imos Constraints Technology (ICT)

Parametrizable 2D-Geometries can be applied user-friendly with ICT. For example, parts can be generated from the geometries and applied for stretchable purchased parts. The advantage is that no mathematical formula has to be defined to describe a parameter module. Only simple constraints have to be formulated to meet the requirement. ICT searches independently for a geometrical solution for the constraints.

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However, due to the continuous development of described software, it is not possible to guarantee up to date and accurate information, integrity or quality of the content at all times.
As far as we are able to detect errors or omissions or those, which have been reported to us, our attempt is to correct these with the following versions.
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Content

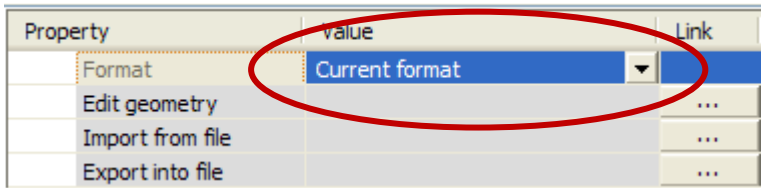
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1. ICT Designer

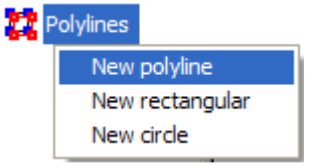
1.1 Draw new cross-section

For this purpose, open the **Element Manager** and change to the **stretchable purchased parts**.
The value for the format must be modified to the **current format** in the properties.

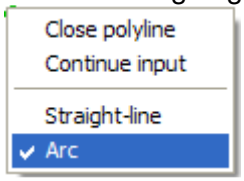


With Edit geometry the ICT Designer appears.
The cross section geometry can be defined by constraints via **ICT Designer**.

By right-clicking on the entry **polylines**, a new cross-section can be drawn and there is a selection to define the section with a polyline or a rectangle.



For defining the starting point, click anywhere in the drawing section on the right side. Afterwards continue to draw the polyline. For defining further corner points, click in the drawing section as appropriate.
If the following segment is an arc and not a line, then call the context menu (right click) and select **arc** there.



To finalize the cross section, call the context menu again and select **close polyline** there.

1.2 Constraints for defining a cross-section

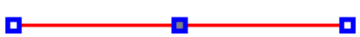
After the polyline or rectangle has been drawn, the position of the lines and points can be defined to one another or also absolutely.
For this purpose click the respective segments or points in the drawing section of the dialog with the context menu (right click).
Depending on which and how many elements have been marked, the available existing options for the definition of the constraints change.
After a constraint has been defined, it appears on the left side below the node constraints.

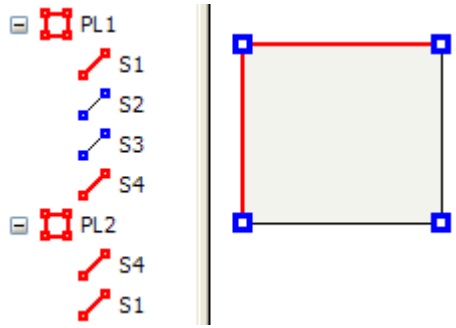
Note:
1. If several elements have to be marked, press the shift button and then click the desired element.
2. Marked elements are displayed red.

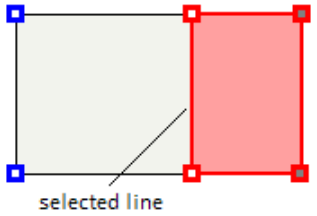
1.2.1 Context menu for a line

If a line has been marked in the drawing section, the following options are available:

Insert midpoint	Defines the center point of the picked segment.
Create new polyline	Creates new cross section with current selection.
New rectangle	Creates a new rectangle with the selected line as a base.
File import aligned segment	An available template (ICT) can be imported and inserted. The alignment takes place on the current selected segment.
Is base segment	Describes the base point of the polyline.
Second base segment	Describes the second base point of the polyline.
Define length of line	The length of the segment can be







Note:
The angle can be defined with the **parameter** (See chapter 1.7 **Formula**). For this purpose the value must start with "=".

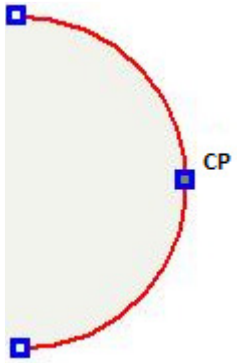
	defined. The length can also be defined with the parameter. (See chapter Formula)
Define the angle of line	The angle can be defined between the starting- and end point.
Turn point sequence	Changes the drawing direction and therefore the alignment of the line.
Delete	Deletes the marked segment.
Attributes	The AutoCAD Dialog **attributes** opens.
Visualization	The dialog **Properties** opens. Find out more in chapter 1.6.1 **Properties of the Visualization**.

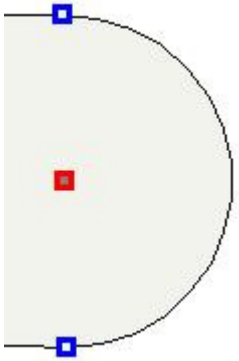
Note:
Only segments, which are not within a polyline and without an allocation to a constraint, can be deleted.

