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ME424

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Project Learning: SolidWorks Fillets

Introduction

Fillets are one of the most important features to be able to model into a system and design, used for a variety of applications from appearances to stress concentration relief. Complex geometry, however, can lead to incomplete or incorrect fillet geometry, or the complete refusal by SolidWorks to implement the feature. For this reason, multiple methods are required to enable the implementation of a fillet on any complex geometry. For reference images, the edge used is Figure 1. This is the edge that prompted the learning in this report.

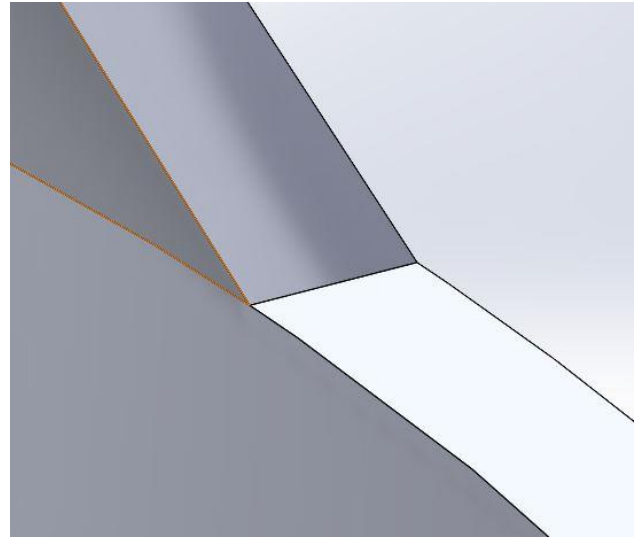


Figure 1: Example edge without fillet

Method 1: Edge Fillet

The first method for creating a fillet is the baseline, the simple edge fillet. This is labelled in SolidWorks as a constant size fillet. This path only requires the desired edge(s) and radius as inputs, automatically creating the geometry if possible. The constraints of this automated feature generation are that the fillet creates a perpendicular end, creating a discontinuous end for many complicated geometries, shown in figure 2. Additionally, the tool can set limits for how large the radius can be, failing to create the feature if a larger radius is defined and creating errors.

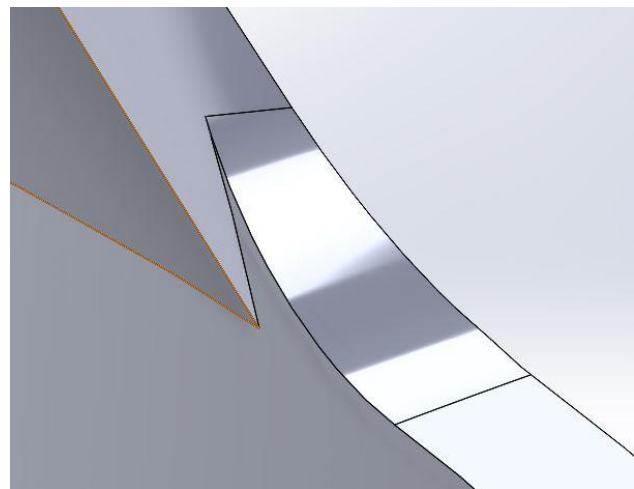


Figure 2: Edge fillet on complex geometry

Pros:

- Simple
- Fast
- User-friendly

Cons:

- Limited control
- Highly dependent on input geometry being fairly simple

Method 2: Face Fillet

The second method for creating a fillet is the face fillet tool. Also found in the fillet tool in SolidWorks, the face fillet attempts to use adjacent feature faces as references for a fillet instead of an edge. In many instances of slightly more complicated geometry, the edge definition is inconsistent. Using faces enables SolidWorks to maintain feature continuity. As seen in figure 3, the faces for the fillet are too complicated, with the first face having a twist and the second face curving. This highlights the constraint of the face fillet: even if the edges can be rather complicated, the reference surfaces must be somewhat simple.

