Tekla Structures Basic Training

Tekla Structures 10.0

April 23, 2004

Contents

3 Creating Interactive Connections

In this lesson

Tekla Structures system connections cover a great variety of the connections 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 connections.

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 connection, modify the ungrouped objects and then add objects to connection using a system connection detail.

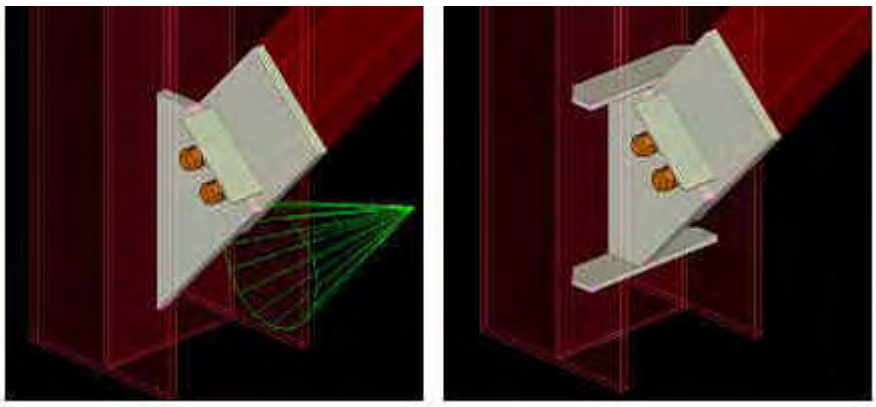
We will also create a whole new connection (i.e. all connection objects: parts, welds, bolts and cuts) interactively from scratch without using any system connections.

3.1 Create Gusset Plate with Stiffeners Interactively

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

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

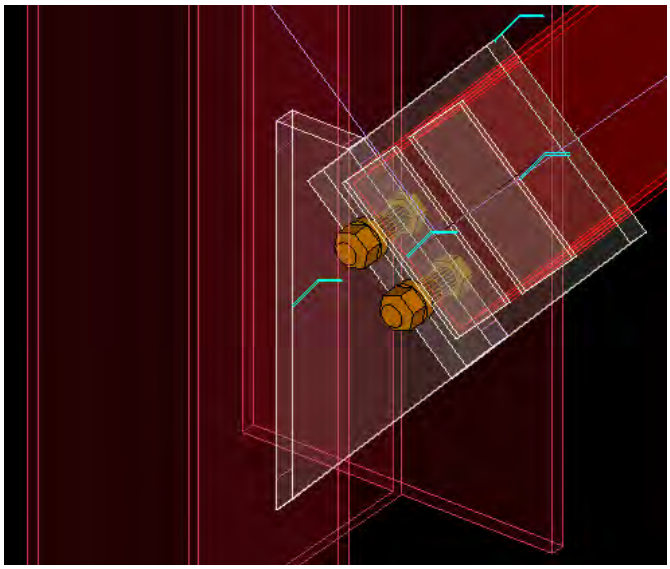
Before exploding the connection you should take advantage of the connection to get as close to the desired result as possible since editing connection macros is faster and easier than editing objects outside the connection.

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.

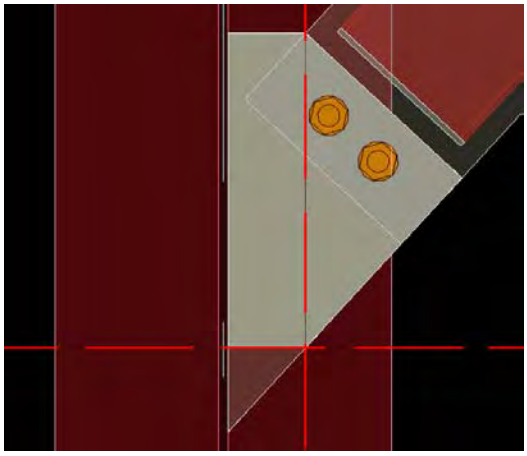


After exploding the connection, the objects that were in the connection are no longer connection objects.

They will be presented in the model as objects (main parts) both in wire frame or in shaded wire frame. You can also only select the objects by using the select objects select switch.

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.

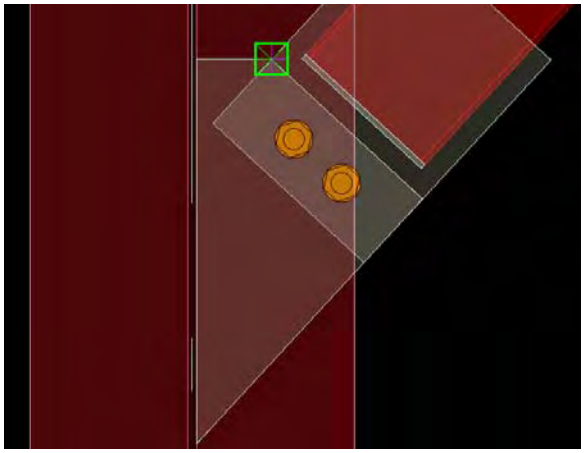


Create a construction line

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.

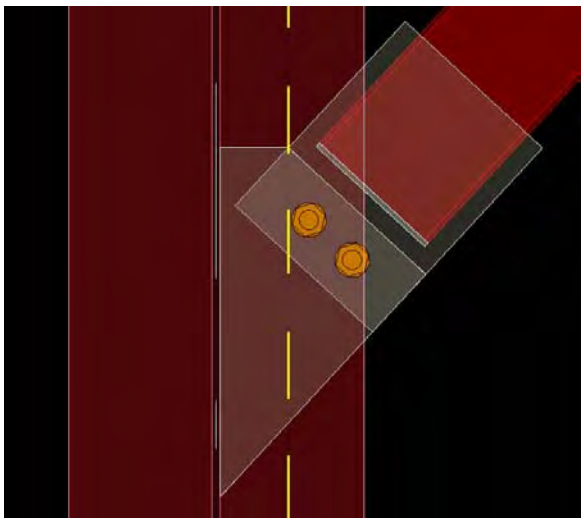
2. Pick the top right corner of the gusset plate as the starting point of the line.



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

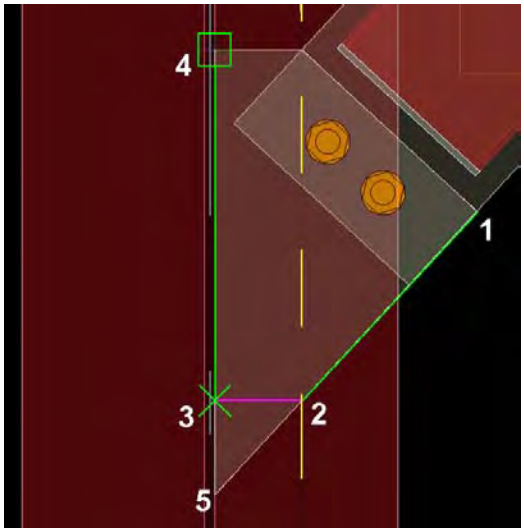


Instead of recreating the polygon plate we will now reshape the existing plate by using the **Edit > Polygon shape** command.

Help: Modeling > Detailing > Detailing commands >Edit polygon shape

Edit polygon shape

1. Select **Edit > Polygon shape** and follow the instructions on the command line.
2. Pick gusset plate corner (1), see the figure below.
3. Pick intersection of gusset plate edge and the construction line (2).
4. Snap to perpendicular point in gusset plate edge and pick point (3). (Make sure you pick the plate edge instead of grid line).
5. Pick gusset plate top left corner (4).
6. Pick bottom corner (5) as the corner to be removed, the plate is now reshaped.



