



# System Components for Precast Concrete

Tekla Structures 12.0 Basic Training

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# 2

# System Components for Precast Concrete

## In this lesson

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

You will learn how to:

- Create connection and reinforcement components
- Work with component properties
- Save the properties for later use.

## 2.1 About System Components

You can model connections, reinforcements, etc, quickly with the Tekla Structures system components.

The greatest benefits of using system components 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 object's profile in the model, all of the connections to the object are automatically modified at the same time.
- If you select options such as move or copy, all components are automatically included.
- With AutoDefaults you can create rules defining when to use different component properties.

All available system components are located in the component catalog, which can be opened using Ctrl+F or by clicking the binocular icon on the component toolbar.



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: Detailing > Getting started > Using components > Creating components](#)

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

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

[Help: Detailing > Getting started > Basics > Up direction](#)

# Check clashing of structures

In lesson 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.

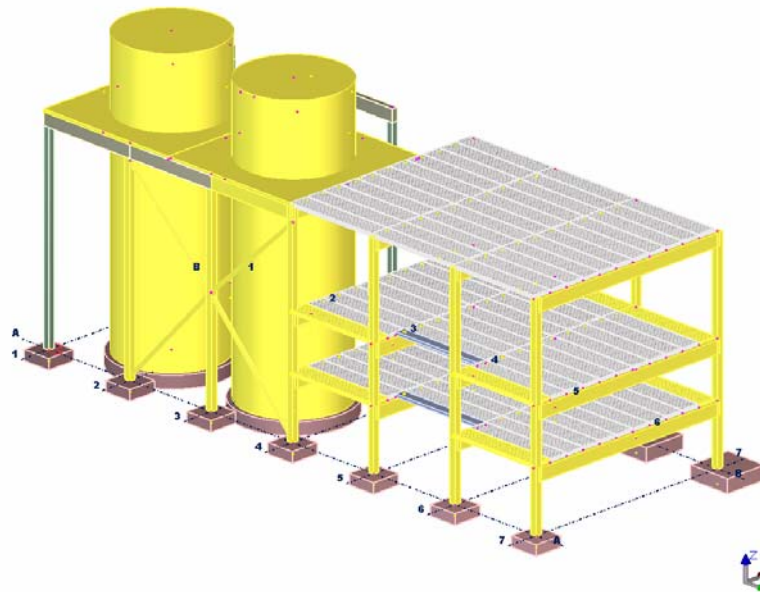
By using the **Clash check** command we can check which parts in the model collide. We will run a clash check now and then again after the connections components have been applied.

**Help: Modeling > Settings and Tools > Querying objects > Clash check**

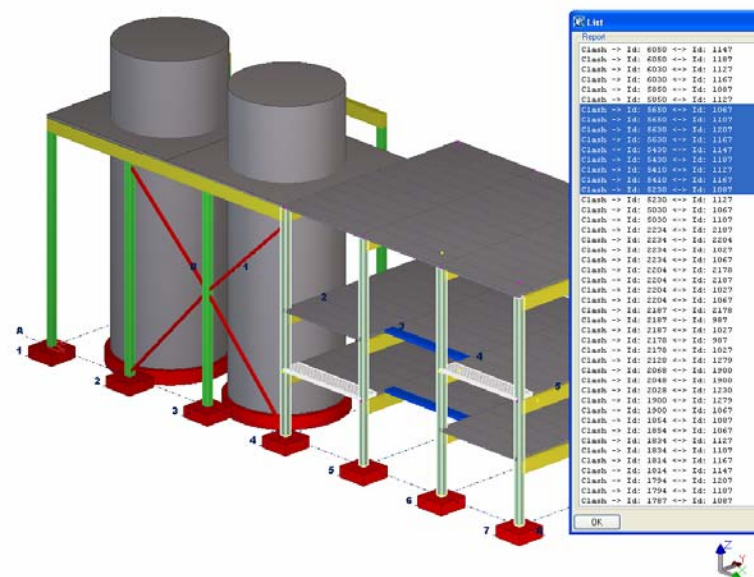
## Check clashing

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 the parts in the model collide.



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



## 2.2 Create System Components

Next we will create connection components to beam-to-beam and beam-to-column situations. The connections will automatically fit the concrete members.



Use of components:

- Click once on the component icon to activate the command.
- Double-click on the component icon to activate the command and open the component dialog.

Note: if you click again on an already active command, the command will be deactivated.

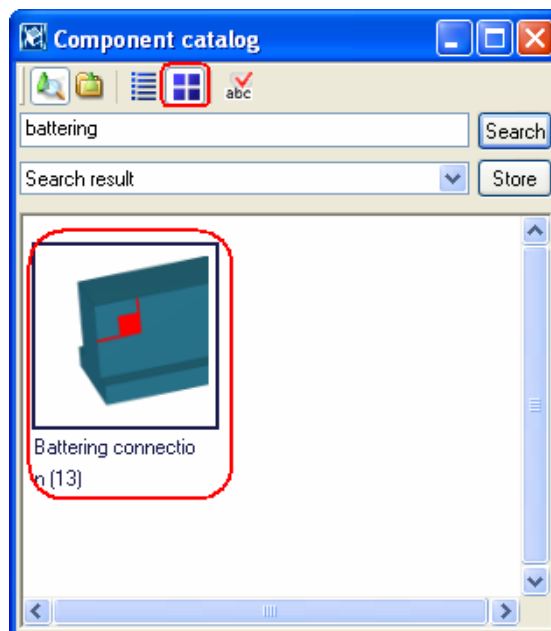
### Fitting concrete members

The beams between gridlines 1 and 4 at elevation +13400 will be in-situ concrete beams. In lesson 3 we will create a cast unit out of the beams, but first we will need to fit the beams and columns. We will use the battering component.

1. Open the component catalog by clicking on the binocular icon or by typing **Ctrl+F**.



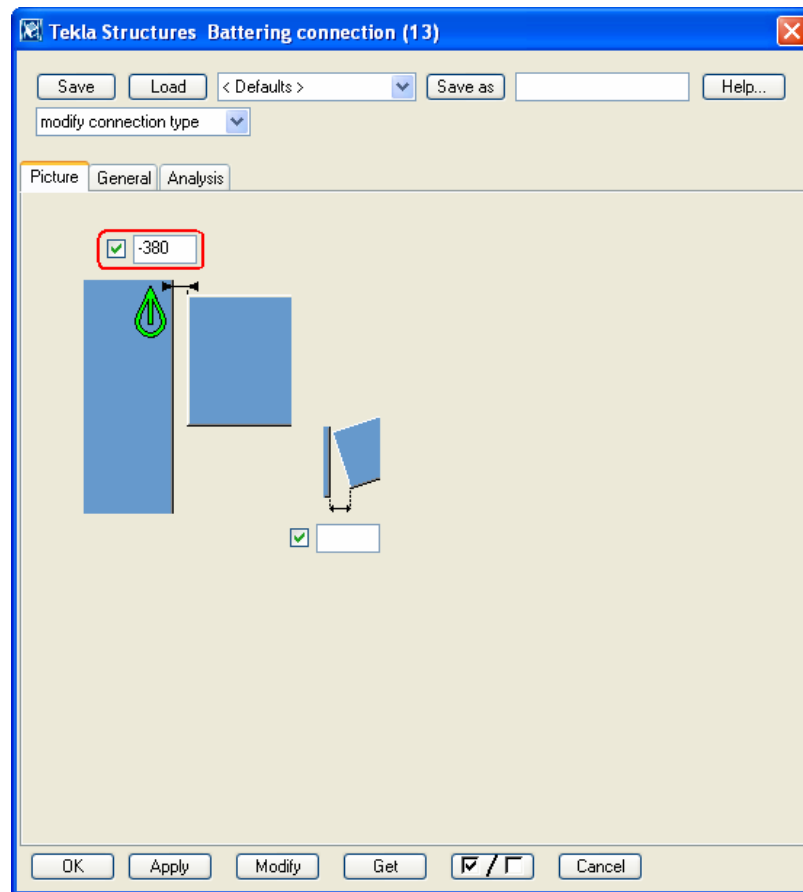
2. To see pictures of the connection, check that the **Thumbnails** icon is active, see below.
3. Type "battering" into the upper field and click on the **Search** button.



#### Set the connection parameters

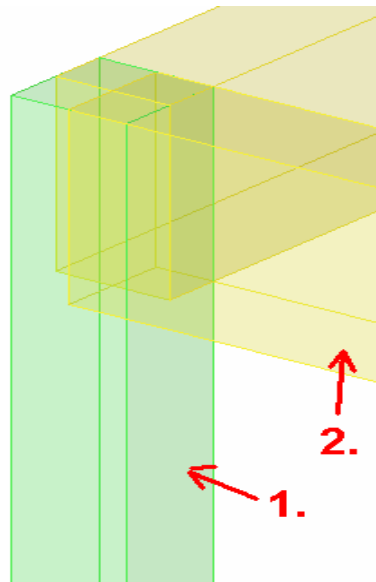
1. Double-click on the **Battering connection (13)** icon to activate the command and open the dialog.

2. Change the distance to –380 as shown on the dialog below.

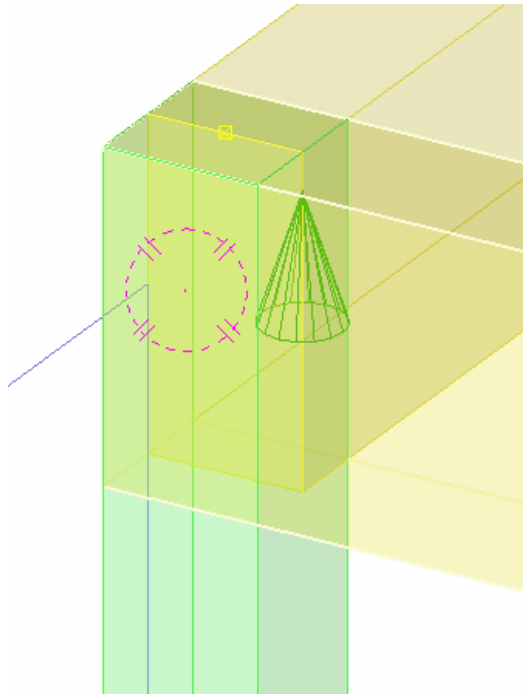


3. Click **Apply** to take the component setting in to use (the dialog is left open).
4. Pick the column and then a beam at grid intersection A-1 to extend the beam.

