



# Tekla Structures

## Steel Connection Guide



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# 1 Steel connection properties

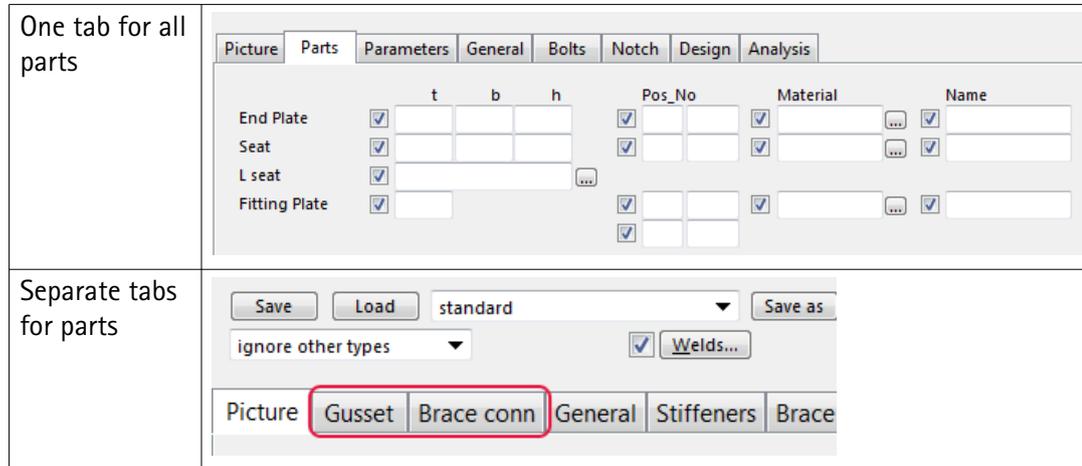
Once you have created a frame of parts in your Tekla Structures model, you will need to connect the parts to complete the model.

This section explains the properties that are common to many different Tekla Structures connections.

- See also** [Parts in steel connections on page 3](#)  
[Stiffeners on page 5](#)  
[Haunch on page 8](#)  
[Notch on page 9](#)  
[BCSA notch on page 14](#)  
[Bolts on page 17](#)  
[Beam cut on page 24](#)  
[Doubler plate on page 27](#)  
[Angle box on page 30](#)  
[Welds on page 34](#)  
[General tab on page 35](#)  
[Design and Design type tabs on page 36](#)  
[Analysis tab on page 38](#)

## 1.1 Parts in steel connections

Use the **Parts** tab to define the parts that Tekla Structures creates for a connection. Some connections have all the parts on one **Parts** or **Plates** tab. Other connections have separate tabs for the parts. See the example images below.



Property	Description
Thickness (t), width (b), height (h)	<p>Define the thickness, width and height of the parts.</p> <p>For some connection types, you do not have to enter these properties. For example, in end plate connections, Tekla Structures calculates the width and height by using the number of bolts and bolt edge distances.</p> <p>You can delete a part by entering zero (0) as the thickness.</p>
Profile	Select a suitable profile from the <b>Profile Catalog</b> , or enter a profile name.
Part position number (Pos_No)	<p>The part position number consists of a prefix and a start number.</p>  <ol style="list-style-type: none"> <li>1. Prefix</li> <li>2. Start number</li> </ol> <p>Some connections have a second row for the part position number where you can enter the assembly position number.</p> <p>The part position number defined in the connection dialog box overrides the settings defined on the <b>Tools --&gt; Options --&gt; Options... --&gt; Components</b> tab.</p>
<b>Material</b>	Select a suitable material from the <b>Material Catalog</b> .
<b>Name</b>	Define a name that is shown in drawings and reports.

## 1.2 Stiffeners

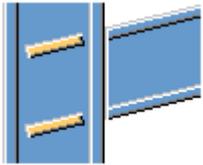
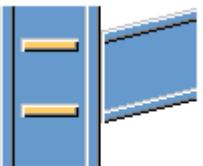
Stiffeners are used to strengthen a steel beam or a column. Stiffeners are usually plates.

### Stiffener plate dimensions

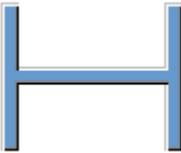
Part	Description
Top NS	Define the top near side stiffener thickness, width and height.
Top FS	Define the top far side stiffener thickness, width and height.
Bottom NS	Define the bottom near side stiffener thickness, width and height.
Bottom FS	Define the bottom far side stiffener thickness, width and height.

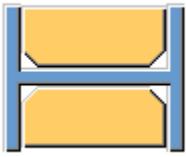
Option	Description	Default
Pos_No	Define a prefix and a start number for the part position number.	The default part start number is defined on the <b>Tools --&gt; Options --&gt; Options... --&gt; Components</b> tab.
Material	Define the material grade.	The default material is defined on the <b>Tools --&gt; Options --&gt; Options... --&gt; Components</b> tab, in the <b>Part material</b> box.
Name	Define a name that is shown in drawings and reports.	

### Stiffener orientation

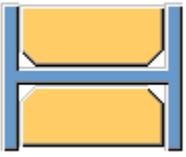
Option	Description
	Creates stiffeners parallel to the secondary part.
	Creates stiffeners perpendicular to the main part.

### Stiffener creation

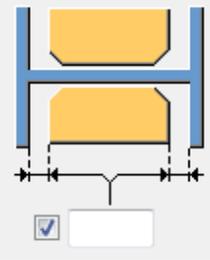
Option	Description
	Stiffeners are not created.

Option	Description
	<p>Creates stiffeners.</p> <p>For some components, you can also:</p> <ul style="list-style-type: none"> <li>• Select the option that Tekla Structures determines the size of the stiffener based on the shear tab size. Tekla Structures attempts to keep the bottom edges of the stiffener plate and shear tab on the same level, if possible.</li> <li>• Create a partial stiffener that leaves a gap between the stiffener plate and the bottom flange of the main part.</li> </ul>

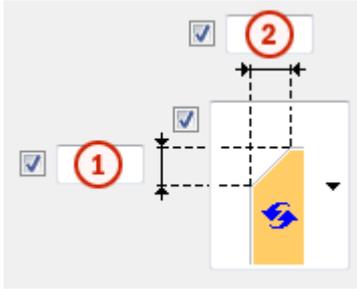
### Stiffener shape

Option	Description
	<p>Creates square stiffener plates with a gap for the main part web rounding.</p>
	<p>Creates stiffener plates with line chamfers.</p>

### Stiffener gap

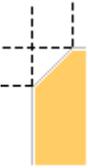
Option	Description
	<p>Define the size of the gap between the main part flanges and the stiffener.</p> <p>For some components, you can also define:</p> <ul style="list-style-type: none"> <li>• The distance from the edge of the flange to the edge of the stiffener</li> <li>• The vertical dimension of the stiffener line chamfer</li> <li>• The horizontal dimension of the stiffener chamfer or the radius of an arc type chamfer</li> </ul>

### Stiffener chamfer dimensions

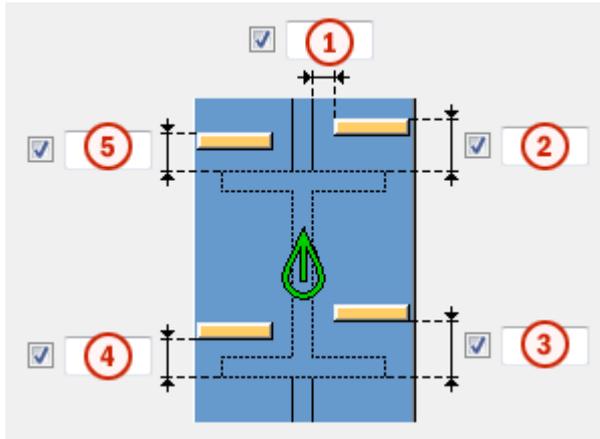


1. Vertical dimension
2. Horizontal dimension

**Stiffener chamfer types**

Option	Description
	No chamfer
	Line chamfer
	Convex arc chamfer
	Concave arc chamfer

**Stiffener position**



1. Gap between the stiffener and the beam web edge
2. Gap between the top near side stiffener and the beam flange edge
3. Gap between the bottom near side stiffener and the beam flange edge
4. Gap between the bottom far side stiffener and the beam flange edge
5. Gap between the top far side stiffener and the beam flange edge

By default, Tekla Structures positions the edges of the stiffener level with the flanges of the secondary part.

### 1.3 Haunch

Haunch is a wedge-like structure that is used to strengthen a beam at its end.

#### Haunch plates

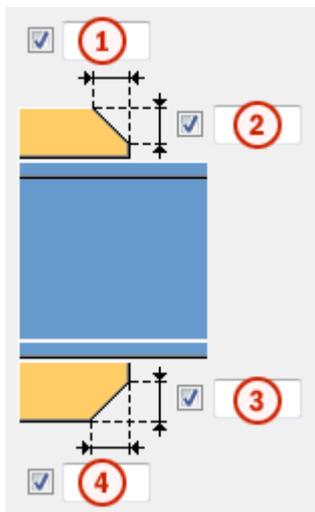
Part	Description
Top plate	Define the top haunch plate thickness, width and height.
Bottom plate	Define the bottom haunch plate thickness, width and height.

Option	Description	Default
Pos_No	Define a prefix and a start number for the part position number.	The default part start number is defined on the <b>Tools --&gt; Options --&gt; Options... --&gt; Components</b> tab.
Material	Define the material grade.	The default material is defined on the <b>Tools --&gt; Options --&gt; Options... --&gt; Components</b> tab, in the <b>Part material</b> box.
Name	Define a name that is shown in drawings and reports.	

#### Haunch plate creation

Option	Description
	<p>Creates top and bottom haunch plates.</p> <p>To create a single plate, enter 0 as the thickness for the plate that is not created.</p>
	<p>Haunch plates are not created.</p>

### Haunch plate chamfers



1. Width of the top haunch plate chamfer
2. Height of the top haunch plate chamfer
3. Height of the bottom haunch plate chamfer
4. Width of the bottom haunch plate chamfer

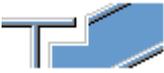
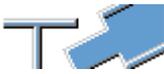
## 1.4 Notch

You can create notches for the secondary beam. The **Notch** tab has separate options for automatic and manual notching.

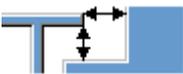
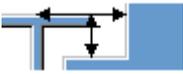
### Automatic notching

Automatic notching options affect both the top and the bottom flange.

### Notch shape

Option	Description
	Creates notches to the secondary beam. The cuts are square to the main beam web.
	Creates notches to the secondary beam. The cuts are square to the secondary beam web.
	Creates notches to the secondary beam. The vertical cut is square to the main beam, and the horizontal cut is square to the secondary beam.
	Automatic notching is not in use.
	Creates notches to both flanges of the secondary beam. The cuts are square to the secondary beam.

### Notch size

Option	Description
	Measures the notch size from the edge of the main beam flange and from underneath the top flange of the main beam.
	Measures the notch size from the center line of the main beam and from the top flange of the main beam.

