AUTODESK. UNIVERSITY

CP473669 - Debugging your Fusion Design: Let’s Get Rid of Those Red and Yellow Features

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Phil Eichmiller is a Senior Software Quality Assurance Engineer for Autodesk, on the Fusion 360 team. He enjoys helping the Fusion online community and at night he shares his knowledge by teaching Fusion 360 for the CAD program at Portland Community College. Roller Derby is his favorite pastime, especially watching his daughters, who are both derby stars in Portland, Oregon

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Jeff Strater is a Senior Software Architect in the Fusion 360 team. I've been with Fusion since the very beginning. My focus is on general modeling/sketching. Before that, I was a developer and architect on Inventor, also before R1. So, I'm a long-time CAD guy. When not working with Fusion or its customers, I like to run, cycle, hike, and read science fiction.

About the speakers

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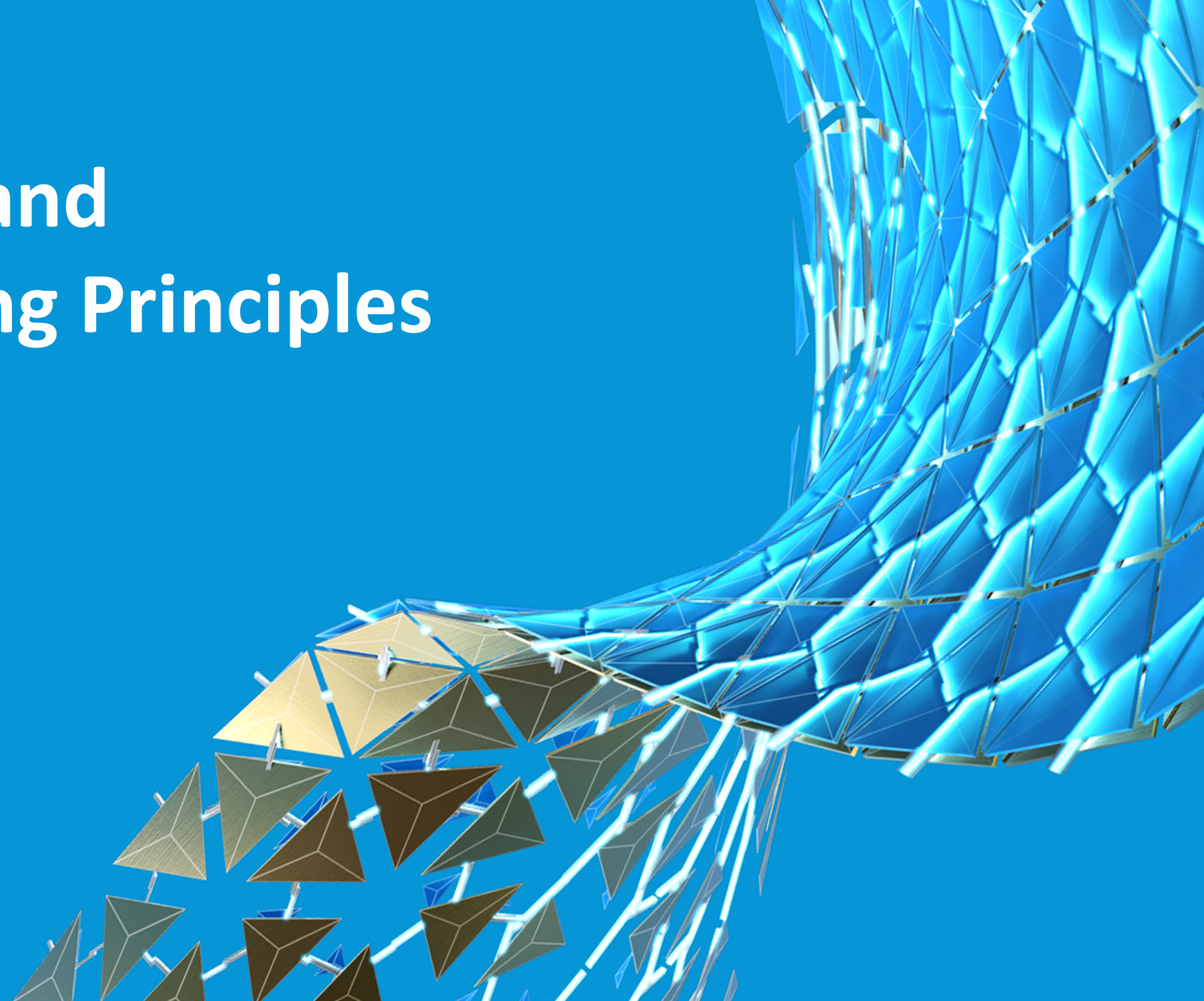
Class Outline

- Class goals, and starting principles
- Intro to Errors and Warnings in Parametric Design
- Understanding the Causes of Errors/Warnings
- Debugging/Fixing Strategies
- Preventing Errors and Warnings

Class Goals and Some Starting Principles



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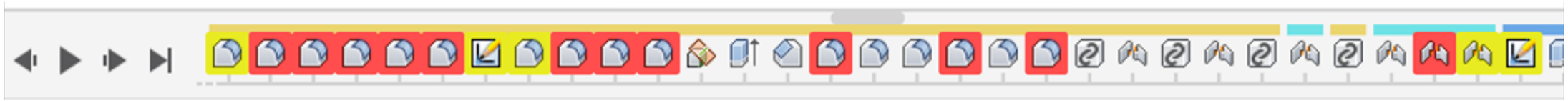
Class Goals

- **Teach you how to fix and prevent this:**

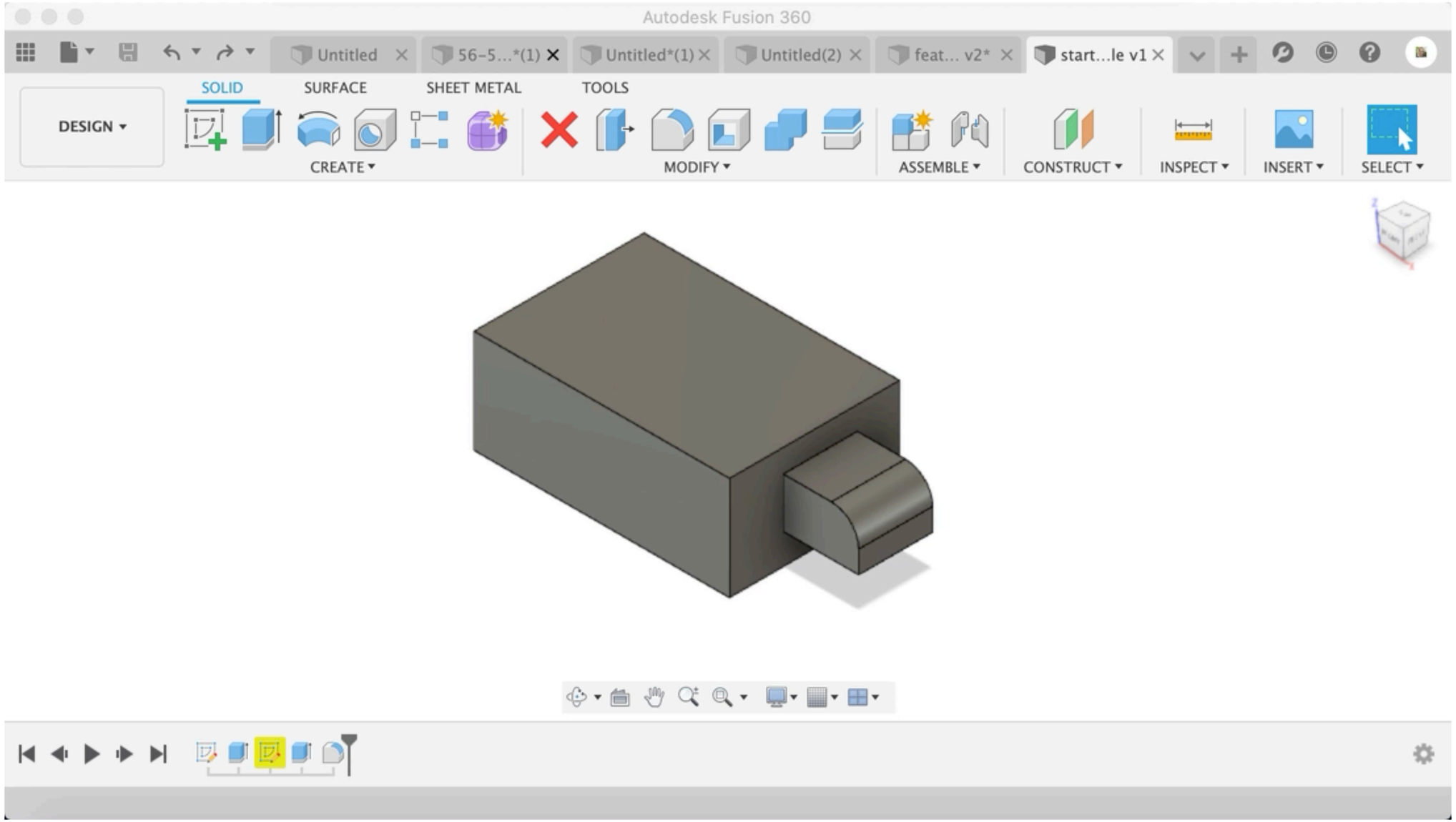


- **Design Workspace only, Parametric designs only**
- **Understand some of how Fusion detects and reports these errors**
  - To help in your ability to deal with and prevent failures

Some Starting Principles

- **Fix it when you see it**
- **Warnings are serious, too**
- **Compute All is your friend**
- **Editing when rolled back can hide errors**

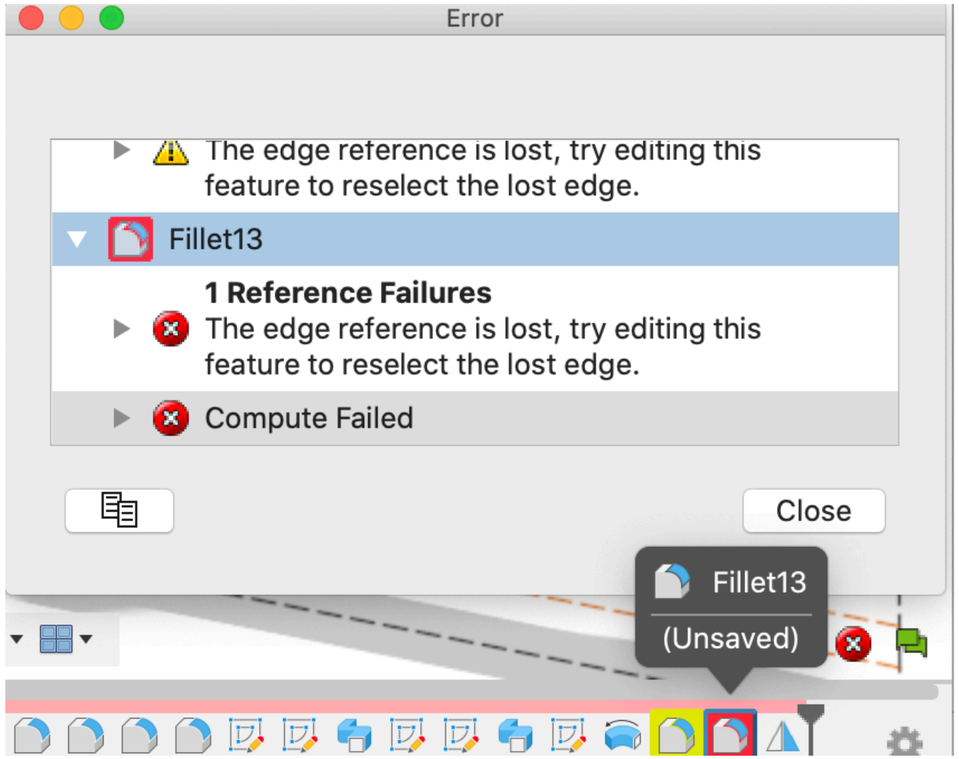
Some Starting Principles



Errors and Warnings in Fusion's Parametric Design Environment

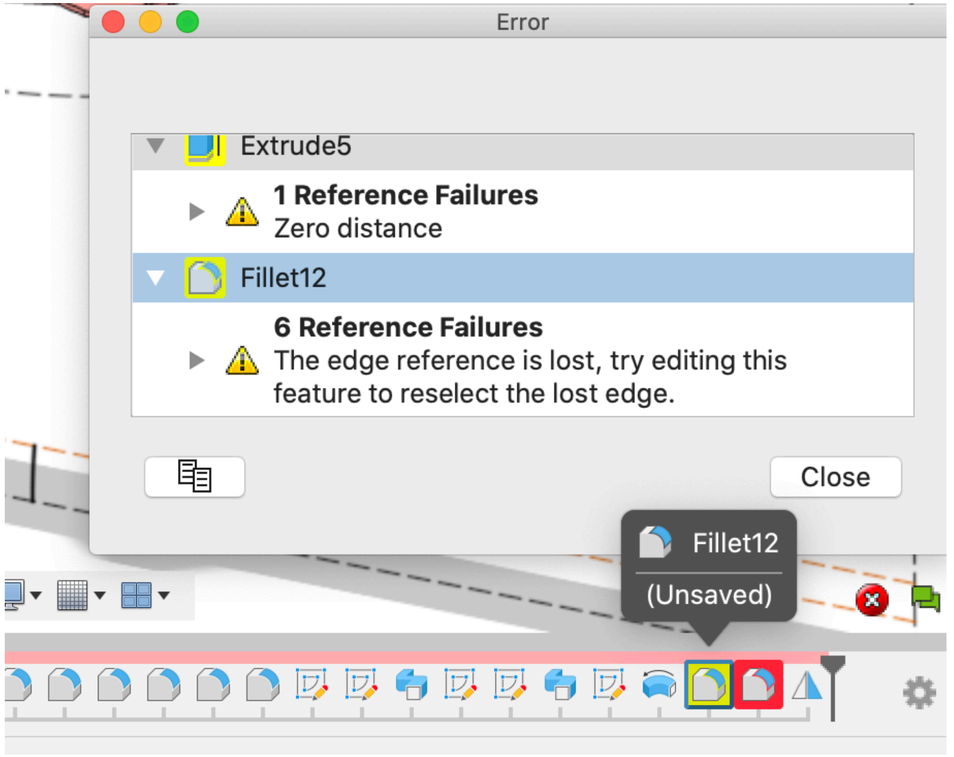
Errors vs. Warnings

- **Error: A failure that prevents the feature from computing at all**



Errors vs. Warnings

- **Error: A failure that prevents the feature from computing at all**
- **Warning: A failure that still allows the feature to produce some result**
- **Failure propagation**
  - Error – dependent features will also be in an Error state
  - Warning - downstream features can be OK