#### Extend beams



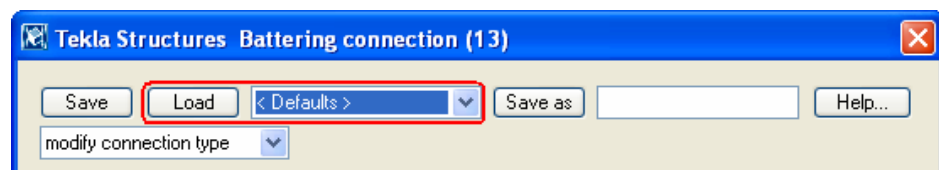




5. Repeat for grid intersections A-4, B-1, B-2, B-3 and B-4.
6. Leave the command running.

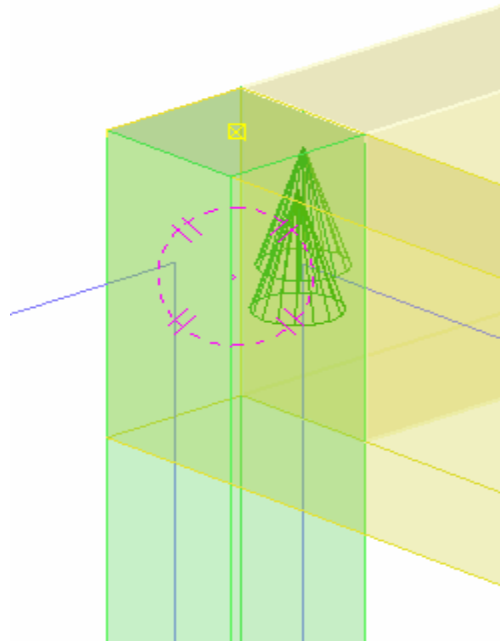
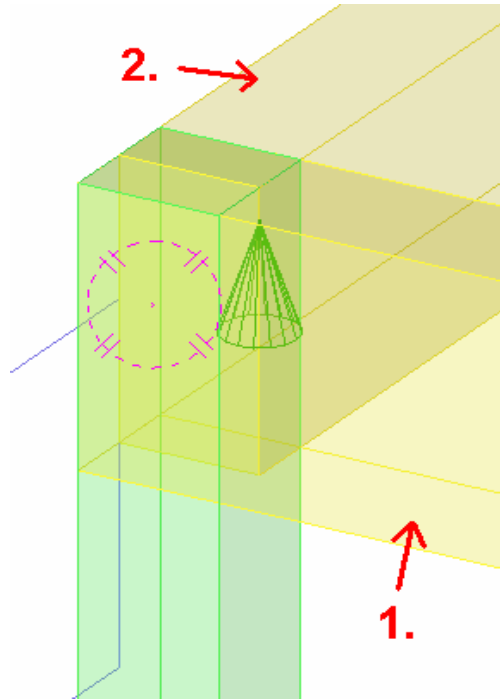
#### Change the connection parameters

1. Select **standard** from the drop-down menu at the top of the dialog and click **Load** (the clearance value field is cleared).



#### Shorten all the other beams

2. Click **OK** to apply the settings and close the dialog.
3. Pick the extended beam at the grid intersection A-1 and then the other beam. The secondary beam is fit according to the primary beam.

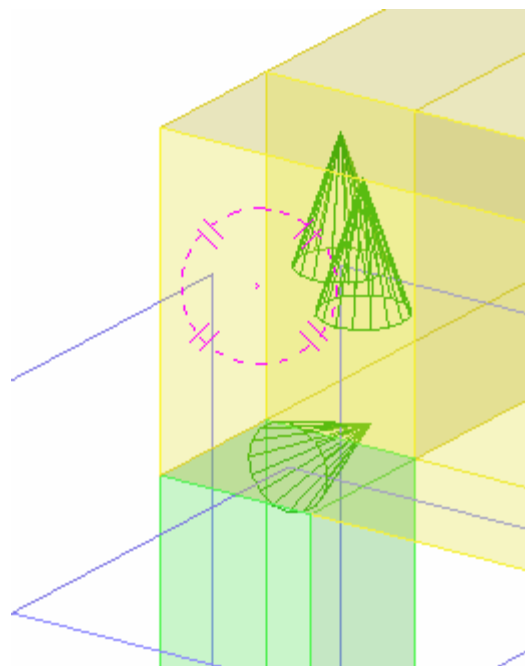
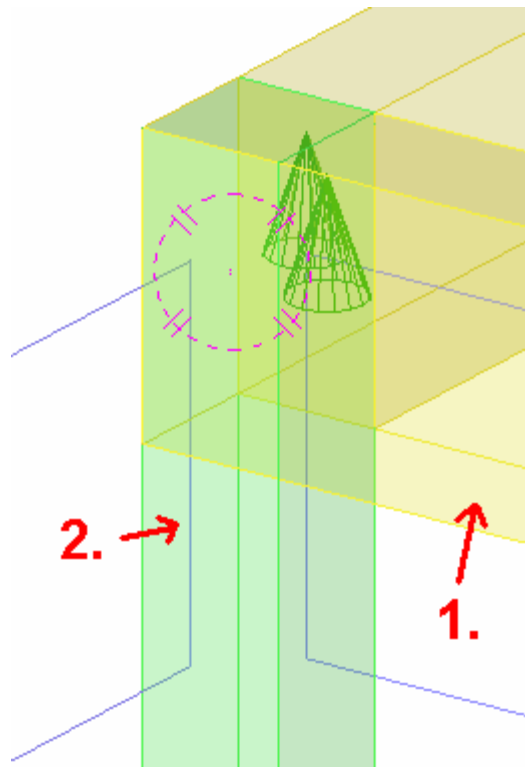


4. Repeat the procedure for all those beam-to-beam situations in the model where beams clash with each other.

## Shorten the columns

Next cut the column on grid A-4 in the same way:

1. Pick beam.
2. Pick column.

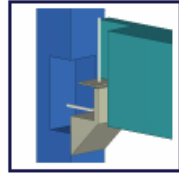


3. Repeat to all the columns on gridlines 1 to 4. (Note! If you are working on level +13400 and the view depth is 500, you may not see the cut columns, but they are visible in other views.)
4. Interrupt the command.

## Create corbel connection

We will use the **Corbel connection (14)** to create corbels to columns on gridlines 4 to 7 at elevations +3850 and +7350. The corbel is automatically added to the same cast unit as the column. This connection will cut the beam and add a bearing pad and a reinforcing bar according to the connection settings. For more information on the corbel connection click the **Help...** icon on the connection dialog.

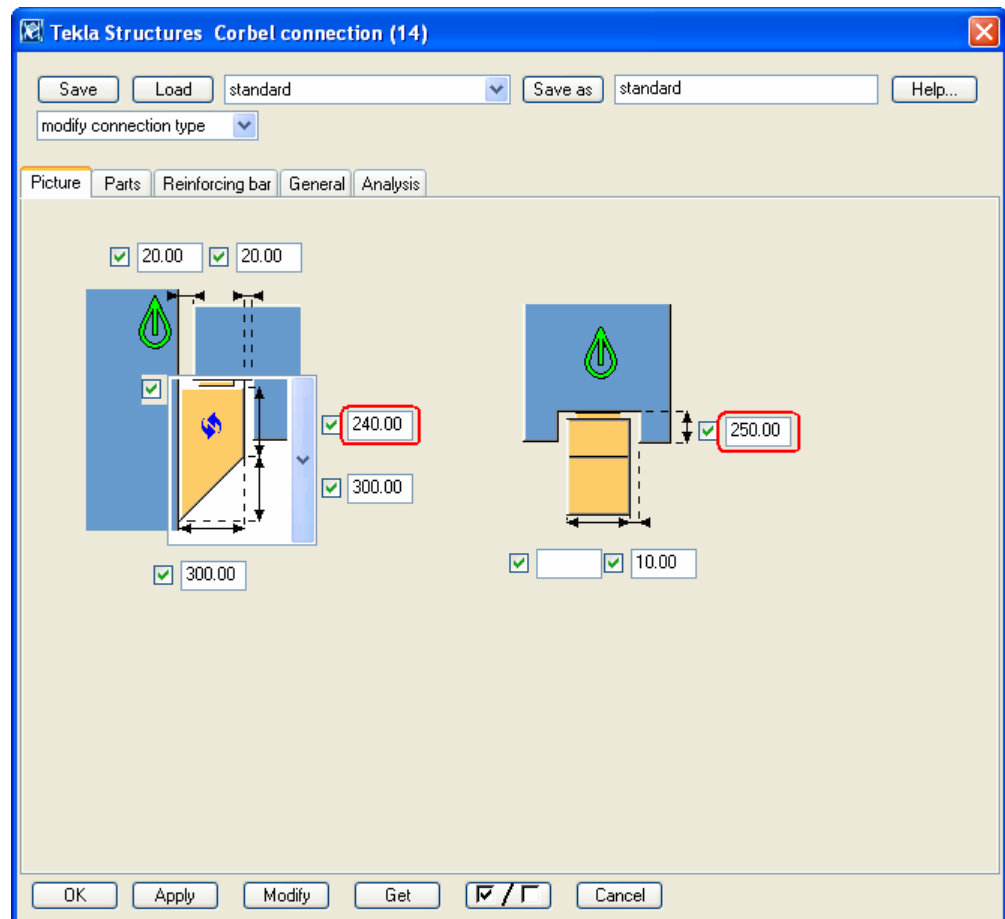
1. Click **Ctrl+F** and find Corbel connection (14).



