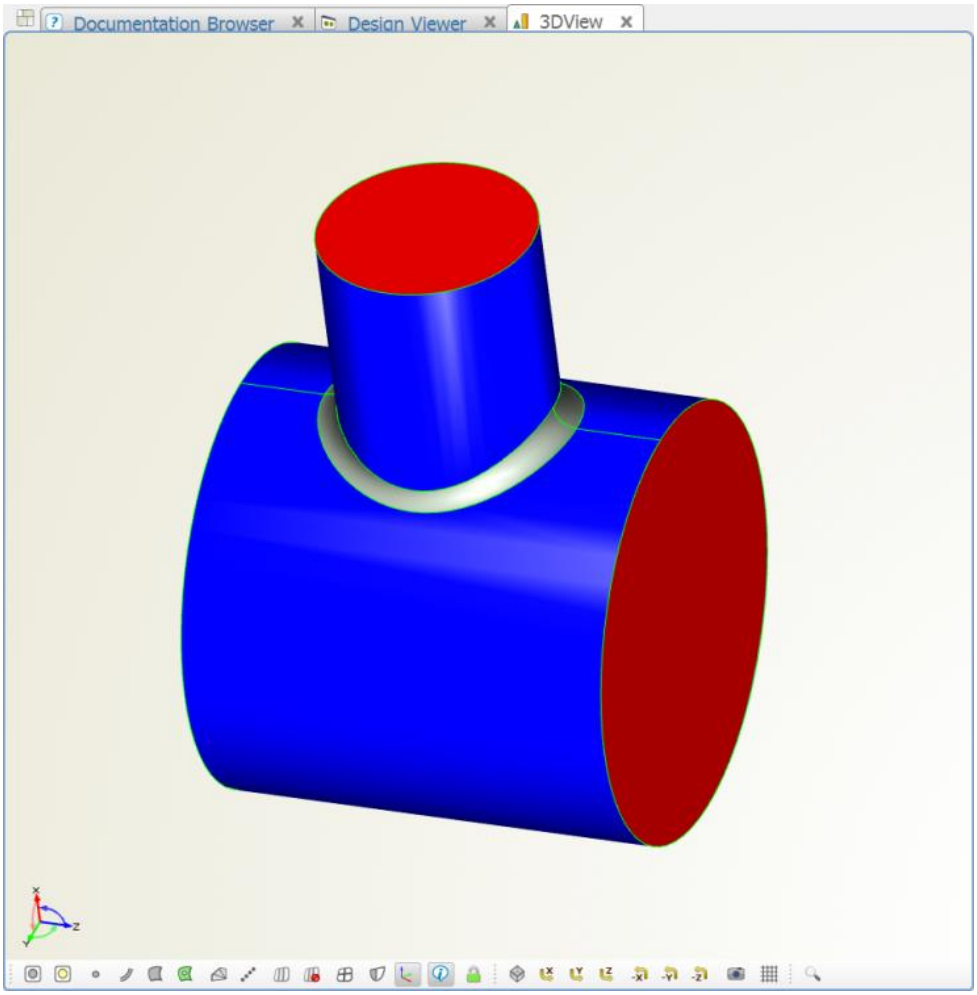
Introduction to BReps

Boundary Representations (BReps) are surface or volume geometries that are mathematically defined by their boundary surfaces. Breps are widely used in CAD systems for creation of trimmed surfaces, watertight geometries and fillet operations.

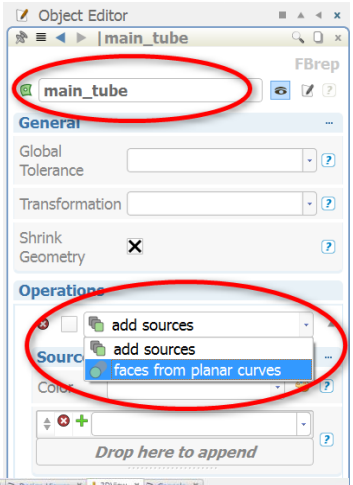
Since version 3.1, CAESES also offers BReps that internally work with NURBS curves and surfaces. In this tutorial, you will create two simple cylinders that are then merged using Boolean Operations. For the closed geometry, a fillet gets finally generated at the intersection of the two bodies.