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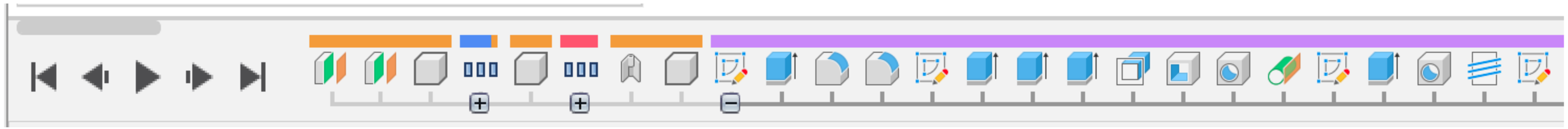
Parametric Feature Design 101

- **Parametric design is a sequence of features**
  - Entries in the Timeline
  - Computed in order
  - Order determined by feature dependencies



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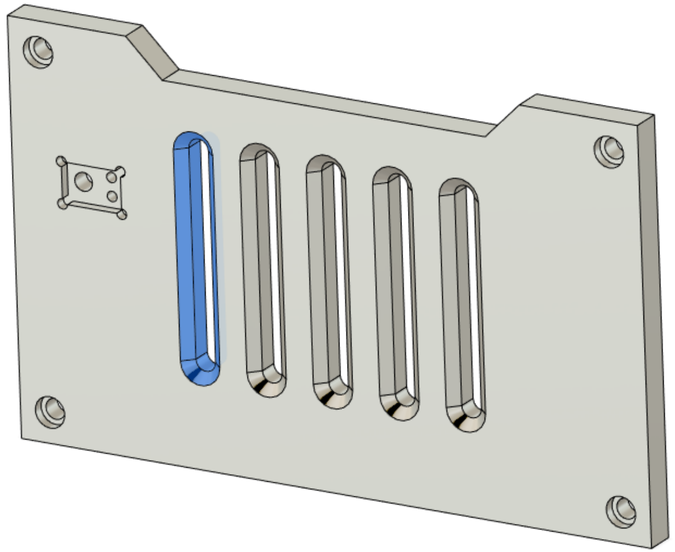
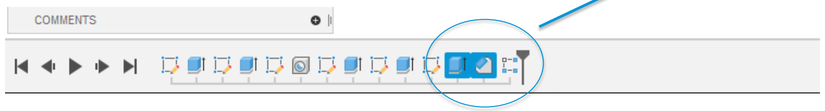
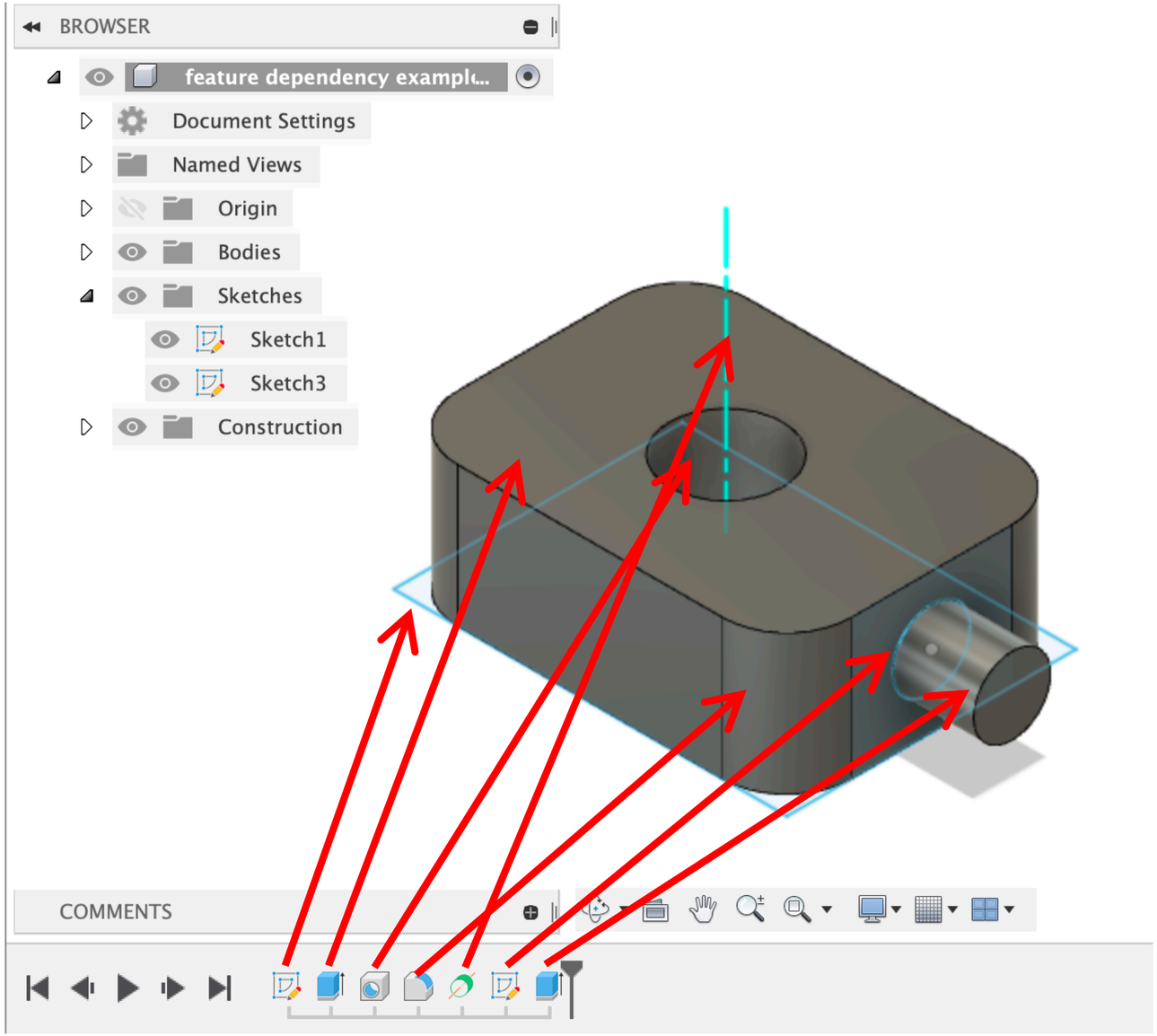
Feature Dependencies

- **If a feature uses geometry from another feature, that is a *dependency***
- **Always a result of a geometry selection in a command**