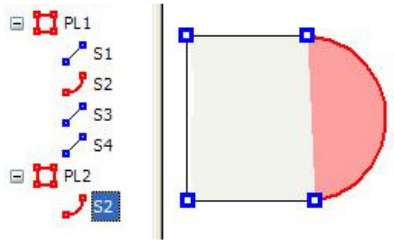
1.2.2 Context menu for arc

If an arc has been marked in the drawing section, the following options are available:

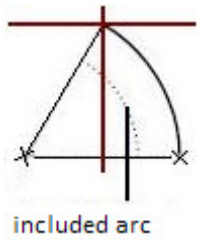
Insert midpoint	Defines the center point of the picked segment.
Insert center point	Creates a new point in the center of the circular arc.
Create new polyline	Creates new cross section with current selection.
Is base segment	Describes the base point of the polyline.
Is second base segment	Describes the second base point of the

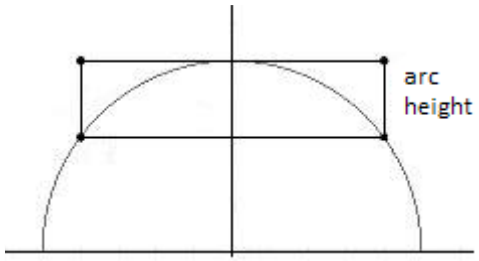






	polyline.
Define radius of the arc	A fixed value for the radius is entered. The arc can be defined with the parameter. (See chapter 1.7 Formula)
Define included angle of arc	A fixed value for the included angle is entered. The angle can be defined with the parameter. (See chapter 1.7 Formula)
Define arc deviation	A fixed value for the angle height is entered. The angle can be defined with the parameter. (See chapter 1.7 Formula)
Turn point sequence	Changes the **drawing direction** and therefore the alignment of the line.

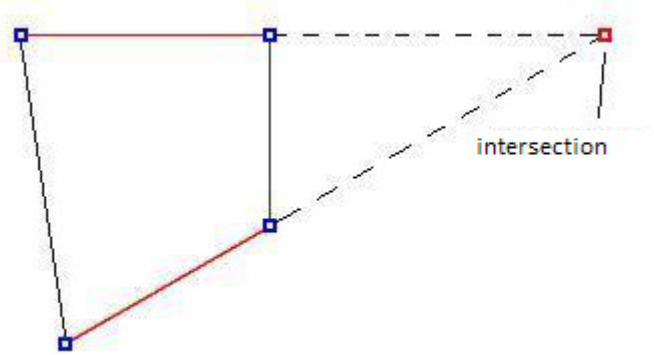
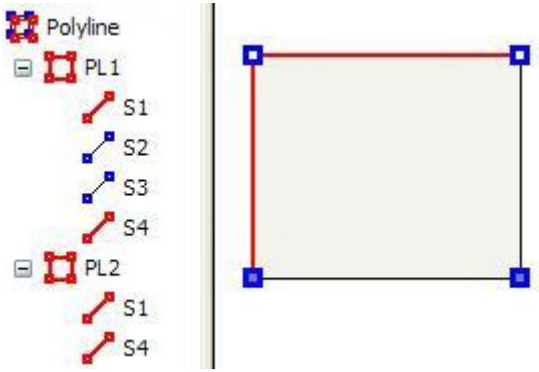




Note:
Parameters can allocate formulas as values. For this purpose the value must start with "=".

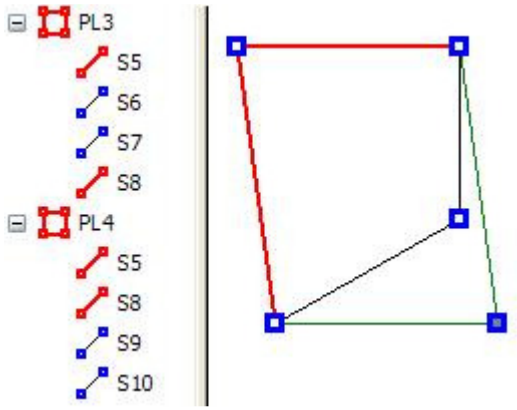
1.2.3 Context menu for 2 lines

If two lines have been marked in the drawing section, the following options are available:

Insert intersection point	A new point is created in the imaginary intersection point of both selected lines.	
Create new polyline	Creates a new polyline with current selection.	

Note:
Several elements can be marked by holding down the shift key during the marking.

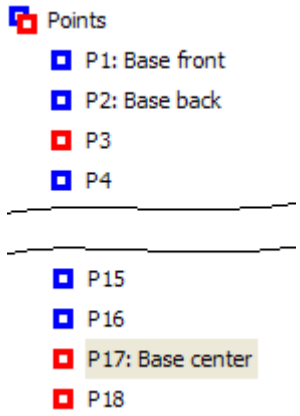
Create new parallelogram	Creates a parallelogram on the basis of both selected lines.
File import align two segments	An available template (ICT) can be imported and inserted. The alignment takes place on the current selected segment.
Define angle between lines	The angle can be defined between both lines. The angle can also be defined with the parameter. (See chapter 1.7 Formula)
Define length relation	The length ratio of both lines can be defined to one another.
Delete	Deletes the marked segments.
Attributes	The dialog **attributes** opens.
Visualization	The dialog **Properties** opens. Find out more in chapter 1.6.1 **Properties/Visualization**.



1.2.4 Context Menu for a point

If a point has been marked in the drawing section, the following options are available:

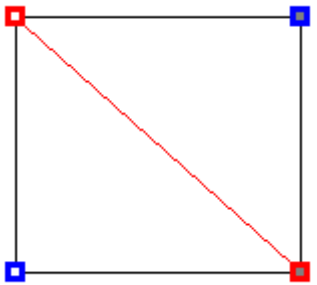
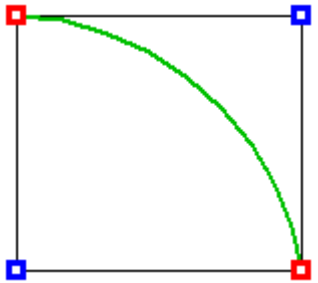
Fixing point	The point is fixed in its absolute position. Thereby the display of the point changes and is deposited grey shaded now.
Release point	Allocation to line is deleted but not the constraint.
Is Base point	Describes the base point of the polyline. (See also section 0)
Is second base point	Describes the second basis point of the polyline. (See also section 1.3)
Label	The name of a point can be defined. After calling the functions, a new dialog opens to enter the name. This name is shown on the left side next to the relevant point after leaving the dialog with OK.