Corbel connection (14)

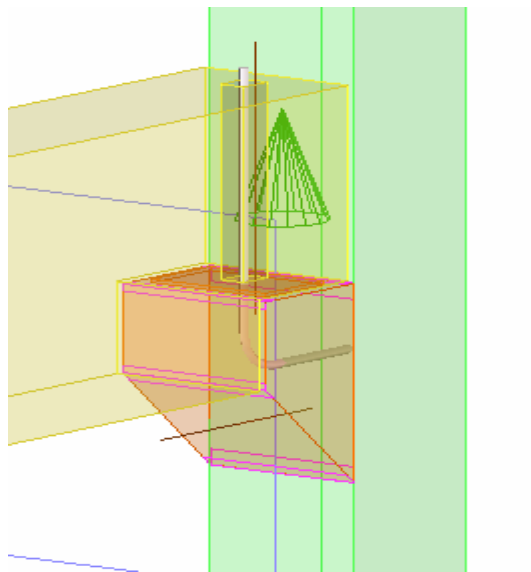
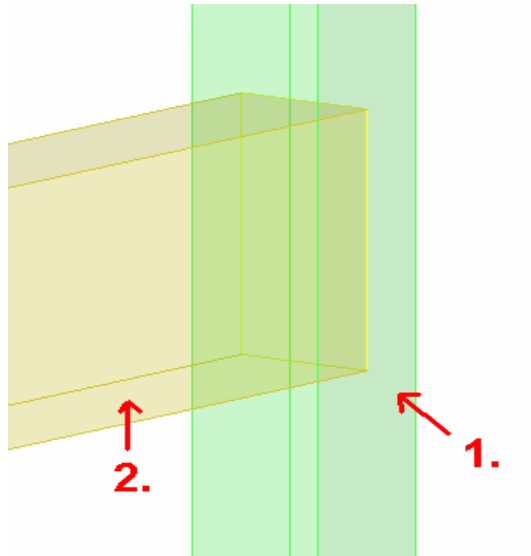
2. Double-click on the connection icon to open the connection dialog.
3. Change the component settings according to the dialog below.

**Set the connection parameters**



4. Accept the settings by clicking **OK**.
5. At grid A-4, elevation +3850, pick the column and then the beam.

**Create the connection**



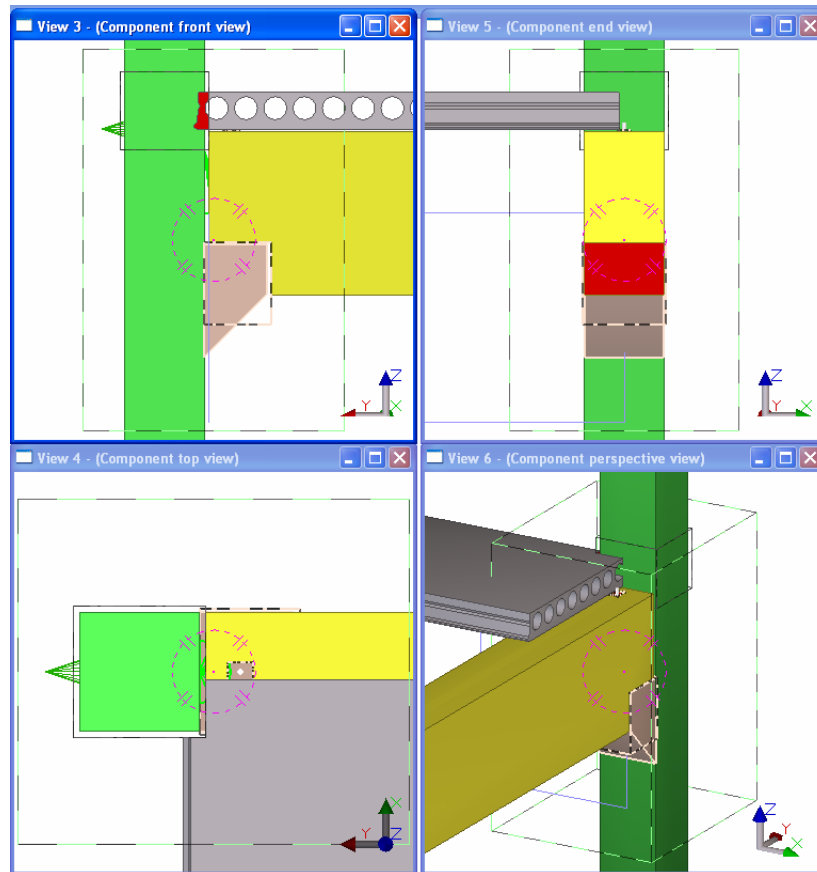
6. Interrupt the command.

## Check 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 Select connection

1. Select the component.
2. Right mouse click.
3. Select **Create view > Component basic views**.



4. Keep the connection front view open and close the other connection basic views.

### Check dimensions

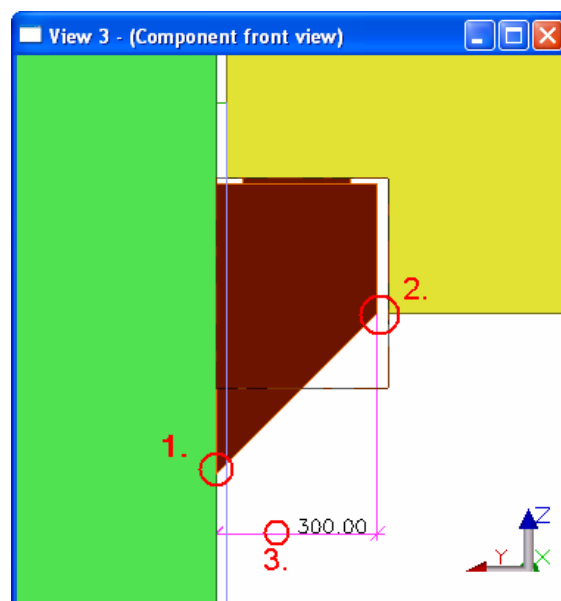
We will now check that the corbel dimensions are as we defined on the connection dialog.

**Help: Modeling > Settings and Tools > Querying objects > Measure**

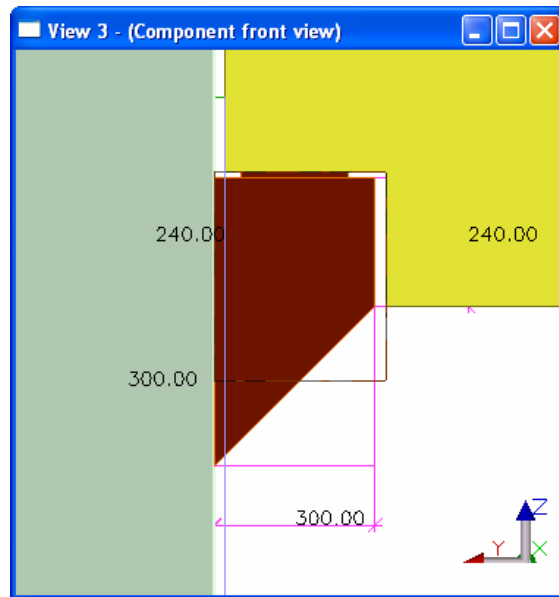
1. Click **Create x measure**.



2. Pick two points at the edges of the corbel.
3. Pick a third point to define the dimension line location.



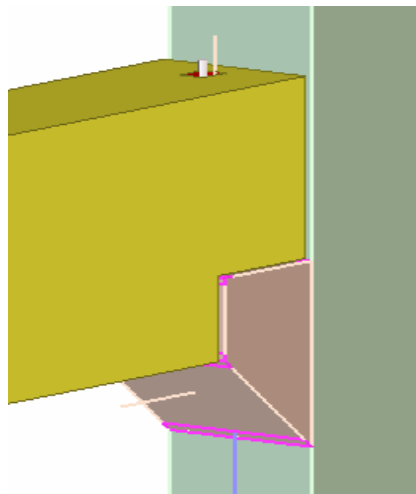
4. Check also the y dimensions.



#### Check cast unit

We will now check the cast unit. [Help: Modeling > Parts > Cast units and assemblies](#)

1. Press down **ALT** and then pick column. The corbel will also be highlighted.



The corbel and the other connection objects are automatically added to the column cast unit.

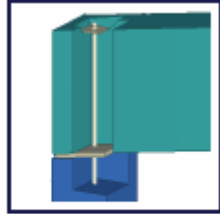
#### Create the rest of the corbel connections

1. Reactivate the **Corbel connection (14)** command.
2. Repeat the creation procedure to all the other column-beam situations on gridlines 4 to 7 at elevations +3850 and +7350.

## Create dowel connection

Next we will create dowel connections in the beam-to-column situations on gridlines 5 to 7 at elevation +13400. We will use the **Seating with dowel (75)** connection. This connection automatically fits the column according to the beam. It also creates the necessary cuts to the beam, adds a bearing pad and the dowel according to the connection settings. For more information on the Dowel connection click on the **Help...** icon on the connection dialog.

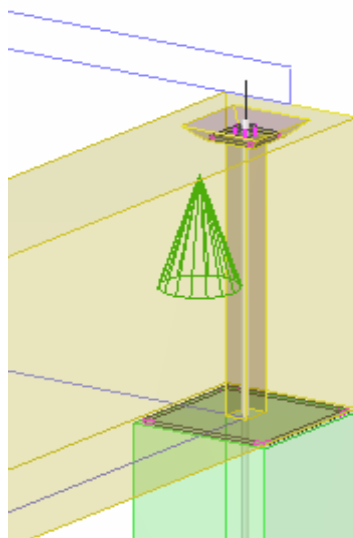
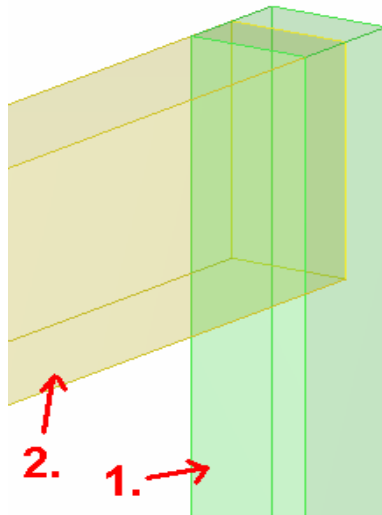
1. Click **Ctrl+F** and find Dowel connection (75).



Seating with dowel  
(75)

2. Use the default settings (click the connection only once).
3. Pick the column and the beam on grid B-7, elevation +13400.