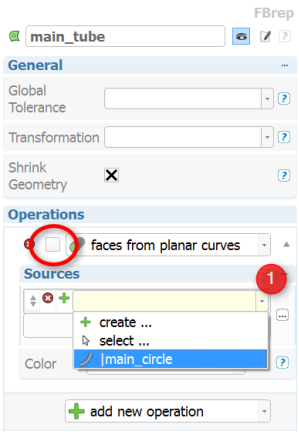


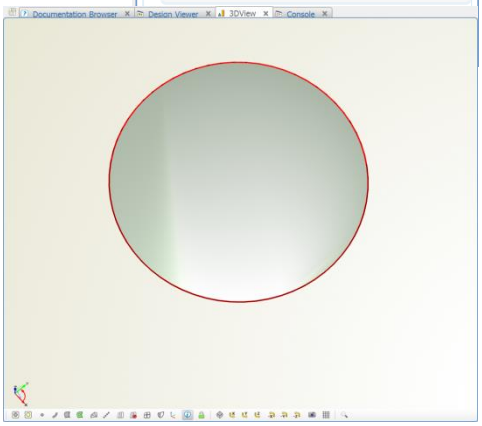
1 Create a Circle Face using BReps

We create the circle face of the main tube using a simple circle and the BRep operation “faces from planar curves”.

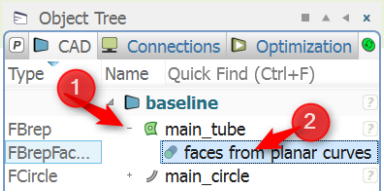
- Save the project (CTRL + s).
- Create a circle via *menu > CAD > curves > circle.*
- Change the name to “main_circle”.
- Create a BRep via *menu > CAD > BReps > BRep.*
- Change the name to “main_tube”.
- Change the *Operation* “add sources” to “faces from planar curves”.
- Choose “main_circle” in the drop down menu of *Sources* (see “1” in the screenshot below).
- Toggle the highlighted checkbox to activate the operation.







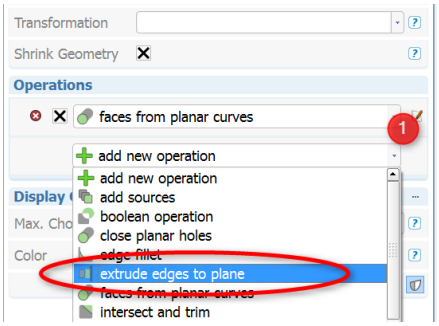
✓ When you add a new operation in a BRep, it is inactive by default. After adding a new operation you can fill it with all needed inputs and set it active afterwards. To set an operation active, simply toggle the check box in front of the operation. Additionally, you can click on the “+” icon in front of the BRep object in the object tree and click on the operation. This also sets the operation active or inactive).

