is more convenient to work with shorter part cuts.

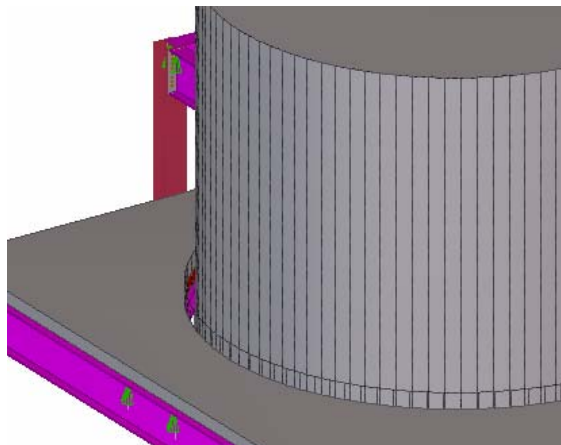
By inquiring the slab (select object, right-click, select **Inquire > Part**) you can see that the slab bottom level is +13400 and top level +13575.

Change part cut height

Double-click on the blue part cut to open the **Column properties** dialog box. On the **Position** tab page:

1. Change the bottom level to **13000** and top level to **13800**.
2. Click **Modify**.

Now the part cut is just a little thicker than the slab, which is enough.



Copy the part cut to the other silo

1. Copy it 9000 mm in the x direction to the other silo.

The antimatter part will automatically adjust to the new situation and cut the other slab.

Create slab penetration (polygon cut)

We will now create a penetration through a slab using a polygon cut.

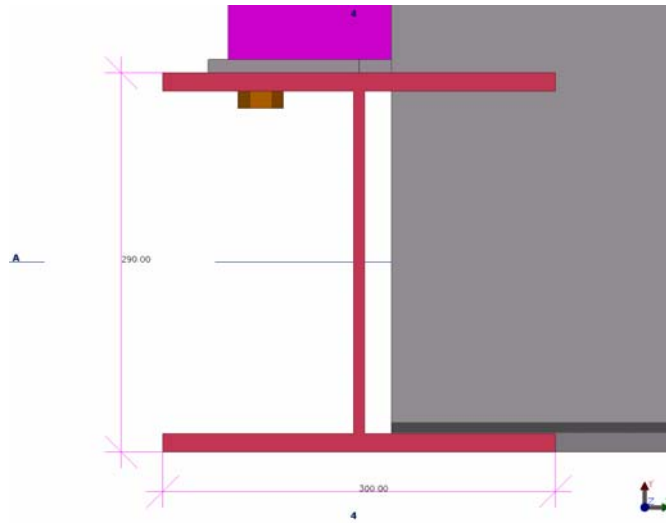
We will create a 20 mm clearance between the penetrating column and the slab simply by picking positions to outline the polygon cut.



You should always define the polygon so that there is some tolerance between the edges of the part and the edges of the cut. If the edge of a cutting polygon is in exactly the same position as the edge of the part to be cut, it can be unclear whether the edge should be cut away.

Create polygon cut

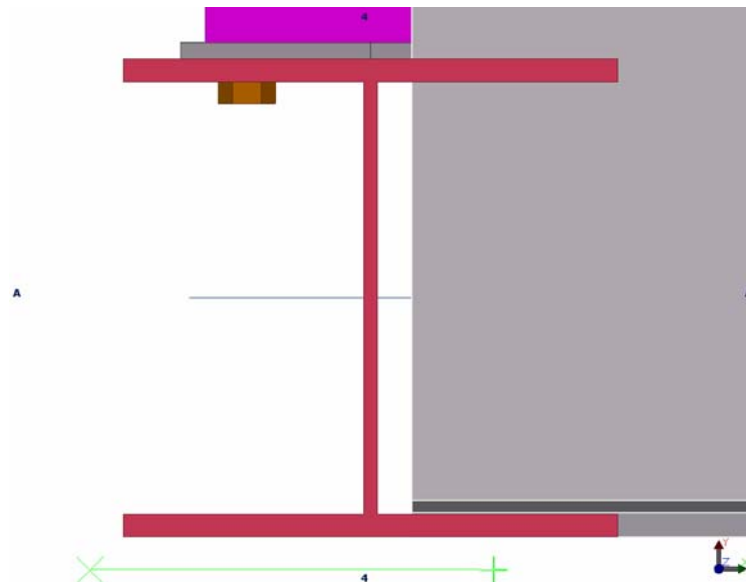
1. In the view +3850 zoom close to the column on grid A-4.



2. Click the **Create polygon cut** icon.



3. Select the hollow-core slab as the part to be cut.
4. Hold down the **Ctrl** key and pick the bottom left corner of the column to set the “From” location coordinates.
5. Type **-20,-20**, Press **Enter**, the cursor picks the point.
6. Press **o** (to snap to positions in orthogonal directions).
7. Move the cursor to the right to the track along the ortho line.



8. Enter **340** to specify the distance from the last point picked. Press **Enter**.
9. Move the cursor upwards, type **330** and press **Enter**.
10. Move the cursor to the left, type **340** and press **Enter**.

11. Click the middle mouse button to create the polygon cut.

