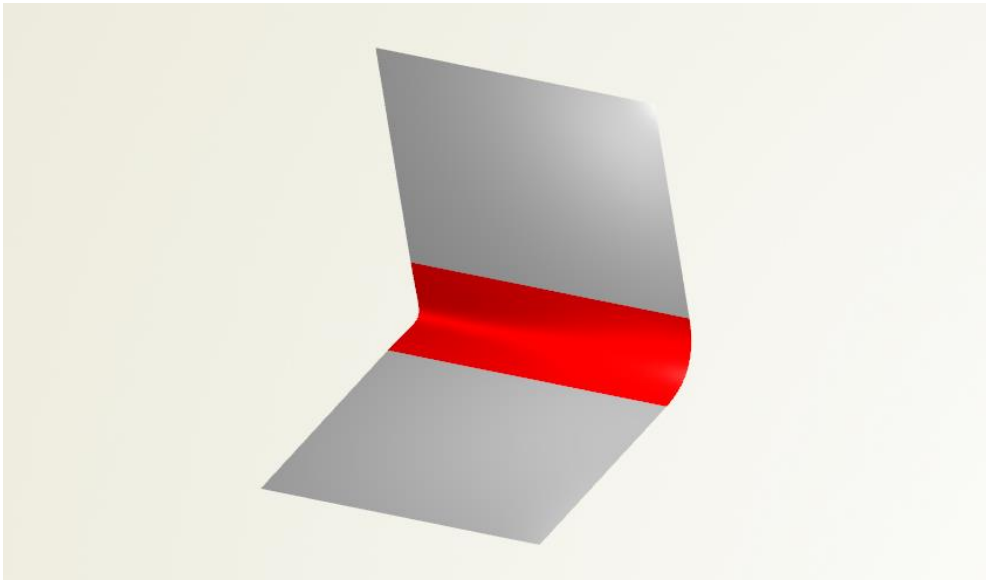
Fillet Surface

In this tutorial the settings and controls for a *fillet surface* are illustrated. This type of surface can be used to connect two surfaces smoothly. The tangential angles at the two surface boundaries can be controlled either by a single constant value or by a function.



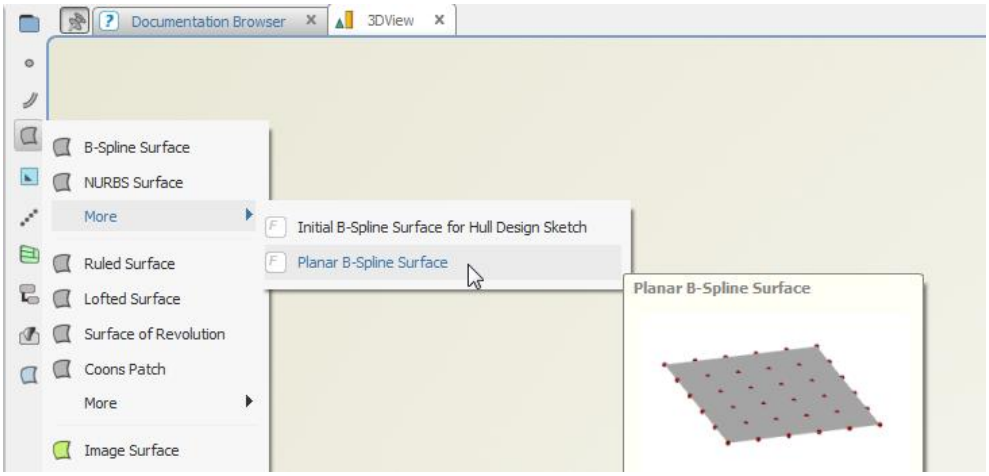
CAESES Project

The resulting model can be found in the section *samples* > *tutorials* of the documentation browser.