Define horizontal and vertical values for the cuts:



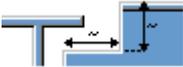
### Flange cut shape

Option	Description
	Cuts the secondary beam flange parallel to the main beam.
	Cuts the secondary beam flange square.

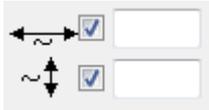
### Notch dimension rounding

Use the notch dimension rounding options to define whether the notch dimensions are rounded up. Even if the dimension rounding is set to active, the dimensions are rounded up only when necessary.

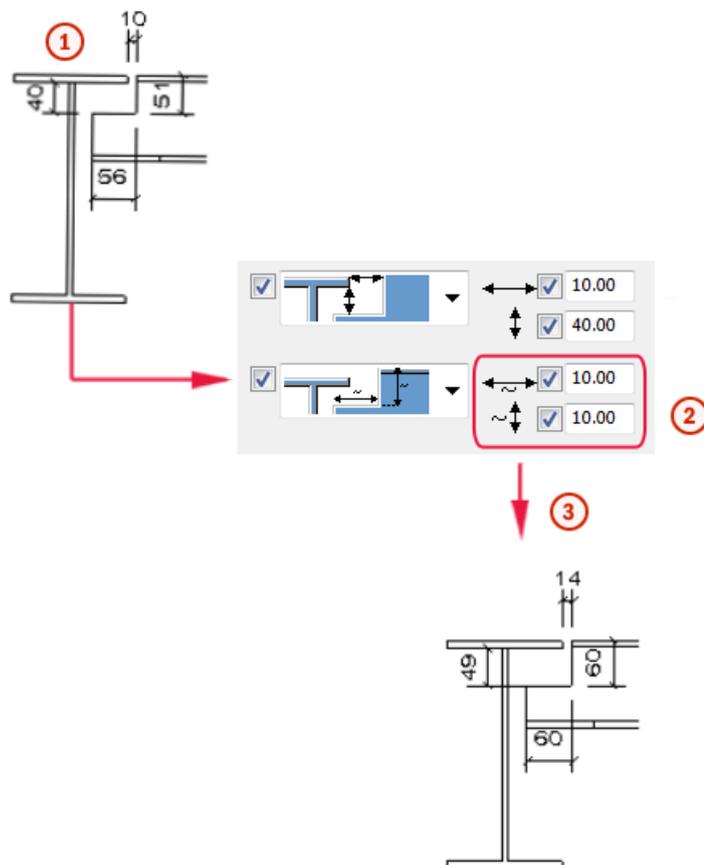
	Notch dimensions are not rounded.
---	-----------------------------------

	Rounds the notch dimensions using the horizontal and vertical values that are entered.
---	--

The dimensions are rounded up to the nearest multiple of the entered value. For example, if the actual dimension is 51 and you enter a round-up value of 10, the dimension is rounded up to 60.

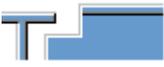


The image below shows an example of rounding:



1. Before rounding
2. Tekla Structures applies the horizontal and vertical rounding values.
3. After rounding

### Notch position

Option	Description
	Creates the cut below the main beam flange.
	Creates the cut above the main beam flange.

### Notch chamfer

Option	Description
	The notch is not chamfered.
	Creates a notch with a line chamfer.
	Creates a notch with a chamfer according to the radius that you enter.

Enter a radius for the chamfer.

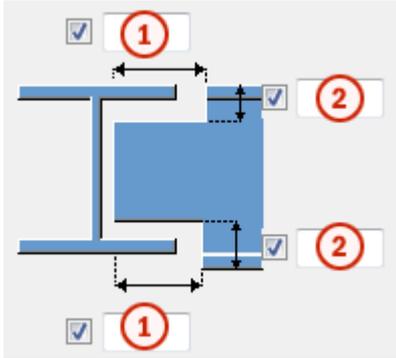
### Manual notching

Use manual notching when a part that does not belong to the connection clashes with the secondary beam. When you use manual notching, the connection creates cuts using the values that you enter on the **Notch** tab. You can use different values for the top and the bottom flange.

### Side of flange notch

Option	Description
	Creates notches on both sides of the flange.
	Creates notches on the near side of the flange.
	Creates notches on the far side of the flange.

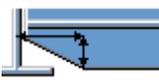
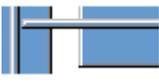
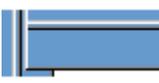
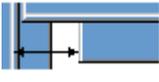
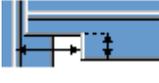
### Cut dimensions



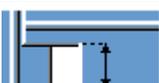
1. Dimensions for the horizontal flange cuts. The default is 10 mm.
2. Dimensions for the vertical flange cuts.

The gap between the notch edge and the beam flange is equal to the main part web rounding. The notch height is rounded up to the nearest 5 mm.

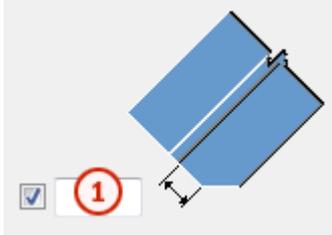
### Flange notch shape

Option	Description
	Creates chamfers in the flange. If you do not enter a horizontal dimension, a chamfer of 45 degrees is created.
	Creates cuts to the flange with the default values unless you enter values for the horizontal <b>1</b> and vertical <b>2</b> dimensions, see the image of cut dimensions above.
	The flange is not cut.
	Creates cuts to the flange according to the horizontal dimension <b>1</b> to make it flush with the web, see the image of cut dimensions above.
	Creates cuts to the flange according to the horizontal <b>1</b> and vertical <b>2</b> dimensions, see the image of cut dimensions above.

### Flange notch depth

Option	Description
	Defines the flange notch depth.
	Defines the flange notch depth with a dimension from the secondary beam web center line to the edge of the notch.

### Dimension from web to flange cut



1. Distance between the web and the flange cut

## 1.5 BCSA notch

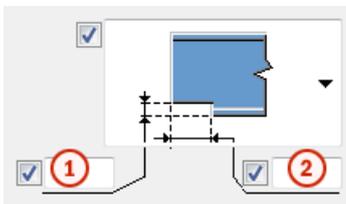
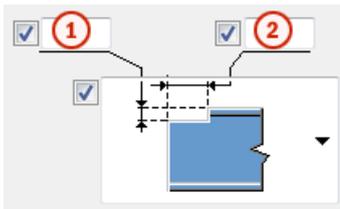
### Notch shape for the top and the bottom of the secondary beam

You can select from the **BCSA notch def** list whether the notch is created according to British Constructional Steelwork Association (BCSA) specifications.

Option	Description
Default	Define the notch dimensions.
Yes	Creates a 50 mm notch for simple beam-to-beam connections.
No	The component uses the options on the <b>Notch</b> tab to define the notch dimensions.

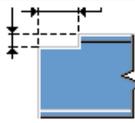
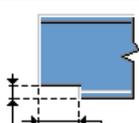
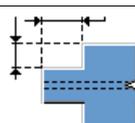
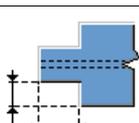
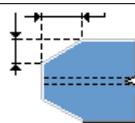
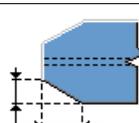
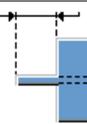
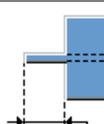
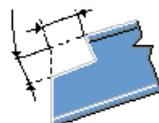
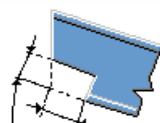
### Notch dimensions

Define the top and the bottom dimensions of the notch if you have set the **BCSA notch def** option to **No**.



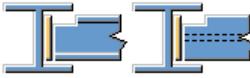
1. Vertical notch dimension
2. Horizontal notch dimension

### Notch shape

Option	Option	Description
		Notch is not created.
		Creates a square notch on the top side or on the bottom side of the secondary beam.  You can define the notch dimensions. In beam-to-beam connections with a sloped secondary beam, the depth is measured as shown in the image.
		Creates a notch on both sides of the secondary beam.  You can define the notch dimensions.
		Creates a chamfered notch on both sides of the secondary beam.  You can define the chamfer dimensions.
		Creates a strip.  You can define the length of the strip. The flanges are cut completely.
		Creates a special type of square notch.  You can define the notch dimensions. The notch is square to the secondary beam. There are no default values for the length or the depth.

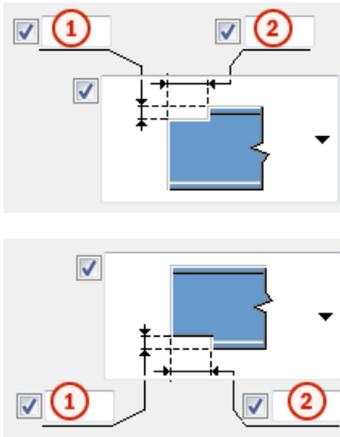
### Notching side

Option	Description
	Creates notches on both sides.
	Creates a notch on the left side.

Option	Description
	Creates a notch on the right side.

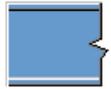
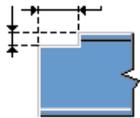
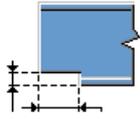
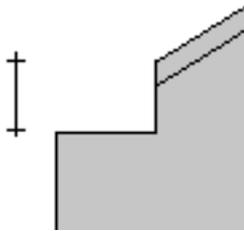
### Notch dimensions

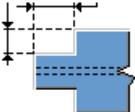
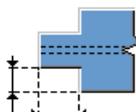
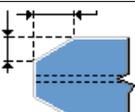
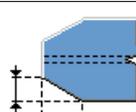
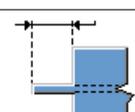
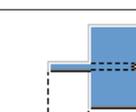
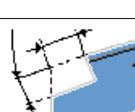
Define the top and the bottom dimensions of the notch if you have set the **BCSA notch def** option to **No**.



1. Vertical notch dimension
2. Horizontal notch dimension

### Notch shape

Option	Option	Description
		Notch is not created.
		<p>Creates a square notch on the top side or on the bottom side of the secondary beam.</p> <p>You can define the notch dimensions. In beam-to-beam connections with a sloped secondary beam, the depth is measured as shown in the image.</p> 

Option	Option	Description
		Creates a notch on both sides of the secondary beam. You can define the notch dimensions.
		Creates a chamfered notch on both sides of the secondary beam. You can define the chamfer dimensions.
		Creates a strip. You can define the length of the strip. The flanges are cut completely.
		Creates a special type of square notch. You can define the notch dimensions. The notch is square to the secondary beam. There are no default values for the length or the depth.

#### Notching side

Option	Description
	Creates notches on both sides.
	Creates a notch on the left side.
	Creates a notch on the right side.

## 1.6 Bolts

#### Bolt basic properties

Option	Description	Default
<b>Bolt size</b>	Define the bolt diameter.	The available sizes are defined in the <b>Bolt Assembly Catalog</b> .
<b>Bolt standard</b>	Select the bolt standard from the <b>Bolt Assembly Catalog</b> .	
<b>Tolerance</b>	Define the gap between the bolt and the hole.	