**Create the connection**



5. Repeat in all the beam-to-column situations on gridlines 5 to 7 at elevation +13400.

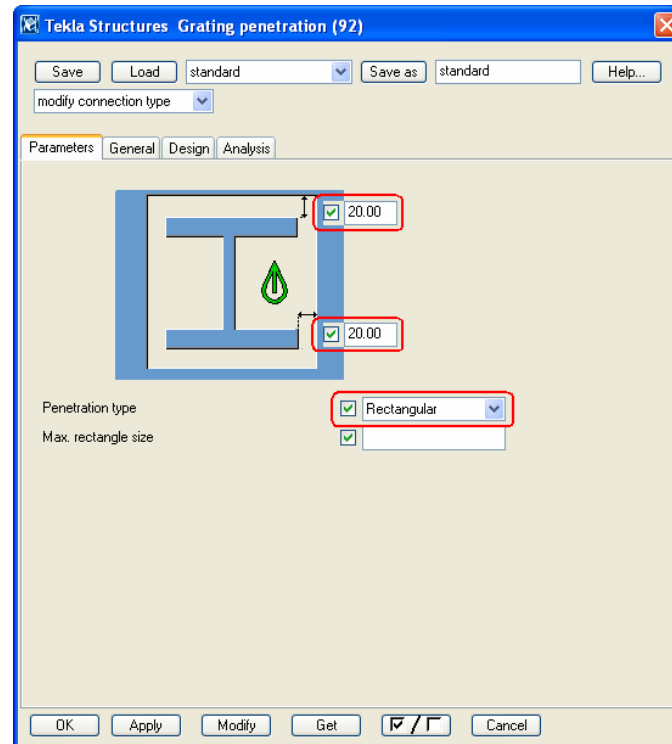


## Create cuts to hollow-core slab corners

We will next fit the hollow-core slab corners to the columns. For this we'll use the grating penetration component.

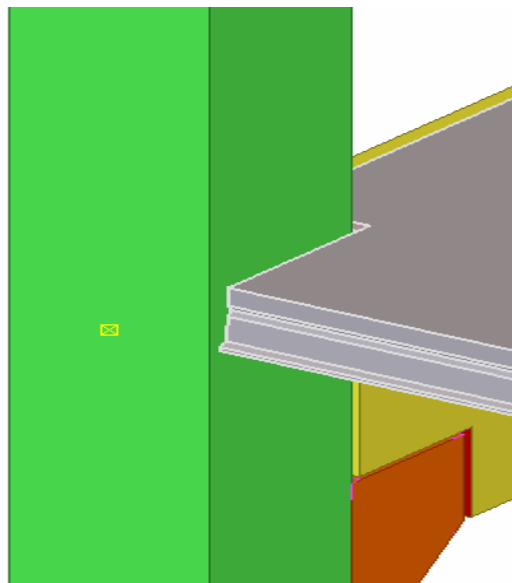
### Set the connection parameters

1. Find **Grating penetration component (92)** in the component catalog.
2. Double-click on the icon to open the properties dialog.
3. Set the Penetration type to Rectangular and the clearance around the column to 20 mm.



### Create the connection

4. Close the dialog with **OK**.
5. At grid A-4, elevation +3850, pick the hollow-core slab.
6. Pick the column.



7. Repeat steps 5 and 6 for all other hollow-core slab corners that collide with columns.

## 2.3 Create Rebars Using System Components

Once you have created and detailed a model of concrete parts, you may need to reinforce the parts. Reinforcing macros create the entire reinforcement of a part in one go. The reinforcement is created according to the component attributes. Reinforcement created using a component is updated automatically if the dimensions of the reinforced concrete part change.

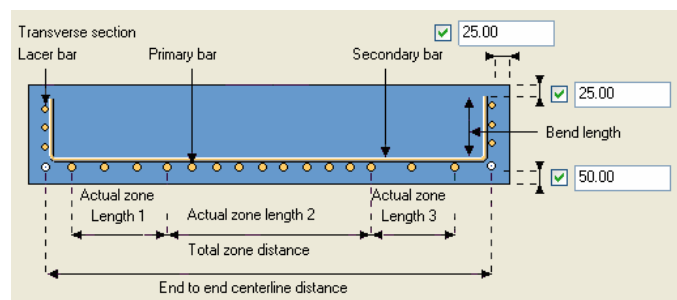
See more about reinforcements in Tekla Structures [help: Detailing > Reinforcement > Getting started with reinforcement](#) and in [help: Detailing > Reinforcement > Basic reinforcement properties](#).

### Reinforcing pad footings

We will first put reinforcements into the 1800\*1800 pad footings, which are 650 mm high. For this we use the Pad footing reinforcing macro. For more information click the **Help...** icon in the component dialog.

#### Define component parameters

1. Find the **Pad footing (77)** component in the component catalog.
2. Double-click on the component to define the properties to be used.
3. Check the cover thicknesses on the **Picture** tab page:



4. Next define primary bars as described below. Select the grade and size from the **Select reinforcing bar** dialog, which opens when you push the button in the size field. Exit the dialog with **OK**.

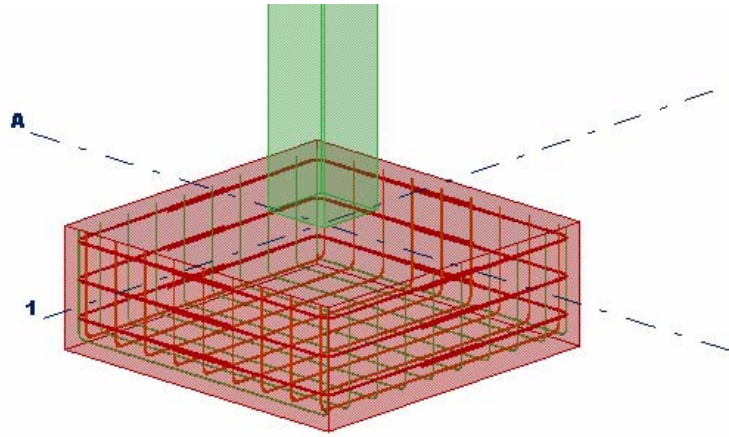
5. Use the same settings for the secondary bars and put 12 mm reinforcement in 200 mm intervals.
6. Then you need to set the lacer bars as described below.

Group	Grade	Size	Number of bars	Spacing	Start	End
Lc1	A500	8	200.00	100.00	500.00	
Lc2						
Lc3						
Lc4						
Lc5						
Lc6						

Group	Type	Orientation	p1	p2	p3	p4	L1	L2	L3	L4
Lc1		Front					400.00	400.00	400.00	400.00
Lc2		Front								
Lc3		Front								
Lc4		Front								
Lc5		Front								
Lc6		Front								

7. Save the values in the **Save as** field with the name 1800\*1800-650.
8. Close the dialog with **OK**.
9. Now pick the Pad footing at A-1 sized 1800\*1800\*650. The macro generates the reinforcement inside the pad footing.
10. Repeat to all the other 1800\*1800\*650 sized pad footings.

## Create reinforcements

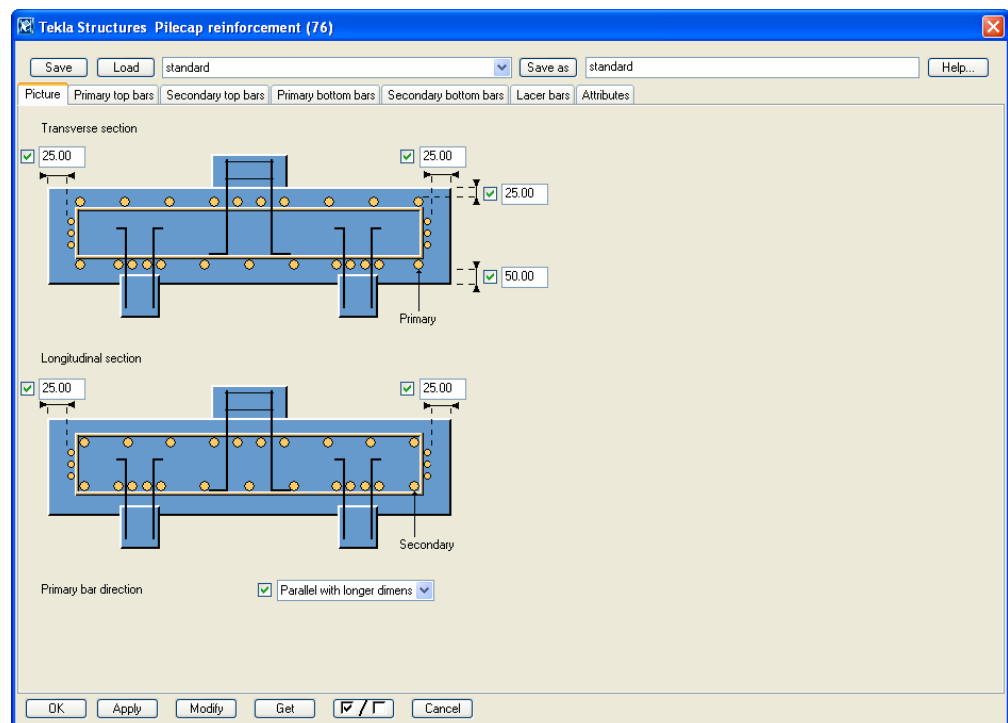


You can create reinforcements components to multiple parts by using area select, e.g. activate component, area select all pad footings on grid line A. Note, if you already have reinforcement created e.g. A&1 and you area select it together with the others, second set of reinforcements will be created.

For pad footings on gridline **B** we will use the **Pilecap reinforcement (76)** component, which creates reinforcement also to the top of the footing. For more information click the help in the component dialog.

#### Define component parameters

1. Find the **Pilecap reinforcement (76)** component in the component catalog.
2. Double-click on the reinforcing component to define the properties to be used.
3. Check the cover thicknesses on the **Picture** tab page:

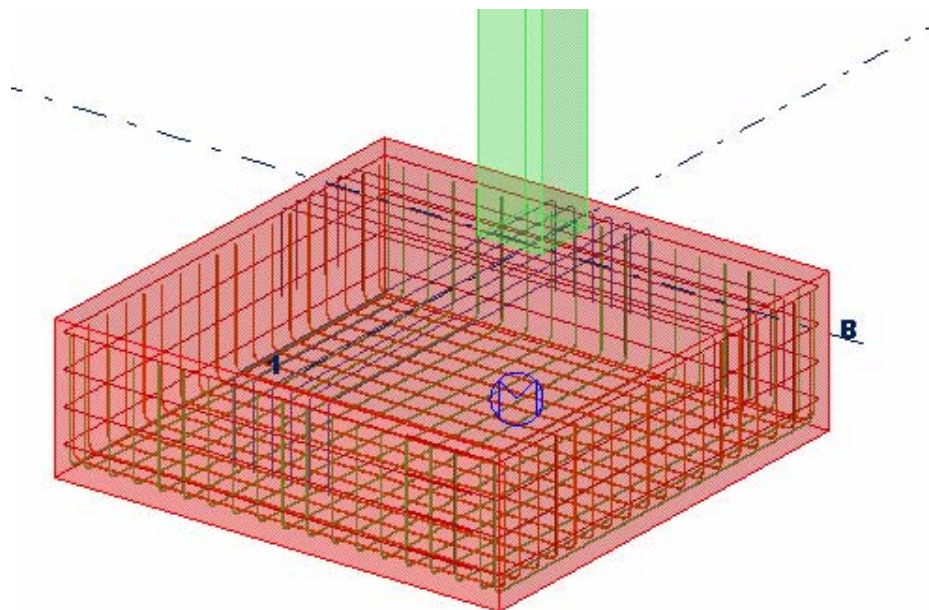


4. Next define **top primary and secondary bars** as described below. Select the grade and the size in the **Select reinforcing bar** dialog, which opens when you click on the button [...] in the size field. Exit the dialog with **OK**. With these settings, top bars will be created only under columns 150% of the column size.