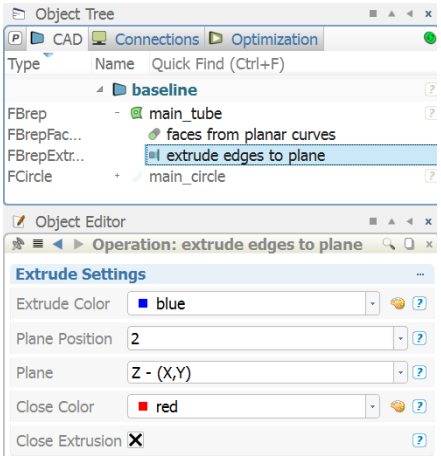


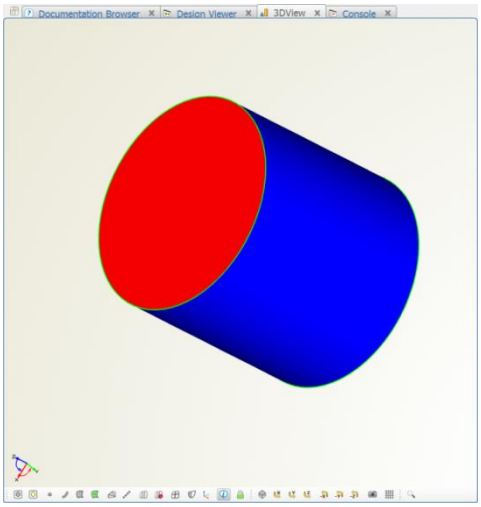
2 Extrude Face to Plane

We will extrude the face and create a closed tube.

- Set “main_circle” to invisible by clicking on the object symbol in the *Object Tree* (we don’t need the circle anymore for the time being).
- Add a new operation *extrude edges to plane*.
- Set *Plane Position* to “2”.
- Set *Extrude Color to* “blue”.
- Set *Close Color* to “red”.
- Toggle *Close Extrusion.*
- Click on the *extrude edges to plane* symbol in the O*bject Tree* to activate it. Alternatively, use the checkbox again (see last step of previous page).





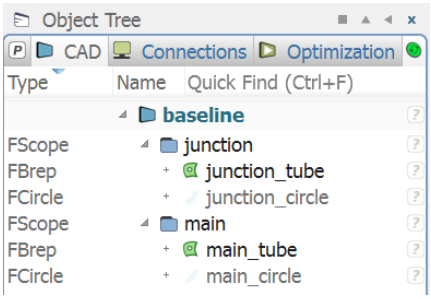


✓ Again, you can select each operation very quickly by first clicking on the “+” in front of the BRep symbol in the object tree. This lists all operations of the Brep, and you can simply select it.

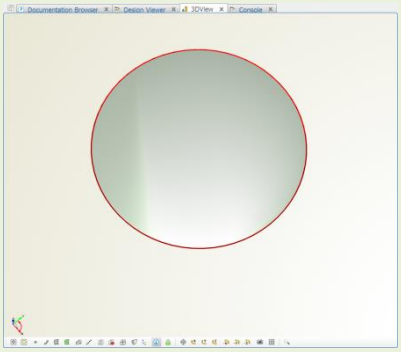
3 Create another Tube

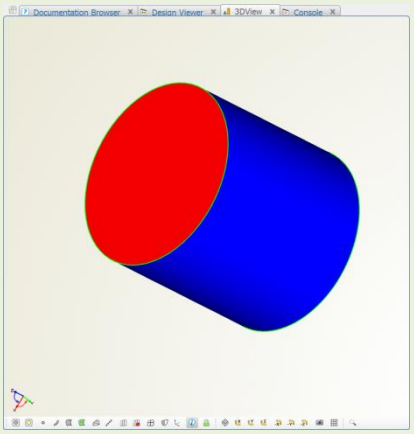
In this step you will create the second tube.

- Select “main_tube” and “main_circle” and create a scope via *menu >CAD > scope.*
- Change the name of the scope to “main”.
- Select “main” and press CTRL + C.
- Press CTRL + V to paste the copied scope.
- Change the name to “junction”.
- Change the name “main_tube” in the scope “junction” to “junction_tube”.
- Change the name “main_circle” in the scope “junction” to “junction_circle”.
- Change the radius of “|junction|junction_circle” to “0.5”-



✓ In the 3D view, a red curve shows an open edge and a green shows a closed edge.