Note:
All points marked with a name can be applied as base points for the construction when using the ICT with the free construction!

1.2.5 Context menu for 2 points

If two points have been marked in the drawing section, the following options are available:

New straight-line by points	A new line is **spanned** between the two marked points.	
New arc by points	A new arc is spanned between the two marked points.	
Insert midpoint	A new point is inserted to bisect the line between both points.	
File import aligned two points	An available template (ICT) can be imported and inserted. The alignment takes place on the current selected points.	

Note:
Several elements can be marked by holding down the shift key during the marking.

Define distance between points	The distance of the two points can be defined to one another. The length can also be defined with the parameter. (See chapter 1.7 Formula)
Define angle of points	The angle between the two points can be defined. The angle can also be defined with the parameter. (See chapter 1.7 Formula)

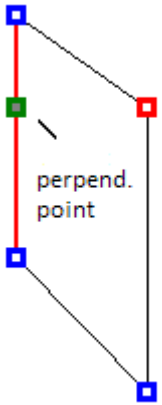
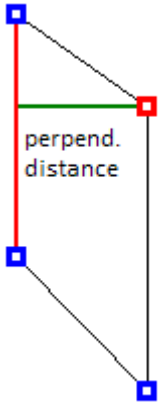
1.2.6 Context menu for 3 or more points

If 3 or more points have been marked in the drawing section, the following options are available:

Fixing points together	Freeze the current connection of the points Can also be defined with a scaling factor.
File import aligned three points	An available template (ICT) can be imported and inserted. The alignment takes place on the current selected points.

1.2.7 Context menu of point and line

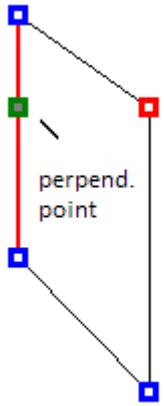
If one point and one line has been marked in the drawing section, the following options are available:

Insert perpendicular point	A new point is defined that is perpendicular to the line. Thereby the distance is variable. The new created point is deposited grey shaded.	
Define perpendicular distance from point to line	A new dialog appears and the distance for the perpendicular point to the line can be defined.	

1.2.8 Context menu of point and arc

If one point and one arc has been marked in the drawing section, the following options are available:

Insert perpendicular point	A new point is defined that is perpendicular to the line. Thereby the distance is variable. The new created point is deposited grey shaded.
Define perpendicular distance from point to arc	A new dialog appears and the distance for the perpendicular point to the arc can be defined.
Tangent angle	The tangent angle can be defined between point and arc.

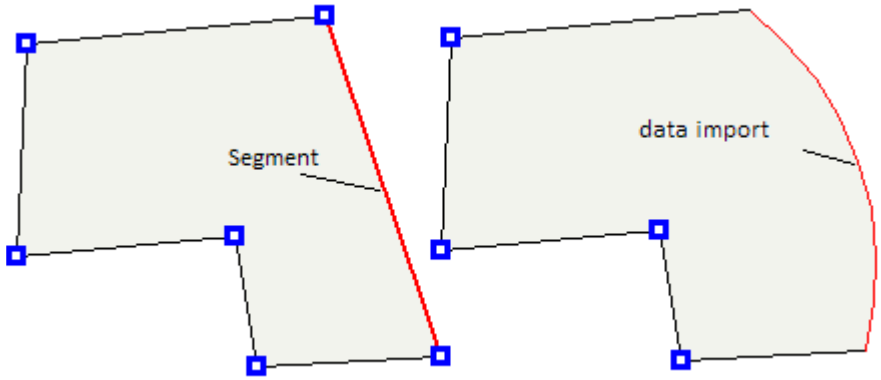


Note:
Several elements can be marked by holding down the shift key during the marking.

1.2.9 Context menu of polyline and segment

If the complete polyline and a single segment have been marked, the following options are available:

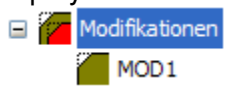
Replace polyline with file import	The selected segment is replaced by the imported segment. After selecting the function, the dialog opens for the selection of an already applied ICT file. The alignment of the imported segments is determined by the base points of the polyline.



Add polyline segments	A further segment is added to the polyline which has the same properties as the selected segment. It also receives the same name in the list of polylines.
Is base point of polyline	Describes the base point of the polyline.

Note:
The complete polyline can be marked by clicking in the middle of the polylines.

Note:
After importing a new segment, it is displayed as modification in the list of polylines.



1.3 Define base point

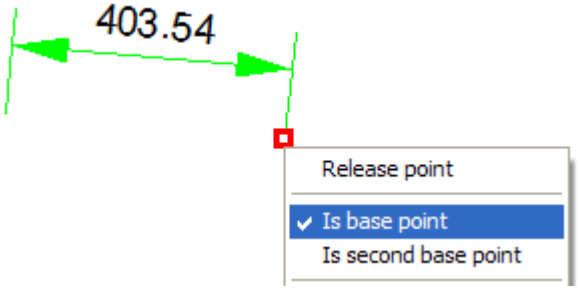
There are two possibilities to define a base point with the ICT Designer. Both are called with the context menu of a point.