Picture	Primary top bars	Secondary top bars	Primary bottom bars	Secondary bottom bars	Lacer bars	Attributes
Grade	<input checked="" type="checkbox"/>	A500HW				
Size	<input checked="" type="checkbox"/>	10				
End conditions left	<input checked="" type="checkbox"/>	Straight				
End conditions right	<input checked="" type="checkbox"/>	Straight				
Bend lengths left	<input checked="" type="checkbox"/>	500.00				
Bend lengths right	<input checked="" type="checkbox"/>	500.00				
Creation method	<input checked="" type="checkbox"/>	Number of bar:				
Creation by numbers	<input checked="" type="checkbox"/>	6				
Creation by spacing	<input checked="" type="checkbox"/>	200.00				
To suite column	<input checked="" type="checkbox"/>	Yes				
% of column width	<input checked="" type="checkbox"/>	150.00				
Bar portioning (%)	<input checked="" type="checkbox"/>	100.00				
Bar portioning (number of bars)	<input checked="" type="checkbox"/>					

### Create reinforcements

- Now define **bottom bars for primary and secondary directions** using 16 mm bars in 150 mm spacing, bend length on both sides is 700 mm. The bottom bars don't need to suit the piles, so you can use the default in that field and leave the % fields empty.
- Then set 10 mm diameter lacer bars at 200 mm intervals starting at 100 and ending at 700 mm.
- Save the values in the **Save as** field with the name 2700\*2700-850.
- Close the dialog with **OK**.
- Now pick first the Pad footing sized 2700\*2700\*850 at B-1, then the column on top of the footing. End with clicking the middle mouse button. The macro generates the reinforcement inside the pad footing and concentrates top bars under the column.
- Repeat step 9 for all pad footings on gridline **B**.



## Reinforcing columns

We will now create reinforcements into columns using the Rectangular column reinforcement component. See more information by clicking the **Help...** icon in the component dialog.

**Define component parameters to be used on gridlines 5 to 7**

1. Find **Rectangular column reinforcement (83)** in the component catalog.
2. Double-click on the component to define the properties to be used.
3. Turn on side bars, and define cover thickness and rebar diameters as described below:

Picture Main bars Main bar attributes Stirrups Stirrup attributes Inter

Number of side bars / spacings

☒ 2  
☒ 80.00

☒ 2  
☒ 80.00

☒ 160.0  
☒ 25.00

Picture Main bars Main bar attributes Stirrups Stirrup attributes

☒ 0.00  
☒ 0.00  
☒ 0.00

☒ -25.00 Corner bars  
☒ -25.00 Side bars 1  
☒ -25.00 Side bars 2

☒ -225.00 Corner bars  
☒ -25.00 Side bars 1  
☒ -25.00 Side bars 2

Picture Main bars Main bar attributes Stirrups Stirrup attributes Intermediate links Top

	Corner bars	Side bars 1	Side bars 2
Grade	<input checked="" type="checkbox"/> A500HW	<input checked="" type="checkbox"/> A500HW	<input checked="" type="checkbox"/> A500HW
Size	<input checked="" type="checkbox"/> 25	<input checked="" type="checkbox"/> 16	<input checked="" type="checkbox"/> 16
Class	<input checked="" type="checkbox"/> 3	<input checked="" type="checkbox"/> 14	<input checked="" type="checkbox"/> 12
Name	<input checked="" type="checkbox"/> REBAR	<input checked="" type="checkbox"/> REBAR	<input checked="" type="checkbox"/> REBAR
Prefix	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Start number	<input checked="" type="checkbox"/> 1	<input checked="" type="checkbox"/> 1	<input checked="" type="checkbox"/> 1

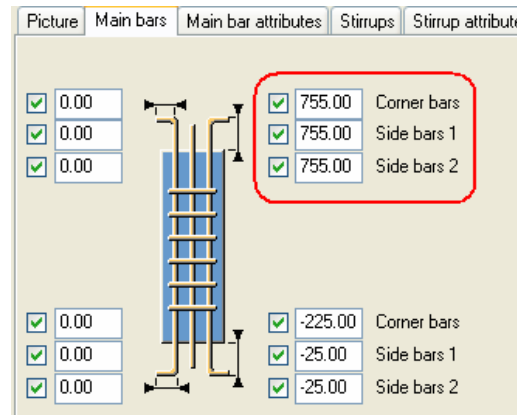
4. Set the top bars so that they hold the dowel as shown below:



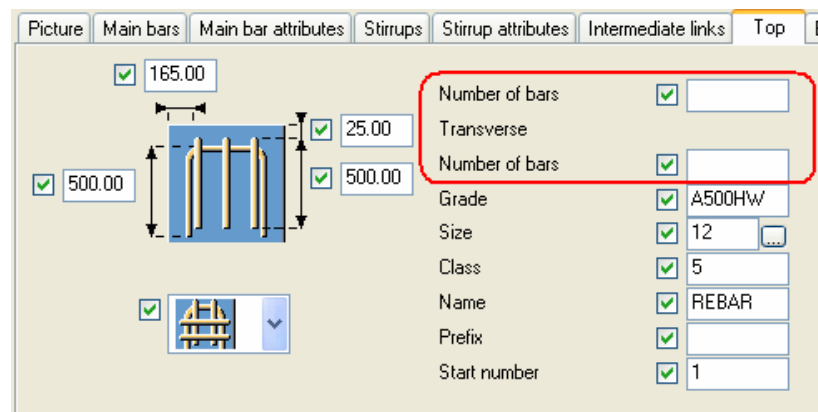
We will now change the component settings to be used on the columns between gridlines 1 and 4.

### Define component parameters to be used on gridlines 1 to 4

1. Double-click on the component in the component catalog again.
2. Change the main rebars to come out from the top of the column (into the in-situ beams) as shown below.

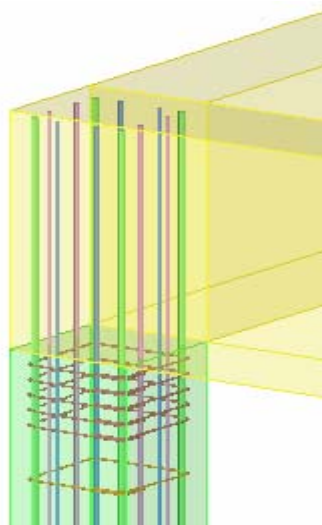


3. Turn off the top rebars.



4. Click **OK** to lock the settings and close the dialog.
5. Pick the column at A-1, and the component creates reinforcements as defined.

### Create reinforcements



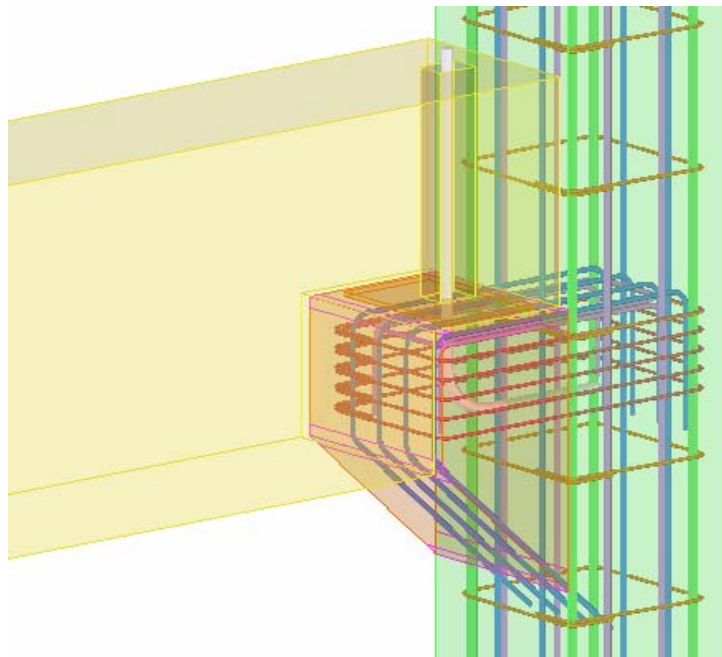
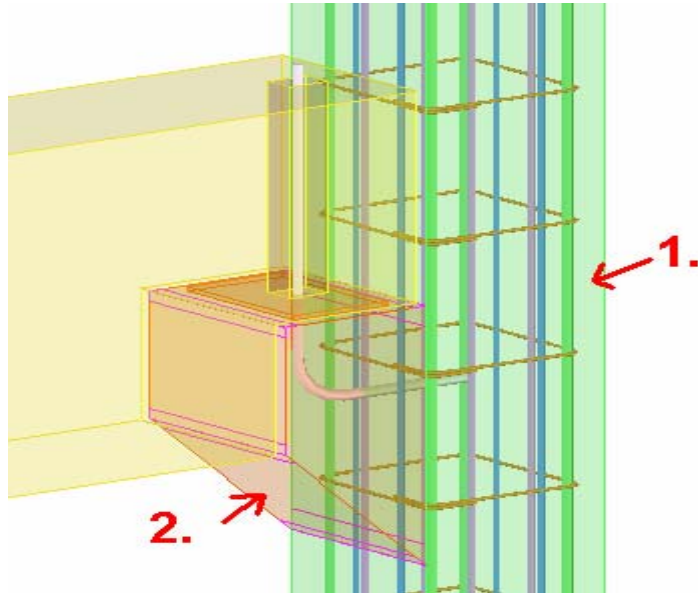
6. Pick, one by one, all the columns on gridlines A and B between gridlines 1 and 4. (Note: you can also use area select as explained on page 17)



## Create reinforcements

We will next reinforce the column corbels using the **Corbel reinforcement (81)** component. See more information by clicking the **Help...** icon in the component dialog.