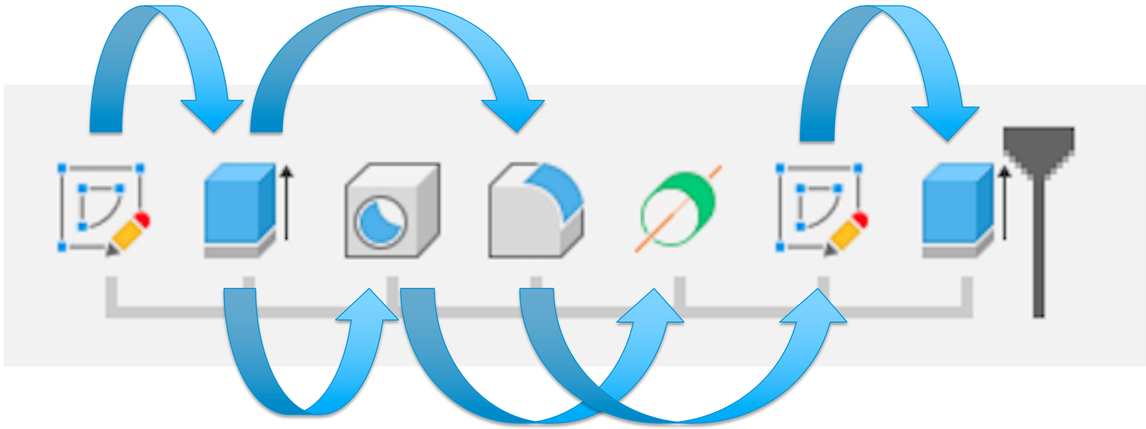


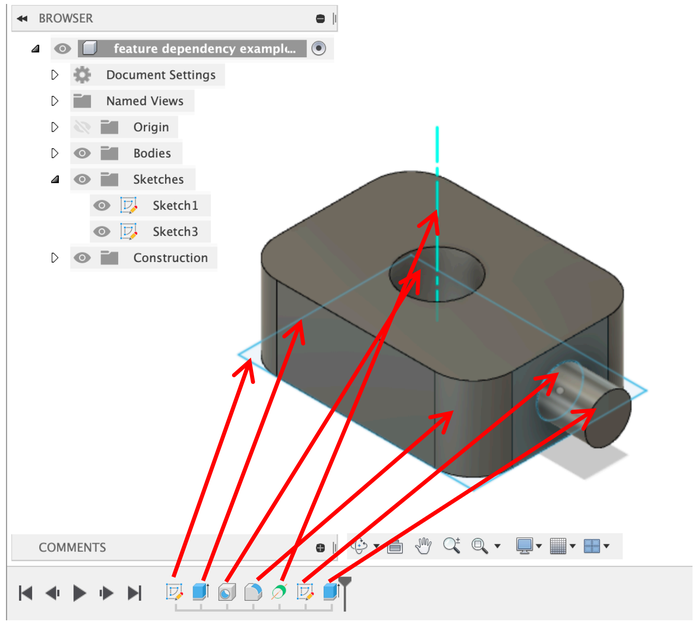


Dependency Example

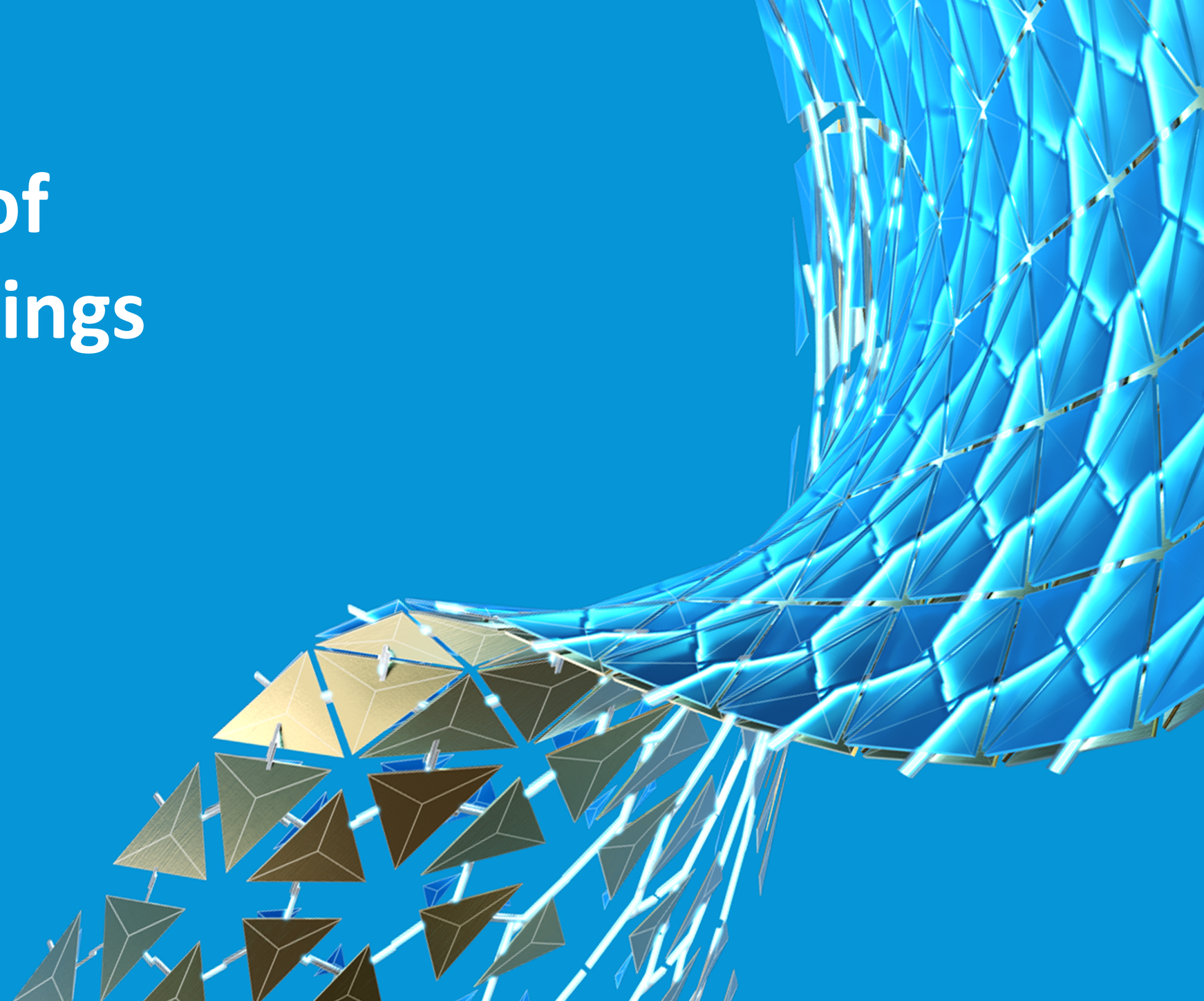


Feature Dependencies From this Example





The Causes of Errors/Warnings



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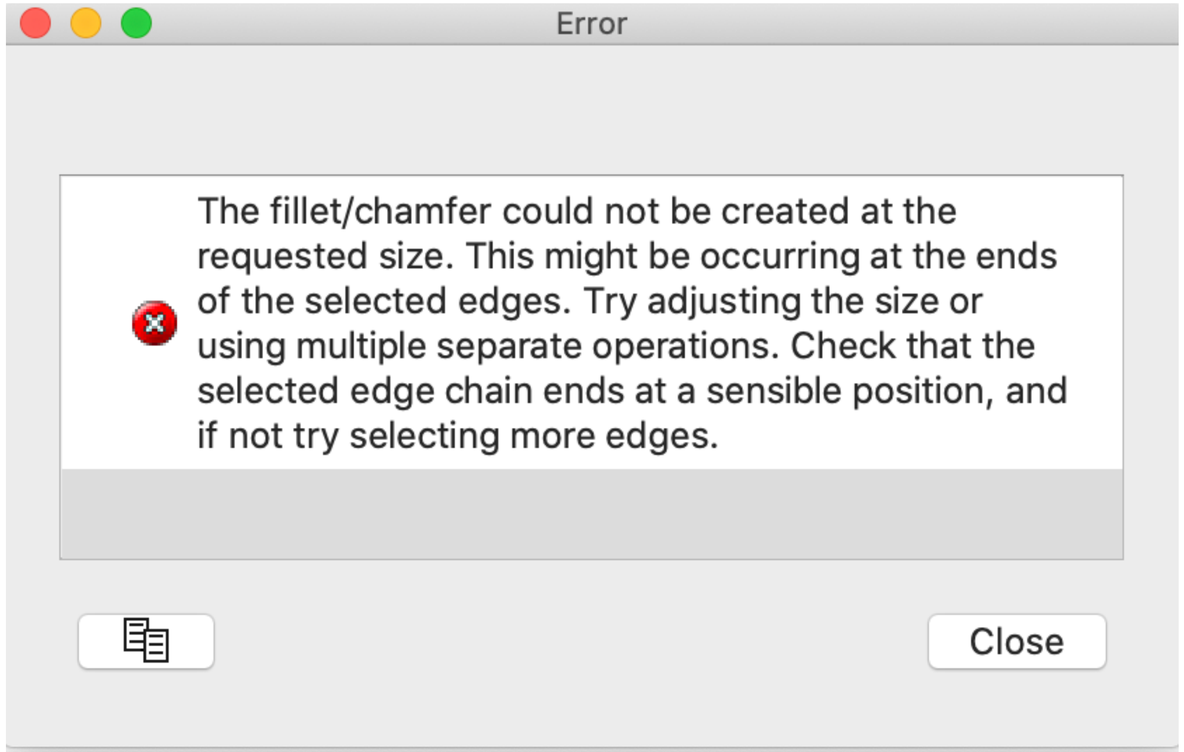
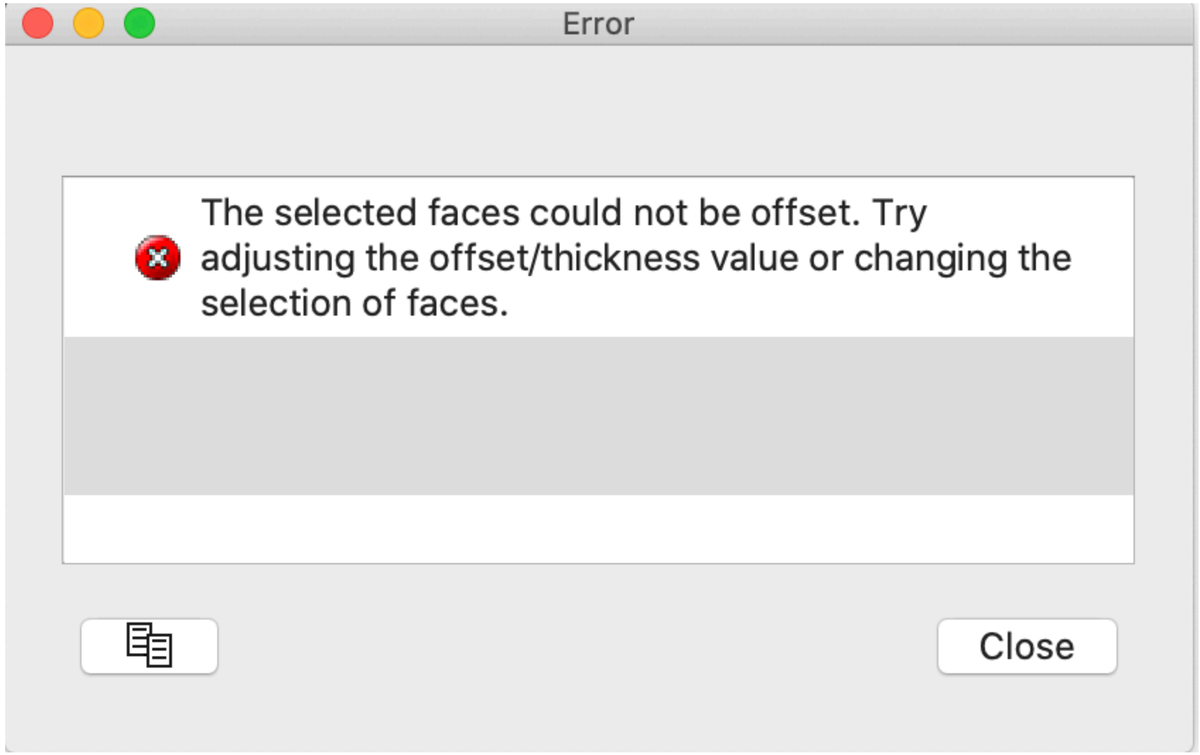
What Causes a Design to Fail?

- **Errors are always caused by edits to the design**
- **Two main categories of design errors:**
  - Geometry Errors
  - Dependency Errors

Geometry Errors

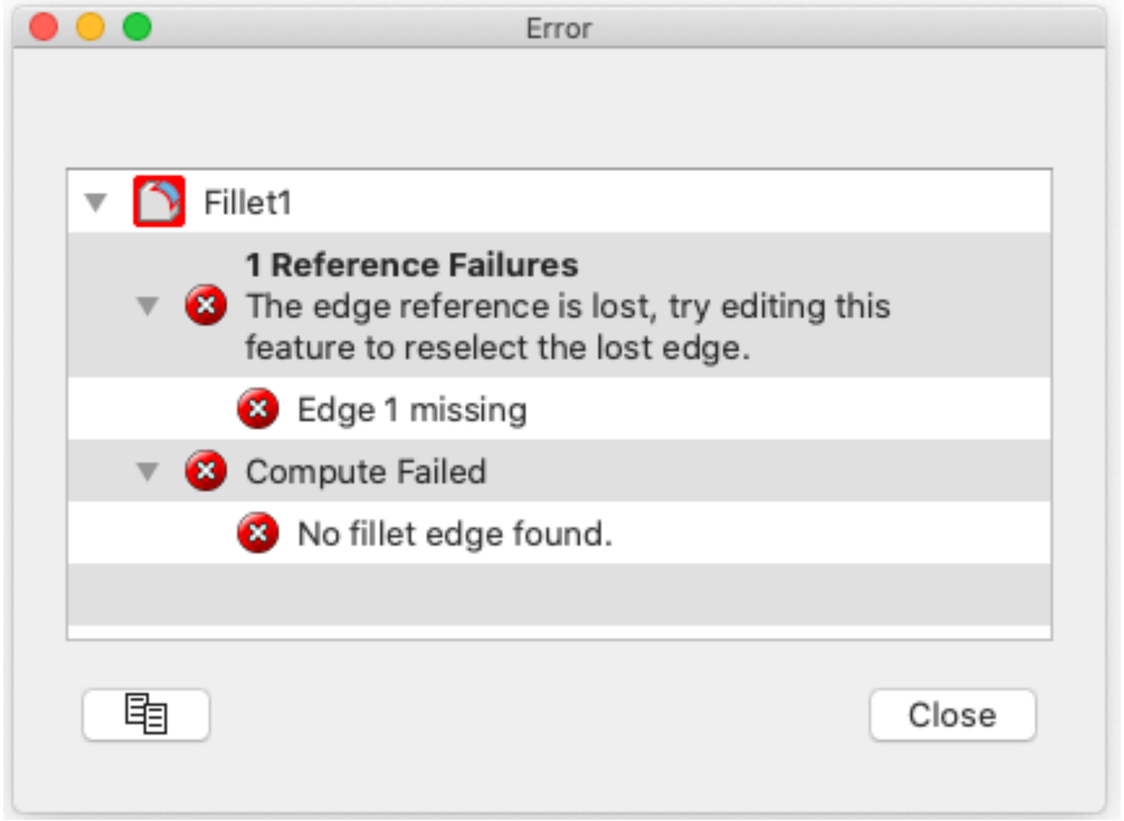
- **Happens when the modeling kernel fails**





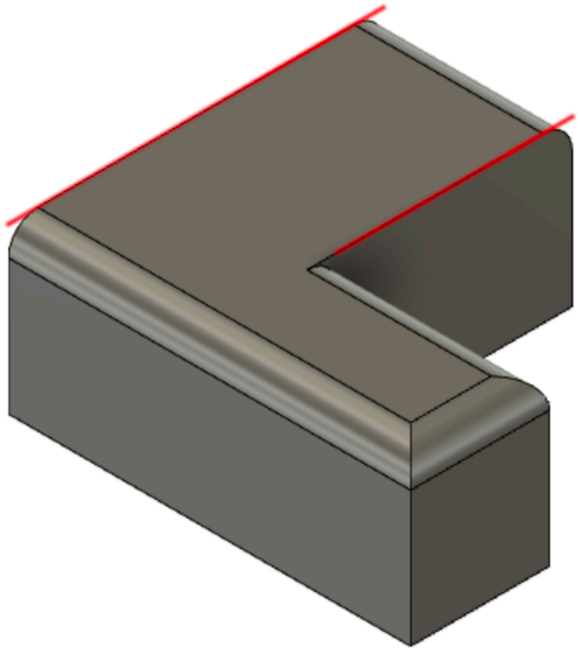
Dependency Errors

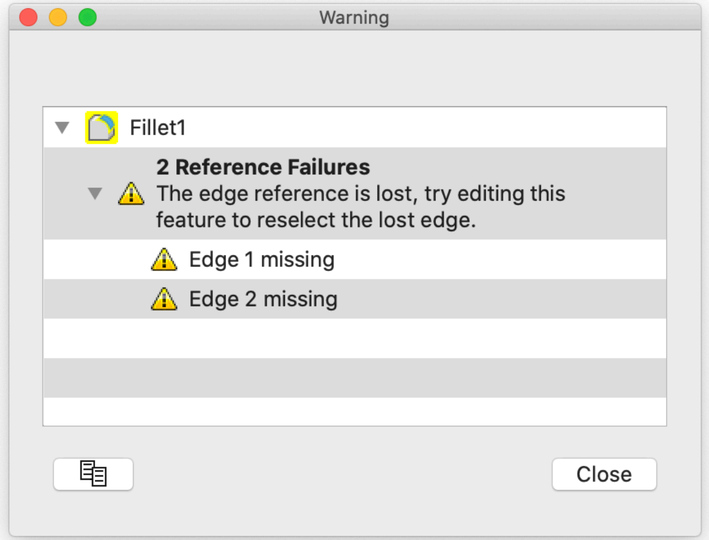
- More common error after a design edit
- Caused when a Geometry Dependency fails



Types of Dependency Failures

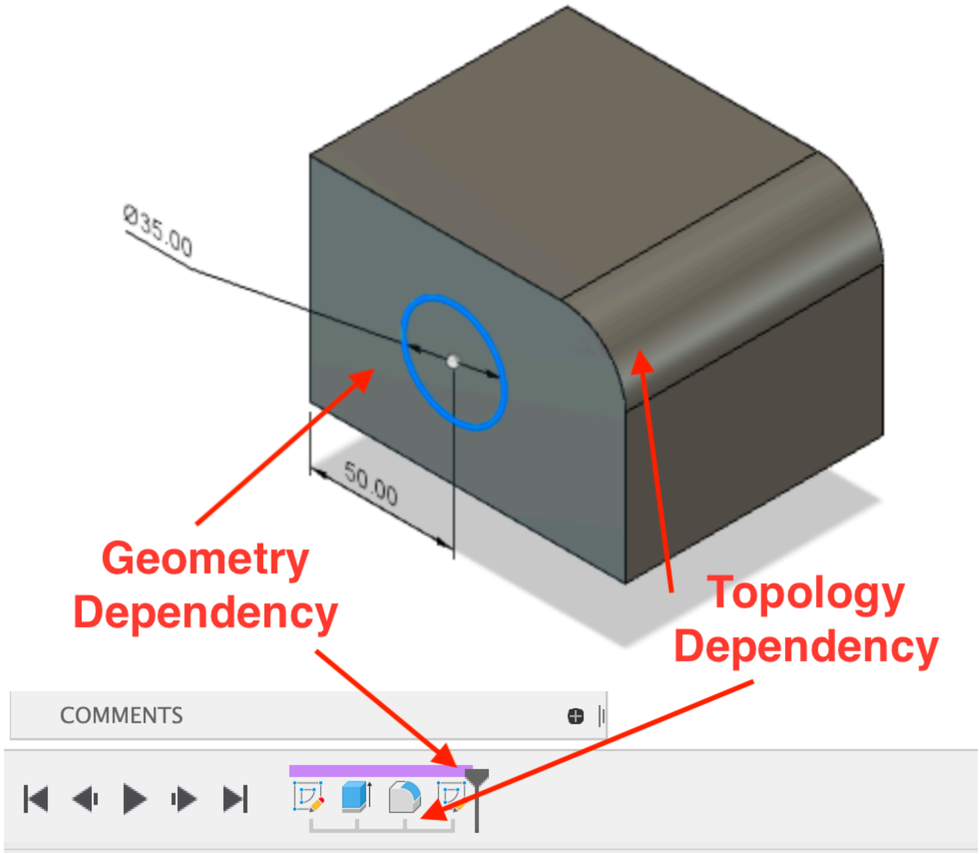
- **No match found**
- **Too many matches found**
  - Expected to find N edges, found >N
  - Usually not a Warning/Error
- **Mixed results**
  - Some, but not all matches found – only applies to features than can accept multiple inputs