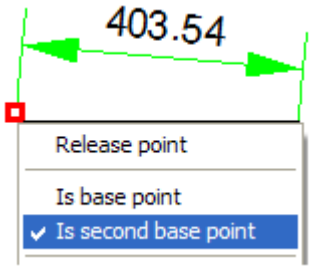
1. Checkmark the **Is base point** and **Is second base point.** (see 1.2.4)
2. A name is given for the point. (see 1.2.4)

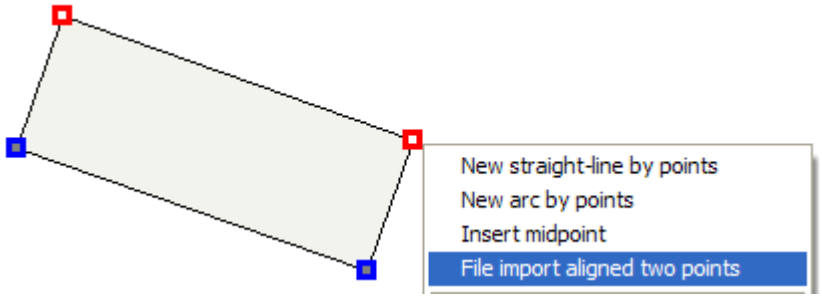
1.3.1 Application of "Is base point and Is second base point"

The base point is applied as insertion point for example for SPPs if no named point is available or has been selected.
The base point is also required for the import functions in the ICT Designer.

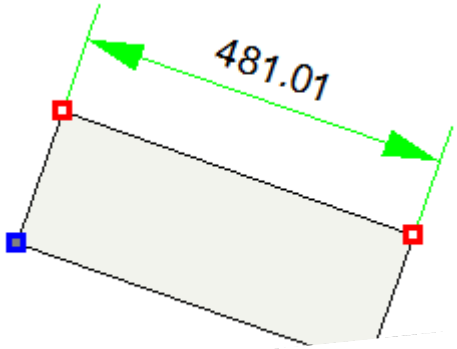
Example 1: Import on two points



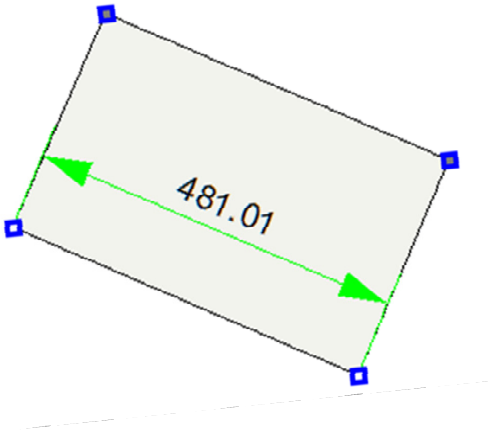




An ICT file is imported in a new ICT with a rectangle.



Both base points from the imported ICT file are anchored on the selected points. By dragging the points of the rectangle, the dimension is dragged at the same time.



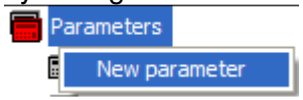
If the definition of both base points took place the other way round, that means the base point would be left and the second base point would be right, then the imported dimension would be inserted the other way round.

1.3.2 Application of named points

Named points are required for the application of ICT elements in the free construction. The **named points** can be selected as base points of the cross section and can simply move the cross sections. (see also 3 **ICT in the free construction**)

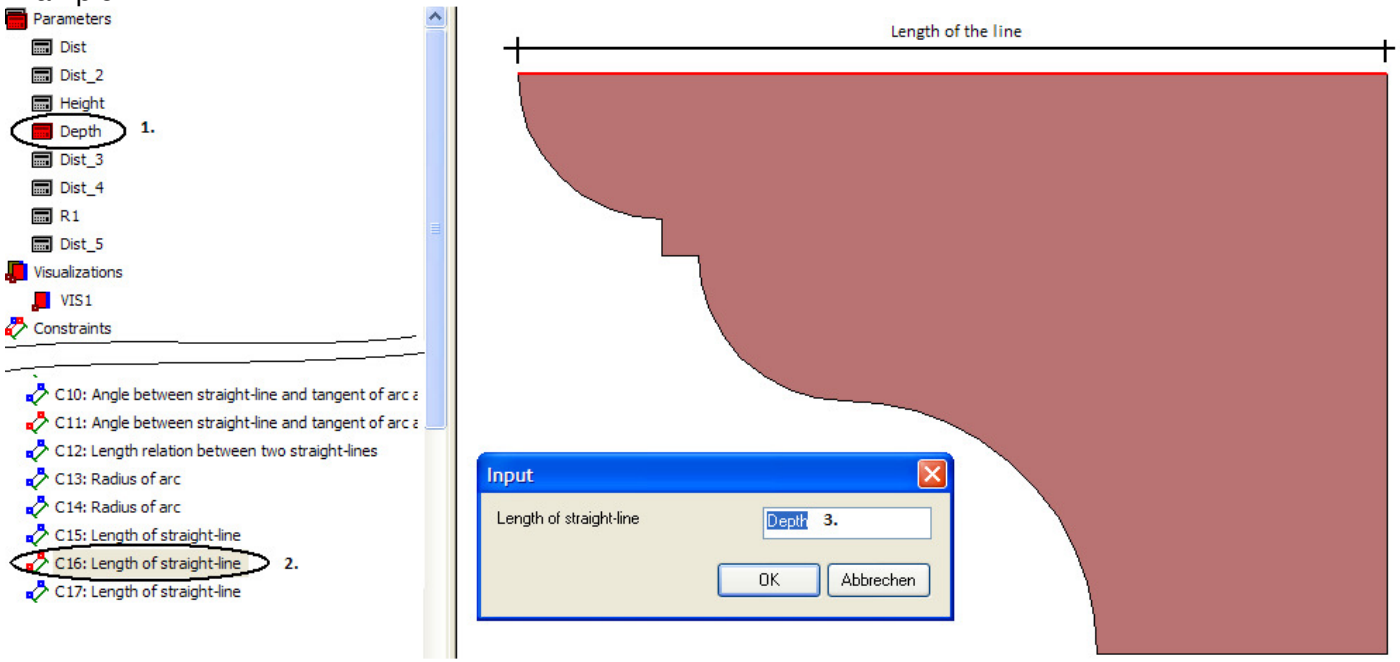
1.4 Parameter

Parameters are similar to variables in imos.
By calling the context menu with a right click, a **new parameter** can be applied.