Option	Description	Default
<b>Thread in mat</b>	Define the thread within the bolted parts when bolts are used with a shaft.  This has no effect when full-threaded bolts are used.	Yes
<b>Site/Workshop</b>	Define the location where the bolts should be attached.	Site

### Slotted holes

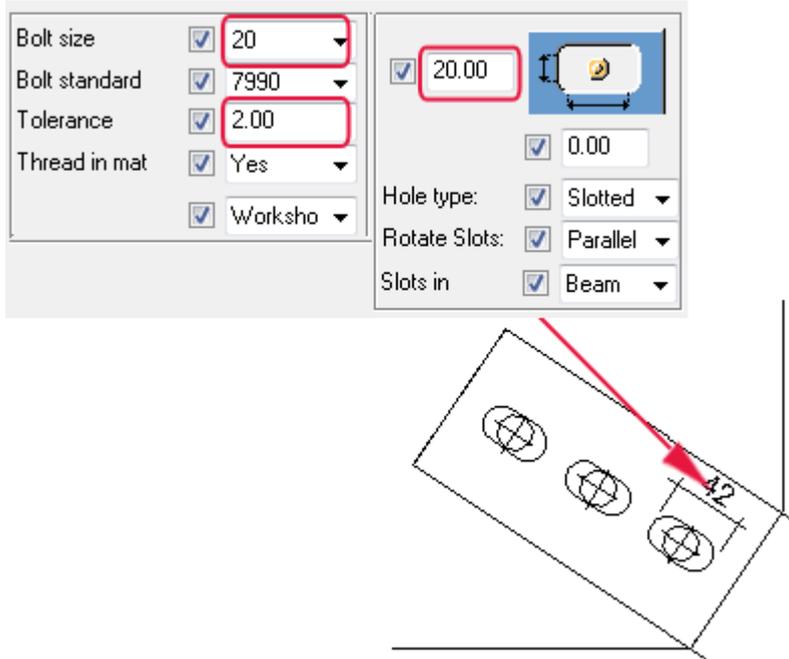
Holes can be slotted, oversized, or tapped.



1. Vertical dimension  
The default value 0 creates a round hole.
2. Horizontal dimension, or the allowance for oversized holes.  
The default value 0 creates a round hole.

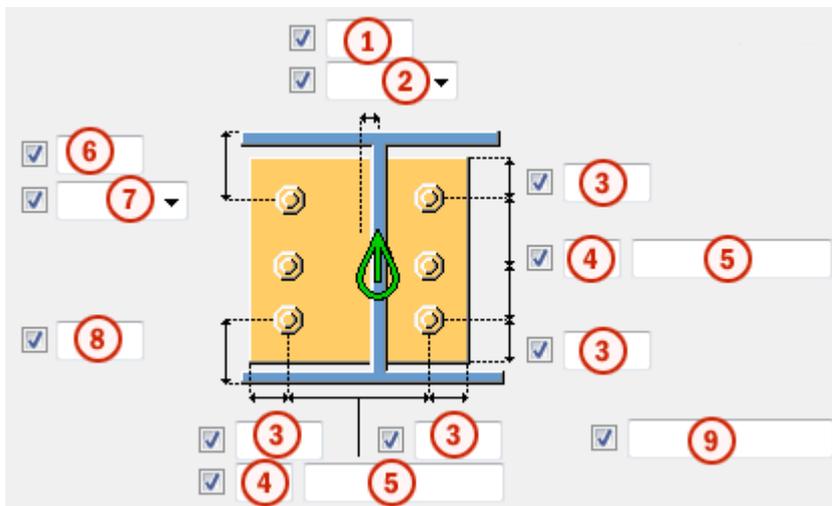
Option	Description
<b>Hole type</b>	<b>Slotted</b> creates slotted holes. <b>Oversized</b> creates oversized or tapped holes.
<b>Rotate Slots</b>	When the hole type is <b>Slotted</b> , this option rotates the slotted holes.
<b>Slots in</b>	Part(s) in which slotted holes are created. <b>No</b> creates round holes.

The image below shows an example of slotted hole length:

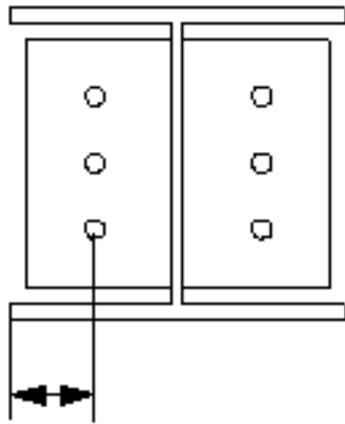


### Bolt group dimensions

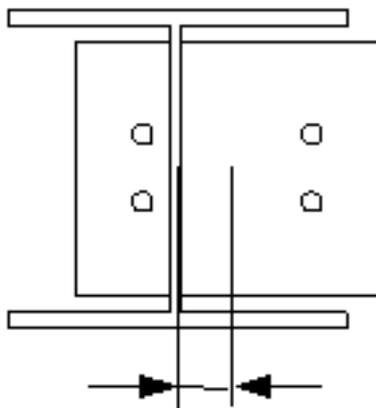
You can define the bolt group dimensions to control the size and position of the end plate. You can also delete bolts from the bolt group. The example image below shows the bolt group dimensions of the **End plate (144)** connection.



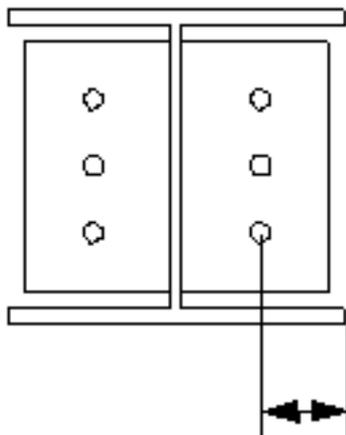
1. Dimension for the horizontal bolt group position
2. Select how the dimensions for the horizontal bolt group position are measured:
  - **Left:** From the left edge of the secondary part to the leftmost bolt.



- **Middle:** From the center line of the secondary part to center line of the bolts.



- **Right:** From the right edge of the secondary part to the rightmost bolt.



3. Bolt edge distance

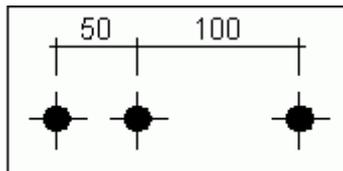
Edge distance is the distance from the center of a bolt to the edge of the part.

4. Number of bolts

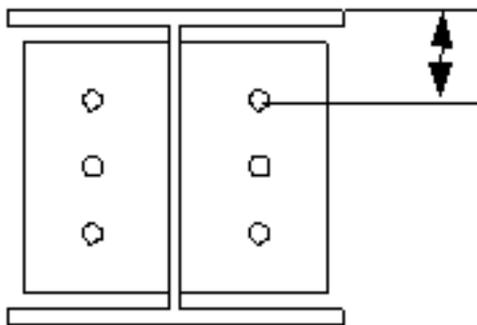
5. Bolt spacing

Use a space to separate bolt spacing values. Enter a value for each space between bolts.  
 For example, if there are 3 bolts **1**, enter 2 values **2**.

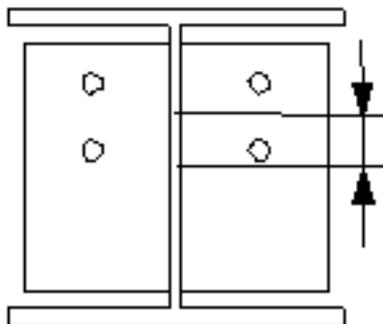
The image below shows the bolt group layout:



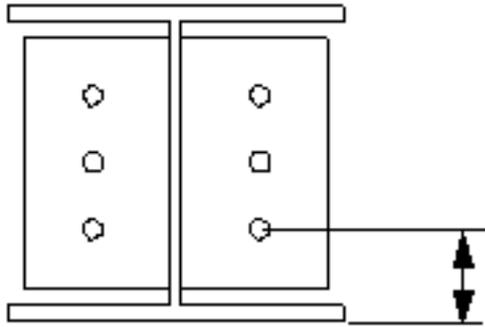
6. Dimension for the vertical bolt group position
7. Select how the dimensions for vertical bolt group position are measured:
  - **Top:** From the upper edge of the secondary part to the uppermost bolt



- **Middle:** From the center line of the bolts to the center line of the secondary part



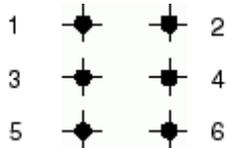
- **Below:** From the lower edge of the secondary part to the lowest bolt



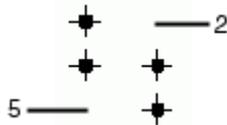
8. Distance from the bottom of the beam to the lowest bolt
9. Bolts to delete from the bolt group

Enter the bolt numbers of the bolts to be deleted and separate the numbers with a space. Bolt numbers run from left to right and from top to down.

For example, when you delete bolts 2 and 5 from the bolt group shown in the image:



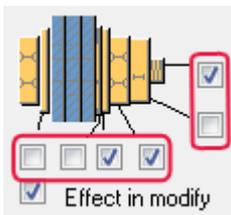
The modified bolt group is:



### Bolt assembly

The selected check boxes define which component objects (bolt, washers, and nuts) are used in the bolt assembly.

If you only want to create a hole, clear all the check boxes.



To modify the bolt assembly in an existing component, select the **Effect in modify** check box and click **Modify**.

### Bolt length increase

You can increase the bolt length. Use this option when, for example, painting requires the bolt length to be increased. Tekla Structures uses the value in bolt length calculation.



### Staggering of bolts

You can use different bolt group patterns.

Option

### Staggering of bolts on clip angles

Option	
	<p>Bolts are not staggered.</p> <p>The bolts that connect the clip angle to the secondary part are on the same horizontal level as the bolts that connect the clip angle to the main part.</p>
	<p>Bolts on the main part are staggered.</p> <p>The bolts that connect the clip angle to the main part are moved downwards by half the bolt vertical spacing value.</p>
	<p>Bolts on the secondary part are staggered.</p> <p>The bolts that connect the clip angle to the secondary part are moved downwards by half the bolt vertical spacing value.</p>
	<p>Bolts on the secondary part are staggered.</p> <p>The bolts that connect the clip angle to the sloped secondary part are parallel to the secondary part.</p>

### Bolt group orientation

Option	Description
	Bolts are staggered in the direction of the secondary part.
	Square bolt group is positioned horizontally.
	Square bolt group is sloped in the direction of the secondary part.