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

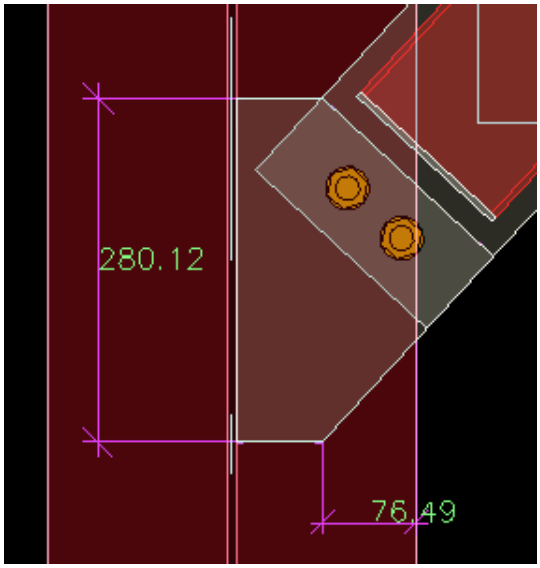
Add Stiffeners

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. In the model take the following measurements: 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:

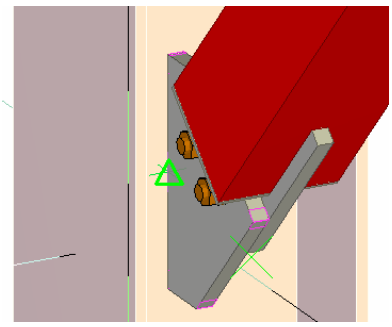


Create stiffeners using macro

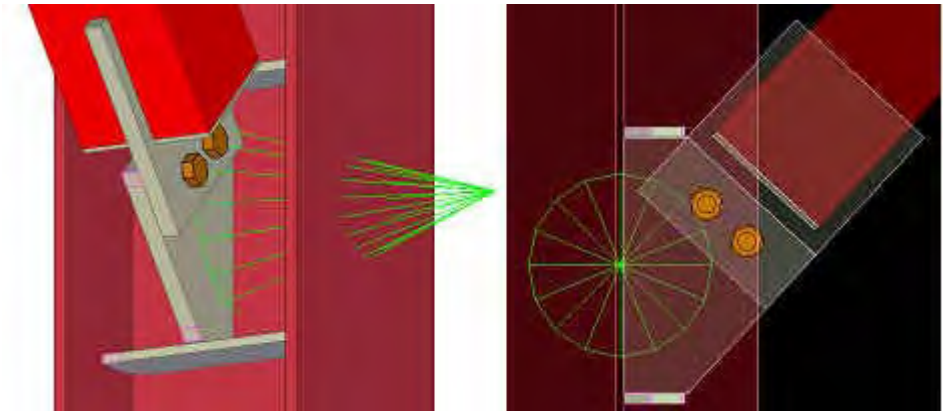
1. Double-click the **Multiple stiffeners (1064)** icon located on the page 5 connection toolbar.

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, the stiffeners are created.



You can see the final results in the figures below.

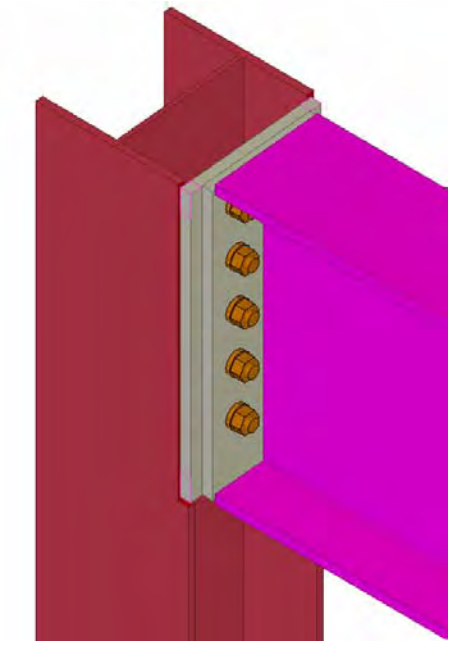


We could now explode the stiffener detail but since we have not edited the connection objects outside of the way that the detail was created we can also just leave it.

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

3.2 Creating an End Plate Connection from Scratch

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



Create Plate and Fitting for the Beam

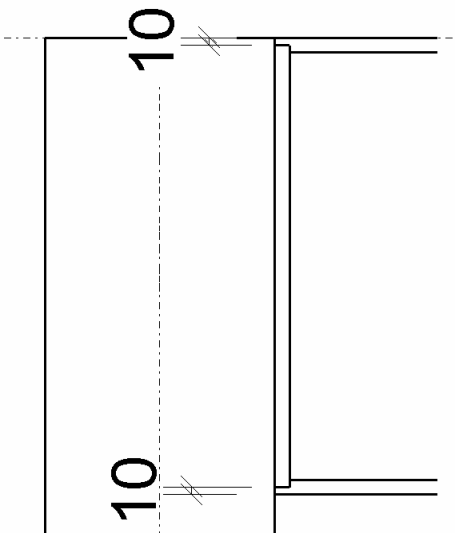
At the grid intersection B-3 at level 13400:

Create connection basic views and delete the connection

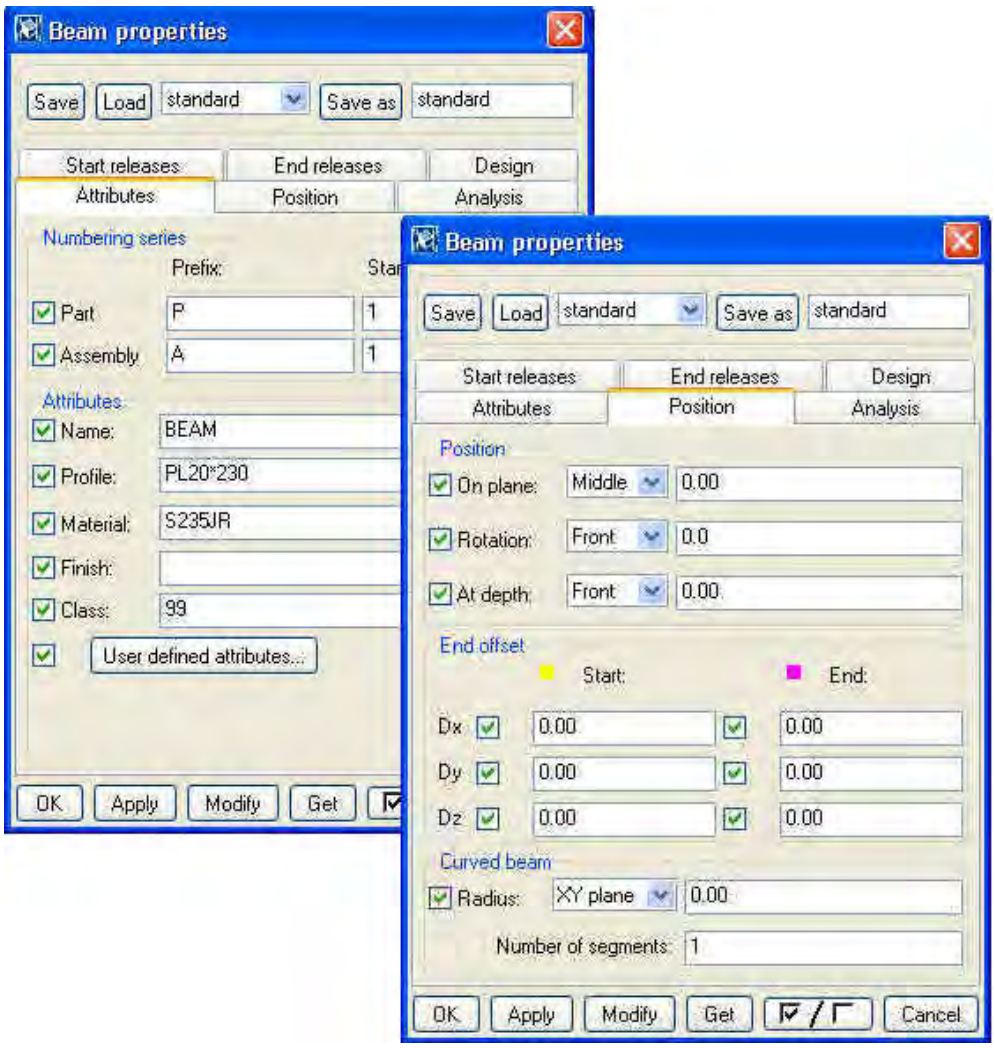
1. Select the existing end plate connection, right-click and select **Create view > Component basic views**.
2. Delete the existing connection.