The **parameter name** and the **parameter value** can be defined.
Afterwards the parameter can be allocated to a **constraint** with the parameter name.

Example:



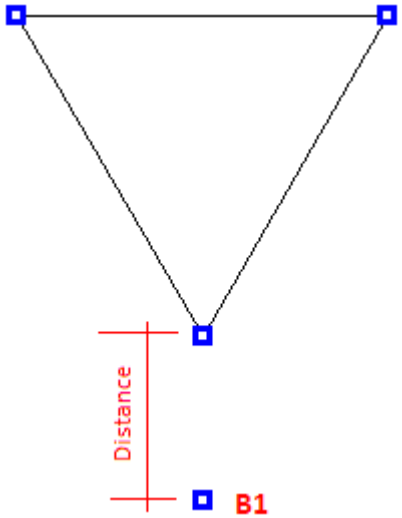
A parameter with the name **depth** (1.) is applied.
Afterwards the value can be changed for the constraint **length of the line** (2.) with the context menu.
Then the parameter **depth** (3.) is entered instead of a numeric value in the appearing input field.

1.5 Visualization of cross sections

The display of a cross section, individual segments or points can be modified with the **visualization** in the left window. Thereby different visualizations can be applied for a cross section.
For applying a new cross section, call the context menu with a right click and select the function **new visualization** there.
By simply clicking in the list, the different displays can be called again later on.

Different visualizations can be applied to display, for example, auxiliary construction objects but which should not be displayed when generating a SPP later.

Example:
The triangle has a defined distance to the base point but this should not be displayed. Whereas the base point (B1) can be hidden in an additional applied visualization.

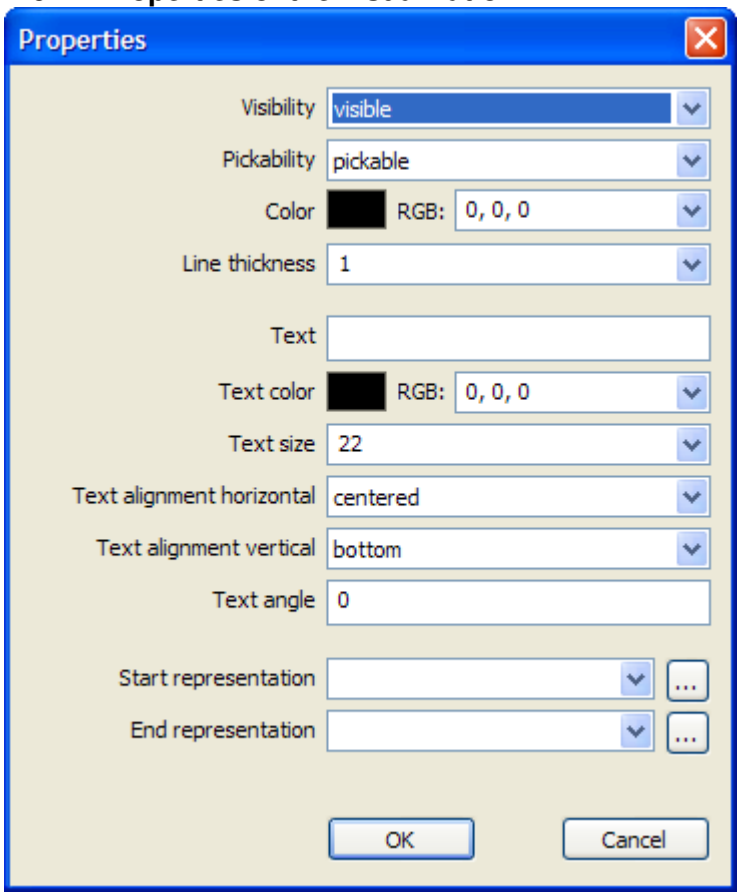


Note:
The visualization for storing the ICT is then applied for generating SPPs

1.6 Visualization for individual elements

The display of individual elements can be modified by marking the elements and by calling the function **visualization** with the context menu.

1.6.1 Properties of the visualization



The dialog **properties** can be called with the function **visualization** in the context menu of the elements. The display can be modified with this dialog.

Visibility	not visible	The element is not displayed in the preview of the cross section
	visible	The element is displayed with the entered parameter below in the preview of the cross section.
Pickability	not pickable	Afterwards the element cannot be selected in the preview anymore.
	pickable	The element can be selected in the preview and therefore further settings can be made.
Color		Defines the color of the element.
	color	Shows the preview of the selected color for the element.
	RGB	The color can be either specified directly with the RGB value or with **select color** a color can be selected from the dialog.
Line thickness		Defines the thickness of the selected line. Cannot be defined for a point.
Text		A text can be entered for displaying on the line or lateral to the point.

Text color		Defines the color of the entered text.
	color	Shows the preview of the selected color for the text.
	RGB	The color can be either specified directly with the RGB value or with **select color** a color can be selected from the dialog.
Text size		Defines the font size of the entered text.
Text alignment	horizontal	It can be defined if the text is displayed in horizontal direction left, right or in the middle of the line or the point. Thereby the alignment of the element depends on the drawing direction of the line or the point!
	vertical	It can be defined if the text is set in vertical direction above, below or in the middle of the line or the point. Thereby the alignment of the element depends on the drawing direction of the line or the point!
Text angle		Defines the angle where the text is displayed relative to the element.
Start point display		Defines the display of the start point of a line or the display of the point.
End point display		Defines the display of the end point of a line or the display of the point. Can only be defined for lines!