1 First Surface

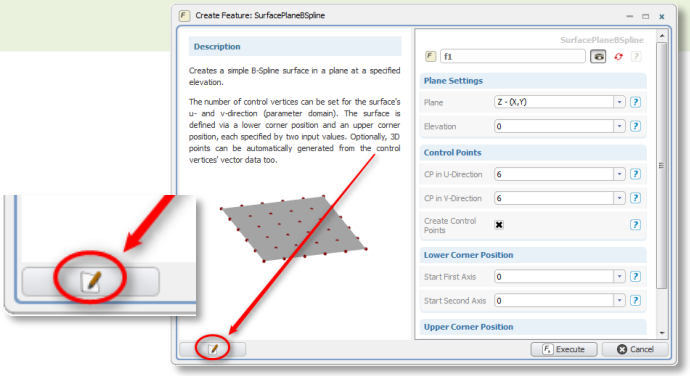
We want to insert a fillet surface in between two given surfaces. In the following two steps, the two surfaces are created which are kept rather simple for demonstration purposes.

- Choose *CAD > surfaces > more > planar b-spline surface* from the b-spline menu.



- Set *CP in U-Direction* and *CP in V-Direction* to "2".
- Press *execute*.
- Rename scope "f1" to "A".

✓ We use a so-called *feature* in order to create an initial *b-spline surface*. Features encapsulate a set of commands. For instance, in the feature "Planar B-Spline Surface" a command to create a b-spline surface is fed with user input like plane, elevation and number of control vertices etc. Execution of this feature then creates a new scope ("f1") where all of the feature objects (surface and points) are contained. Click on the edit button of the dialog and have a first look at the feature syntax. Learn more about features in the next tutorial section.

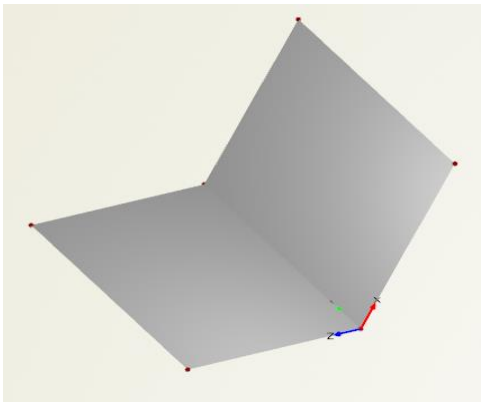


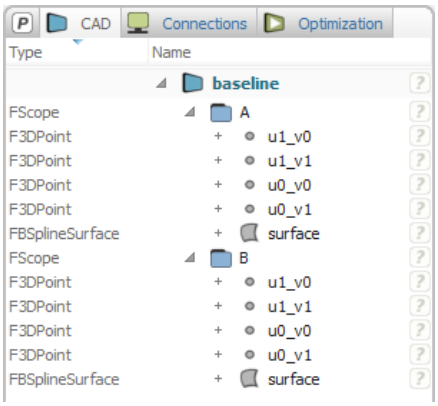
2

Second Surface

Again, we use the auxiliary feature to create our second surface. Please note that we do not use copy & paste of our first scope “A” since we want to generate the second surface in another plane (so this is the easier way):

- Create the second *b-spline surface* in the same way via the b-spline menu but set the *plane* attribute of the dialog to “X - (Y,Z)” and again *CP in U-Direction* and *CP in V-Direction* to “2”.
- Press *execute* and rename the new scope to “B”.