1. Find the **Corbel reinforcement (81)** in the catalog.
2. Click the component icon once to active the command.
3. Pick first the column, then the corbel and end the selection with the middle mouse button. The component generates reinforcements inside the corbel and the column.



4. Create corbel reinforcement for all the corbels.



To see connections, such as a corbel connection, in shaded wire frame, use the shortcut **Shift+2**.



You can create the corbel reinforcement in a two-sided situation by picking first the column, then both the corbels and then end the selection with the middle mouse button.



Two components don't interact together - depending on the settings, it is possible that reinforcements collide. Check collisions with clash check option. Remember to use object in components select switch, see page 27.

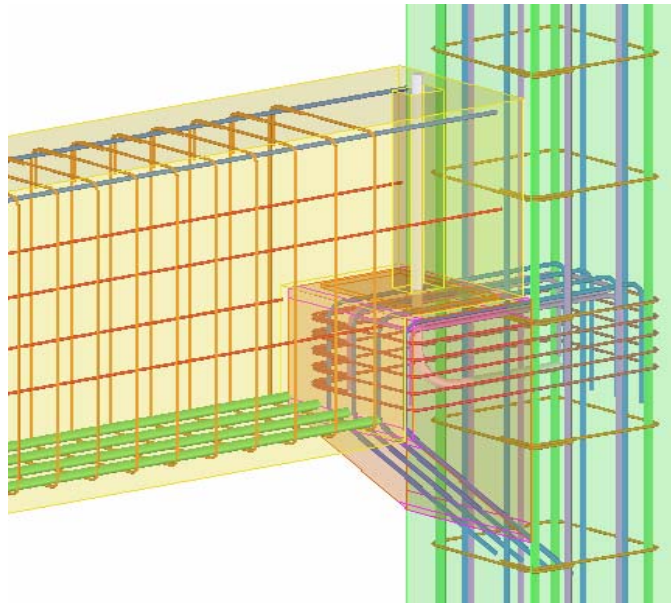
## Reinforcing beams

We will next create reinforcements into beams using two reinforcing components. See more information by clicking the **Help...** icon in the component dialog.

We will first create main bars and stirrups.

1. Find **Beam reinforcement (63)** in the catalog.
2. We are going to use the default settings. Click on the reinforcing component once to activate the command.
3. Pick the beam at gridline 7 at elevation +3850. The component generates reinforcements inside the beam and cuts the bottom bars at the corbels.

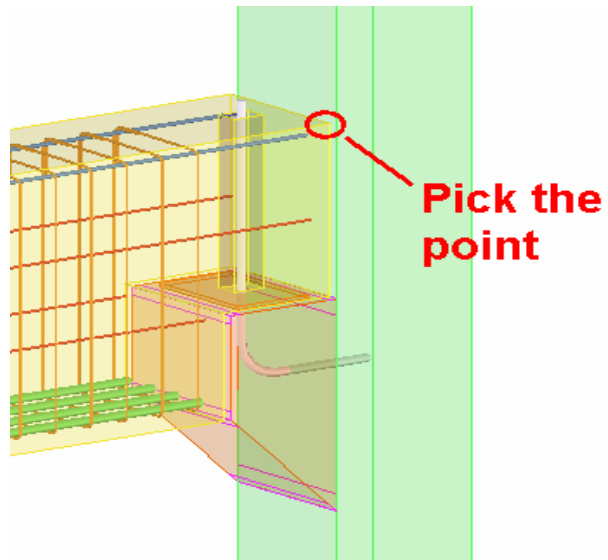
### Create reinforcements



4. Pick, one by one, all the precast concrete beams between gridlines 4 and 7. (Note: you can also use area select as explained on page 16)

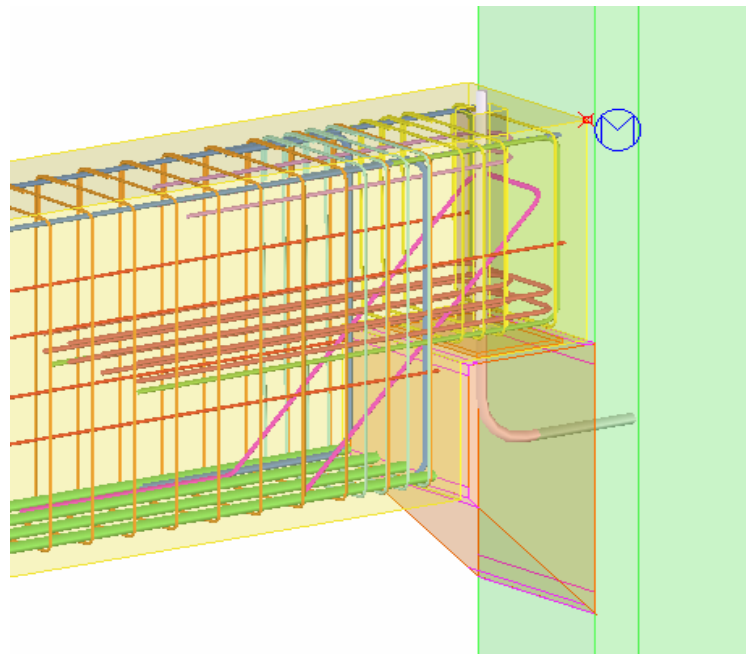
We will continue reinforcing the beams by inserting additional rebars at the beam ends. This we will do with the **Beam end reinforcement (79)** component. See more information by clicking the **Help...** icon in the component dialog.

1. Find the **Beam end reinforcement (79)**.
2. We are going to use the default settings. Click on the reinforcing component once to activate the command.
3. Pick a position at the end of a beam. (Note: this point can be any corner at the end of the beam)



#### Create reinforcement

4. Pick the beam, and the component generates reinforcements inside the beam.

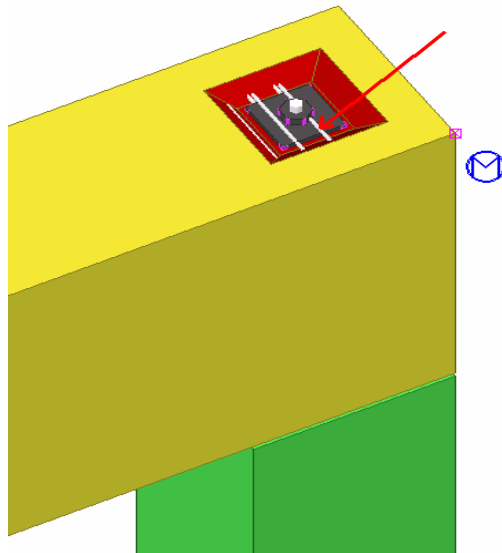


5. Repeat the picking for each end of all **precast concrete beams** between gridlines 4 and 7 at elevations +3850 and +7350.

Next we will create the beam end reinforcement for a beam at elevation +13400.

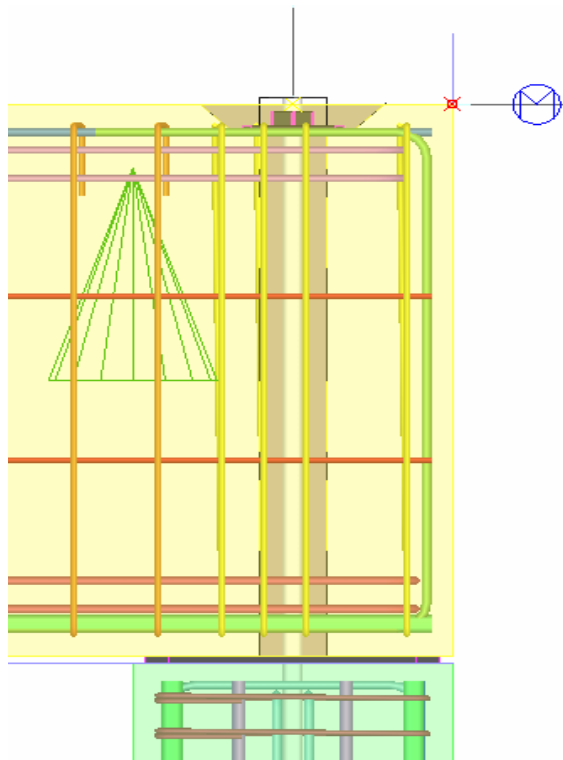
#### Create reinforcement

1. Using the same settings, create the beam end reinforcement at grid intersection A-7 at +13400.

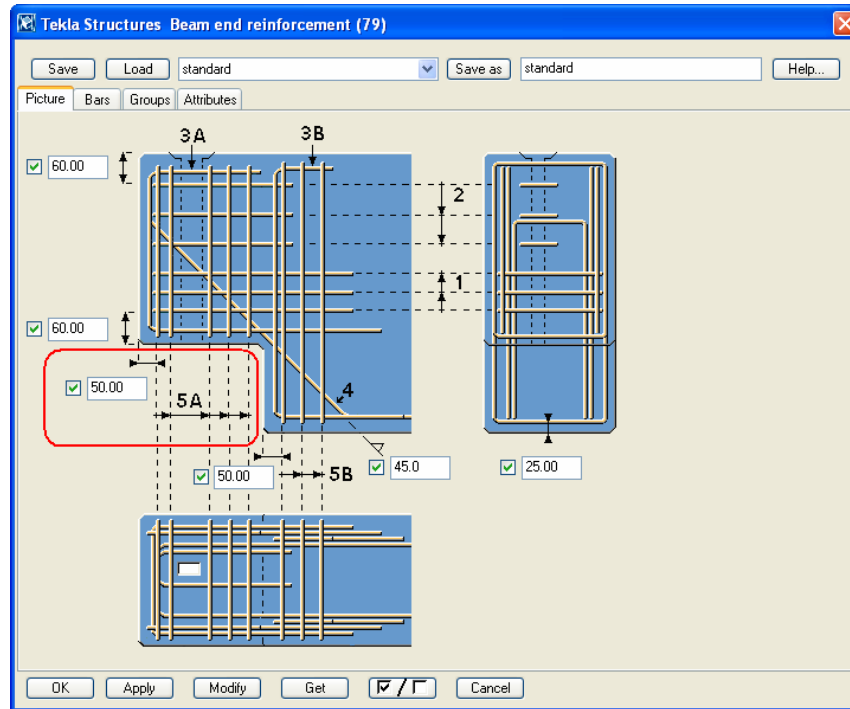


As shown above, the reinforcements come through the cut at the top of the beam. So we need to change the parameters and modify the connection.