1.7 Formulas

The parameters and constraints cannot only process numerical values but also formulas.
In the formula it is possible to add (+), subtract (-), multiply (*), divide (/), exponentiated (^) and negate (-). The usual rules of preferences apply (keyword: “please excuse my dear aunt sally (pemdas)". If you would like to avoid the usual rules of preferences, then brackets (“()") can be applied.
Instead of numerical values user defined parameters can also be applied.

In addition certain functions and certain constants can be applied. These are described in the following sections.

1.7.1 Functions with a point as an argument

n is the number of the point
Syntax: FUNCTION (Pn)
Example: X (P1)

X => X-Coordinate of the point
Y => Y-Coordinate of the point

1.7.2 Functions with two points as arguments

n is the number of the first point, m the number of the second point.
Syntax: FUNCTION (Pn, Pm)
Example: ABS (P1, P2)

ABS => Distance of the points (ABS = Absolute)
ANGLE => Angle between the points (atan2(Y(Pm)-Y(Pn), X(Pm)-X(Pn)))

1.7.3 Functions with a segment as an argument

n is the number of the segment
Syntax: FUNCTION(Sn)
Example: RADIUS(S1)

RADIUS => Radius of a arc
ARCANGLE => Included angle of an arc
CENTX => Center coordinate X of an arc
CENTY => Center coordinate Y of an arc
ANGLE => Angle from the start point to the end point
ABS => Length from the start point to end point (ABS = Absolute)
ARCALT => Arc Altitude of a segment. With a straight line is ARCALT=0
MIDX => X-coordinate of the middle point on the arc. Do not mistake it with the center.
MIDY => Y-coordinate of the middle point on the arc. Do not mistake it with the center.
DX => Difference of X-coordinates of start point and endpoint.
DY => Difference of Y-coordinates of start point and endpoint.

1.7.4 Functions with two segments as arguments

n is the number of the first segment, m the number of the second segment.
Syntax: FUNCTION(Sn, Sm)
Example: ANGLE(S1, S2)

ANGLE => Angle between the segments
SECTX => Section point coordinate X of both segments
SECTY => Section point coordinate Y of both segments

1.7.5 Functions with a point and a segment as arguments

n is the number of the point, m the number of the segment.

Syntax: FUNCTION(Pn, Sm) or also

FUNCTION(Sm, Pn)
Example: ABS(S1, P1)

ABS => Perpendicular distance between point and segment
PROJX => Projection point coordinate X. (Pn on Sm projected)
PROJY => Projection point coordinate Y. (Pn on Sm projected)
TANANG => Tangent angle on projection point.(Pn on Sm projected)

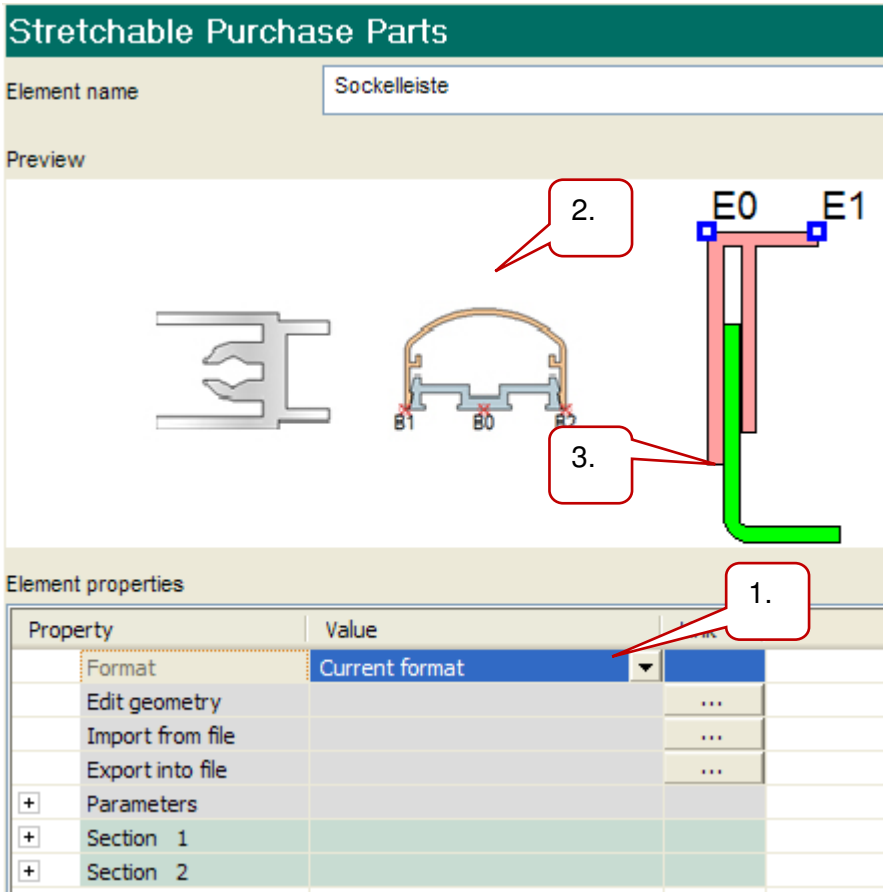
1.7.6 Numeric functions with an argument

Syntax: FUNCTION(ARGUMENT)

2. Stretchable purchased parts with ICT

Now it is possible to select in the stretchable purchased parts (abbr. SPP) if the cross section of a SPP is defined with cross section geometry as before or with ICTs.

This selection can be either selected with the pulldown menu for format (1.) or with the preview above (2.).



The preview on the right side (3) is interactive as well and, for example, different cross sections can be picked and these are also marked in the properties and can be further processed there.

2.1 Properties for cross sections

These properties are only available if the **current format** is selected for the format:

Format	The **current format** must be selected here to define a cross section with the ICT Designer.
Process geometry	With the button….. the ICT Designer opens. A detailed description is in the previous chapter **ICT Designer**.
Import from file	An already applied and saved **ICT** file can be loaded.
Export from file	The defined ICT file here can be exported.
Parameter	The defined parameters of the ICT cross section are listed here.