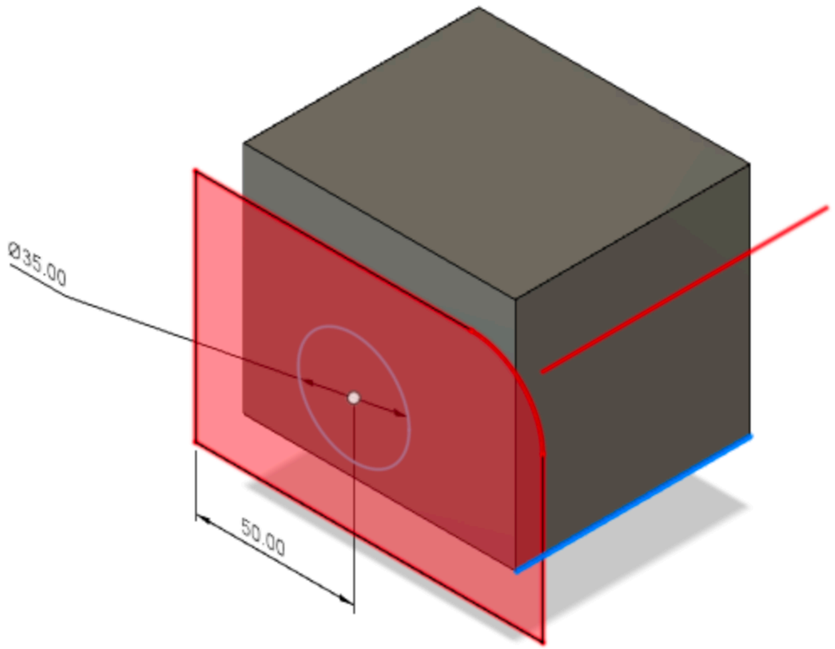
Two Kinds of Dependency

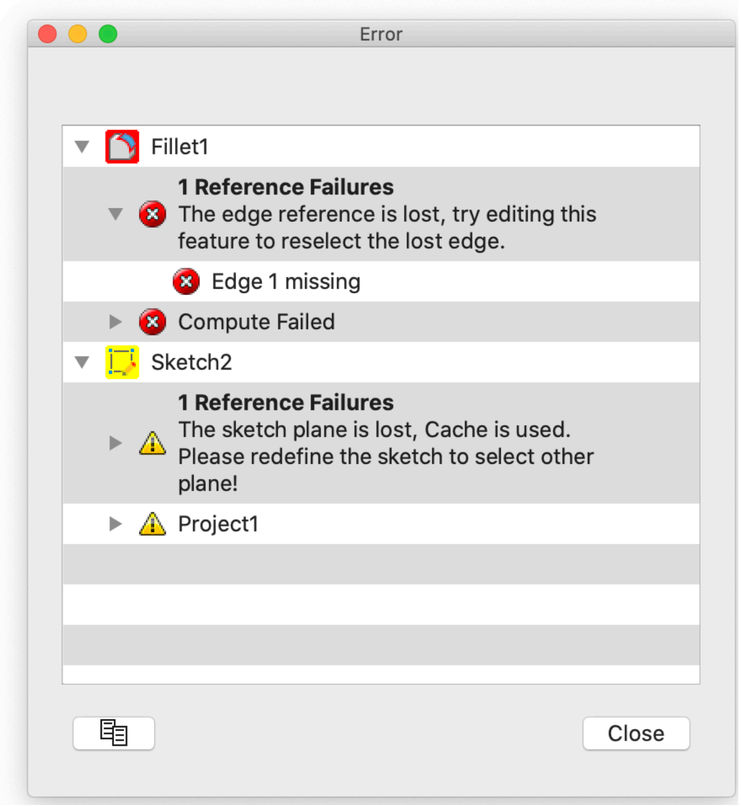
- **Geometry Dependency**
  - The geometry of the selection is required
    - Offset Workplane (needs the plane from the selection)
    - Sketch Edge Projection (needs the line or curve from the edge)
- **Topology Dependency**
  - The actual entity is required
    - Fillet (cannot fillet a line, you need the edge)
    - Shell (cannot shell a plane, you need the face)



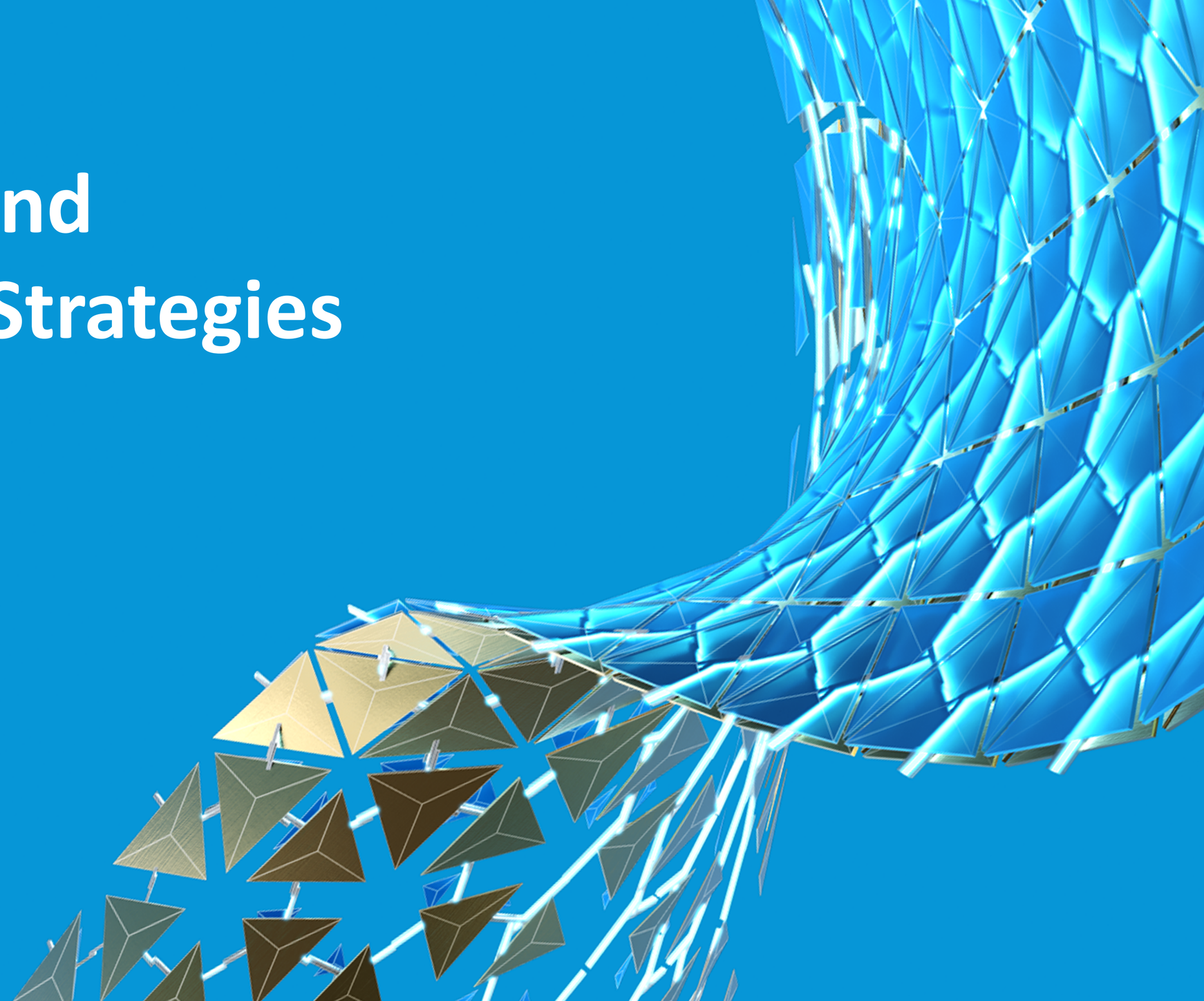
Why is This Important to Know?

- **Geometry Dependency failures result in <u>Warnings</u>**
- **Topology Dependency failures result in <u>Errors</u>**
- **Why?**
  - Geometry can be cached. Topology cannot





Debugging and Error Fixing Strategies



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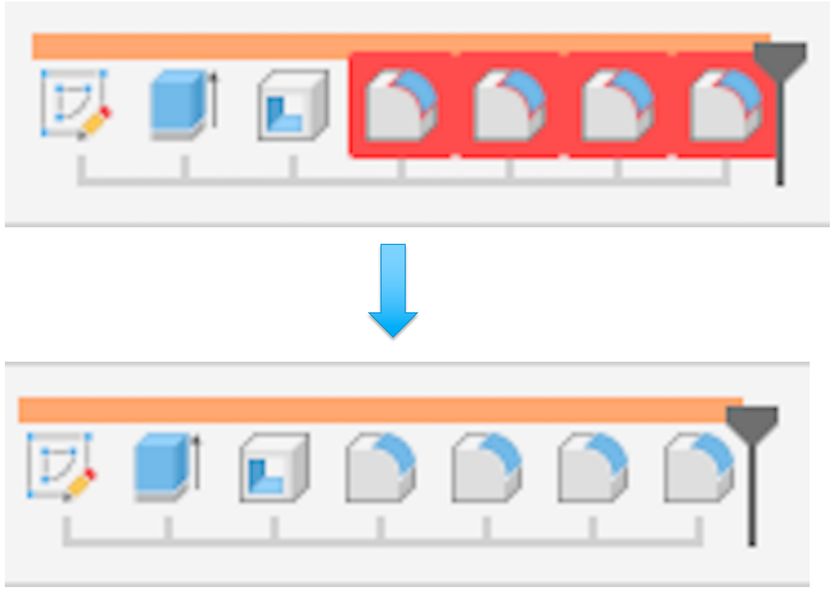
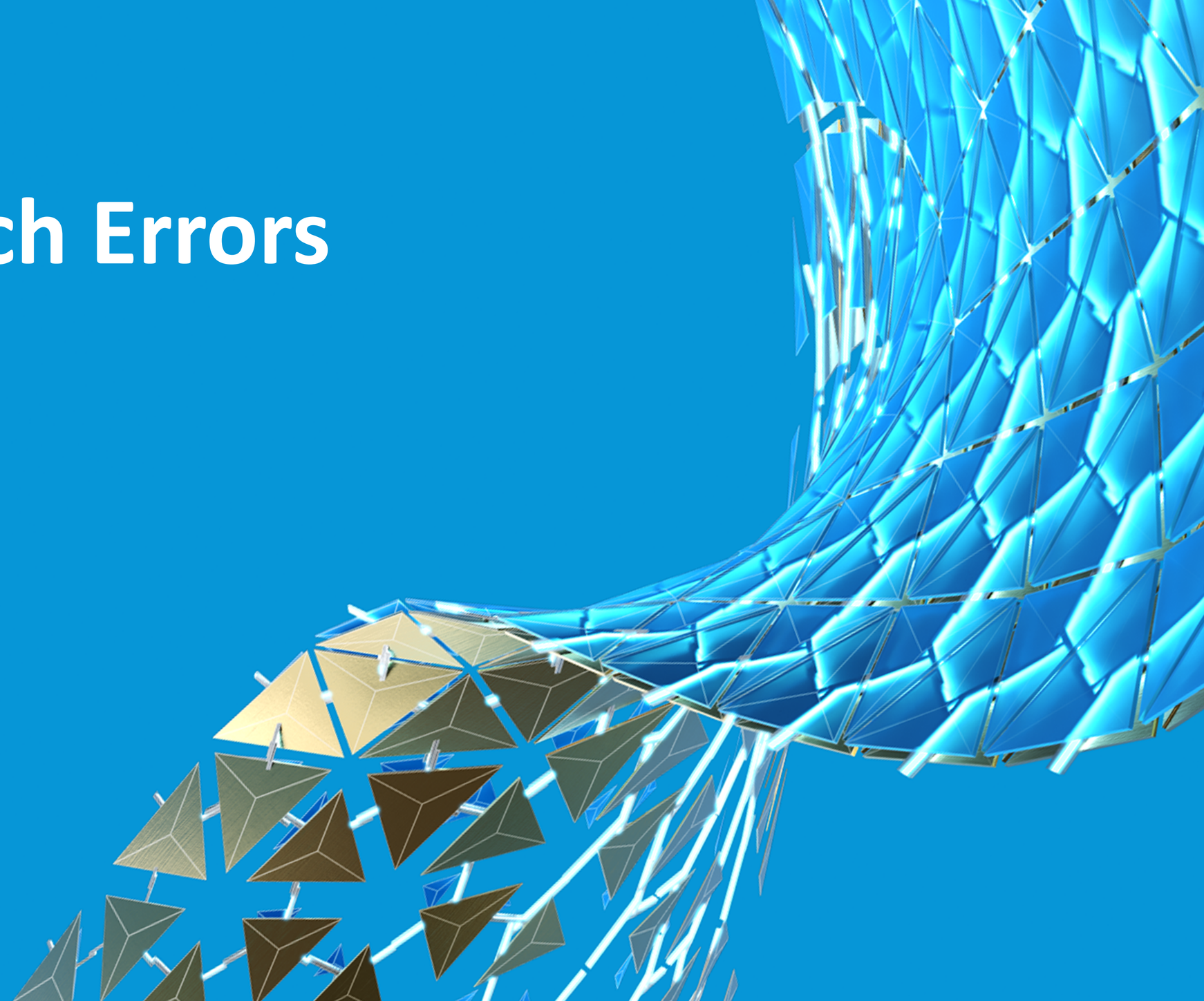
General Strategies

- **Read the error messages**
- **Fix Errors/Warnings when they happen**
- **Fix the Errors in Timeline order**