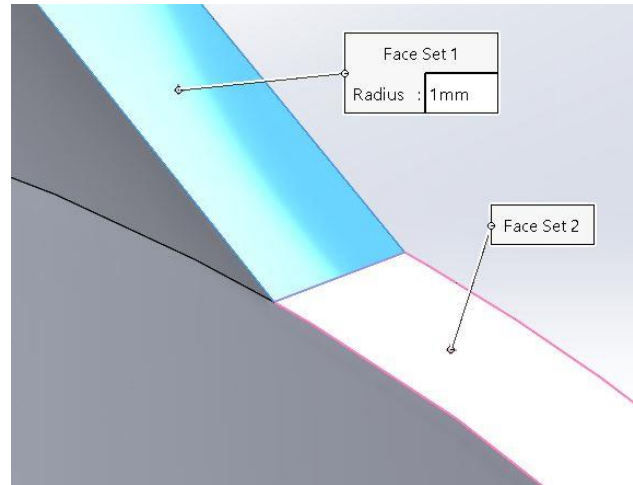


Figure 3: Failed face fillet on complex geometry

Pros:

- Can accommodate more complicated edge geometry
- Fairly simple
- Relatively fast

Cons:

- Limited control
- Dependent on input surface geometry being fairly simple

Method 3: Solid Geometry

The third method is the use of basic solid modelling tools, including extrusions, revolves, lofts and sweeps, both bosses and cuts. This is a much more manual method of defining the desired fillet that uses sketches to define the feature. The issue of complex feature interfaces persists, shown in figure 4. The desired feature cannot be properly completed using bosses or cuts due to the non-uniform geometry and discontinuous surface contacts of existing geometry.

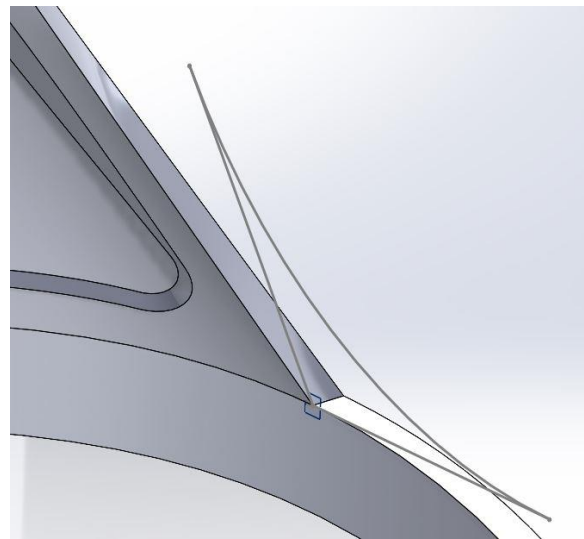


Figure 4: Failed solid geometry fillet on complex geometry

Pros:

- Greater control
- Less reliant on existing geometry, makes the process less likely to fail

Cons:

- Slower
- Not a guarantee that the surrounding geometry will be simple enough to complete the feature

Method 4: Surfaces

The surface tools toolbox in SolidWorks is one of, if not the most, involved toolbox in terms of geometry definition. Solid modelling automatically creates three-dimensional geometry from input sketches. Surface modelling creates two-dimensional features from input sketches that can then be knitted together to create solids. Surface tools can be used to manually define the faces of complex geometry or to cut existing geometry. Using these tools, complex geometry can be combined together, such as a fillet that conforms to three different curvatures. For the example shown in figure 5, multiple surfaces were used to cut and split a rectangular boss extrusion to the correct shape.

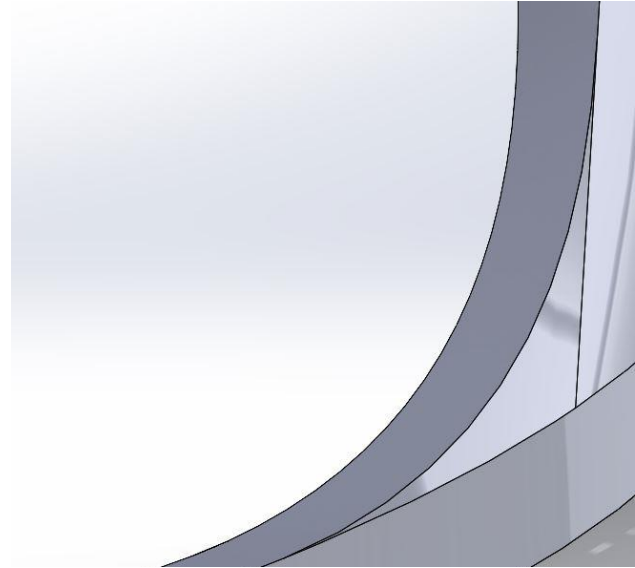


Figure 5: Surface fillet on complex geometry

Pros:

- Direct control over all aspects of the feature
- Minimal reliance on surrounding geometry

Cons:

- Slow
- Requires many features

Summary

Fillets are a critical design feature to be able to model, but the easy method is not always an effective method. To resolve this issue, I learned multiple methods to create a fillet for complex parent geometry, ranging from minimal to near complete control over the feature geometry. While more efficient to start with the simple methods, having options for more control over complex geometry makes more features possible.