If **current format** as format has been selected in the stretchable purchased parts and already one or several cross sections have been applied with the ICT Designer, then these are shown in the properties of the stretchable purchased parts. Following parameters can be defined for the cross section:

Geometry

Color principle	An imos color principle can be allocated. Then the SPP is rendered with this color.
Costs [€/m]	Entry for the costs per running meter of the stretchable purchased part. This entry is multiplied with the **calculation factor** and transferred to the bill of materials.
Calculation factor	Multiplier for calculating the costs for the stretchable purchased part. This factor is multiplied with the costs and gives the sale price for the stretchable purchased part. The value 1.1 is for the surcharge of 10%.
Mass length [kg/m]	Entry for the weight of the stretchable purchased part per running meter. The actual weight results from the mass length multiplied with the length.
Wall thickness	The wall thickness is for creating hollow profiles. By activating the function, a wall with the set thickness is created along the inner cross section edge.

Bill of materials information

Order number	The order number of the stretchable purchased part is output in the bill of materials.
Article number	The article number of the stretchable purchased part is output in the bill of materials.

Contour outline

Linear division

With the linear division the extruded SPP can be interrupted. For example, a division of 1:50mm: 1 interrupts the stretchable purchased part by 50mm exactly in the middle. The stretchable purchased part is shortened at the start and end by 20mm each with the division 20mm:1:20mm.

Connector

Add

By clicking once on the button  next to the entry, the level of the **connection situations** appears.

Workings

Groove generation

By clicking once on the button next to the entry, the level of the groove generation appears. In the dropdown box are the last applied principles.

Drilling holes

The number next to the entry indicates how many drilling holes have already been allocated. By clicking once on the button next to the entry, the drilling hole editor opens.

Lineboring

The number next to the entry indicates how many lineborings have already been allocated. By clicking once on the button next to the entry, the lineboring editor opens.

Groove

The number next to the entry indicates how many grooves have already been allocated. By clicking once on the button next to the entry, the groove editor opens.

Workgroups

The number next to the entry indicates how many workgroups have already been allocated. By clicking once on the button next to the entry, the workgroup editor opens.

Rectangular pocket

The number next to the entry indicates how many rectangular pockets have already been allocated. By clicking once on the button next to the entry, the rectangular pocket editor opens.

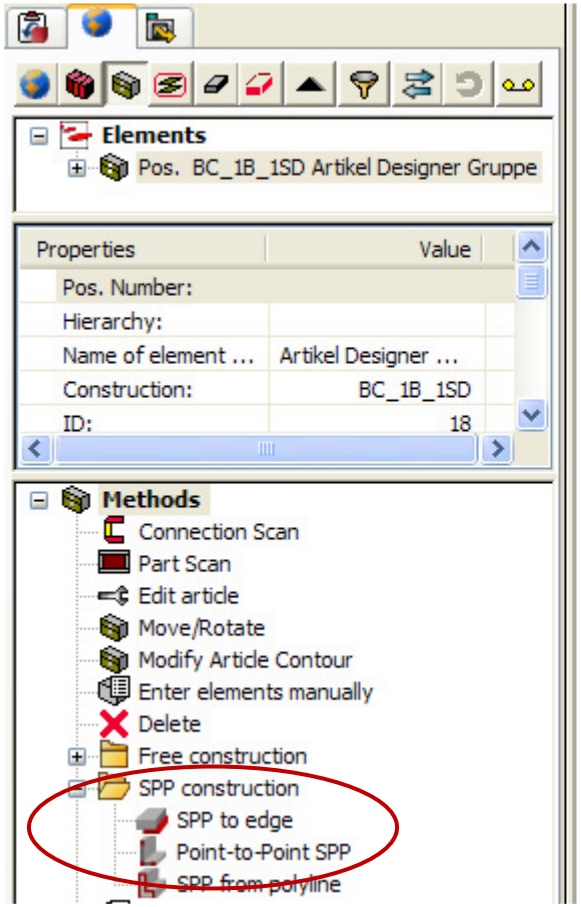
Circular pocket	The number next to the entry indicates how many circular pockets have already been allocated. By clicking once on the button next to the entry, the circular pocket editor opens.
Lock box	The number next to the entry indicates how many lock boxes have already been allocated. By clicking once on the button next to the entry, the lock box editor opens.
Latch	The number next to the entry indicates how many latches have already been allocated. By clicking once on the button next to the entry, the latch milling editor opens.

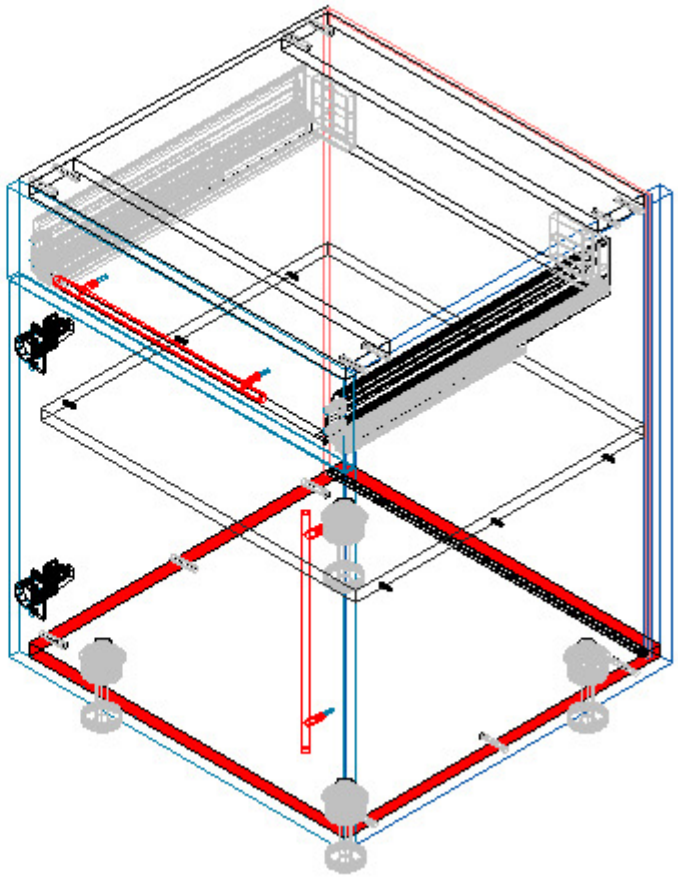
Production information

Production information	By clicking once on the button next to the entry, the level of the production information appears. In the dropdown box is the last applied production information.