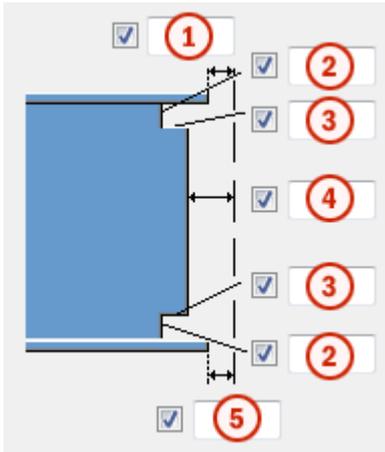
## 1.7 Beam cut

### Weld backing bar

Part	Description
<b>Weld backing bar</b>	Define the weld backing bar thickness and width.

Option	Description	Default
<b>Pos_No</b>	Define a prefix and a start number for the part position number.  Some components have a second row of boxes where you can enter the assembly position number.	The default part start number is defined on the <b>Tools --&gt; Options --&gt; Options... --&gt; Components</b> tab.
<b>Material</b>	Define the material grade.	The default material is defined on the <b>Tools --&gt; Options --&gt; Options... --&gt; Components</b> tab, in the <b>Part material</b> box.
<b>Name</b>	Define a name that is shown in drawings and reports.	

### Weld access hole dimensions



1. Gap between the secondary part top flange and the main part
2. Vertical dimensions for the top and the bottom weld access holes
3. Horizontal dimensions for the top and the bottom weld access holes
4. Gap between the secondary part web and the main part

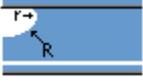
Tekla Structures adds the value you enter here to the gap you enter on the **Picture** tab of the component.

5. Gap between the secondary part bottom flange and the main part

Tekla Structures adds the value you enter here to the gap you enter on the **Picture** tab of the component.

#### Weld access holes

Option	Description
	Creates a round weld access hole.
	Creates a square weld access hole.
	Creates a diagonal weld access hole.
	Creates a round weld access hole with a radius that you can define in <input type="checkbox"/> <input type="text"/> .

Option	Description
	<p>Creates an extended cone-shaped weld access hole with a radius and dimensions that you can define in <input checked="" type="checkbox"/> <input type="text"/> and</p> <p>Top Prep  <input checked="" type="checkbox"/> <input type="text"/></p> <p>Bottom Prep  <input checked="" type="checkbox"/> <input type="text"/></p>
	<p>Creates a cone-shaped weld access hole with radiuses that you can define in <input checked="" type="checkbox"/> <input type="text"/> and <input checked="" type="checkbox"/> <input type="text"/>.</p> <p>Capital R defines the large radius (height). The default is <math>R = 35</math>.  Small r defines the small radius. The default is <math>r = 10</math>.</p>

### Beam end preparation

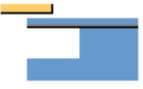
Option	Description
	Beam end is not prepared.
	Creates preparation to the top and the bottom flange.
	Creates preparation to the top flange.
	Creates preparation to the bottom flange.

### Flange cut

Option	Description
	Flange is not cut.
	Cuts the flange.

### Weld backing bars

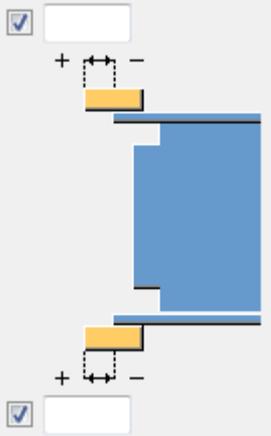
Option	Option	Description
		Backing bars are not created.

Option	Option	Description
		Creates backing bars inside the flanges.
		Creates backing bars outside the flanges.

### Weld backing bar length

Option	Description
	Absolute length of the backing bar
	Extension beyond the edge of the flange

### Weld backing bar position

Option	Description
	Positive or negative value to move the front end of the backing bar relative to the end of the flange

### Assembly type

**Assembly type** defines the location where the weld backing bar welds are made. The **Workshop** option includes the backing bars in the assembly.

## 1.8 Doubler plate

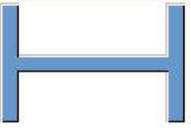
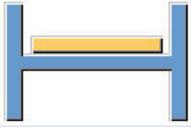
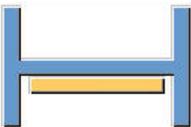
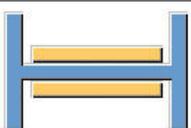
Doubler plates are used to strengthen the web of the main part. Tekla Structures does not create them by default.

### Web plate

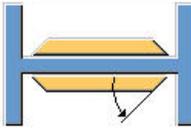
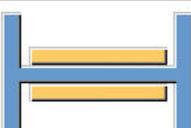
Part	Description
Web plate	Define the web plate thickness and height.

Option	Description	Default
Pos_No	Define a prefix and a start number for the part position number.	The default part start number is defined on the <b>Tools --&gt; Options --&gt; Options... --&gt; Components</b> tab.
Material	Define the material grade.	The default material is defined on the <b>Tools --&gt; Options --&gt; Options... --&gt; Components</b> tab, in the <b>Part material</b> box.
Name	Define a name that is shown in drawings and reports.	

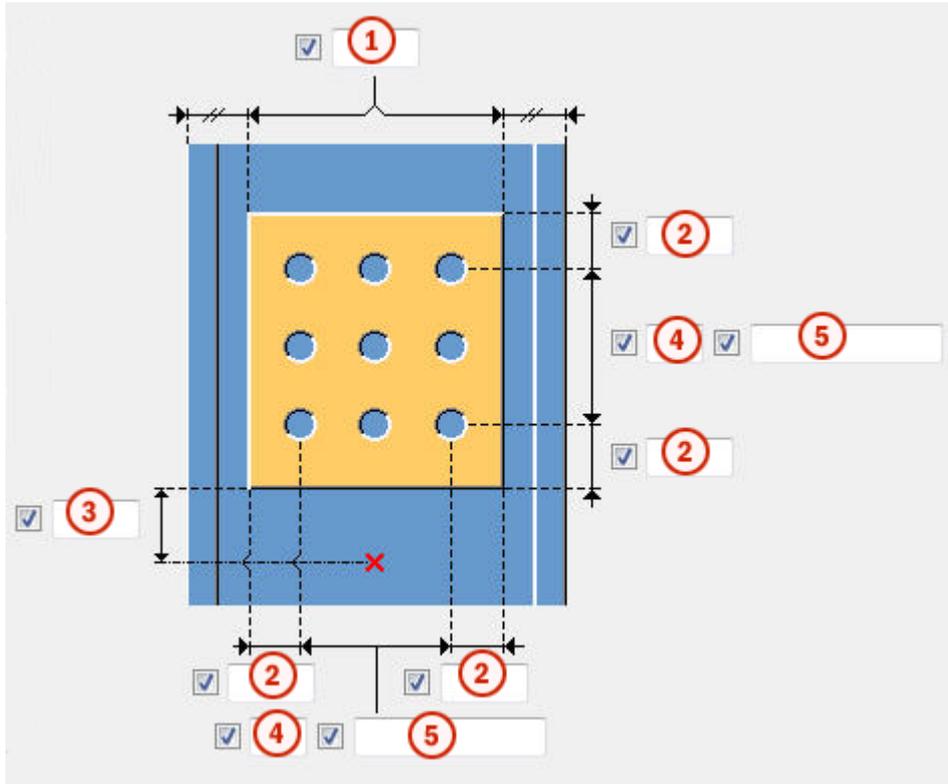
### Doubler plates

Option	Description
	Doubler plates are not created.
	Creates a doubler plate on the far side.
	Creates a doubler plate on the near side.
	Creates doubler plates on both sides.

### Doubler plate edge shape

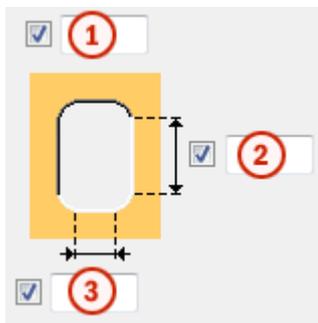
Option	Description
	Creates bevel doubler plates using the angle defined in <input checked="" type="checkbox"/> <input type="text"/> (0 - 90)
	Creates square doubler plates.

## Dimensions



1. Edge distance from the column flange
2. Doubler plate edge distance  
Edge distance is the distance from the center of a hole to the edge of the part.
3. Edge distance of the doubler plate in relation to the bottom of the secondary part
4. Number of holes
5. Hole spacing  
Use a space to separate hole spacing values. Enter a value for each space between holes.  
For example, if there are 3 holes, enter 2 values.

## Weld hole size



1. Hole diameter

2. Slot length
3. Slot width

## 1.9 Angle box

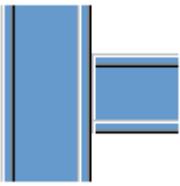
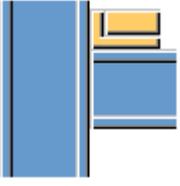
### Seat angle

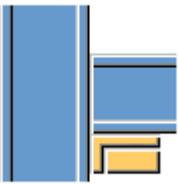
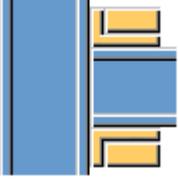
The purpose of seat angles is to carry loads from the secondary part. Seat angles can be positioned to top, bottom or both flanges of the secondary part. The seat angle can be stiffened, and bolted or welded to the main and secondary parts. The **Angle profile box (170)** connection and **Angle profile box (1040)** detail create seat angles by default.

Part	Description
<b>Stiffeners</b>	Define the stiffener thickness, width and height.
<b>Profile</b>	Define the seat angle profile by selecting it from the <b>Profile Catalog</b> .

Option	Description	Default
<b>Pos_No</b>	Define a prefix and a start number for the part position number.	The default part start number is defined on the <b>Tools --&gt; Options --&gt; Options... --&gt; Components</b> tab.
<b>Material</b>	Define the material grade.	The default material is defined on the <b>Tools --&gt; Options --&gt; Options... --&gt; Components</b> tab, in the <b>Part material</b> box.
<b>Name</b>	Define a name that is shown in drawings and reports.	

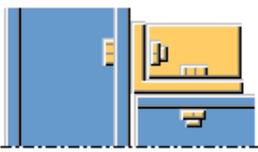
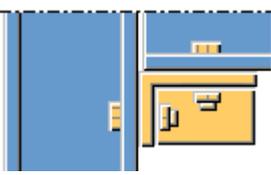
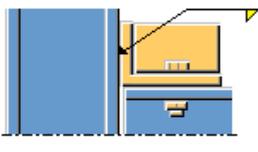
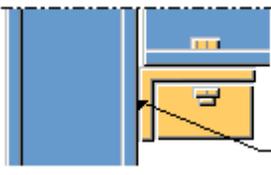
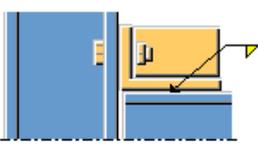
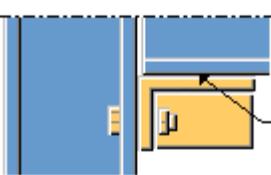
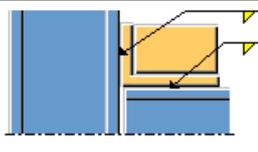
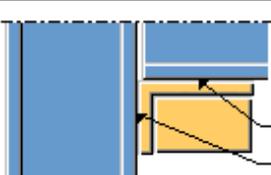
### Seat angle position

Option	Description
	Seat angle is not created.
	Creates a seat angle at the top of the flange.