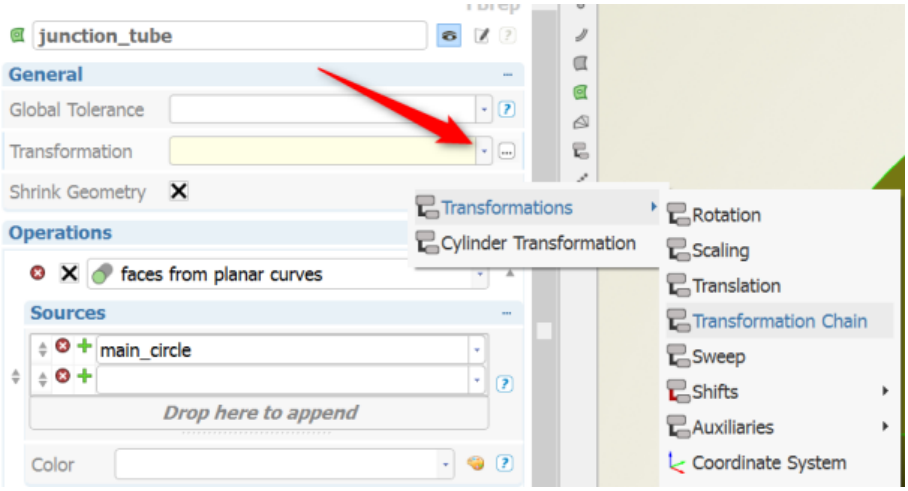




4 Transform the Second Tube

We will rotate and translate the second tube for which we need a transformation chain.

- Select the second BRep "|junction|junction_tube".
- Create a *transformation chain:* Click on the drop down menu from *Transformation* and select *create > Transformations > Transformation Chain.*
- Change the name of the new object to "chain".

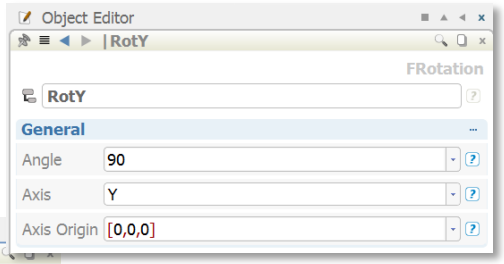


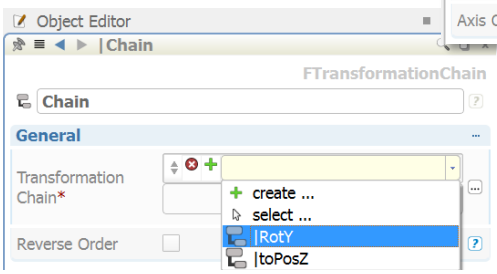
5

Create a Rotation

So far, nothing gets transformed. In this step, we will create the rotation for the junction tube.

- Create a rotation via *menu > CAD > Transformations > Rotation.*
- Change the name to “RotY”.
- Set *Angle* to “90”.
- Set *Axis* to “Y”.
- Select “chain”.
- Select “RotY” in the drop down menu.