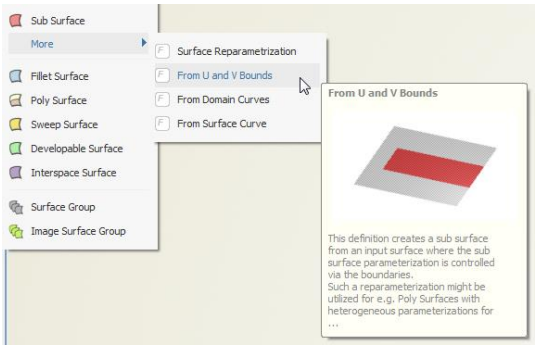




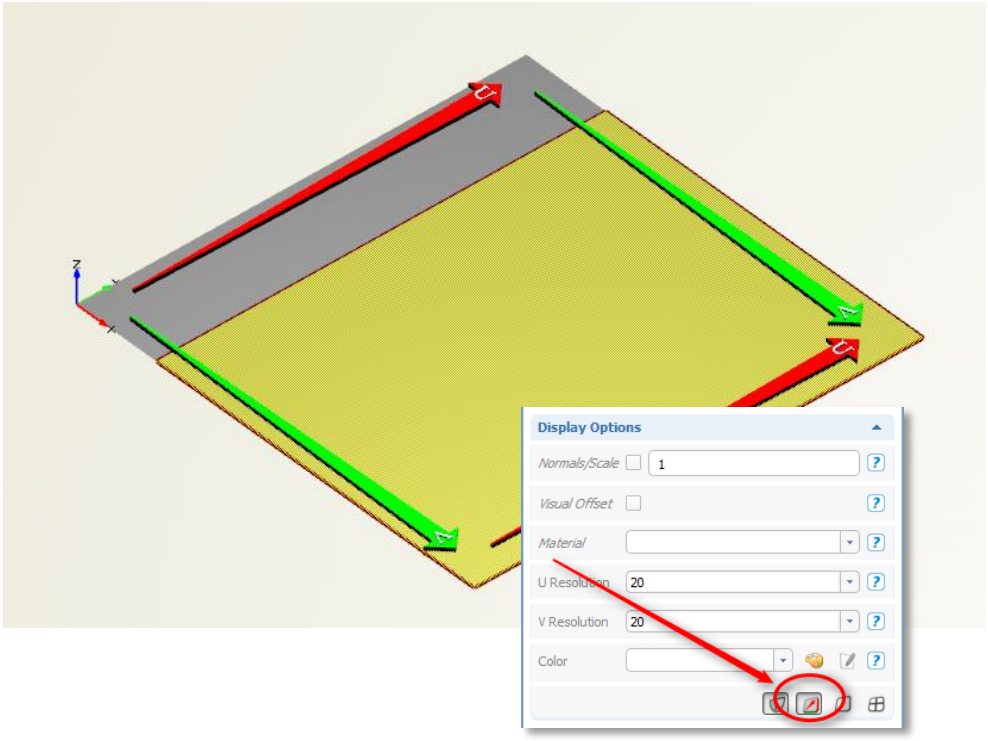
3 First Sub Surface

In the next two steps, we remove "portions" of the initial surfaces in order to have space for our fillet surface.

- Select "surface" of scope "A".
- Create a sub surface via *CAD > surfaces > more > from u and v bounds* from the sub surface menu.
- For attribute *V0* of the dialog, enter the value "0.2".
- Attention: Press *create* (and not *execute*!).
- Rename the new object "f1" to "partA".



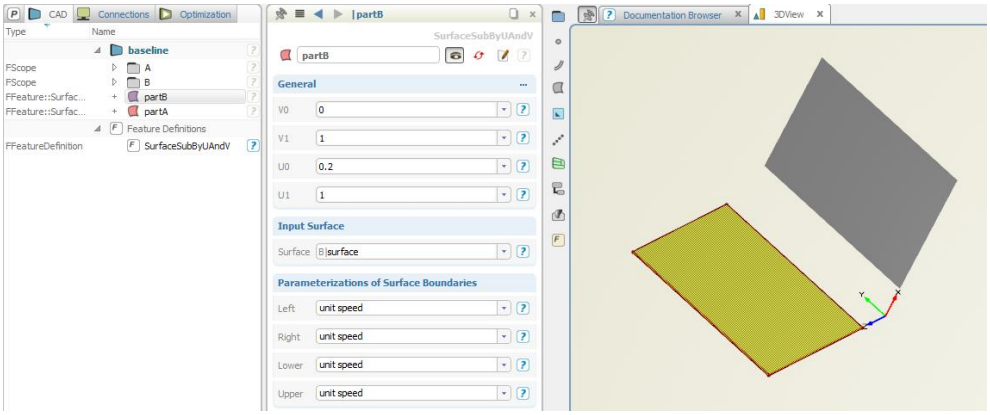
✓ In this step, the V-domain of the parent surface is restricted to the interval [0.2,1]. If you switch on the UV-visualization of surface A (button in category display options) you see the U- and V-directions displayed. See first remarks about *sub surfaces* at the end of this tutorial.