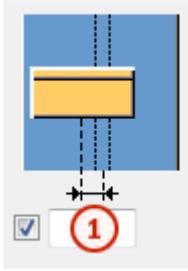
Option	Description
	Creates a seat angle at the bottom of the flange.
	Creates seat angles on both sides of the flange.

### Seat angle attachment

Seat angle is positioned at the top or at the bottom of the secondary part.

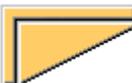
Option	Option	Description
		Seat angle is bolted to the main part and to the secondary part.
		Seat angle is welded to the main part and bolted to the secondary part.
		Seat angle is bolted to the main part and welded to the secondary part.
		Seat angle is welded to the main part and to the secondary part.

### Seat angle offset



1. Horizontal offset from the center line of the main part

### Stiffener type

Option	Description
	Creates a rectangular stiffener plate.
	Creates a triangular stiffener plate.
	The line connecting the ends of the seat angle legs defines the stiffener plate shape.

### Seat angle rotation

Option	Description
	Seat angle is not rotated.
	Rotates the seat angle 90 degrees horizontally. The <b>Middle stiffeners</b> option in the <b>Middle stiffener position</b> list stiffens the rotated seat angle.

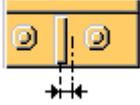
### Seat angle orientation

Option	Description
	Connects the longer leg of the seat angle to the secondary part.
	Connects the longer leg of the seat angle to the main part.

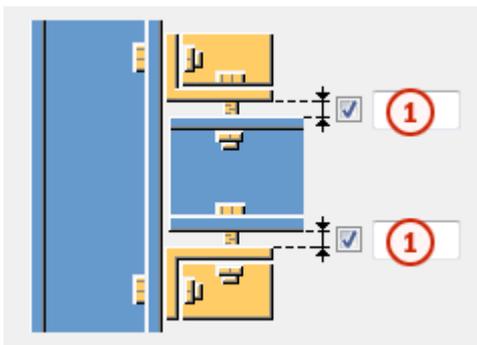
### Side stiffener position

Option	Description
	Side stiffeners are not created.
	Creates side stiffeners on the near side.
	Creates side stiffeners on the far side.
	Creates stiffeners on the near side and the far side.

### Middle stiffener position

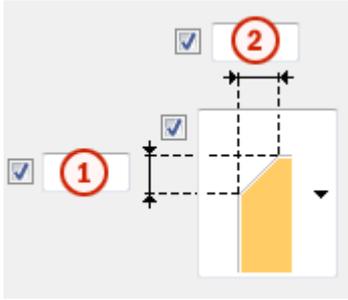
Option	Description
	Middle stiffener plate is not created.
	Creates the stiffener plate in the middle of the seat angle. Enter the number of middle stiffeners in the <b>Number of middle stiffeners</b> box. Multiple stiffeners are centered and equally spaced.
	Creates the stiffener plate between the bolts in the middle of the bolt spacing. By default, stiffener is created between every two bolts. Enter the number of middle stiffeners in the box below the option.

### Gap



1. Top gap and bottom gap between the seat angle and the secondary part

### Chamfer dimensions



1. Vertical dimension of the chamfer
2. Horizontal dimension of the chamfer

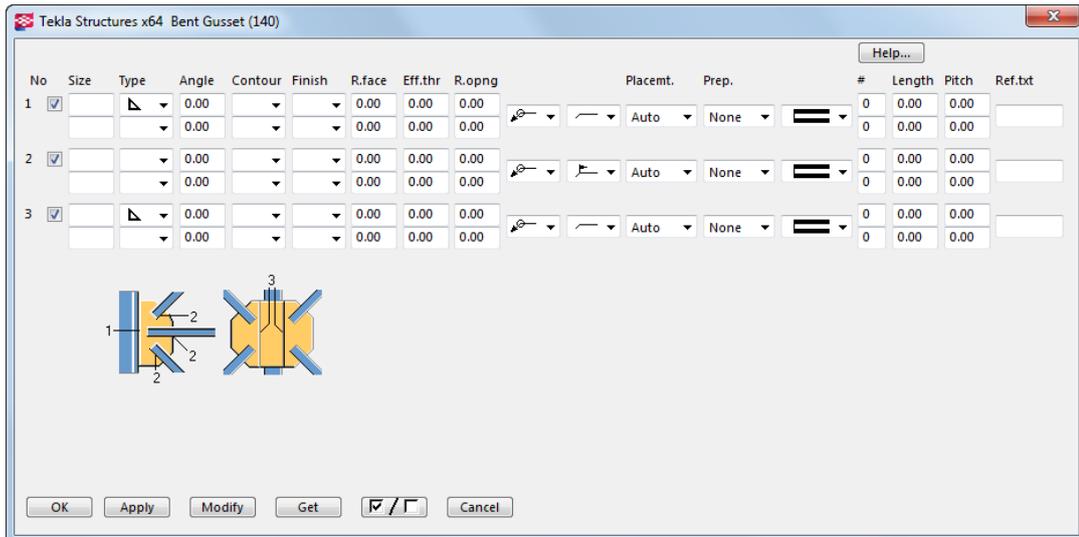
### Chamfer type

Option	Description
	No chamfer
	Line chamfer
	Convex arc chamfer
	Concave arc chamfer

## 1.10 Welds

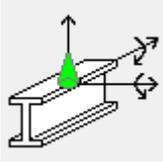
You can define the properties of the welds used in a component. Tekla Structures displays the appropriate weld dialog box when you click the **Welds** button in the component properties dialog box.

The example image shows each weld definition using a number for the **Bent gusset (140)** connection. For each weld definition, use the upper row to define the above-line properties of the weld, and the lower row for the below-line properties.



## 1.11 General tab

The **General** tab is available in steel connections and steel details.

Option	Description
<b>Up direction</b> 	Rotates the connection around the secondary part or the detail around the main part.  You can define the rotation angle around the x- and y-axis of the secondary part. The upper box is for the y-axis and the lower box for the x-axis.
<b>Position in relation to primary part</b>	Available only for details. The check boxes next to the images indicate the position of the definition point of the detail, relative to the main part.  <b>Horizontal offset</b> and <b>Vertical offset</b> define the horizontal and vertical alignment of the detail, relative to the main part.
<b>Locked</b>	Prevents modifications.
<b>Class</b>	A number given to all parts the connection creates. You can use class to define the color of the parts in the model.
<b>Connection code</b>	Identifies the connection. Tekla Structures can display this connection code in connection marks in drawings.
<b>AutoDefaults rule group</b>	Automatically sets connection properties according to the selected rule group. Rule group <b>None</b> switches AutoDefaults off.
<b>AutoConnection rule group</b>	Automatically switches the connection to another according to the selected rule group.

## 1.12 Design and Design type tabs

Some component dialog boxes include a **Design** tab, others include a **Design type** tab. You can use the options on these tabs to check if the component will bear the uniform distributed load (UDL). Some **Design** tabs include only the design check. Tekla Structures saves the design summary as a `.txt` file in the model folder.

You can use AutoDefaults rule groups and Excel files in the design check:

- AutoDefaults rule groups automatically modify component properties to take the calculated load. To define which AutoDefaults rule group to use, go to the **General** tab and select the rule in the **AutoDefaults rule group** list box.

For more information, see [Using reaction forces and UDLs in AutoDefaults and AutoConnection](#).

- The information in an Excel file checks the connection design and automatically updates component properties to bear the UDL. This is useful when you want to check connection design according to other design codes. See [Excel spreadsheets in connection design on page 54](#).

**Design tab** This design check is intended to be used with imperial units.

To check the design:

1. Go to the **Design** tab and select **Yes** in the **Use UDL** list.
2. To use information in an Excel spreadsheet in the UDL calculation, select **Excel** in the **External design** list.
3. Enter the information you want to use in the calculation.
4. Select the connection in the model and click **Modify**.

Tekla Structures checks the component. A green component symbol indicates that the connection will bear the UDL, red indicates that it will not.

5. To view the results of the check, right-click the component symbol and select **Inquire** from the pop-up menu.

The **Inquire Object** dialog box shows the summary of the design check and related information.

See also [Excel spreadsheets in connection design on page 54](#).

**Design type tab** This design check is intended to be used with imperial units.

To check the design:

1. Go to the **Design type** tab and select **Yes** in the **Check connection** list.

Tekla Structures checks the connection each time it is used or changed in the model.

2. Enter the information you want to use in the calculation.

3. Select the connection in the model and click **Modify**.

Tekla Structures checks the component. A green component symbol indicates that the connection will bear the UDL, red indicates that it will not.

4. To view the results of the check, right-click the component symbol and select **Inquire** from the pop-up menu.

The **Inquire Object** dialog box shows the summary of the design check: the part checked, the name of the check, the applied and allowed force and how much capacity has been used, the results and possible solutions.

#### Design tab for check design only

The design is based on the British standard BS5950.

The design has the following limitations:

- Design only works in the UK environment.
- Design is available only if the main part and the secondary parts are perpendicular.
- Design is available only with two bolts horizontally.
- Design is available only when vertical bolts are defined from the top.
- Design is valid for I profiles only.

To check the design:

1. Go to the **Design** tab and select **On** in the **Design** list.
2. Enter the **Tie force** in kilo Newtons (kN).

Tie force is required if the design check is turned on and the framing type of the connection is beam-to-column. If there is no tie force, enter 0.

3. Enter the **Shear force** in kN.

If the design check is turned on, enter a positive value. If there is no shear force, enter 0.

4. Select the connection in the model and click **Modify**.

The connection symbol shows the design check status:

- Green means that the design check was successful.
- Yellow means that a warning occurred in the design check.
- Red means that a fatal error occurred in the design check.

5. To view the results of the check, right-click the connection symbol and select **Inquire** from the pop-up menu.

The **Inquire Object** dialog box shows the summary of the design check and related information.



If the message **Numbering not up to date** is shown in the **Inquire Object** dialog box, the marks will not be correct. You need to renumber the model to ensure that the marks are up-to-date. After that use the **Inquire** command again to get the correct marks to the design check summary.

---

## 1.13 Analysis tab

Use the **Analysis** tab in the connection or detail dialog box to define how Tekla Structures handles connections and details in the analysis.