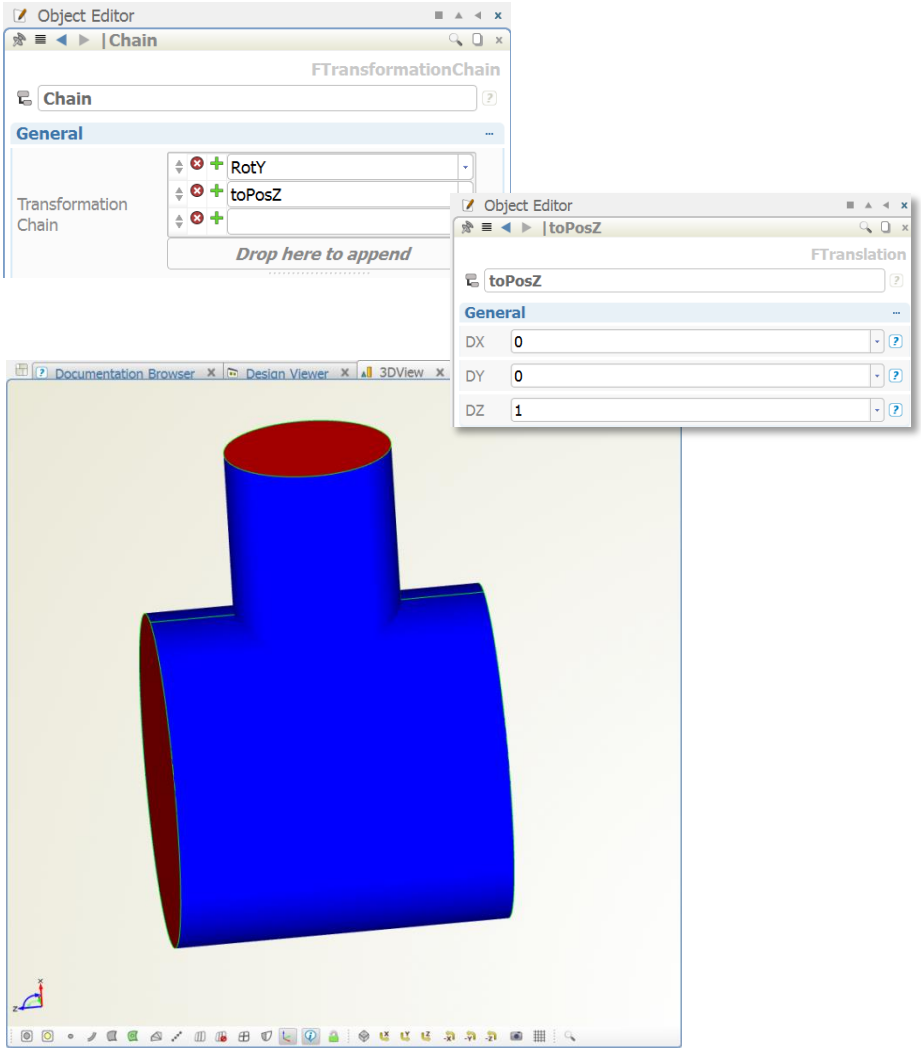




6 Create a Translation

The rotation is applied. Now, we will add the translation for the junction tube, in order to bring it to the right position.

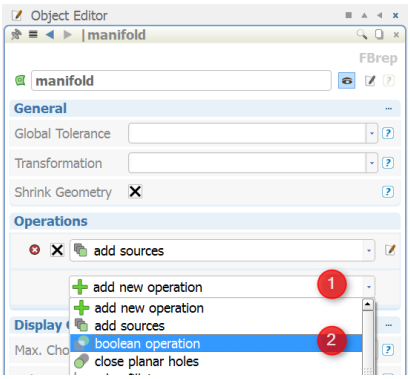
- Create a translation via *menu > CAD > Transformations > Translation.*
- Change the name to “toPosZ”.
- Set *Z* to “1”.
- Select “chain”.
- Select “toPosZ” in the drop down menu.
- Select all transformations and move into the scope “junction” (just to tidy up the project).



7 Merge the two Bodies using a Boolean Operation

Now we can merge the two volumes. For this purpose, we can use a Boolean Operation:

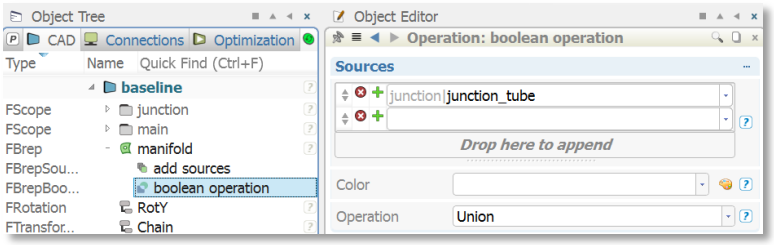
- Select "|main|main_tube in the object tree and create a BRep via *menu > CAD > BReps > BRep.*



This creates a new BRep which automatically sets the selected BRep as source.

- Change the name to "manifold".
- Add a new operation for the brep "manifold" by selecting *boolean operation.*
- Drag and Drop "|junction|junction_tube" into *Sources* of the Boolean Operation.
- Toggle the checkbox in front of the operation to activate it.
- Set scope "main" and "junction" to not visible.

You can see the manifold in the *3DView.*



8

Create a Fillet

In this final step, we will create a fillet between the two tubes.

- Select the brep “manifold”.
- Click on the edit button next to the Boolean Operation.
- Set *Radius/Distance* to “0.1”.
- Activate the operation.