Fixing Sketch Errors

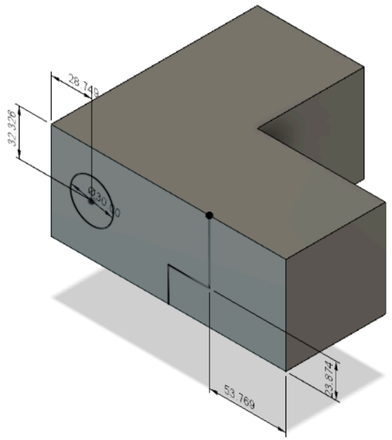


Sketch Errors

- **Sketch Errors come in 3 flavors:**
  - Sketch Plane failures
  - Sketch solve failures
  - Projected geometry failures

Fixing Sketch Plane Failures

- **Sketch Plane is a Geometry Dependency**
  - Failure is a Warning
  - Only available fix is Redefine Sketch Plane
    - Be careful here – Redefine can cause unexpected results



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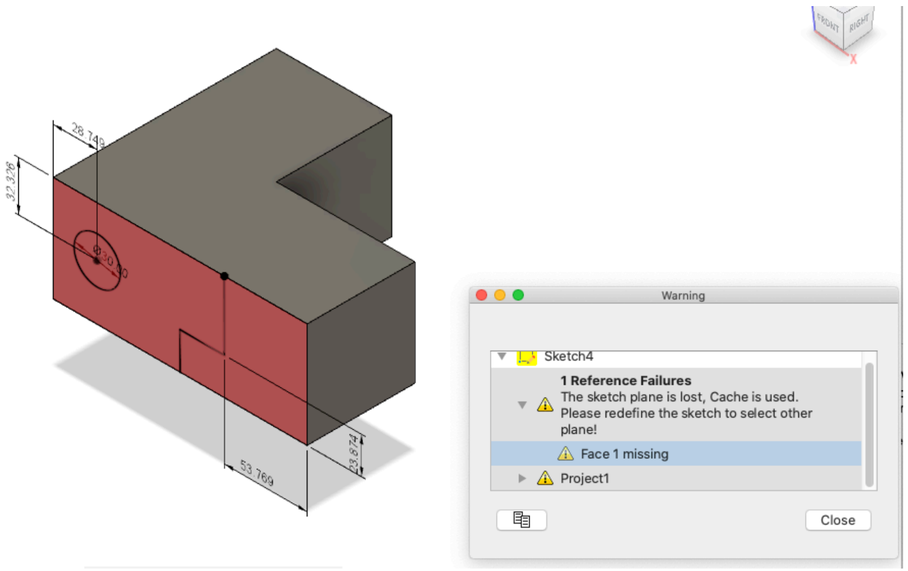

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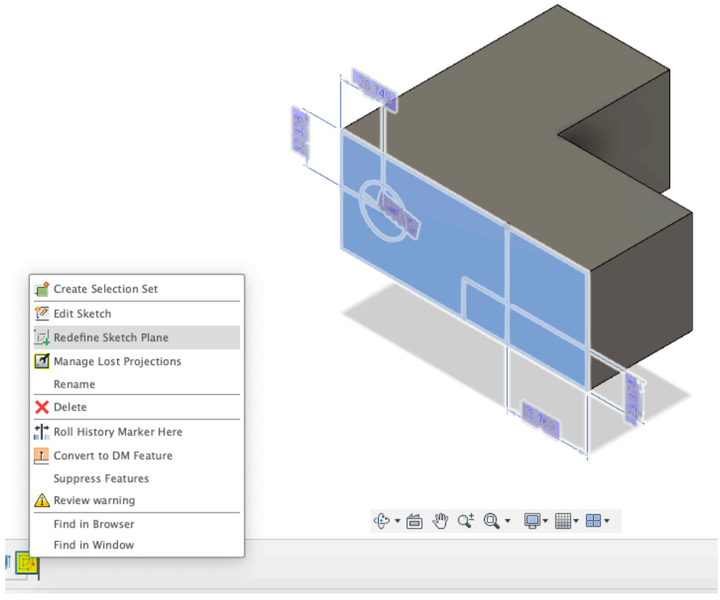

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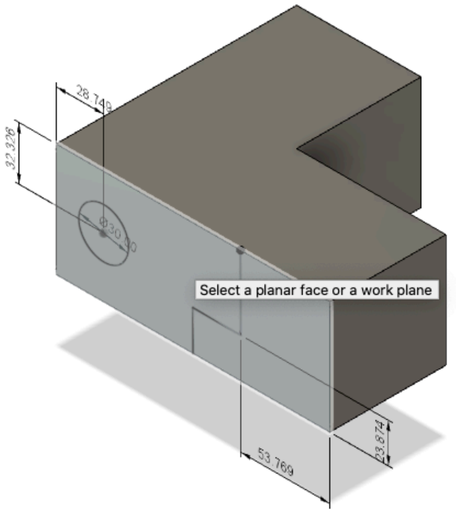

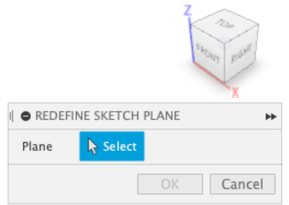

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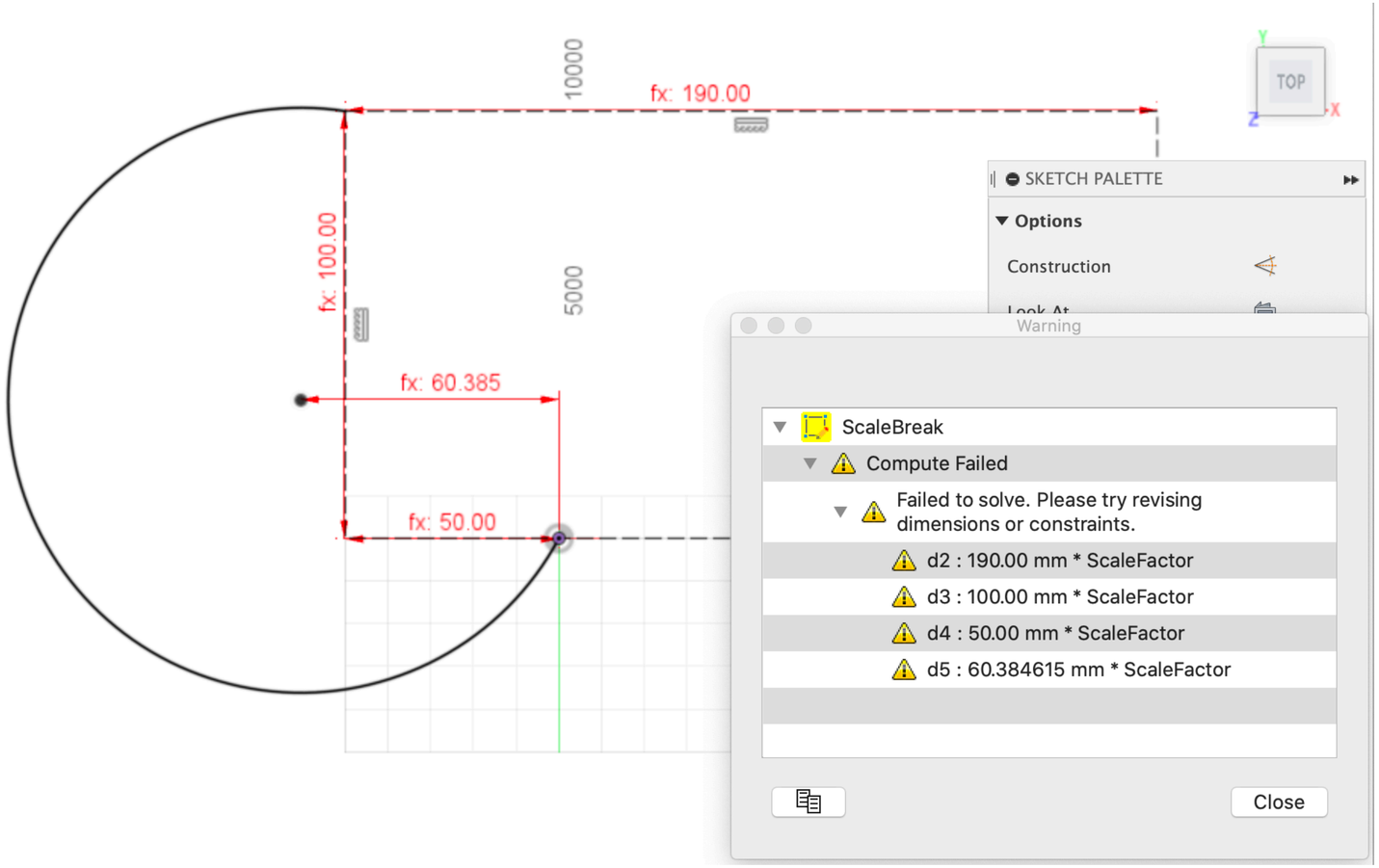
Fixing Sketch Solve Failures

- **Usually, this is because of a conflict between dimensions and/or constraints**
  - You need to find the conflict and remove it



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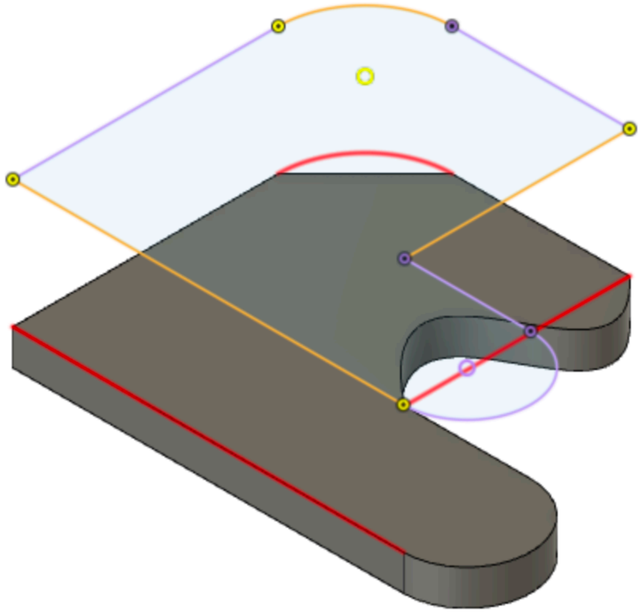
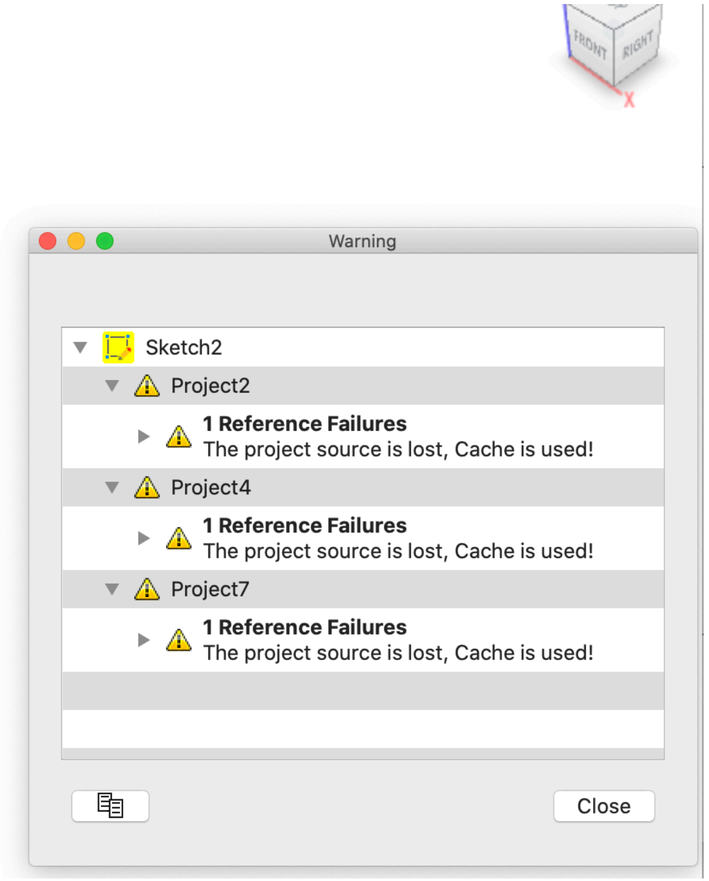
Projected Geometry Failures