Use analysis restraints  Yes

Member selection  Primary

Restrain combination

Support condition  Connected

Ux	<input checked="" type="checkbox"/> Free	0.00
Uy	<input checked="" type="checkbox"/> Free	0.00
Uz	<input checked="" type="checkbox"/> Free	0.00
Rx	<input checked="" type="checkbox"/> Pinned	0.00
Ry	<input checked="" type="checkbox"/> Pinned	0.00
Rz	<input checked="" type="checkbox"/> Pinned	0.00

Longitudinal member offset  0.00

Analysis profile

Analysis profile length  0.00

Option	Description
<b>Use analysis restraints</b>	Set to <b>Yes</b> to use the analysis properties of the connection or detail in the analysis instead of the analysis properties of the parts in the connection.  You also need to set <b>Member end release method by connection</b> to <b>Yes</b> in the <b>Analysis Model Properties</b> dialog box when you create the analysis model.  For more information, see Analysis model properties.
<b>Member selection</b>	Use to associate the analysis properties with each connection part ( <b>Primary</b> , <b>1. secondary</b> , <b>2. secondary</b> , and so on).
<b>Restrain combination</b>	For more information, see Defining support conditions.
<b>Support condition</b>	
<b>Longitudinal member offset</b>	For more information, see Analysis part properties.

Option	Description
<b>Analysis profile</b>	Tekla Structures uses this profile in the analysis instead of the one in the physical model to take the stiffness of the connection or detail into account.
<b>Analysis profile length</b>	In the analysis, Tekla Structures overrides the profile of the part in the physical model for this length.

# 2 Joints.def file

The `joints.def` file contains general connection settings and connection-specific settings for different connection types. You can use the `joints.def` file to set the default properties for different connection types. `Joints.def` is a text file that you can open and edit in any standard text editor.

Tekla Structures uses the values defined in the `joints.def` file for the properties that do not have values in the connection dialog boxes. If you manually enter values in the connection dialog boxes, the manually entered values are used instead of the values in the `joints.def` file. AutoDefaults also override the values defined in the `joints.def` file.

By default, Tekla Structures stores the `joints.def` file in the `\system` folder. Tekla Structures searches for the `joints.def` file in the standard search order: model, project, firm, and system folder.

**See also** [Using the joints.def file on page 40](#)

[Example: How Tekla Structures uses the joints.def file on page 42](#)

[General defaults in the joints.def file on page 43](#)

[Bolt diameter and number of bolts in the joints.def file on page 45](#)

[Bolt and part properties in the joints.def file on page 46](#)

## 2.1 Using the joints.def file

The `joints.def` file contains general connection settings and connection-specific settings for different connection types in separate sections. You can modify the `joints.def` file using any standard text editor.

When you modify the file:

- Enter absolute values or names.
- Do not use feet and inch symbols.
- Ensure that the profiles exist in the **Profile Catalog**.
- Ensure that the bolts exist in the **Bolt Catalog**.

- You can set the measurement units at the beginning of the file.
- You can define in the `JOINTDEFAULT` line whether Tekla Structures uses the default values in the `joints.def` file or the system default values, for example, as follows:

```
// is default file available (1) or not (0)
JOINTDEFAULT 1
```

- Value 1 means that the default values defined in the `joints.def` file are used.
- Value 0 means that the system default values are used.
- The `//` characters at the beginning of a line mean that the line is a comment line. Tekla Structures does not use the information on these lines.
- You can force Tekla Structures to use the system default for a particular property by entering the value `-2147483648` for the property.

### Connection-specific properties

The properties for clip angles, shear tabs, end plates, gusset connections and diagonal connections are in separate sections. Each section begins with a header row that contains the column labels, for example as follows:

```
joints.def
// name          part      lproflength  diameter  number_ofBolts
BOLTHEIGHT      GUSSET    100          20.0      2
```

Do not add columns to the file. If Tekla Structures cannot find a property in the connection-specific section, it searches for the default property in the general defaults section.

### Connections that use the joints.def file

The following connections use the `joints.def` file:

- **Welded gusset (10)**
- **Bolted gusset (11)**
- **Bracing cross (19)**
- **Tube gusset (20)**
- **Tube crossing (22)**
- **Two sided angle cleat (25)**
- **Corner tube gusset (56)**
- **Corner bolted gusset (57)**
- **Wraparound gusset (58)**
- **Hollow brace wraparound gusset (59)**
- **Wraparound gusset cross (60)**
- **Wrapped cross (61)**
- **Gusseted cross (62)**
- **Corner wrapped gusset (63)**

- **Beam with stiffener (129)**
- **Column with shear plate (131)**
- **Bolted moment connection (134)**
- **Clip angle (141)**
- **Two sided end plate (142)**
- **Two sided clip angle (143)**
- **End plate (144)**
- **Shear plate simple (146)**
- **Welded to top flange (147)**
- **Welded to top flange S (149)**
- **Moment connection (181)**
- **Column with stiffeners W (182)**
- **Full depth (184)**
- **Full depth S (185)**
- **Column with stiffeners (186)**
- **Column with stiffeners S (187)**
- **Column with stiffeners (188)**
- **Shear plate tube column (189)**
- **Bent plate (190)**

See also [General defaults in the joints.def file on page 43](#)

[Example: How Tekla Structures uses the joints.def file on page 42](#)

[Bolt diameter and number of bolts in the joints.def file on page 45](#)

[Bolt and part properties in the joints.def file on page 46](#)

## 2.2 Example: How Tekla Structures uses the joints.def file

This example explains how Tekla Structures calculates the bolt diameter and other properties of the **Bolted gusset (11)** connection using the `joints.def` file.

The height of the diagonal profile is 10". Tekla Structures calculates the bolt size and the number of bolts according to the profile height. It searches the `BOLTHEIGHT` rows for a profile height of 10".

As the profile height is greater than 8.0 but under 12.0, Tekla Structures uses the row with profile height 8.0. This sets the bolt diameter to 0.75.

```
// DIAGONAL JOINTS
// diagonal default bolt diameters depending on prof height, higher prior than
//
// name          part          profileheight    diameter    number_of_bolts
BOLTHEIGHT     DIAGONAL         3.0             0.75       1
BOLTHEIGHT     DIAGONAL         8.0             0.75       2
BOLTHEIGHT     DIAGONAL        12.0            0.75       3
BOLTHEIGHT     DIAGONAL        16.0            0.75       4
BOLTHEIGHT     DIAGONAL        18.0            0.75       5
```

Tekla Structures uses the bolt diameter to assign the bolt and part properties. It searches the DIAGBOLTPART rows for bolt diameter 0.75.

```
// name          bolt diameter    angle profile    conn.plate thickness    | number    horizontal bolts    edge_dist    | vertical bolts    number    pitch    edge.
DIAGBOLTPART    0.5             L4X3X1/2        0.375          2           1.5        1.0        -2147483648    -2147483648    1.0
DIAGBOLTPART    0.75            L4X4X1/2        0.375          2           2.5        1.5        -2147483648    -2147483648    1.5
DIAGBOLTPART    1.0             L5X5X1/2        0.375          2           3.0        2.0        -2147483648    -2147483648    2.0
```

The following property values are used:

Bolt diameter	0.75
Number of bolts horizontally	2
Edge distance horizontally	1.5
Edge distance vertically	1.5
Distance between bolts horizontally	2.5
Distance between bolts vertically	System default is used.

Tekla Structures does not use the connection plate thickness or angle profile properties in this connection.

## 2.3 General defaults in the joints.def file

Tekla Structures uses the general defaults if it cannot find a connection property in the connection-specific section.

For example, for clip angles, Tekla Structures determines the bolt diameter and the number of bolts according to the secondary beam height. If the secondary beam is higher than the highest value in the clip angle section in the joints.def file, Tekla Structures uses the default bolt diameter in the general defaults.

The properties in the general defaults section in the joints.def file are:

Property	Description
boltdia	Bolt diameter
pitch	Distance from the center of one bolt to the center of the next bolt

Property	Description
clipweld	Weld size
angle-cc-inc	Tekla Structures adds bolt to bolt distance and web thickness, then rounds up the result using this value. Complies with the US AISC standard.
lprofgapinc	Tekla Structures rounds up the angle profile gap using this value. Complies with the US AISC standard.
lsize	Size of the angle profile
copedepth	Notch size
copelength	Notch size
boltedge	Edge distance
webplatelen	Haunch plate height (h)
webplatewid	Haunch plate width (b)
beamedge	Setback distance between the end of the beam and the main part
knifeclr	No longer used
clipedge	Edge distance for bolts (clip angles only)
gap	No longer used
shearplatethk	Shear tab thickness
endplatethk	End plate thickness
shearweld	Size of weld
cliplsize	Size of angle profile (clip angles only)
flangecutclear	Flange cut clearance
slotsize	Size of slotted hole
clipslots	Part with slotted holes: <ul style="list-style-type: none"> <li>• 1 = beam</li> <li>• 2 = angle profiles</li> <li>• 3 = both</li> </ul> This property is the <b>Slots in</b> option on the <b>Bolts</b> tab.
clip_attac	Clip angle attached to the main part and secondary parts: <ul style="list-style-type: none"> <li>• 1 = both parts bolted</li> <li>• 2 = main part bolted/secondary part welded</li> <li>• 3 = main part not welded</li> <li>• 4 = main part welded/secondary part bolted</li> <li>• 5 = both parts welded</li> <li>• 6 = main part not bolted</li> </ul>

Property	Description
	<ul style="list-style-type: none"> <li>• 7 = secondary part not welded</li> <li>• 8 = secondary part not bolted</li> <li>• 9 = both parts bolted/welded</li> </ul> <p>This property is the bolt attachment option on the <b>Bolts</b> tab where the location of bolts is defined.</p>
copedepth_in c	Tekla Structures rounds up notch depth using this value.
copelength_i nc	Tekla Structures rounds up notch length using this value.

See also [Using the joints.def file on page 40](#)

## 2.4 Bolt diameter and number of bolts in the joints.def file

Tekla Structures determines the bolt diameter and the number of bolts according to the connection type based on the following properties:

For	According to
Clip angles	Secondary beam height
Shear tabs	Secondary beam height
End plates	Secondary beam height
Gusset connections	Angle profile length
Diagonal connections	Profile height

The `BOLTHEIGHT` rows in each connection-specific section of the `joints.def` file show the default bolt diameter and default number of bolt rows for the connection type.

### Clip angle, shear tab, and end plate connections

Tekla Structures calculates the default bolt diameter and the number of bolt rows vertically according to the height of the secondary beam. You can enter the following properties:

Property	Description
name	<code>BOLTHEIGHT</code>
part	<code>ANGLECLIP</code>
sec.beam.height	Maximum height of the secondary beam for a certain number of bolts
diameter	Bolt diameter. The diameter must exist in the <b>Bolt Catalog</b> .
number_of_bolts	Number of bolts vertically

**Gusset connections** Tekla Structures calculates the default bolt diameter and the number of bolt rows horizontally according to the length of the angle profile. You can enter the following properties:

Property	Description
name	BOLTHEIGHT
part	GUSSET
lproflength or angleproflength	Length of the angle profile
diameter	Bolt diameter. The diameter must exist in the <b>Bolt Catalog</b> .
number_of_bolts	Number of bolts horizontally

**Diagonal connections** Tekla Structures calculates the default bolt diameter and number of bolt rows horizontally according to the profile height. You can enter the following properties:

Property	Description
name	BOLTHEIGHT
part	DIAGONAL
conn.pl.height or profileheight	Profile height
diameter	Bolt diameter. The diameter must exist in the <b>Bolt Catalog</b> .
number_of_bolts	Number of bolts horizontally

See also [Bolt and part properties in the joints.def file on page 46](#)

## 2.5 Bolt and part properties in the joints.def file

Once Tekla Structures has used the `joints.def` file to calculate the bolt diameter, it uses the result to assign other properties to bolts and parts, according to the connection type. For example in clip angle connections, the default properties for bolts and parts are in the rows that begin with `ANGLECLBOLTPART` in the `CLIP ANGLE` section of the `joints.def` file.