Create end plate for the beam

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



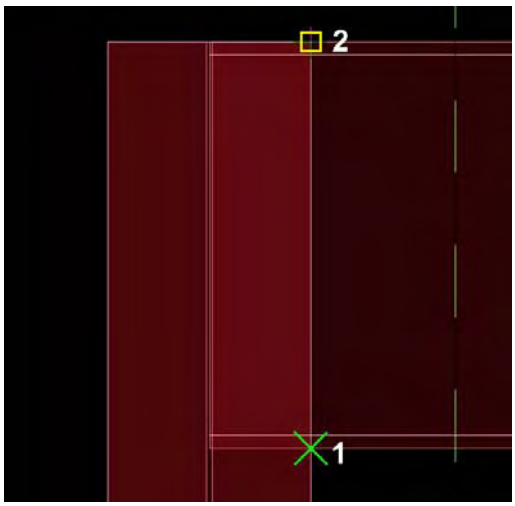
1. Start the beam command and **Apply** the properties for the end plate shown in the dialog box below.



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

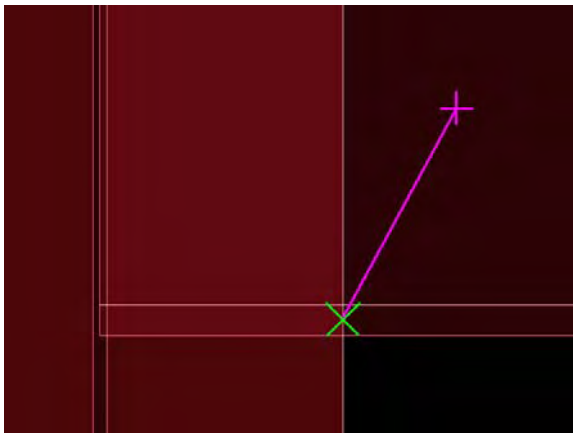
In the **Component front view**:

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!) the top right corner of the column (2) to set the correct direction.

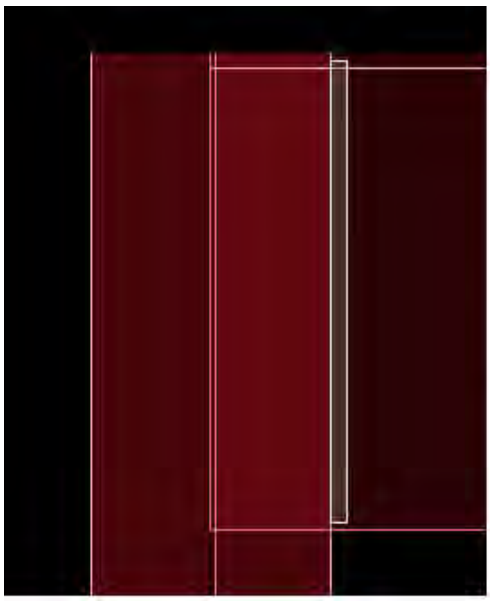


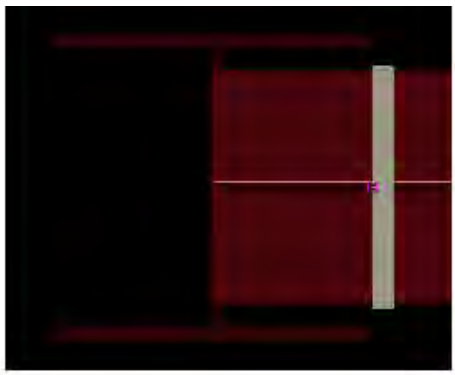
4. Type **10** for the numeric location (the **Enter a numeric location** dialog box will open automatically) and press **Enter**.

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 to direction of point 1).





The plate then appears.

Fit the end of a beam

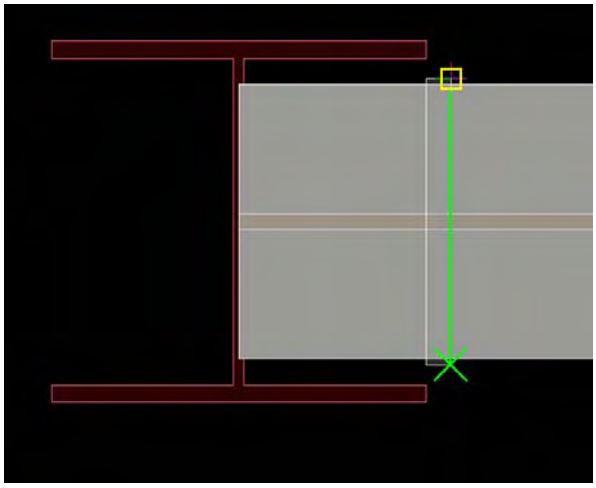
We will use the **Fitting** command to trim the end of the beam at the end plate.

The **Fitting** tool will trim the end of the beam on a plane perpendicular to the view plane, which is defined by picking 2 points on a line.

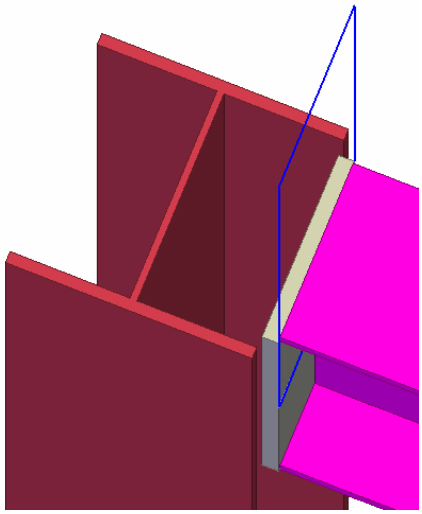
Help: Modeling > Detailing > Fine tuning part shape > Fitting