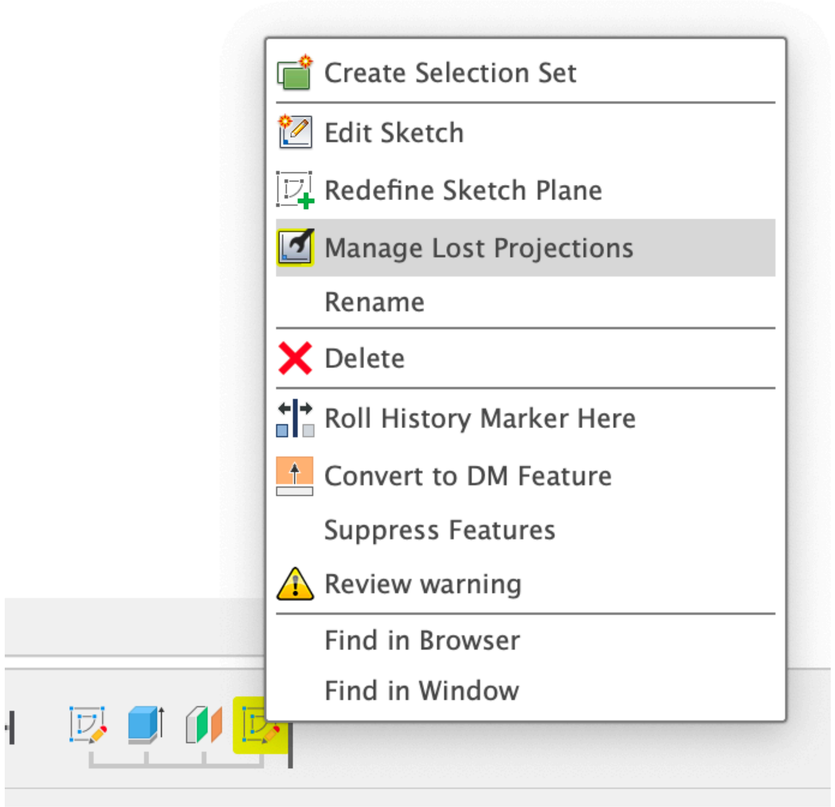
- **Most common sketch failure**

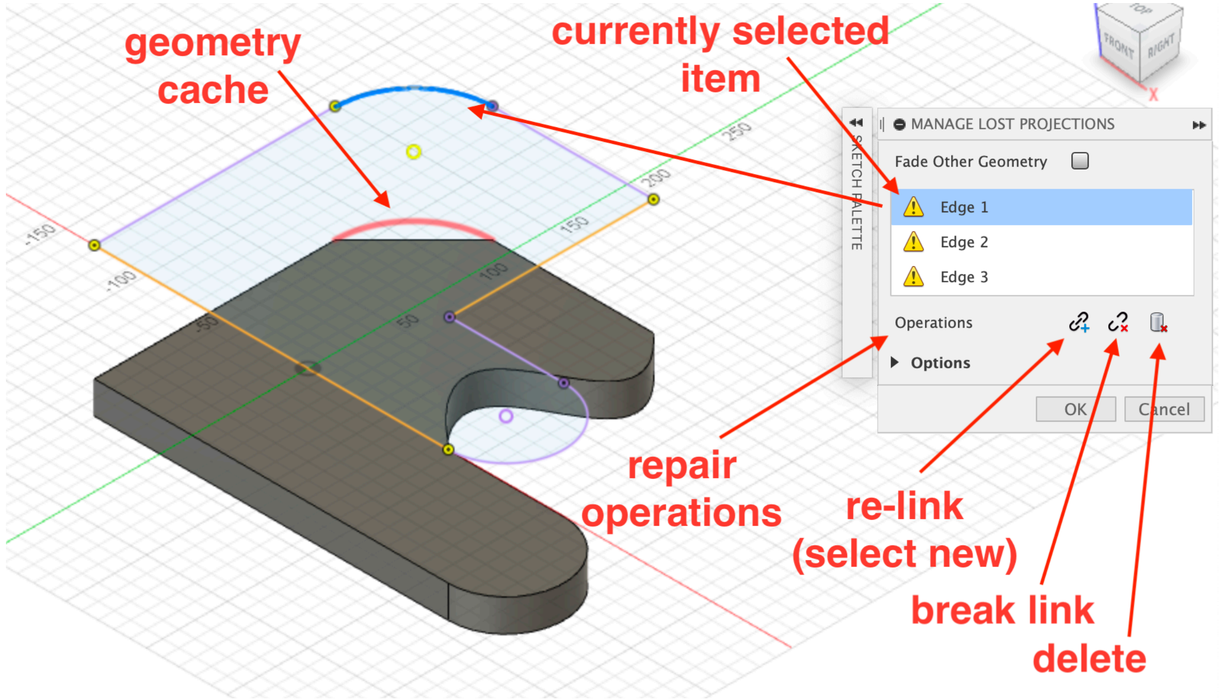




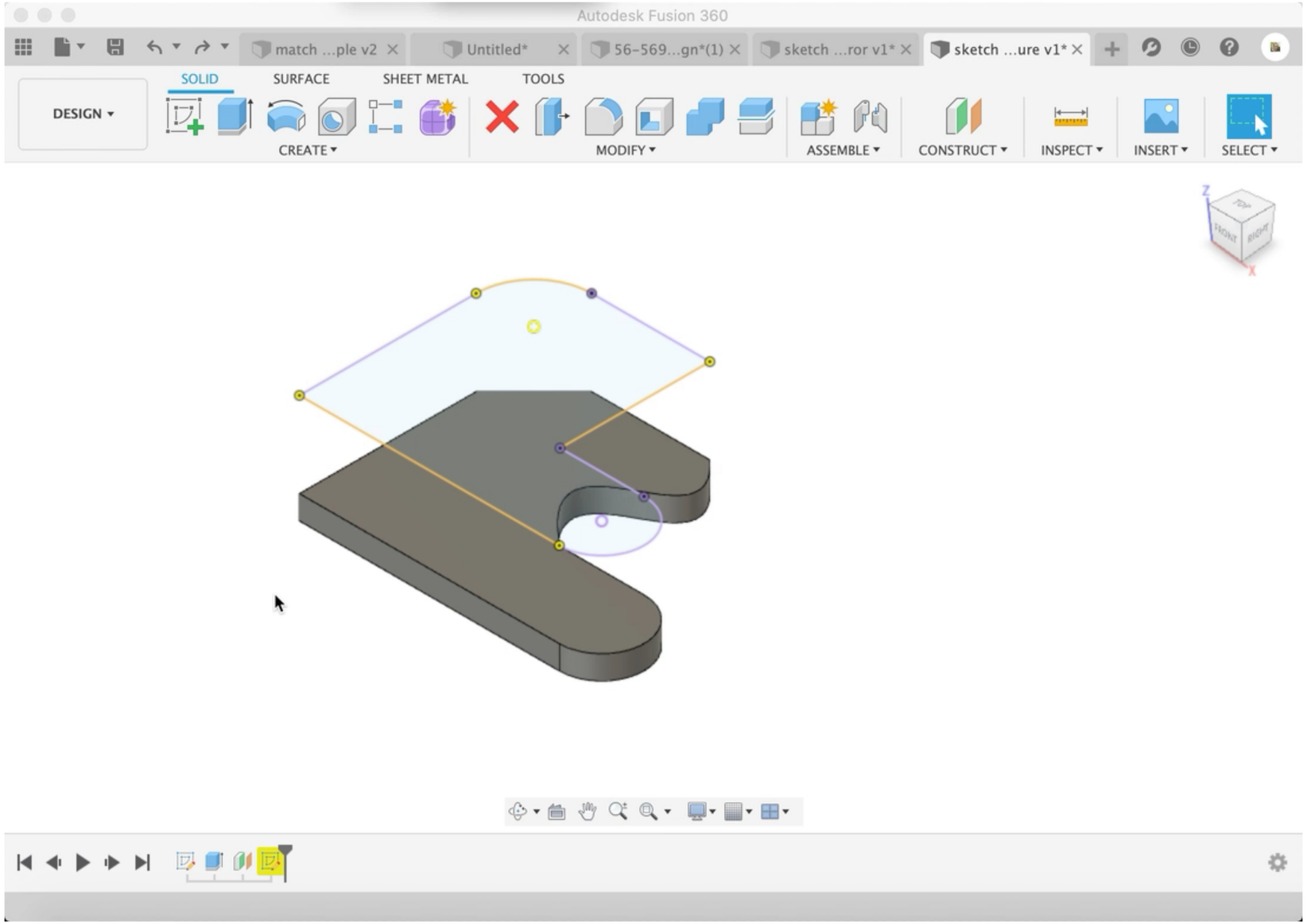
Fixing Projected Geometry Failures

- **In the April, 2019 update, Fusion added “Manage Lost Projections”**





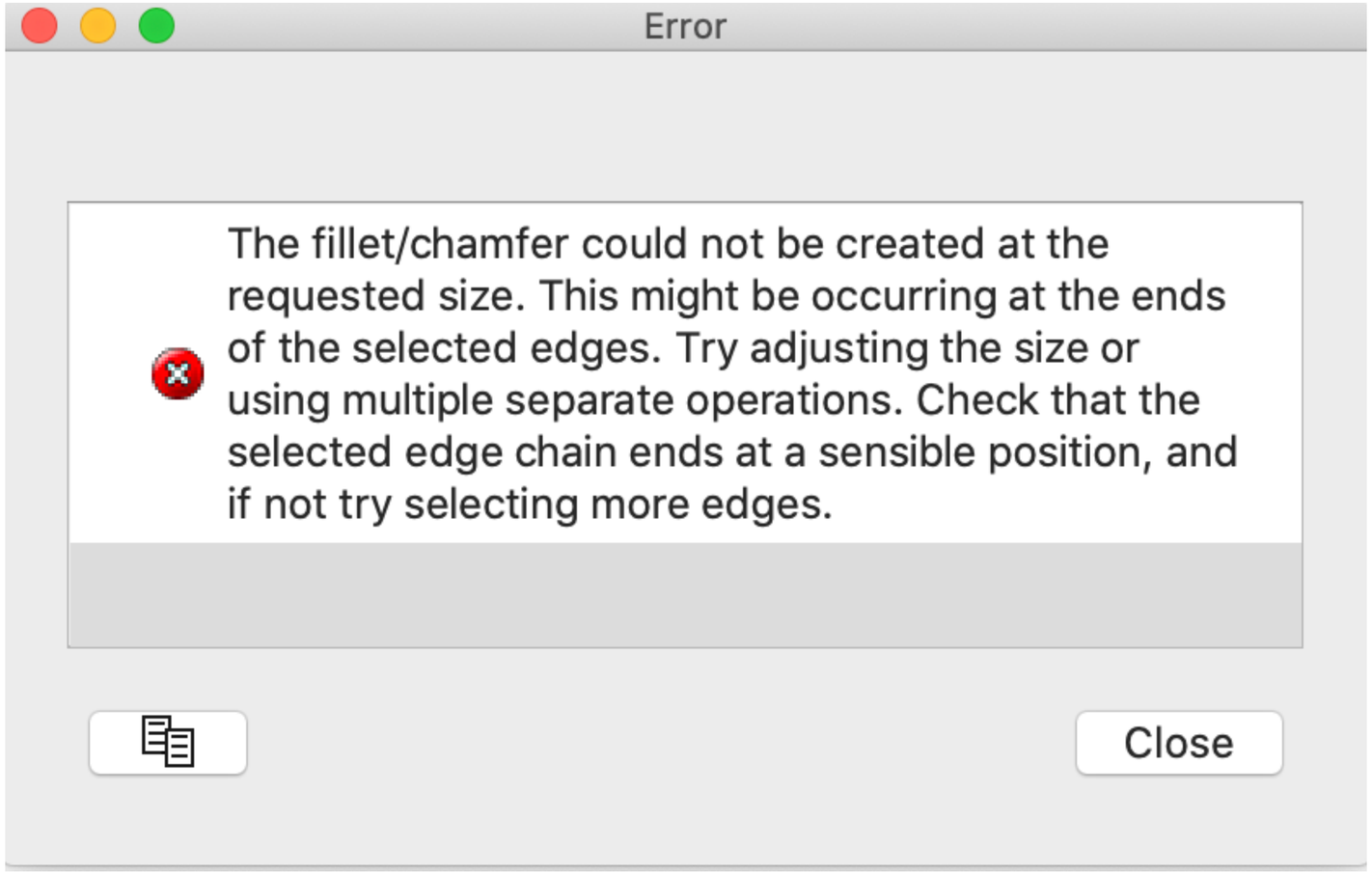
Fixing Projected Geometry Failures



Fixing Modeling Errors

Geometry Modeling Failures

- Usually happen deep in the modeling kernel
- No general solutions here
- Each feature has different common failures



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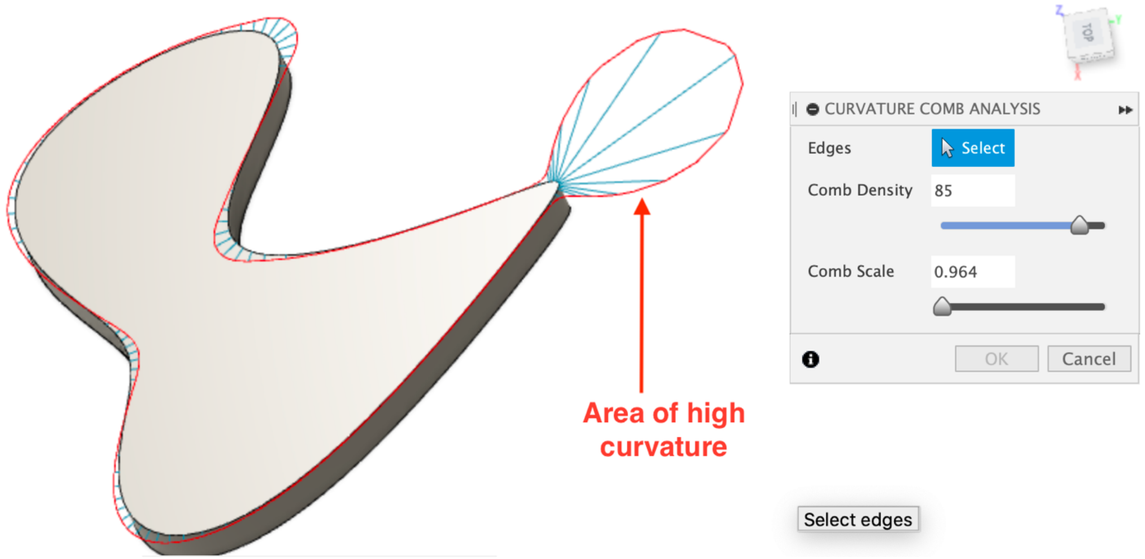
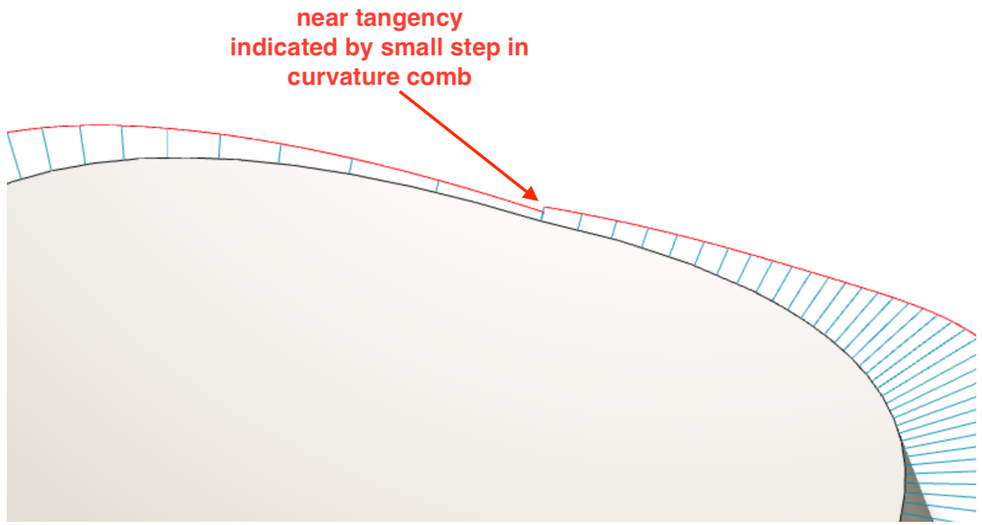
Fillet Geometry Failures