The table below lists the properties that you can assign for bolts and parts in each connection type.

Property	Description	Clip angle	Shear tab	End plate	Gusset	Diagonal
name	Identifies the connection type.  For example, <code>GUSSETBOLTPART</code> for gusset connections.	*	*	*	*	*

Property	Description	Clip angle	Shear tab	End plate	Gusset	Diagonal
bolt diameter	The bolt diameter must exist in the <b>Bolt Catalog</b> .	*	*	*	*	*
shear plate thickness	Thickness of the shear tab		*			
end plate thickness	Thickness of the end plate			*		
gusset thickness	Thickness of the gusset plate				*	
conn. plate thickness	Thickness of the connection plate					*
angle profile or L profile	The name of the used angle profile must exist in the <b>Profile Catalog</b> . Enter the exact profile, for example: L100*100*10.	*			*	*
number	Number of bolts in each row vertically and horizontally.	*	*	*	*	*
pitch	Distance between the bolts from the center of each bolt for vertical and horizontal bolts	*	*	*	*	*
edge distance	Distance from the center of a bolt to the edge of the part for vertical and horizontal bolts	*	*		*	*
vert. bolt first hole	Position of the first vertical row of bolts	*	*		*	

See also [Bolt diameter and number of bolts in the joints.def file on page 45](#)

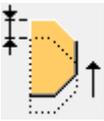
[Gusset connection properties in the joints.def file on page 48](#)

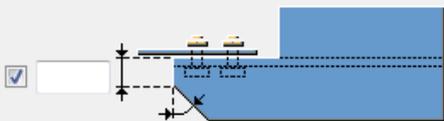
[Diagonal connection properties in the joints.def file on page 50](#)

[Profile dependent bolt dimensions in the joints.def file on page 52](#)

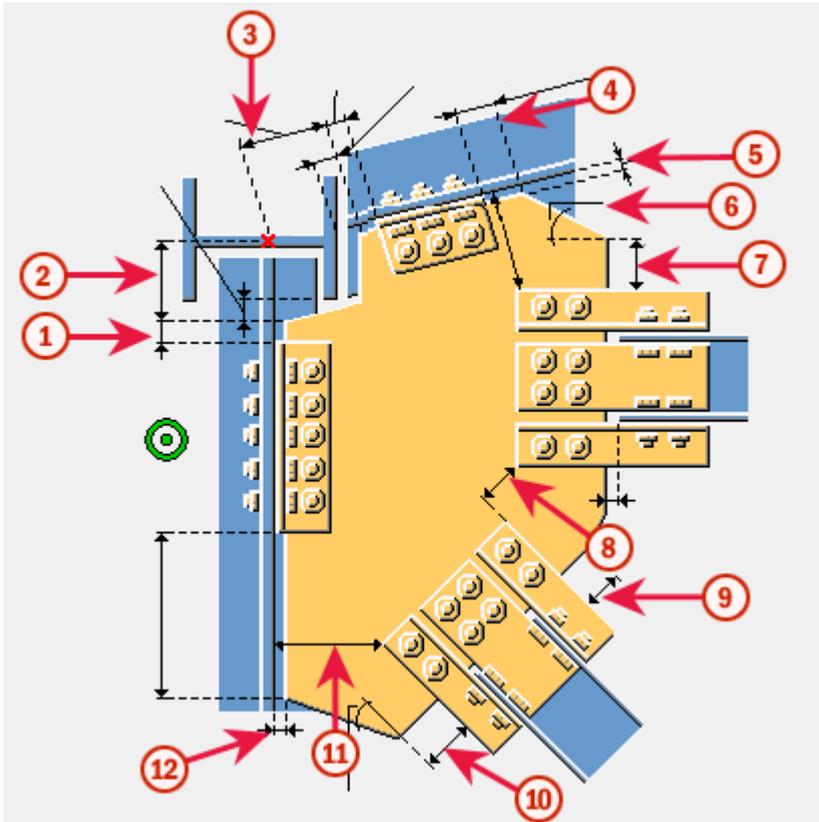
## Gusset connection properties in the joints.def file

Enter the additional default properties for gusset connections in the GUSSETDEFDIM row . All gusset connections do not use all the properties.

Property	Description	Affects plate shape
name	GUSSETDEFDIM	
boltdia_def	Bolt diameter for all bolt groups Tekla Structures uses this value if the <b>Bolt size</b> box is empty in the connection dialog box.	
tol_prim	Tolerance between the gusset and main part web	
tol_sec	Tolerance between the gusset and secondary part web	
dist_diag_prim	Clearance between the first secondary part selected and the main part	
dist_diag_sec	Perpendicular distance from the last secondary part selected to the nearest secondary part	
angle_first_corner	Corner angle dimension	Yes
angle_sec_corner		
dist_between_diag	Clearance between braces	
first_bolt_from_line	Bolt edge distance for the bolt groups on the <b>Gusset</b> tab	
corner_dx	Corner dimension	
corner_dy	Corner dimension	
movey	 option on the <b>Gusset</b> tab	
movez	 option on the <b>Gusset</b> tab	
dist1	Edge length of the gusset plate perpendicular to the lowest brace	Yes

Property	Description	Affects plate shape
dist2	Edge length of the gusset plate perpendicular to the braces	Yes
dist3	Edge length of the gusset plate perpendicular to the uppermost brace	Yes
tol_lprof	Edge tolerance from gusset plate to connection plate	
tol_stiffener	Stiffener tolerance	
chamfer_dx	Stiffener chamfer dimension on the <b>Gusset</b> tab	
chamfer_dy	Stiffener chamfer dimension on the <b>Gusset</b> tab	
chamfer_corner_dx		
chamfer_corner_dy		
side_length	Side length	
diafit_length	<p>Fit length in the <b>Bracing cross (19)</b> connection.</p> <p>Tekla Structures uses this value if the option on the <b>Parameters</b> tab is empty.</p> 	

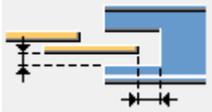
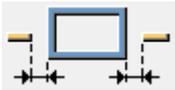
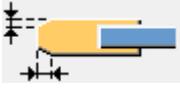
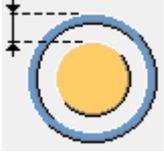
The example image below shows the properties of the **Wraparound gusset (58)** connection on the **Picture** tab.

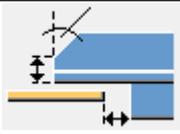


1. tol\_lprof
2. corner\_dy
3. corner\_dx
4. dist\_diag\_sec
5. tol\_sec
6. angle\_sec\_corner
7. dist3
8. dist\_between\_diag
9. dist2
10. dist1
11. dist\_diag\_prim
12. tol\_prim

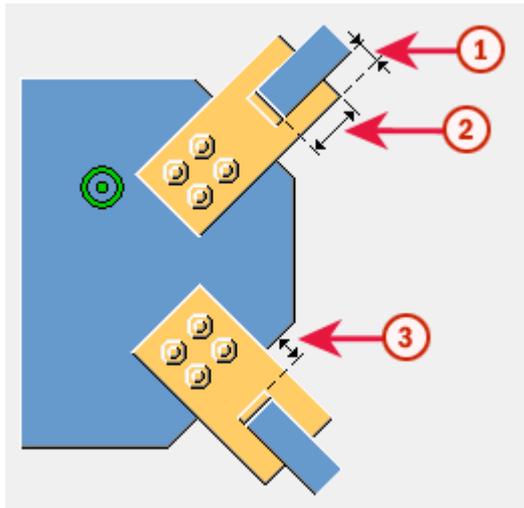
## Diagonal connection properties in the joints.def file

Enter the additional default properties for bolts and parts in the `DIAGDEFDIM` row. All diagonal connections do not use all the properties.

Property	Description
<code>name</code>	<code>DIAGDEFDIM</code>
<code>boltdia_def</code>	Bolt diameter for all bolt groups Tekla Structures uses this value if the <b>Bolt size</b> box is empty in the connection dialog box.
<code>dist_gus_diag</code>	Gap between the gusset plate and the brace If the tube profiles are closed with end plates, <code>dist_gus_diag</code> is the gap between the gusset plate and the end plate. See the <b>Tube crossing (22)</b> image below.
<code>dist_in</code>	Cut depth in the brace. Enter a negative value to prevent the connection plate from being inside the tube brace. See the <b>Tube crossing (22)</b> image below.
<code>dist_dv</code>	Brace edge distance to the edge of the connection plate. This dimension changes the width of the connection plate. See the <b>Tube crossing (22)</b> image below.
<code>sec_cut_tol</code>	On the <b>Brace conn</b> tab:
<code>slot_length_tol</code>	
<code>tube_cut_tol</code>	On the <b>Brace conn</b> tab: 
<code>conn_cut_dx</code>	On the <b>Brace conn</b> tab:
<code>conn_cut_dy</code>	
<code>round_plate_tol</code>	On the <b>Brace conn</b> tab: 
<code>flanges_cut_angle</code>	On the <b>Brace conn</b> tab:

Property	Description
dist_flanges_cut	
dist_skew_cut	
end_plate_thk	End plate thickness

The example image below shows the properties of the **Tube crossing (22)** connection on the **Picture** tab:

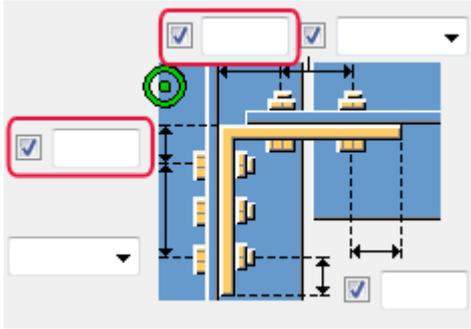


1. dist\_dv
2. dist\_in
3. dist\_gus\_diag

### Profile dependent bolt dimensions in the joints.def file

For some connections, such as **Clip angle (141)** and **Two sided clip angle (143)**, Tekla Structures calculates the bolt size according to the profile size.

For these connections, Tekla Structures takes the bolt size from the PROFILEBOLTDIM rows of the PROFILE TYPE-DEPENDENT BOLT DIMENSIONS section in the joints.def file if you leave the corresponding options empty on the **Bolts** tab.