1. Click 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.



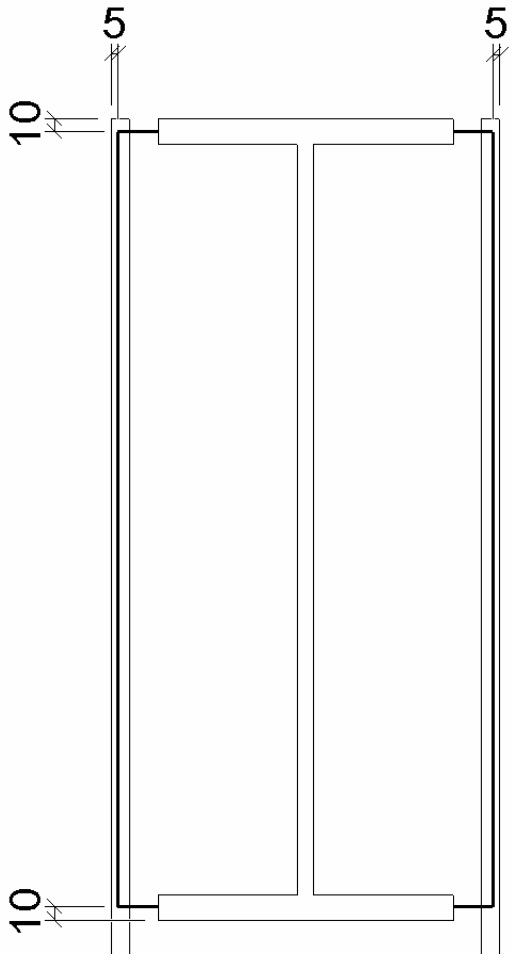
Tekla Structures displays the fitting in the model using a blue fitting symbol.



Create 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.

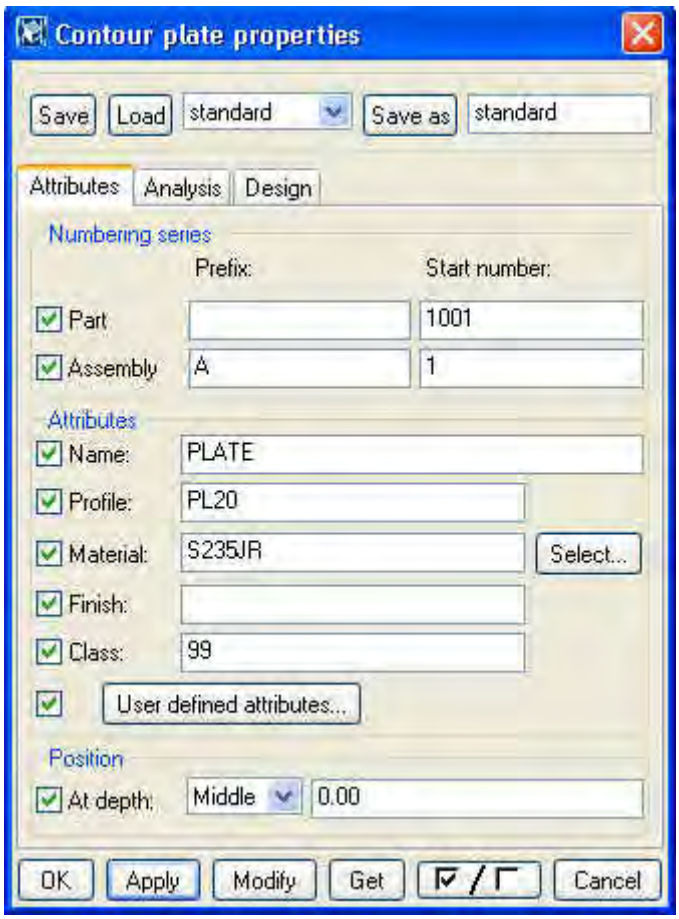
Help: Modeling > Parts > Steel parts commands > Contour plate



Create column plate

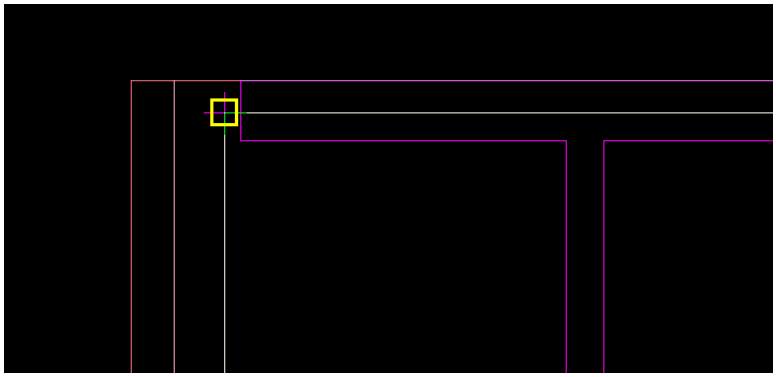
1. Start the **Create contour plate** command.

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

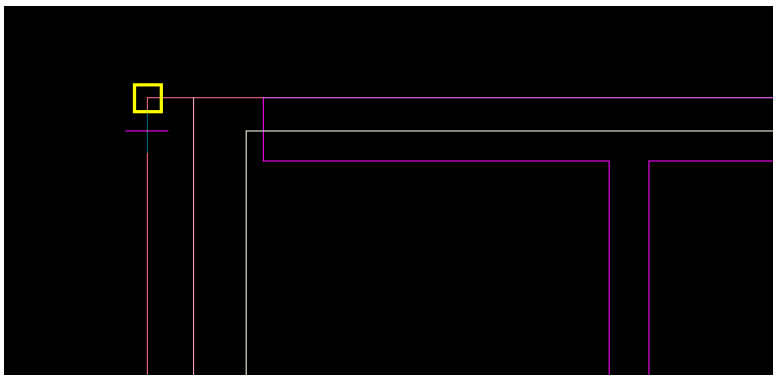


In the **Component end view**:

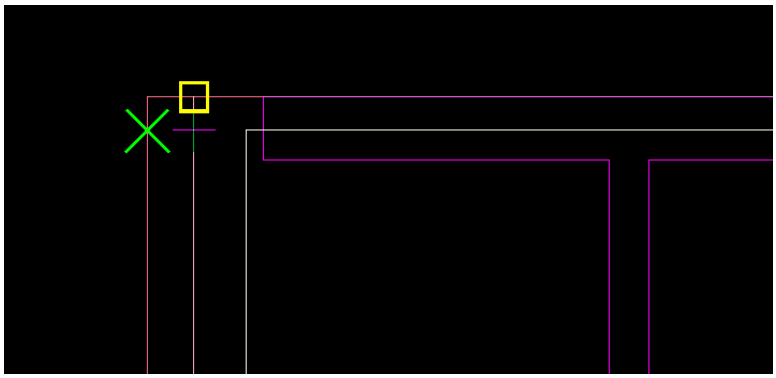
3. Let the cursor snap to the top left corner of the end plate and type **Z** to lock the Z coordinate.



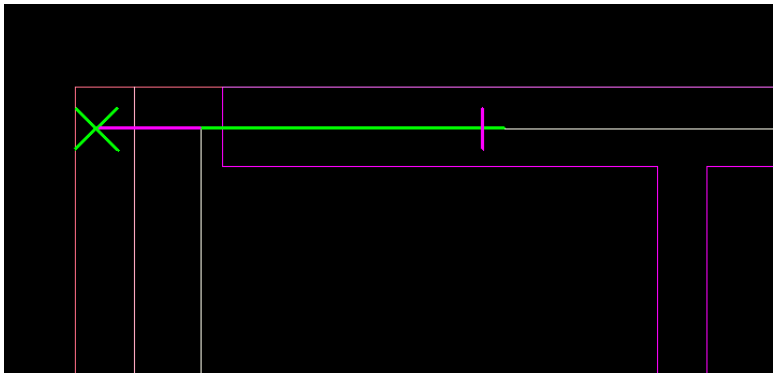
4. Hold down the **Ctrl** key and pick the top left corner of the column to set the “From” location coordinates.