4 Second Sub Surface

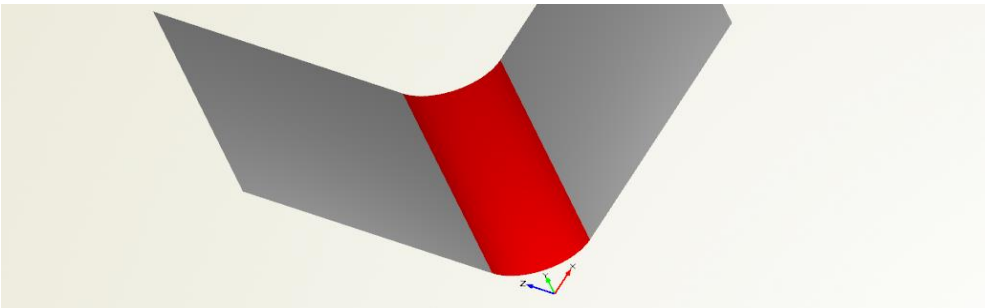
In the same way, we create the second sub surface:

- Select “surface” of scope “B” and create a sub surface via *CAD > surfaces > more > from u and v bounds* from the sub surface menu.
- Set the dialog’s attribute *U0* to “0.2” (attention: this time it is *U0* and not *V0*).
- Rename the new object to “partB”.
- Make scopes “A” and “B” invisible by clicking on their icons in the tree.

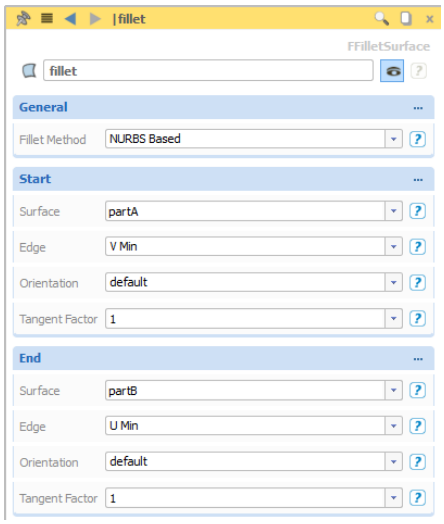


5 Fillet Surface

Let's create the *fillet surface* to join the two sub surfaces. Note that the fillet surface is based on the boundaries of each sub surface.



- Select "partA" and "partB" and choose *CAD > surfaces > fillet surface*.
- Choose NURBS-Based (recommended).



The default creation is not correct for this example so we need to set the right boundary:

- In the category *end*, choose "V MIN" for the *edge* attribute.
- Rename the new surface to "fillet".
- Set a color for "fillet" such as "darkred" for better distinction of the fillet surface.
- Try out different *tangent factors* (*start* and *end* category) in order to see the effect of this attribute.
- Reset these factors back to "1" again.

✓ The *tangent factor* is often a typical *design variable* that can be automatically controlled by *design engines*. It determines the influence of the tangential direction at the corresponding boundary.

The method "NURBS Based" is recommended while the former "Edge Sampling" will be removed in one of the future versions. See the documentation of this attribute for more information.