3. ICT in the free construction

A stretchable purchased part can be extruded along a polyline by the free construction.
For example, a toekick can be extruded on a bottom shelf.





Note:
For this purpose, mark the article on the tab details and activate with **SPP construction/SPP to edge** in the imos Manager.
Afterwards you are required to pick the edges where the SPP should be extruded.
Click on all 4 edges of the bottom shelf (marked red)!

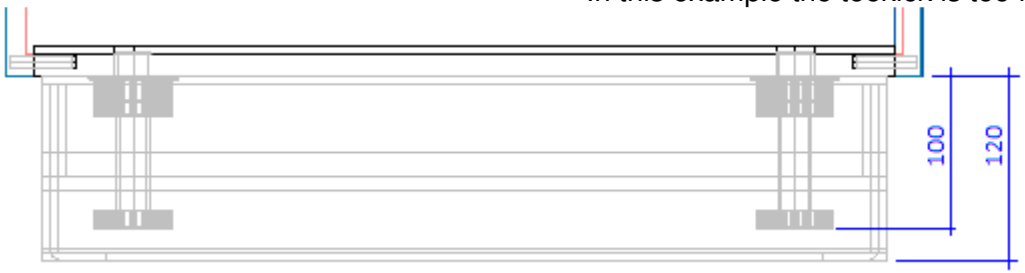
Properties	Value
Face of part	Bottom
Section contour	Sockelleiste
Section contour	>>
Inset	0.00
Offset	0.00
Offset	>>
Protrusion left	0.00
Protrusion left	>>
Protrusion right	0.00
Protrusion right	>>
Rotation Angle	0.00
Create Manufacturin…	
Base point name	

Click on the button next to the entry for defining the **cross section contour** and change to the Element Manager to select and process the cross section there.

The **offset** effects a movement of the cross section in Z direction of the part. It is important to remember that the insertion point of the cross section depends on the definition of the base point too.

The defined base points can be called with the **base point names** to effect a movement of the cross section as well!

In this example the toekick is too high for the applied base plinth.



Therefore change to the manager entry **cross section contour** in the Element Manager to modify the parameter for the stretchable purchased part.

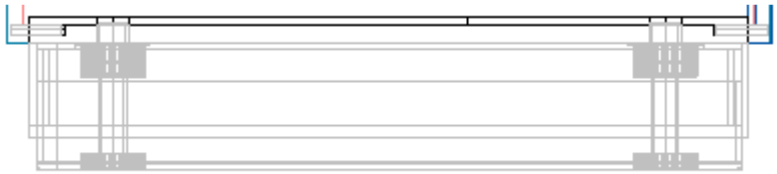
Note:
If no base point name is selected, then the defined base point in the cross section is applied. (see also 1.3 Define base point)

In the properties of the Element Manager you can change the parameters for the SPP.
Therefore change into the parameters and change the settings for the height to 100.

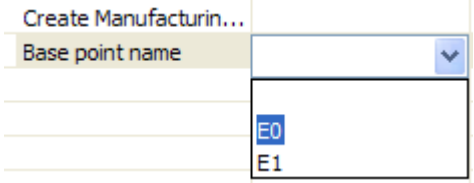
Property	Value	Link
Format	Current format	
Edit geometry		...
Import from file		...
Export into file		...
− Parameters		
Ab	15	
Ab_2	15	
Ab_3	30	
Dicke	5	
H1	75	
Höhe	100	
Tiefe	35	
+ Section 1		
+ Section 2		

Save the changes and leave the dialog.

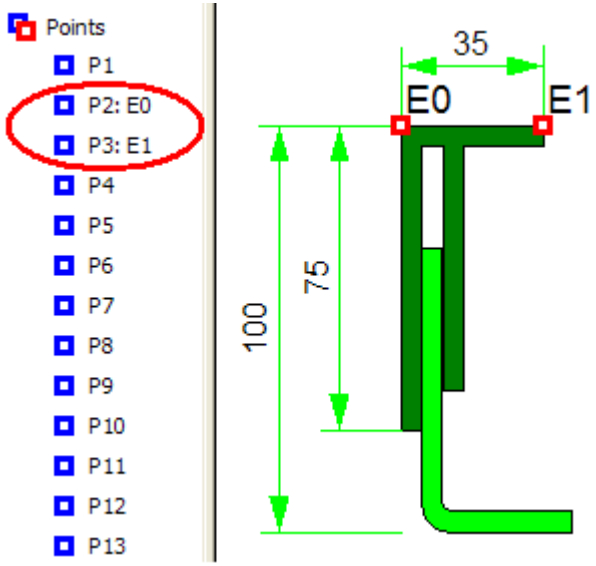
With this the base is inserted with the required height:



If the insertion point of the base in the construction has to be modified, this can take place with the **base point**.



It can be selected in the properties of the **tab details** in imos Manager.



The condition is that the points have received a name in the ICT Designer beforehand which should be applied as base points here.
(See chapter 1.2.4 menu for a point)



By selecting one of the points from the dropdown box, the cross section is moved on the edge.