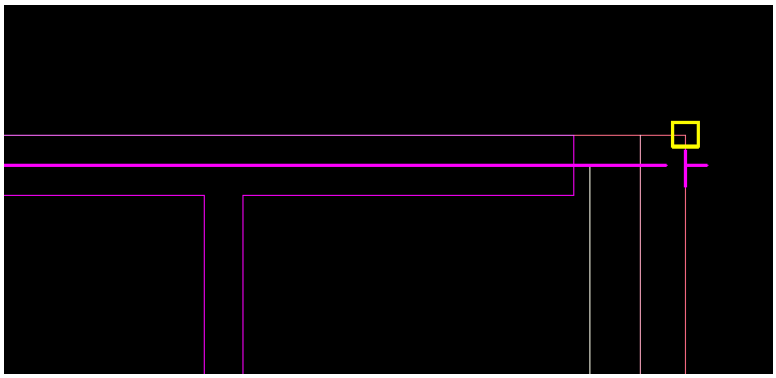
5. Let the cursor snap to the inner side of the flange shown, type **5** and press **Enter**.



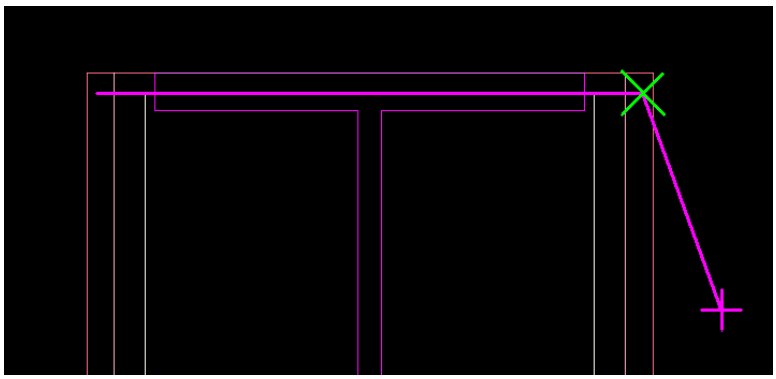
The first point for the plate is now picked.



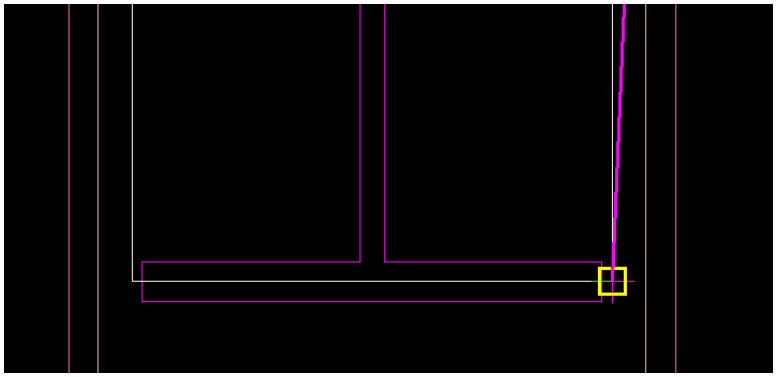
6. Hold down the **Ctrl** key and pick the top right corner of the column to set the “From” location coordinates.



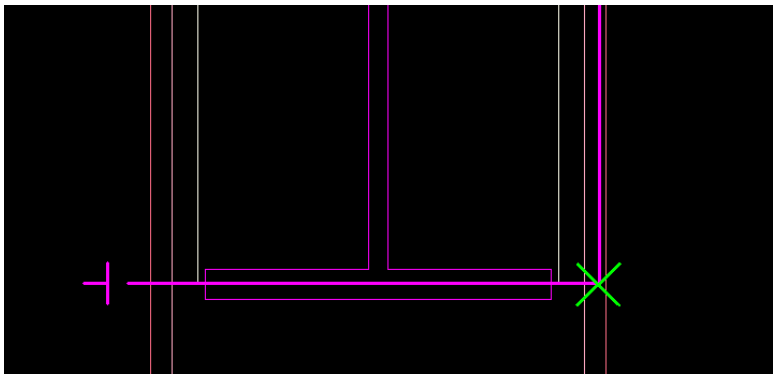
7. Let the cursor snap to the inner side of the flange, type **5** and press **Enter**.
8. The second point is now picked.
9. Press **Z** to release the coordinate lock.



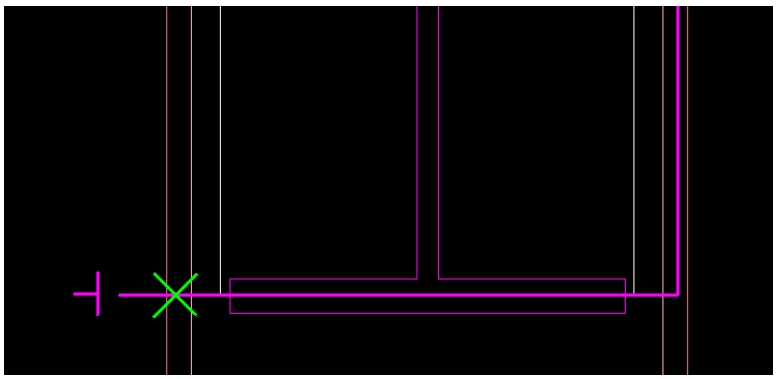
10. Let the cursor snap to the bottom right corner of the end plate and type **Z** to lock the Z coordinate.



11. Repeat steps 4 and 5 to pick the third point for the plate.

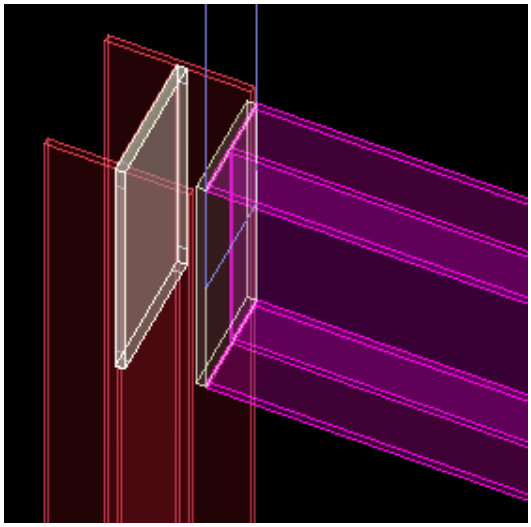


12. Repeat steps 2 and 3 to pick the last position for the plate.



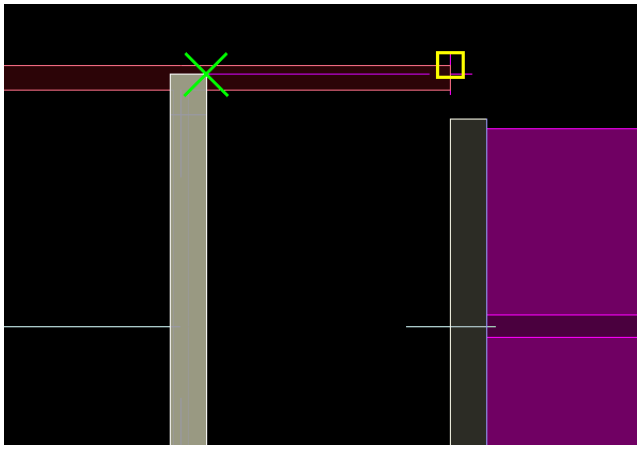
13. Press **Z** to release the coordinate.
14. Press the middle button to create the plate.

    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.