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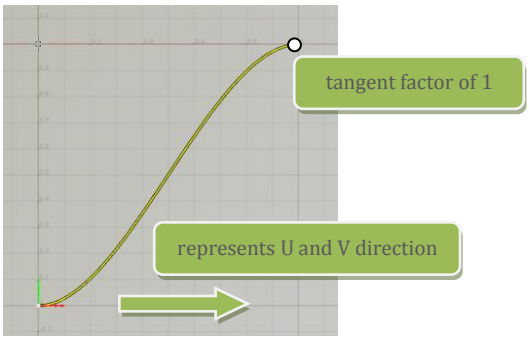
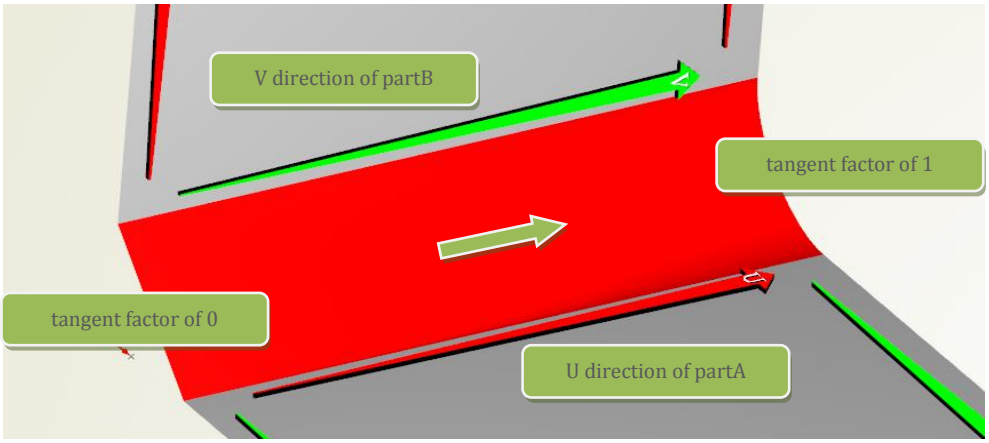
Additional Control: Function for Tangent Factor

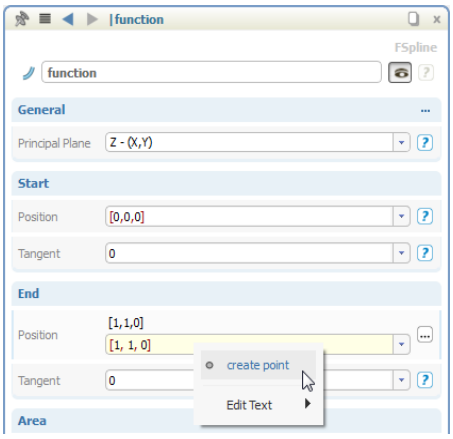
The *tangent factor* controls the influence of the adjacent surfaces with regard to the tangential direction along a surface edge. Instead of using a constant value, we can now introduce a function for a variable factor along the edge. This function needs to be given in the xy-plane in the x-interval [0,1] (i.e. this range represents the parameter interval from the start to the end position of a surface edge).



In this step, we create a smooth function so that the tangential factor equals "0" at the beginning of the fillet and "1" at the end of it.



- Choose *CAD > curves > f-spline curve* and set the name of the new curve to "function".
- To better see the curve in the 3DView, temporarily filter surfaces so that they are not visible, and also change the view to be along the z-axis (by using the icons at the bottom of the window).
- Set the start and end *tangent* attribute to "0".
- Create a point for the end position via the context menu of this attribute field and name it "endpos". We can use this point later on for interactive modifications, see step 8.