- **Areas of high curvature**



- **Near tangent edges**



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Fillet Geometry Failures

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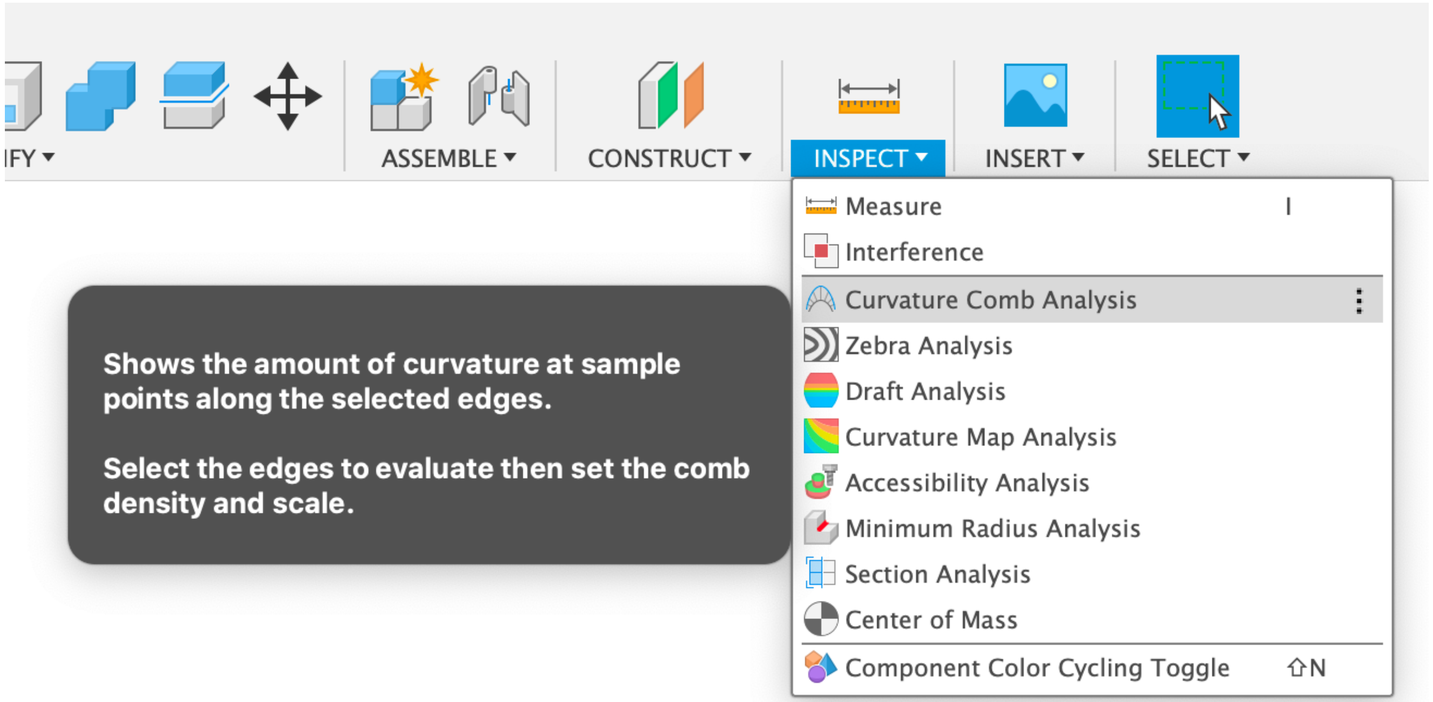

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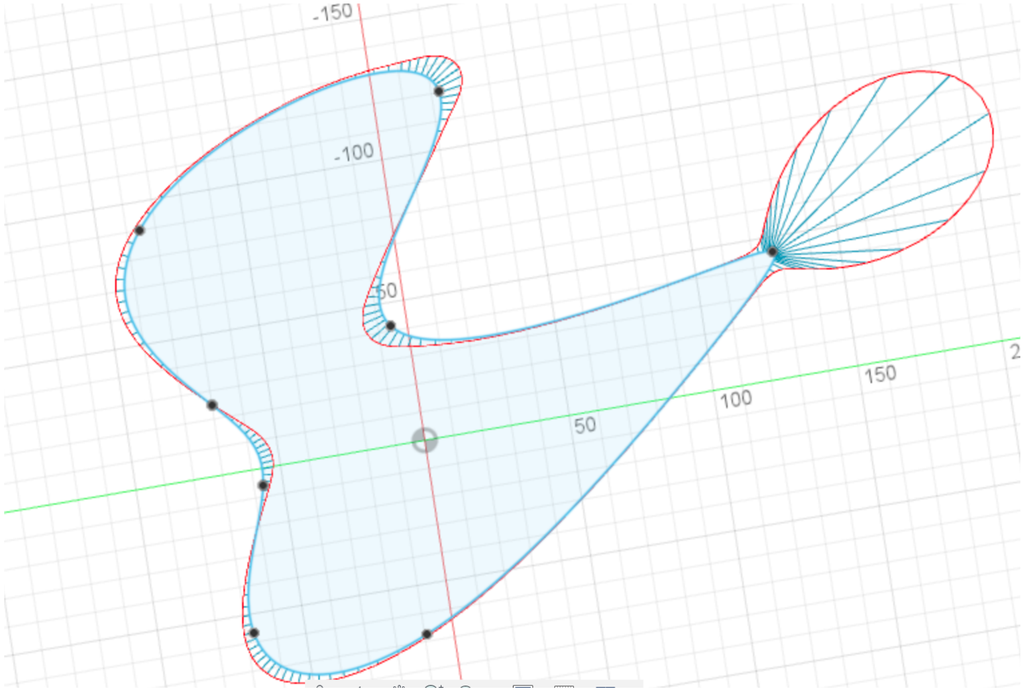
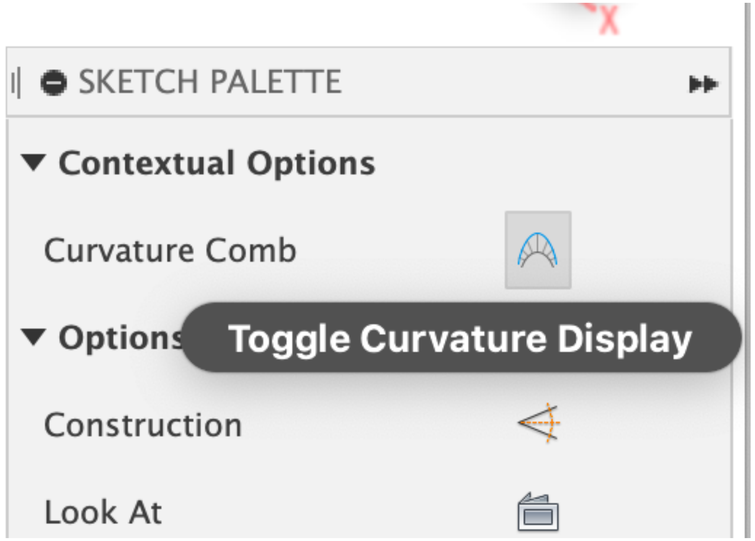
Fillet Areas of High Curvature Fixes

- **Identify areas of high curvature using Curvature Comb Analysis**
- **Only fix is to reduce the curvature**
- **Use Curvature Combs in sketch, then adjust the spline for less curvature**





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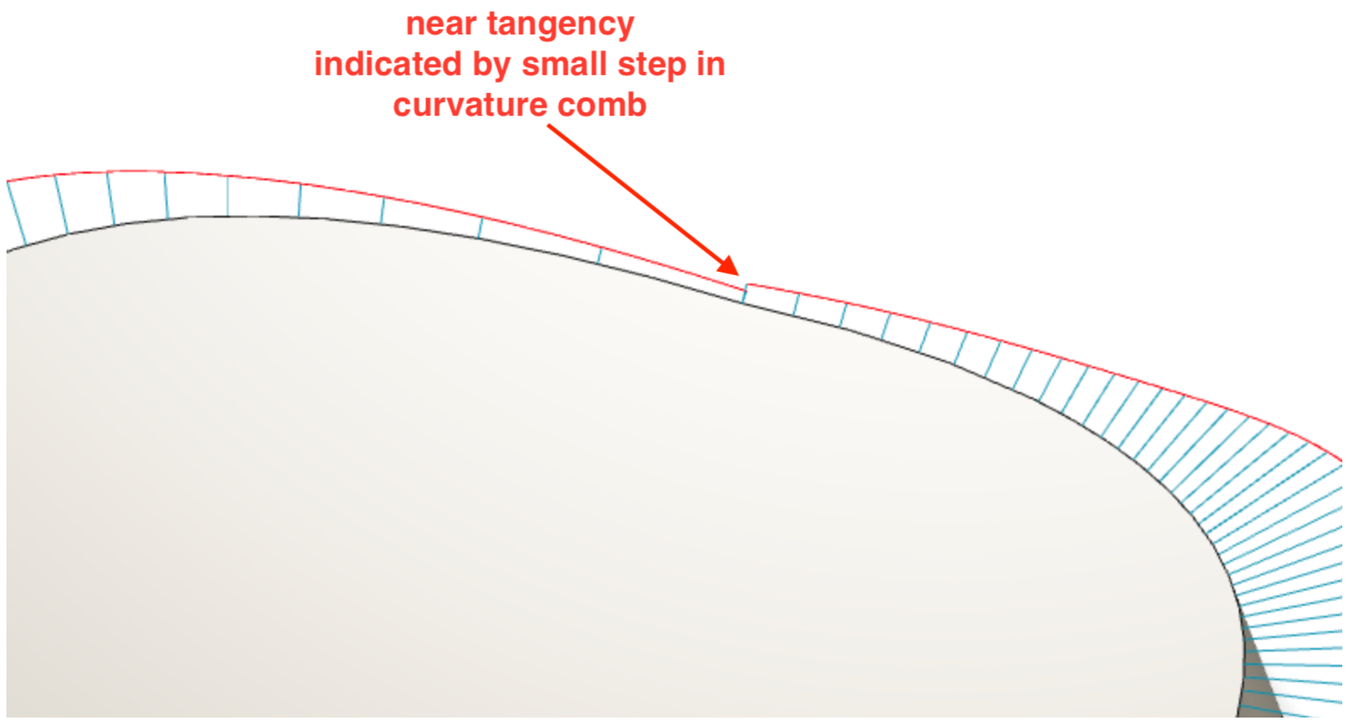
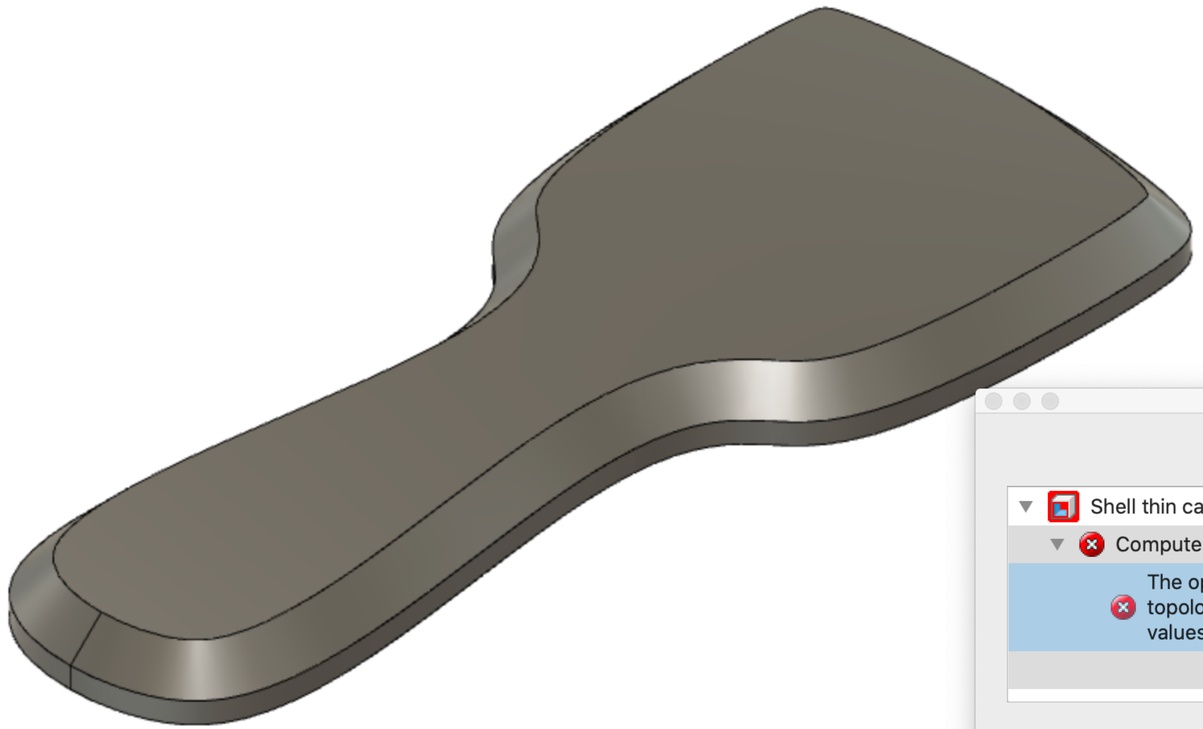
Fixing Fillet Near Tangencies