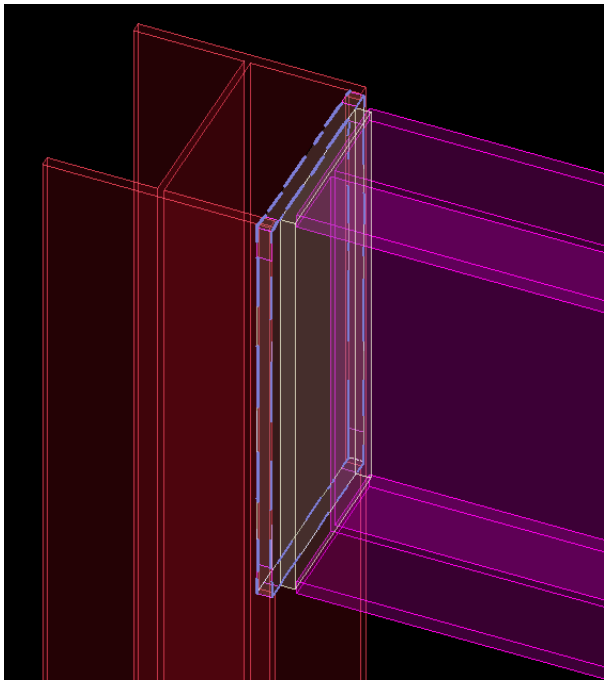
Help: Modeling > Detailing > Detailing commands > Part cut

Create part cut for the column

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

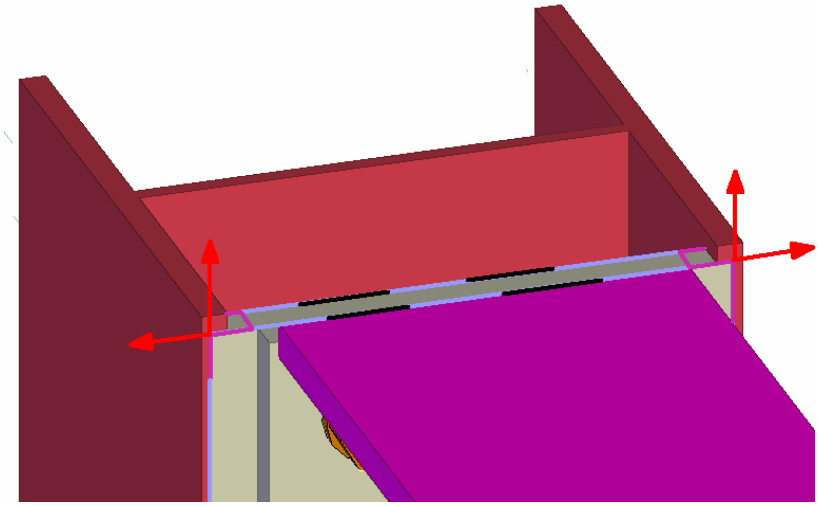
2. Pick the column as the part to be cut.
3. Pick plate as cutting part.

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 correct chamfers to modify.

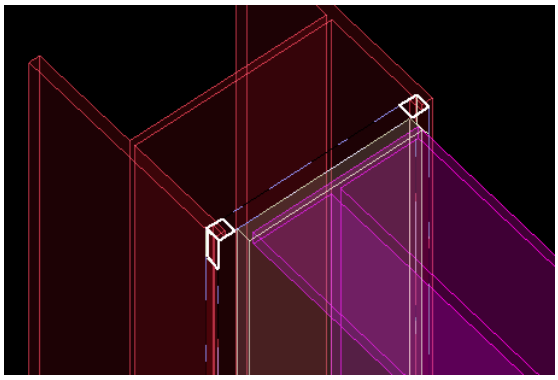


That's why we will temporarily hide the column connection plate and then move the cut chamfers.

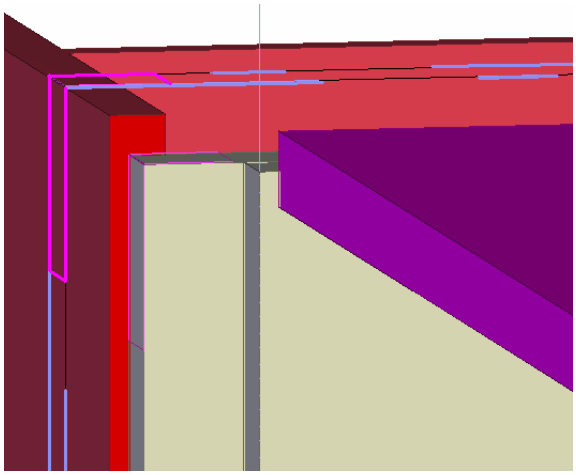
Move the cut chamfers

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

2. Select both of the upper chamfers (using **Ctrl**).
3. Move the chamfers 20 mm upwards.



4. Select 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 20 mm left.



Create Welds

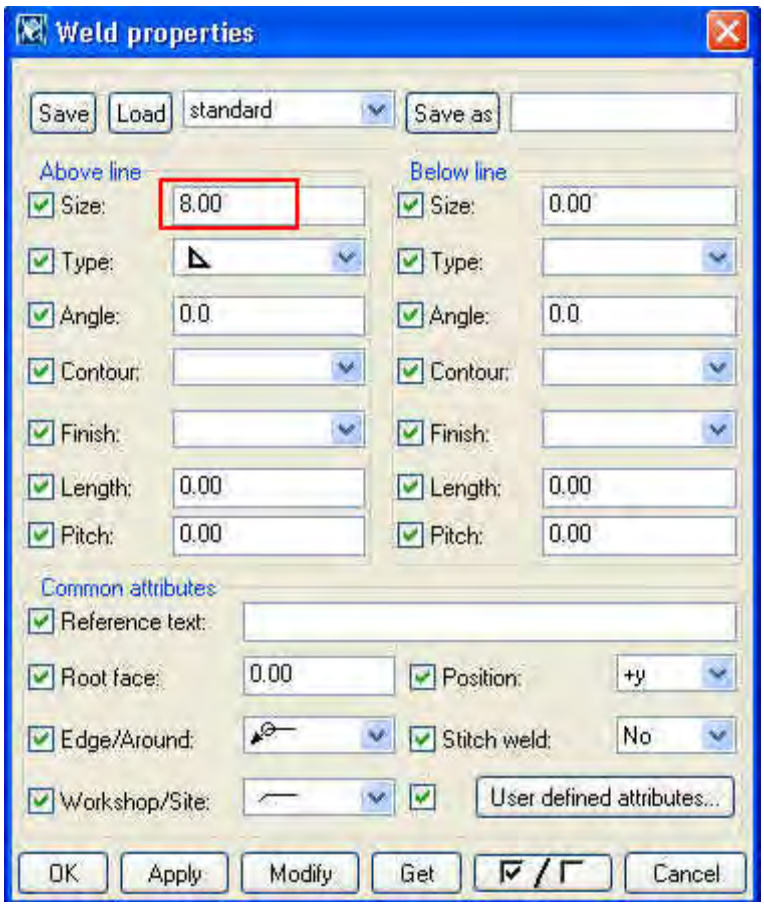
Next we will weld the end plate to the beam and the column connection plate to the column. This will also add the plates to the beam and column assemblies.