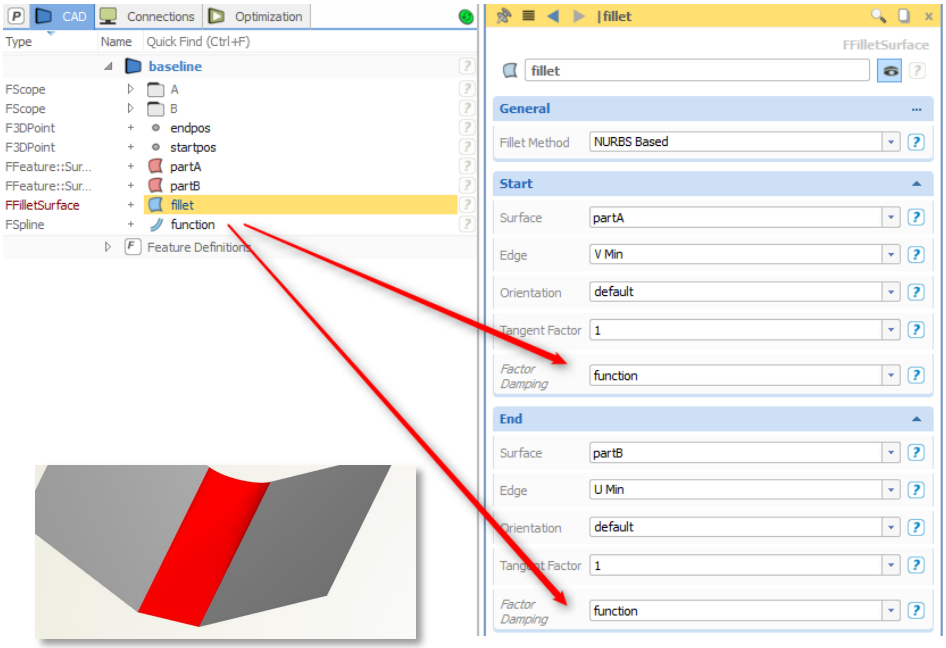


7 Additional Control: Set Function at Fillet

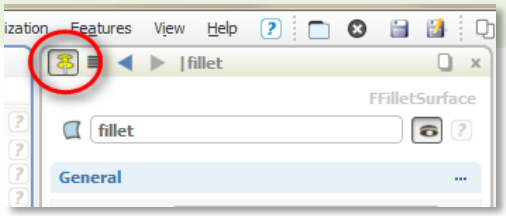
The function now needs to be connected to the fillet surface. This is done as follows:

- Select “fillet” and click on the *start* header in order to show secondary options.
- Drag & drop “function” into the attribute *factor damping*.
- Do the same for the category *end*.

The tangent vector along the edges is now based on the function. Note that the function ordinate values are finally multiplied by the *tangent factor* which is “1” for both surfaces.



✓ You can pin an object if you use drag & drop as above (dragging the function curve into the *damping* attribute). By doing this, the selected object (here: “fillet”) does not get deselected by mistake.