2. Open view **GRID 7** to see the situation better.



3. Double-click on the component to open the component dialog.



In the dialog, study the area marked with a red frame above. The problem rebars are defined as 5A.

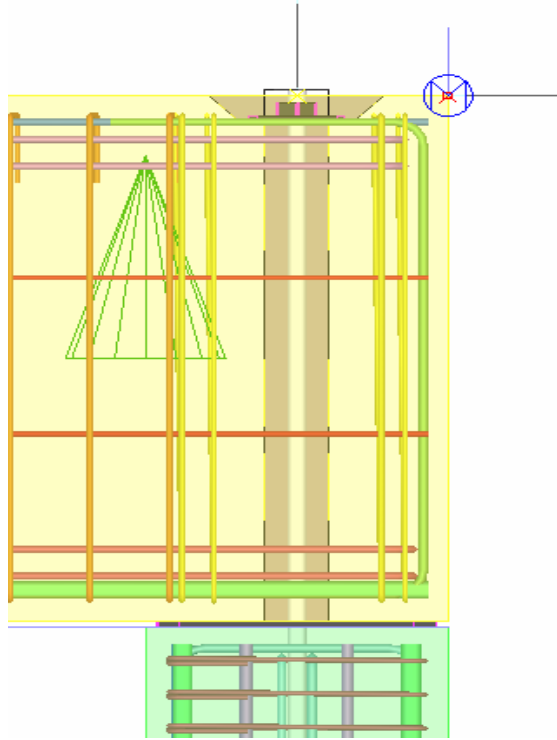
#### Change connection parameters

4. Go to the **Groups** tab and change the distance between the rebars to 30.00 210.00 40.00 as shown below.

	Pcs.	Spacings
Bar 1	<input checked="" type="checkbox"/> 2	<input checked="" type="checkbox"/> 40.00
Bar 2	<input checked="" type="checkbox"/> 2	<input checked="" type="checkbox"/> 40.00
Bar 3A	<input checked="" type="checkbox"/> 2	<input checked="" type="checkbox"/>
Bar 3B	<input checked="" type="checkbox"/> 2	<input checked="" type="checkbox"/>
Bar 4	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Bar 5A	<input checked="" type="checkbox"/> 4	<input checked="" type="checkbox"/> 30.00 210.00 40.00
Bar 5B	<input checked="" type="checkbox"/> 4	<input checked="" type="checkbox"/> 50.00

#### Modify the connection

5. Click **Modify**.



The connection is modified and the rebars are arranged according to the new settings.

#### Create reinforcements

6. Click **Apply** to use the new settings.
7. Create the beam end reinforcements to all the other beams at elevation +13400.



When trying to select the component it is important to understand the **Select component** and **Select objects in component** icons in the **Select** toolbar:



When the **Select component** icon is active you can only select the component, not the objects created by the component. You can open the component dialog by double-clicking on any component object.



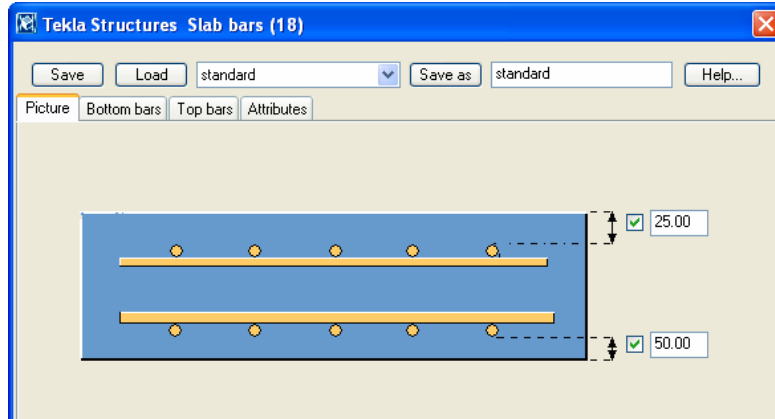
When the **Select objects in components** icon is active you can select objects inside the component: parts, bolts, reinforcements, etc. If you need to modify the component you need to double-click on the component symbol.

# Reinforcing slabs

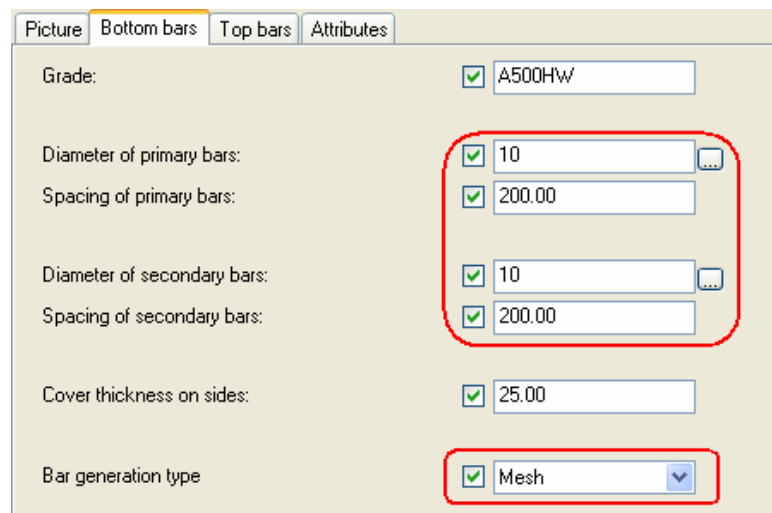
We will next create reinforcement mesh into the slabs at elevations +3850 and +7350 using the **Slab bars (18)** reinforcing component. See more information by clicking the **Help...** icon in the component dialog.

## Define component parameters

1. Find **Slab bars (18)** in the catalog.
2. Double-click on the component to define the properties to be used.
3. Define the cover thickness to be used.

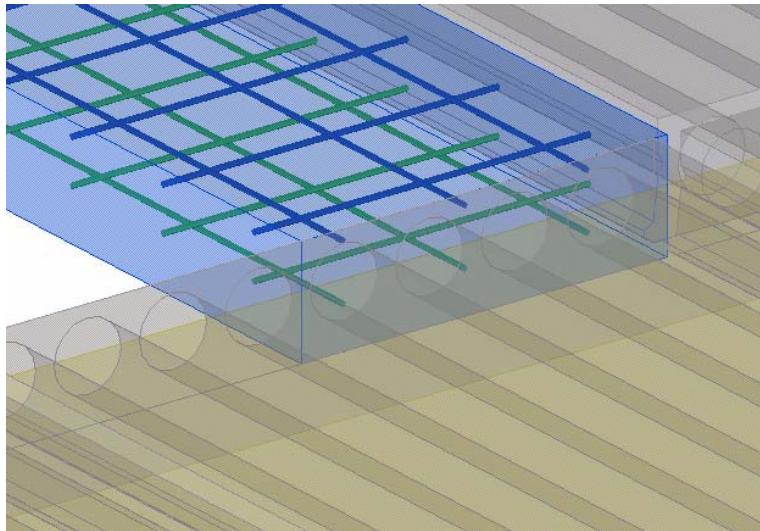


4. Open the **Bottom bars** tab page and set the bar diameter to 10 mm, and spacing in both directions to 200 mm. Change also the bar generation type to mesh.



5. Use the same settings for top bars.
6. Close the dialog with **OK**.
7. Pick the cast in-situ slab between gridlines 5 and 6 at level +3850. The macro generates reinforcements inside the slabs.

## Create mesh



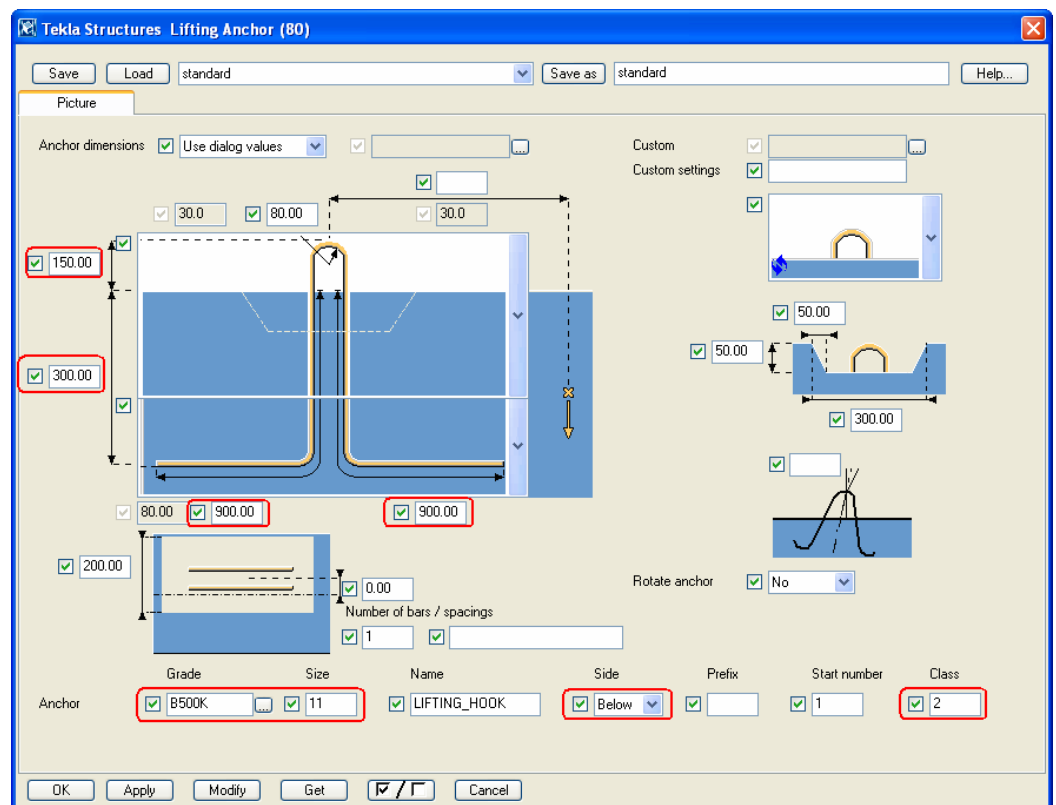
8. Create reinforcements to the in-situ slab at level +7350.