Help: Modeling > Detailing > Detailing commands > Weld

Weld column plate to the beam

1. Double-click 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 effects the position of the parts in the drawings.

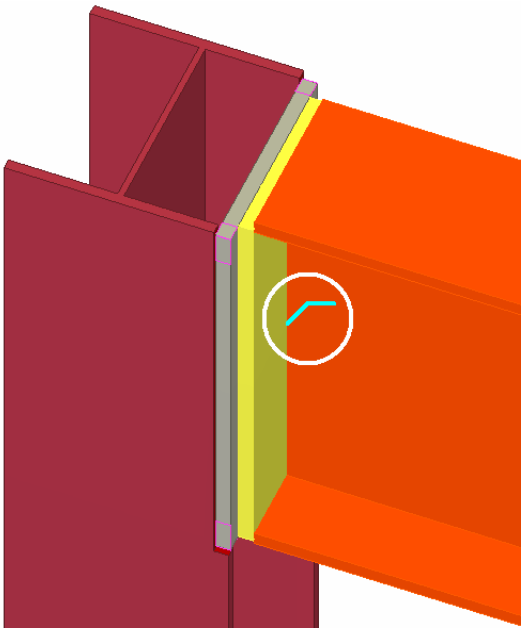
Inquire assembly

You can check assemblies using 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.



In case welds are not automatically placed to desired places, you can manually affect on weld location by setting the desired position for 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.

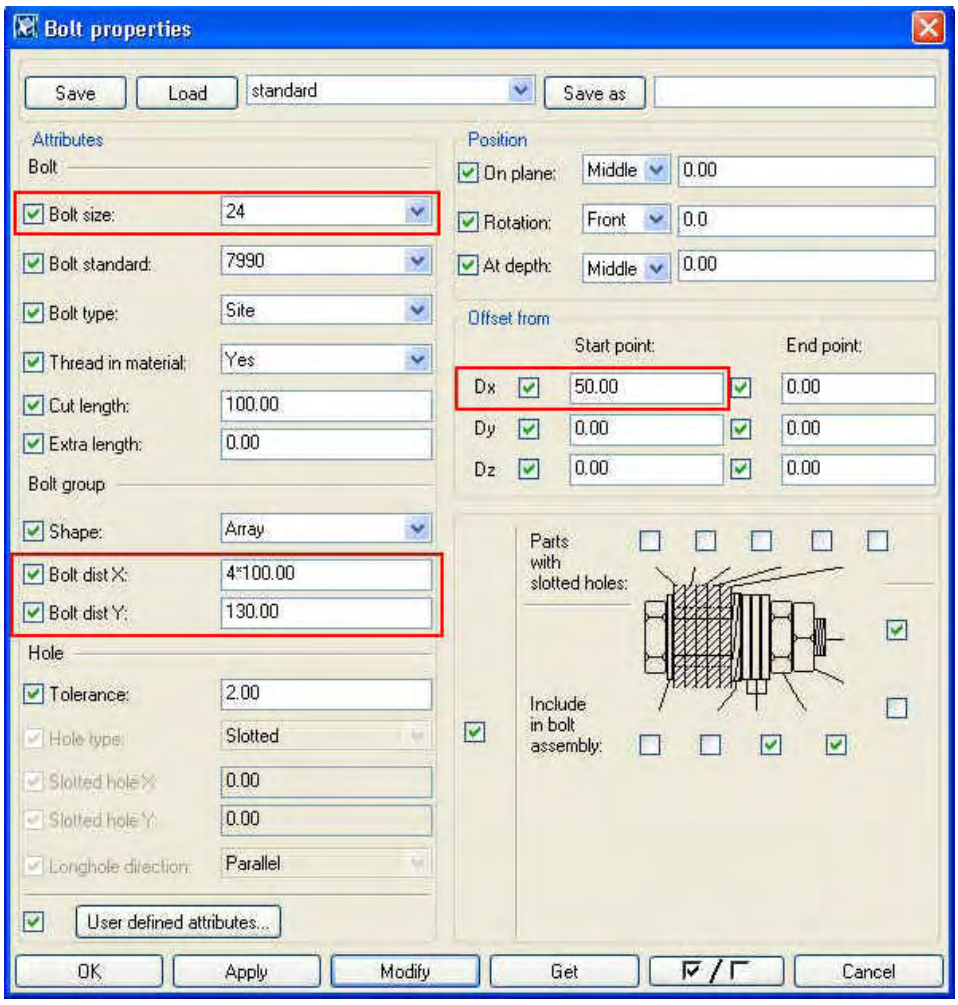
For information on bolt group dimensions see:

Help: Modeling > Detailing > Bolts > Creating a bolt group

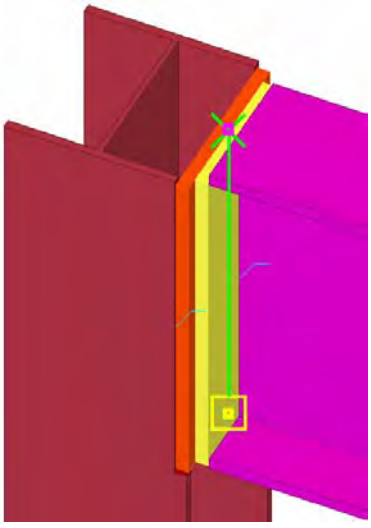
Create bolts

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

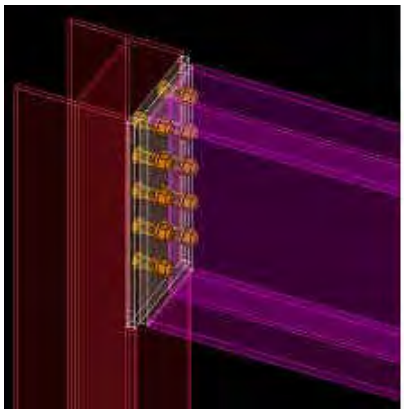
2. Define bolt group properties as shown in picture below and **Apply**.

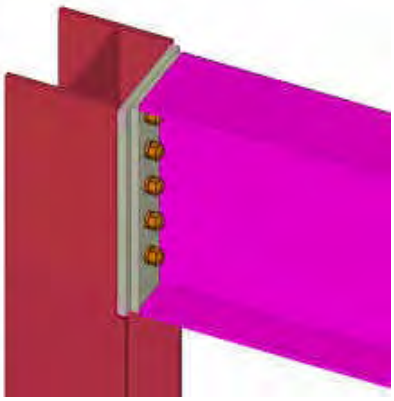


3. Pick the column connection plate as the part to bolt to.
4. Pick the end plate as the part to be bolted.
5. Click the middle mouse button to finish selecting parts.
6. Pick the end plate top point as the first point (this will be the bolt group origin).
7. Pick the end plate bottom point as the second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



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





3.3 Create Cuts Interactively

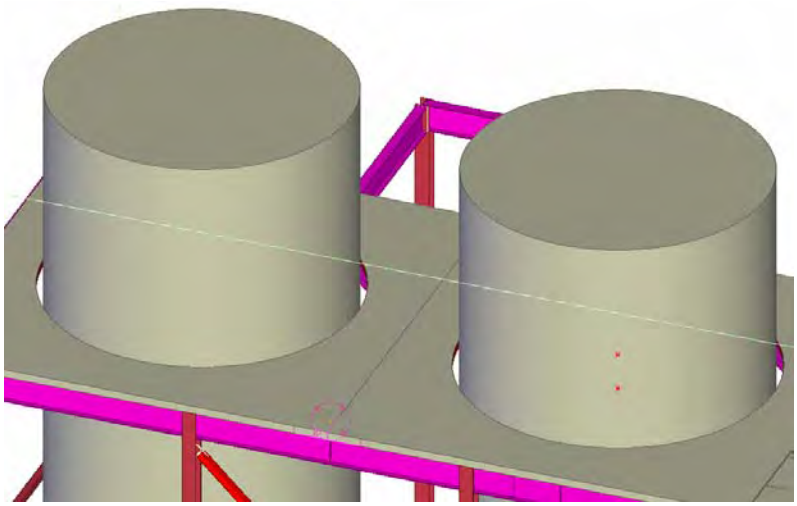
You can cut parts by various methods in Tekla Structures. The available cuts are:

- 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 hollowcore slab.