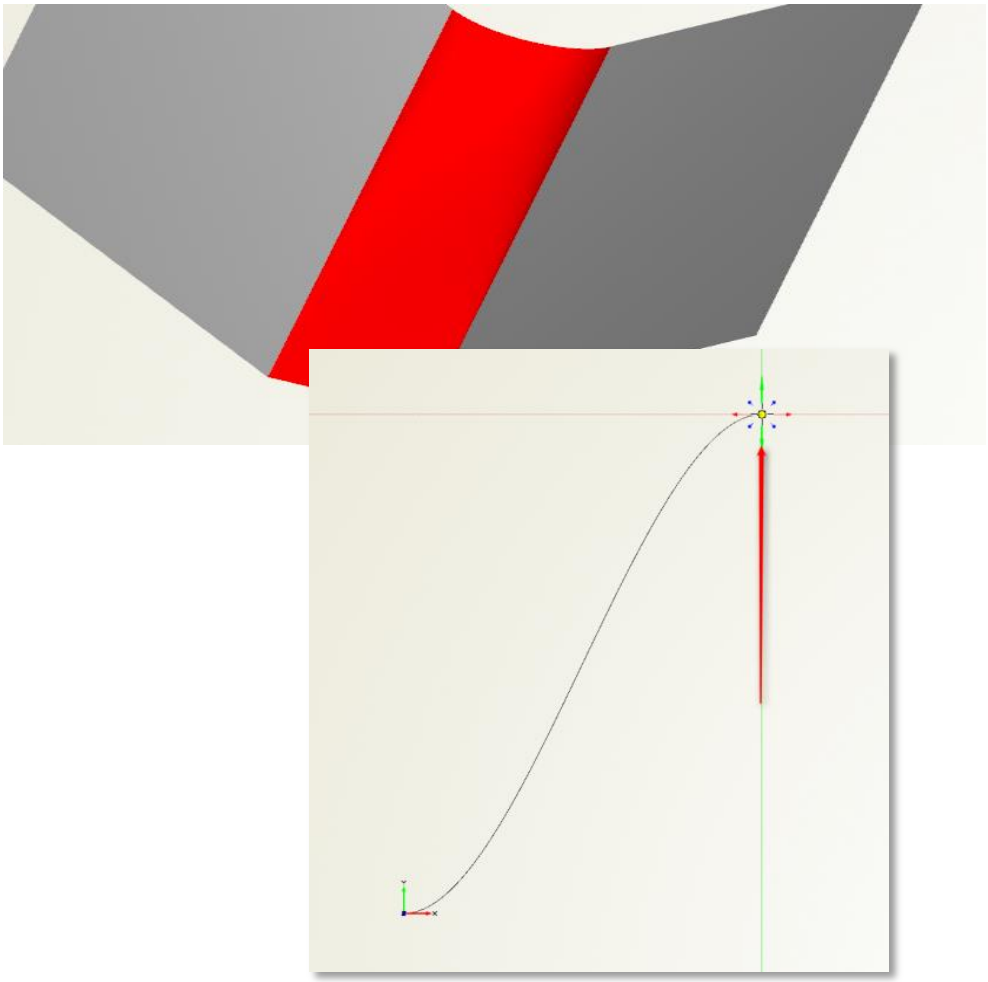


8

Changing the Function

The tangential influence along the two surface edges is now controlled by the new function. This function starts with zero-influence and smoothly increases to a factor of “1”. This means that at the start position of the fillet, a linear connection is given, i.e. the tangential angles have no influence.

- Select the end point of “function” and move it in the y-direction in order to increase the tangential factor at the end of the fillet.
- Optional: create a point for the start position of the “function” and move it in y-direction.

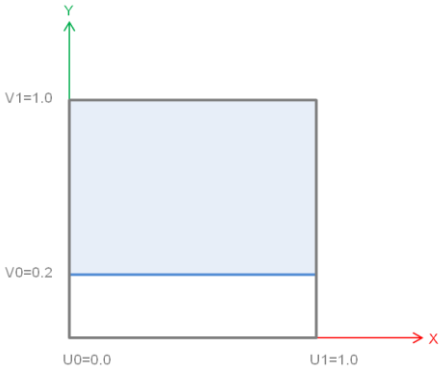


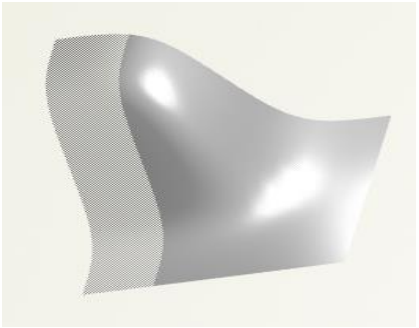
9

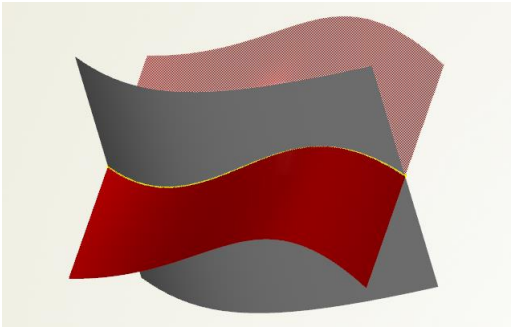
First Remarks about Sub Surfaces

Surfaces in CAESES are *parametric* surfaces that are defined by parameters U and V with a "planar" UV-domain in the range U=[0,1] and V=[0,1]. A *sub surface* of a parent surface can then be created by defining a 4-sided sub domain.

By default, surface domains are assumed to be defined in the xy-plane in the interval x=U=[0,1] and y=V=[0,1]. The feature *sub surface from u and v bounds* in step 3 creates such a sub domain (blue-colored in the illustration) in the xy-plane by using 4 simple *line* elements (see the *features* tutorial section for more details). These lines are then input for *surface curves*. Finally, a sub surface gets created by means of these surface curves. Here, surface curves hold the information about the parent surface. The sub surface coincides exactly with the 4-sided 3D region of the parent surface.







Other *surface curves* are *projection* and *intersection curves* which can also be used as input for a sub surface. This allows e.g. "trimming" of intersecting surfaces for which the feature *sub surface from surface curve* can be utilized (given in the same *sub surface* menu).

✓ Take a first look into the *feature definition* of the sub surface *feature* by clicking at the edit button in the upper right corner (tab *create function* of the dialog). Features are explained in a separate tutorial section.