Property	Description
width	Profile width
one bolt firsthole	For single bolts, distance from the edge of the profile angle to the first hole
two bolts firsthole	For two bolts, distance from the edge of the profile angle to the first hole
pitch	Distance between bolts from the center of each bolt, for vertical and horizontal bolts

For example, to find the bolt dimensions to be used with an L6X6X1/2 profile in a clip angle connection:

1. Tekla Structures first searches the PROFILEBOLTDIM rows for L6X6X1/2 in the PROFILE TYPE-DEPENDENT BOLT DIMENSIONS section.
2. If there is no match, Tekla Structures then searches the ANGLECLBOLTPART rows in the CLIP ANGLE section.

# 3 Excel spreadsheets in connection design

You can use Excel spreadsheets in connection design by linking spreadsheets and steel connections. You can use Excel for all steel connections that have the **Design** or **Design type** tab in the connection dialog box. When you select Excel in the **External design** option and apply or modify the connection, the connection information is transferred to the connection type specific spreadsheet where the needed calculations are made. The calculated properties are saved to an output file and the modified component property values are transferred back to the connection. The connection is modified according to the changes.

You can create an Excel spreadsheet for a connection type using the `component_template.xls` file available in the `..\Tekla Structures \<version>\Environments\Common\exceldesign` folder, or use a predefined file.

- See also** [Files used in Excel spreadsheet connection design on page 54](#)  
[Example of an Excel spreadsheet in connection design on page 55](#)  
[Showing connection status in Excel connection design on page 58](#)

## 3.1 Files used in Excel spreadsheet connection design

The following files are used in connection design with Excel spreadsheets:

File	Description
Visual Basic script file	The <code>Excel.vb</code> file links Tekla Structures with the external software and defines the Excel spreadsheet file names and the locations. The file is located in the <code>..\Tekla Structures \&lt;version&gt;\environments\common\exceldesign</code> folder.  Excel searches for the relevant spreadsheet file in the following order:

File	Description
	<ol style="list-style-type: none"> <li>1. From \exceldesign folder in the current model folder: file named as component_ + number or name + .xls, for example, ..\test_model\exceldesign\component_144.xls.</li> <li>2. From the location defined with the XS_EXTERNAL_EXCEL_DESIGN_PATH advanced option as follows:  XS_EXTERNAL_EXCEL_DESIGN_PATH (=%XS_DIR%\environments\common\exceldesign\) + "component_" + number + ".xls"</li> </ol>
Component type specific Excel spreadsheet	The component type specific spreadsheet contains predefined calculations. When you run the connection design, the connection properties and information of the main and secondary parts are transferred to the <b>Input</b> and <b>Component</b> sheets of the Excel spreadsheet.
Connection specific result file	<p>The result file contains the modified connection properties.</p> <ul style="list-style-type: none"> <li>• The result file is created automatically from the <b>Calculation</b> sheet.</li> <li>• The file is by default stored in the \ExcelDesignResults folder in the model folder and named with the component ID.</li> <li>• The file is updated each time you modify the connection.</li> <li>• The calculation results can be stored as an Excel spreadsheet, or in HTML or PDF format, depending on how the calculation spreadsheet is configured.</li> </ul>
Component catalog file	The ComponentCatalog.txt file in the ..\Tekla Structures\<<version>\Environments\Common\system folder lists the component IDs that are used for file names. Check that you are using the correct ID.
Template spreadsheet	The ..\Tekla Structures\<<version>\Environments\Common\exceldesign folder contains a component_template.xls spreadsheet you should use to create your own spreadsheet applications to use with Tekla Structures components.

### 3.2 Example of an Excel spreadsheet in connection design

The images below show an example of the Excel spreadsheet that is used for the **End plate (144)** connection.

The sample spreadsheet has the following sheets:

The **Calculation** sheet contains a report of the calculations.

	A	B	C	D	E	F	G	H	I	J	K
1											
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52											



### Endplate Unity Check

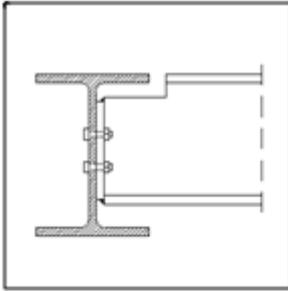
**Contract** Tekla Sample

**Ref:** User

**Date:** 17.03.05 4:52:44 PM

**Calculated according to**  
BS

**Connection Referen** 130



**Framing Condition** Beam - Beam

**Section**

Primary Section	IPE300	S235JR
Secondary Section	IPE300	S235JR
Endplate Size	10 mm	S275JR
Plate (length*width)	200 * 180 mm	

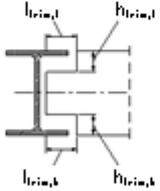
**Bolt**

Bolt	20
Bolt Grade	7990
Shear area	Thread
Screw Thread	Roller
Endplatelength in calculation	

**Parameters of Connection**

$e_{s1}$ = 40 mm	$a_{weld}$ = 6 mm	$e_{bolt}$ = 66 mm
$e_{s2}$ = 40 mm	$s_1$ = 60 mm	$n_{s,prim}$ = 3
$e_2$ = 40 mm	$s_2$ = 67,09999%	$n_{s,prim}$ = 2

**Notch**

$l_{riv,w,t}$ = 82 mm	
$h_{riv,w,t}$ = 26 mm	
$l_{riv,w,b}$ = 82 mm	
$h_{riv,w,b}$ = 26 mm	

**Shear of the endplate**

$F_{s,riv,t}$  = 261 kN [BS 5950-1:2000 6.2.3/6.2.4]

**Bearing of the endplate**

$F_{s,riv,t}$  = 606 kN [BS 5950-1:2000 6.3.3.3]

**Shear of beam near the weld**

$F_{s,riv,t}$  = 200 kN [BS 5950-1:2000 6.8.7.3]

**Shear (& Tension) on the bolts**

$F_{s,riv,t}$  = 230 kN       $F_{s,riv,t}$  = 23 kN      [BS 5950-1:2000 6.3.2/6.3.4.3]

The **Inputs** sheet contains the properties of the connection from the connection dialog box.

	A	B	C	D	E	F
1				<b>Attribute</b>	<b>Value</b>	<b>Type</b>
2		<b>Plate</b>				
3			Material	mat		string
4			Thickness	tpl1	10	double
5			Depth	hpl1	-2147483648	double
6			Width	bpl1	180	double
7						
8		<b>Bolt</b>				
9			Diameter	diameter		double
10			Grade	screwdin		string
11				lbd	-2147483648	string
12				lwd	-2147483648	string
13				lba	-2147483648	double
14				nb	-2147483648	int
15				nw	-2147483648	int
16				rb1	-2147483648	double
17				rb2	-2147483648	double
18				rw1	-2147483648	double
19				rw2	-2147483648	double
20						
21		<b>Weld</b>				
22				w3_size	-2147483648	double
23						
24		<b>Notch</b>				
25				t_cut_length	-2147483648	double
26				t_cope_length	-2147483648	double
27				b_cut_length	-2147483648	double
28				b_cope_depth	-2147483648	double
29						
30		<b>Loading</b>				
31				designcode	0	int
32				<b>END</b>		

The **Outputs** sheet contains the design results. These values are transferred to the connection and the connection in the model is modified accordingly.

The **Component** sheet contains calculations, information on the connection geometry, and on the main part and the secondary parts. The component attributes in the spreadsheet are the same as in the corresponding `.inp` file. See more about `.inp` files in Input files.

	A	B	C	D
1	<b>Connection</b>	<b>Attribute</b>	<b>Value</b>	
2	Connection id in model	id	130	
3	Connection class	group	99	
4		flags	50	
5	Number of the connection	jointnumber	144	
6	Local x-coordinate of Connection up direction	up.x	0	
7	Local y-coordinate of Connection up direction	up.y	0	
8	Local z-coordinate of Connection up direction	up.z	1000	
9	Model Directory	ModelDirectory	C:\TeklaStructuresModels\	
10		END		
11			<b>Primary</b>	<b>Secondaries</b>
12		attribute	value	value 1
13	Primary and secondary ids	id	108	70
14	<b>PartCoordinateSystem</b>	x.x	-9,11626E-13	6000
15	y-coordinate of part origin (first end) point	x.y	8000	-9,13758E-13
16	z-coordinate of part origin (first end) point	x.z	-150	-150
17	x-coordinate of second end point of part	y.x	12000	6000
18	y-coordinate of second end point of part	y.y	8000	8000
19	z-coordinate of second end point of part	y.z	-150	-150
20	x-coordinate of parts up direction point	z.x	-9,11626E-13	6000
21	y-coordinate of parts up direction point	z.y	8000	-9,13758E-13
22	z-coordinate of parts up direction point	z.z	850	850
23	<b>PartExtrema</b>			
24	Minimum x value of primary or secondary part	min.x	-9,11626E-13	5925
25	Minimum y value of primary or secondary part	min.y	7925	-9,13758E-13
26	Minimum z value of primary or secondary part	min.z	-300	-300
27	Maximum x value of extrema	max.x	12000	6075
28	Maximum y value of extrema	max.y	8075	8000
29	Maximum z value of extrema	max.z	0	0
30	<b>FramingCondition</b>			
31	Member type (Column, Beam)	Type	1	1
32	Profile name	Name	COLUMN	BEAM
33	Profile type	ProfileType	1	1
34	Skew angle between primary/sec	SkewAngle		0
35	Slope angle between primary/sec	SlopeAngle		0
36	Cantilever angle between primary/sec	AngleCant		90
37		Offset		0
38	Shear force at connection end of the beam	ShearForce		-2147483648
39	Axial force at connection end of the beam	AxialForce		-2147483648
40	Moment at connection end of the beam	BendingMoment		-2147483648
41	Use uniformly distributed load	UseUDL		0
42	How many percents from maximum uniformly	UDLPercent		0

The following sheets are also included:

- **Data** shows catalog information.
- **Norm** shows the code selection and references to codes.
- **Language** shows translations.

### 3.3 Showing connection status in Excel connection design

When you use Excel in connection design, you can have Tekla Structures use different colors in component symbols to show the status of a component in the model. You can do this by

including an error attribute on the **Outputs** sheet of the component's Excel spreadsheet. The type of the attribute is `int`.

The possible values are:

Value	Color	Status
1	Green	Bolt edge distances are sufficient. The connection passes the connection design check using the UK and US design codes embedded in the system.
2	Yellow	Bolt edge distances are insufficient according to the value defined on the <b>Tools --&gt; Options --&gt; Options... --&gt; Components</b> tab.
3	Red	Tekla Structures cannot calculate the component properties. The possible reasons are: <ul style="list-style-type: none"> <li>• The connection direction is not correct.</li> <li>• The work plane is not correct.</li> <li>• The selected connection is not appropriate for the situation.</li> <li>• The connection design check was carried out using the embedded UK and US design codes and the connection cannot support the loading you have defined.</li> </ul>

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