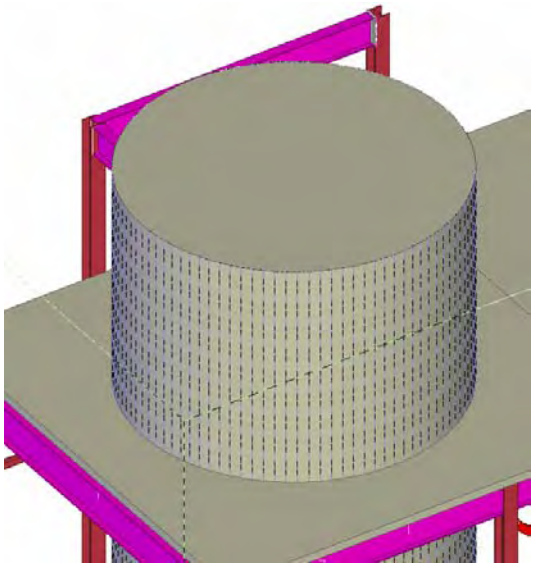
Create Part Cuts for Silos



Create part cut

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

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



Change part cut profile

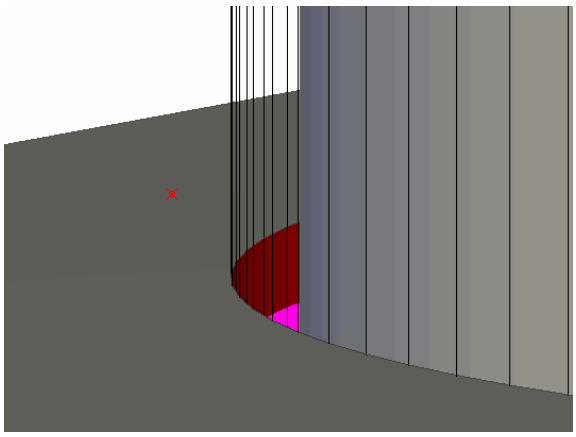
In order to have clearance between the concrete slab and the silo we will now modify the size of the profile used to make the part cut.

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

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

5. Press **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 cutting part (= the silo). Sometimes it is more convenient to work with shorter part cuts.

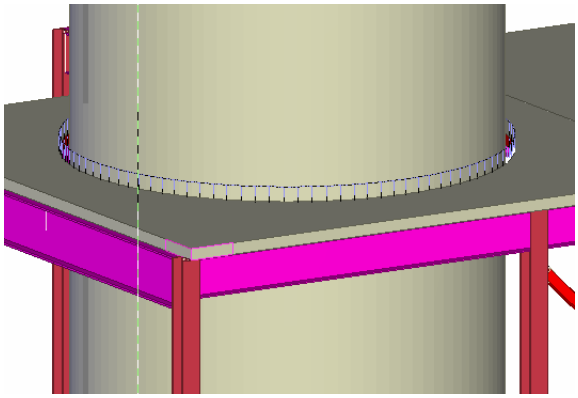
By inquiring the slab (select object, right-click, select **Inquire > Part**) you can see that the slab bottom level is +13400 and top level +13575.

Change part cut height

Double-click the blue part cut to open the **Column properties** dialog box and 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 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 contour plate using a polygon cut.

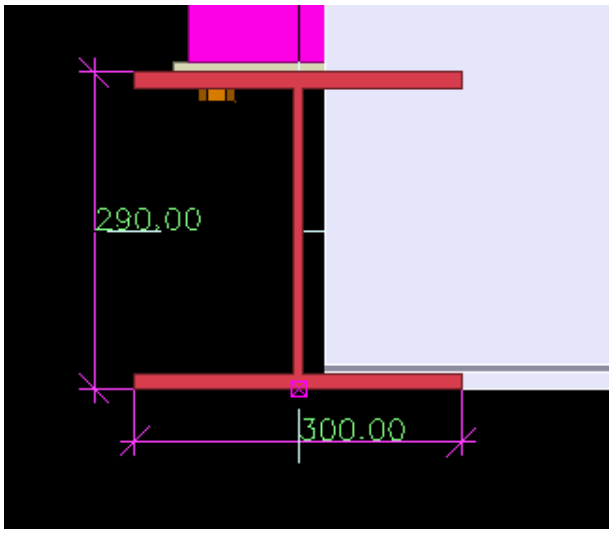
We will create a 20 mm clearance between the penetrating column and the slab simply by picking positions to outline the polygon cut.

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.

Help: Modeling > Detailing > Detailing commands > Polygon cut

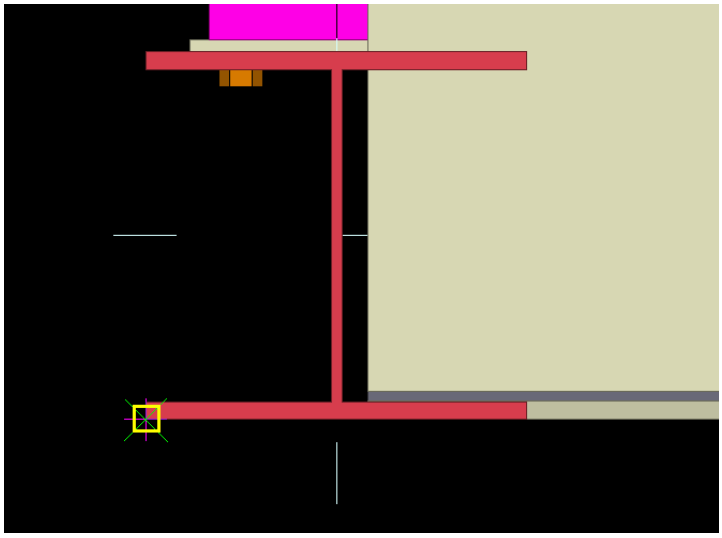
Create polygon cut

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

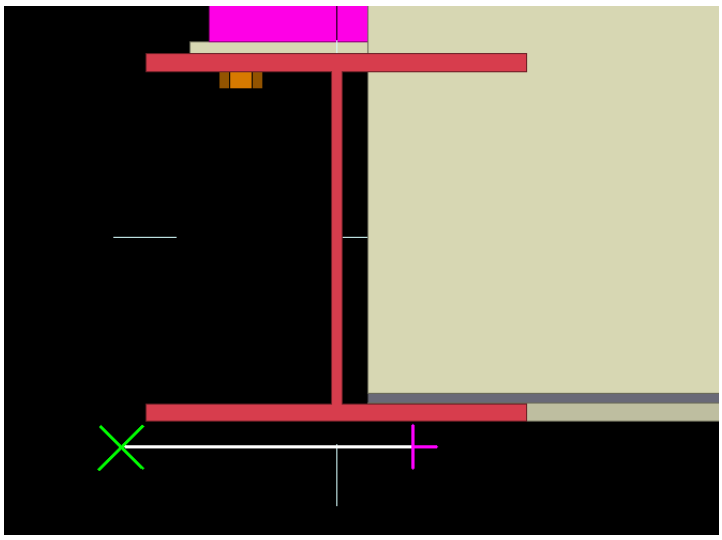


2. Click the **Create polygon cut** icon.

3. Select the hollowcore 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 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 button to create the polygon cut.