## Lifting hooks

We will next create lifting anchors into beams and columns using the **Lifting anchor (80)** macro. The macro generates lifting anchors according to center of gravity. See more information by clicking the **Help...** icon in the component dialog.

### Define component parameters

1. Find **Lifting anchor (80)** in the component catalog.
2. Double-click on the component to define the properties to be used.
3. Select anchor shape and define anchor dimensions.
4. Select anchor size and grade.
5. Change also side and class.

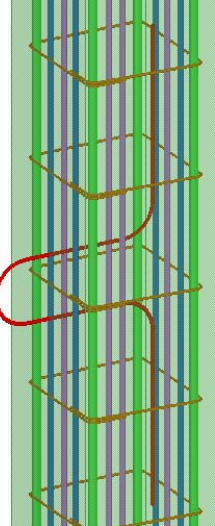


6. Click **Apply** to lock the settings.



## Create lifting anchor

- Pick the column at grid intersection A-1. The macro generates lifting anchors inside the column.

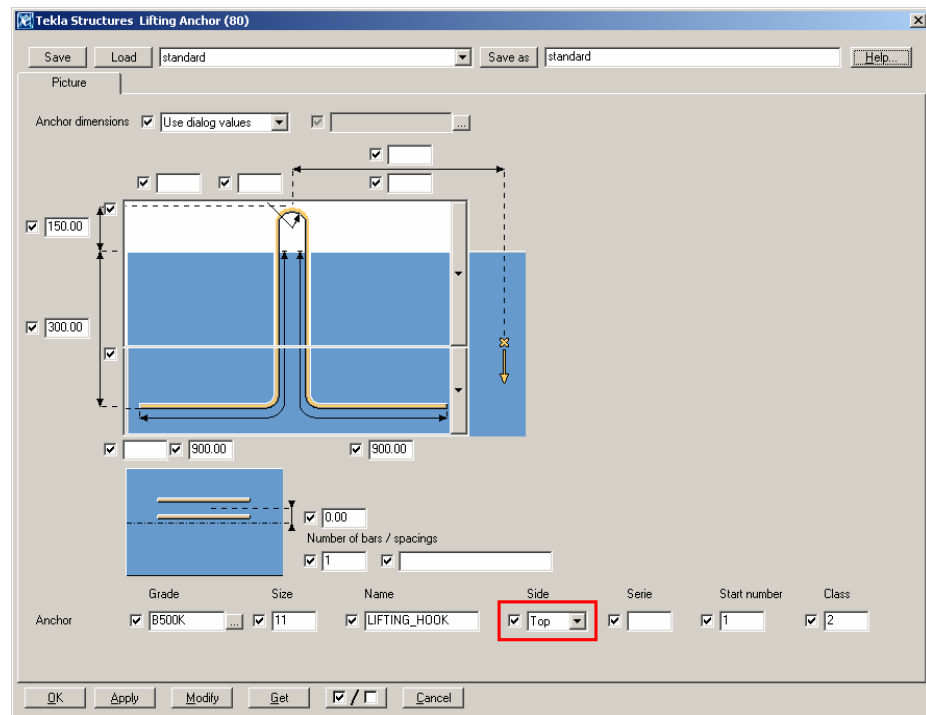


- Pick, one by one, all the columns on gridline A. (Note: you can also use area select as explained on page 16)

The corbels are on the other side of the columns on gridline B so we need to modify the lifting anchors to appear on the other side of the column.

## Change component parameters

- Change the side to **Top**.



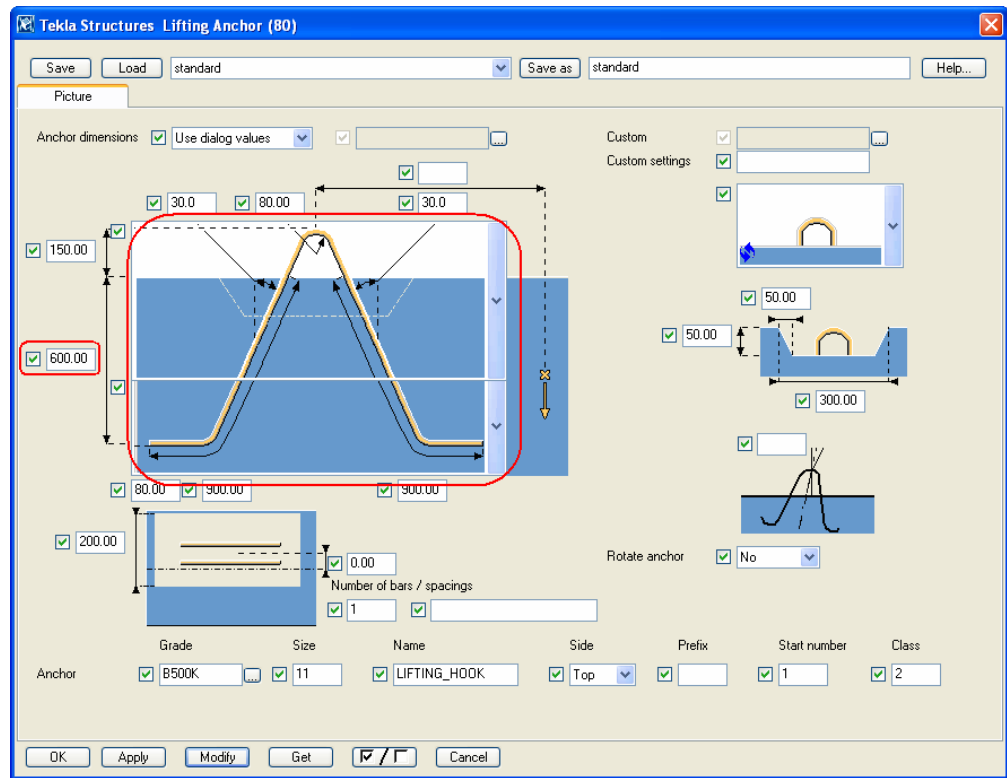
- Click **OK** to lock the settings and close the dialog.
- Pick, one by one, all the columns on gridline B. (Note: you can also use area select as explained on page 16)

## Create lifting anchor

Still using the **Lifting anchor (80)** component, we are going to create lifting anchors to all the pre-cast concrete beams.

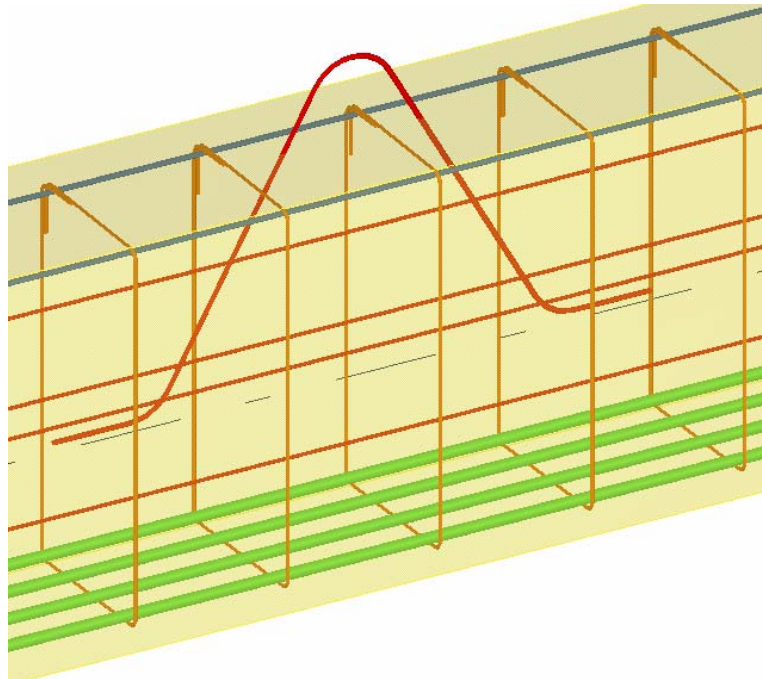
- Double-click on the component again.
- Change the anchor shape and dimensions and apply.

## Change component parameters



### Create lifting anchor

- Pick the beam on gridline 7 at elevation +3850. The macro generates a lifting anchor inside the beam.



- One by one, pick all the pre-cast concrete beams. (Note: you can also use area select as explained on page 16)

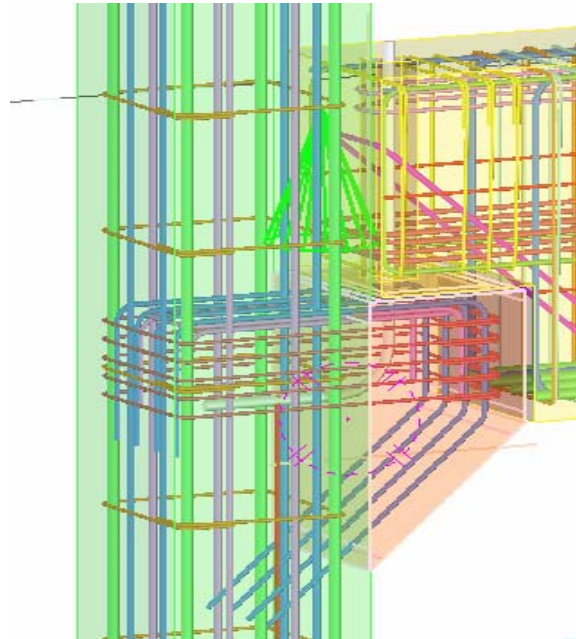
## 2.4 Modify All the Corbel Connections

Next we are going to modify the corbel connections.

1. Double-click on the corbel connection on A-7 at elevation +3850 to open the connection dialog.
2. Select and load the standard settings.



3. Click Modify.

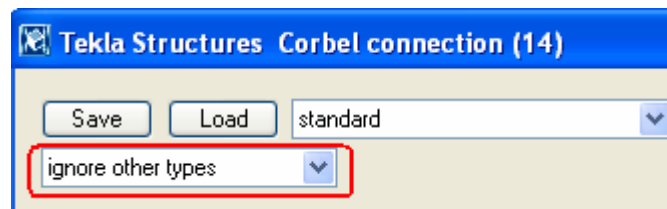


As you can see, the reinforcement inside the corbel and the beam will be modified according to the changed corbel size.

**Modify all the corbel connections at once**

We can easily modify only connections of the same type shown in the connection dialog by selecting **Ignore other types** in the connection dialog box. [Help: Detailing > Getting started > Using components > Modifying components](#)

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



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



3. Click **Modify**.