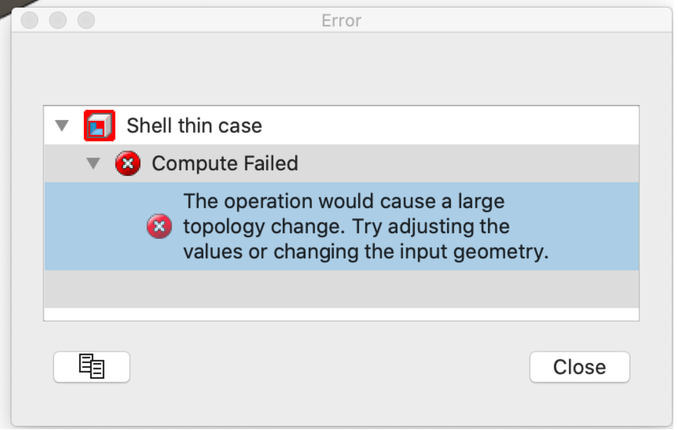
- **Identify the edges involved**
- **Add constraints to force tangency**
- **Text is hard to fix**



Shell/Offset Geometry Failures

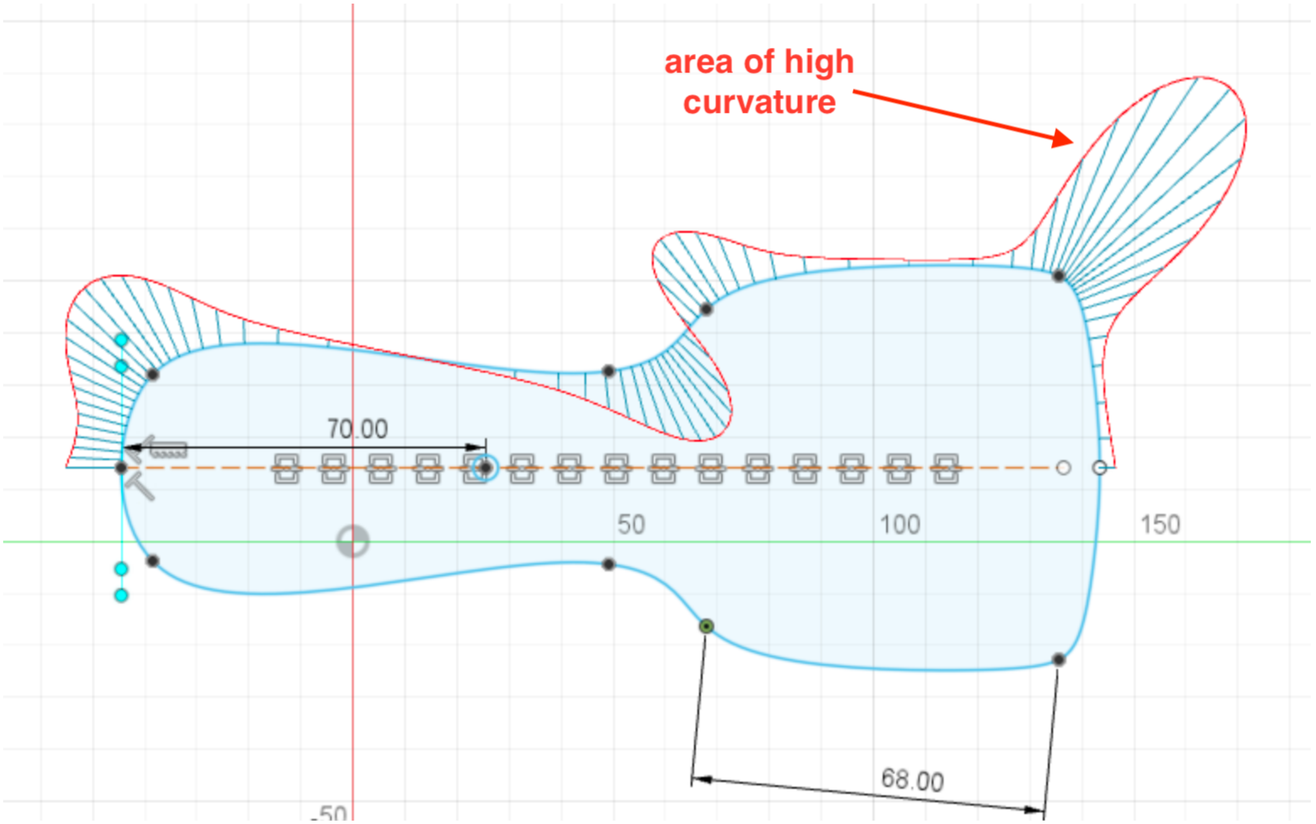
- **Main error is self-intersecting surfaces**



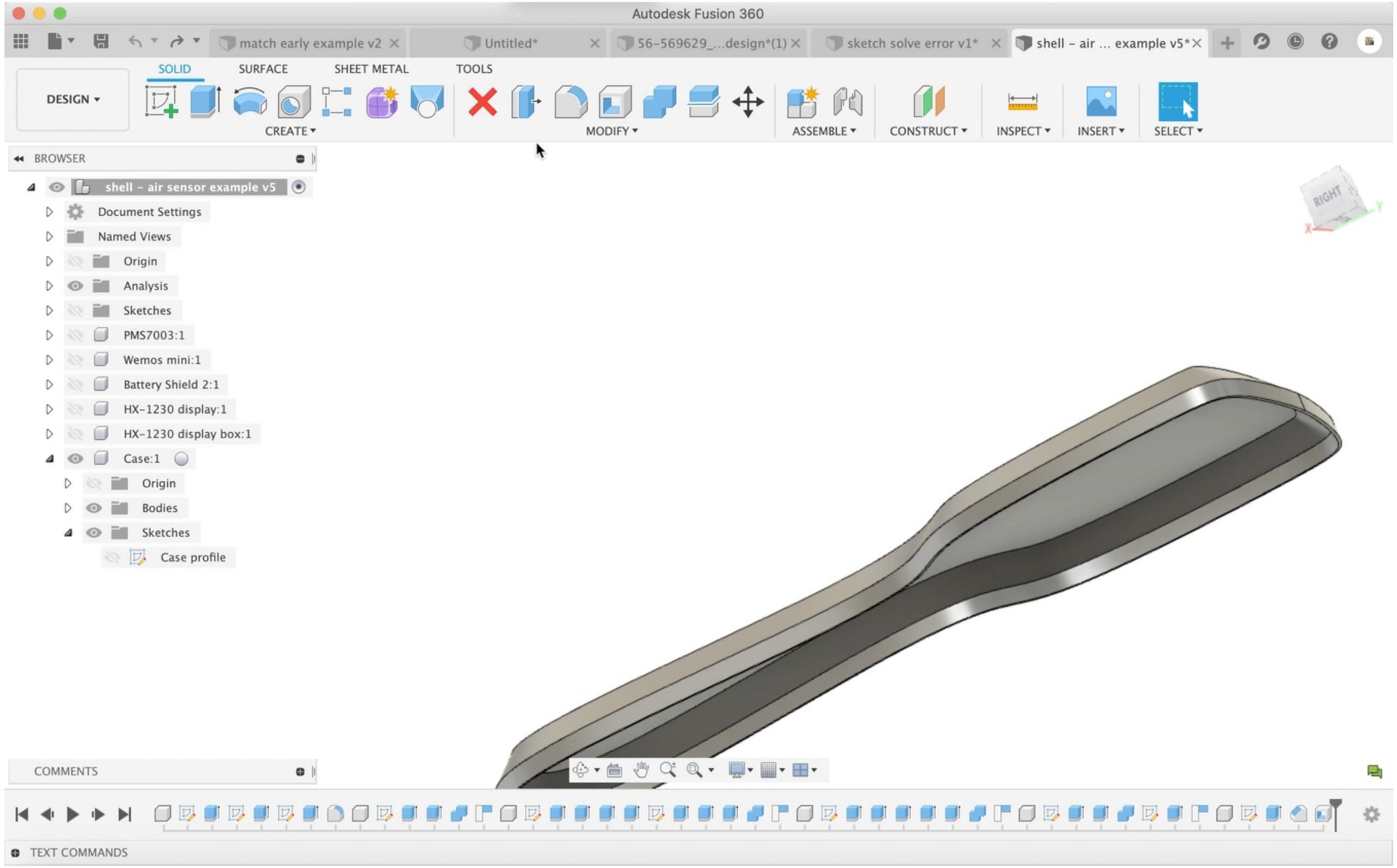


Fixing Shell/Offset Failures

- **Main approach here is to reduce surface curvature**



Shell Example Demo



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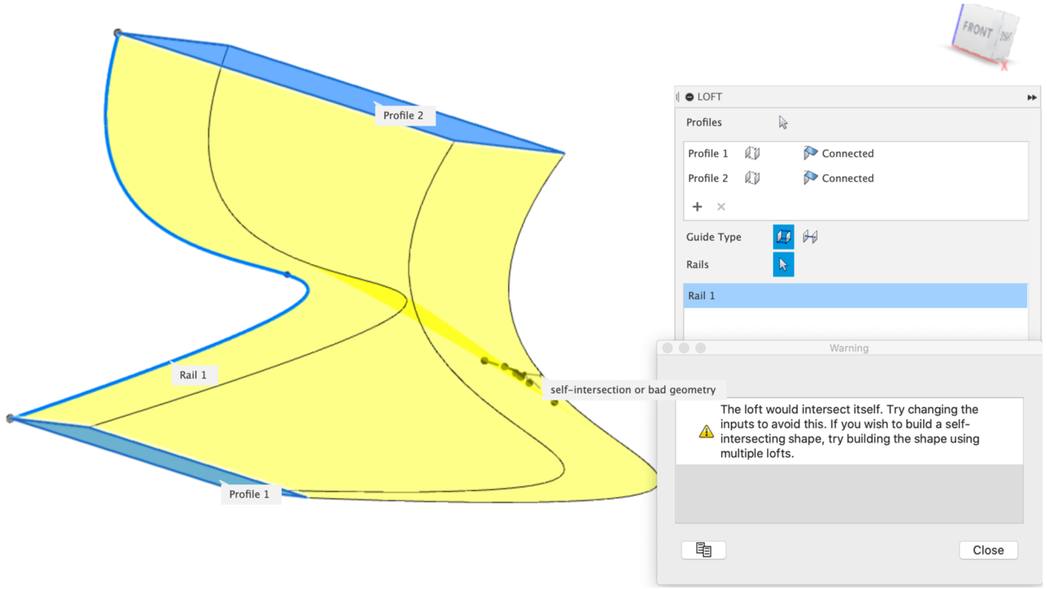
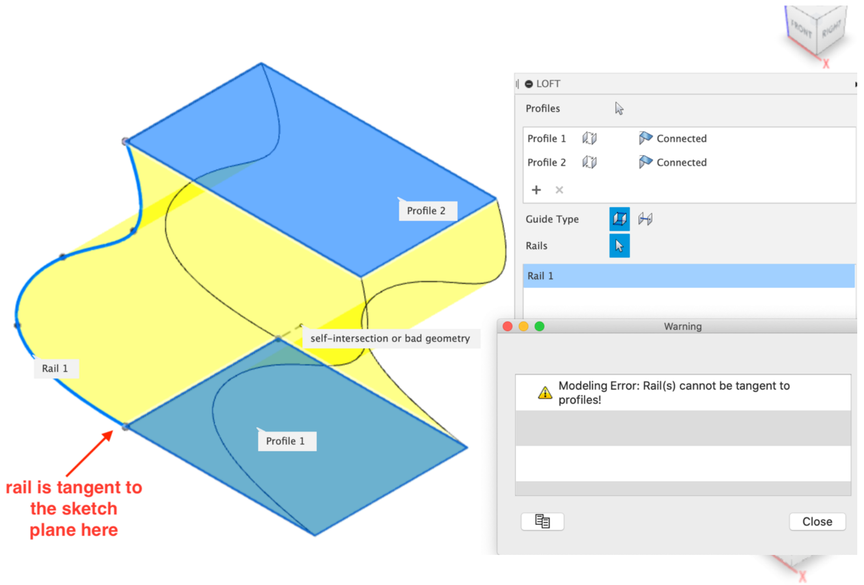
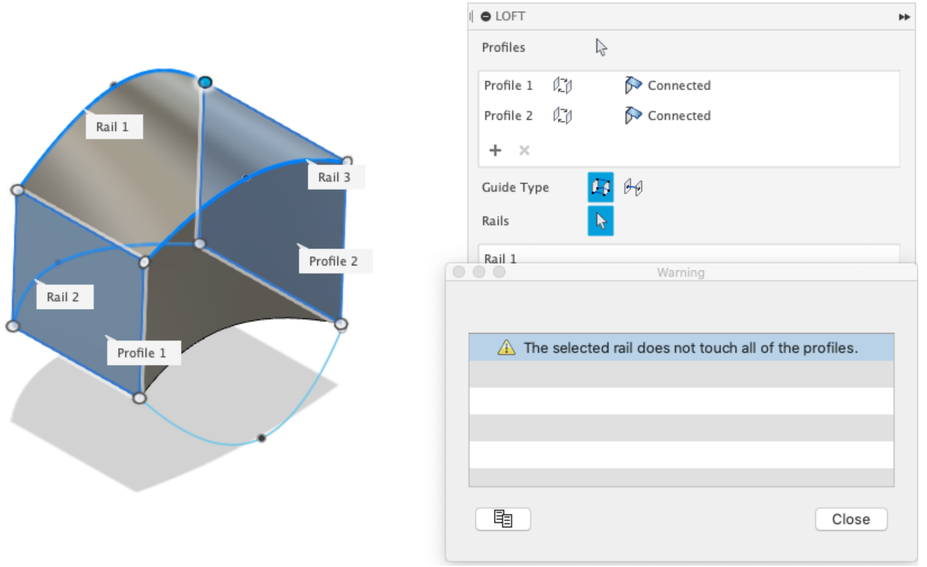
Loft Geometry Errors

- **Self intersections (detecting a pattern here?)**
- **Rail issues**







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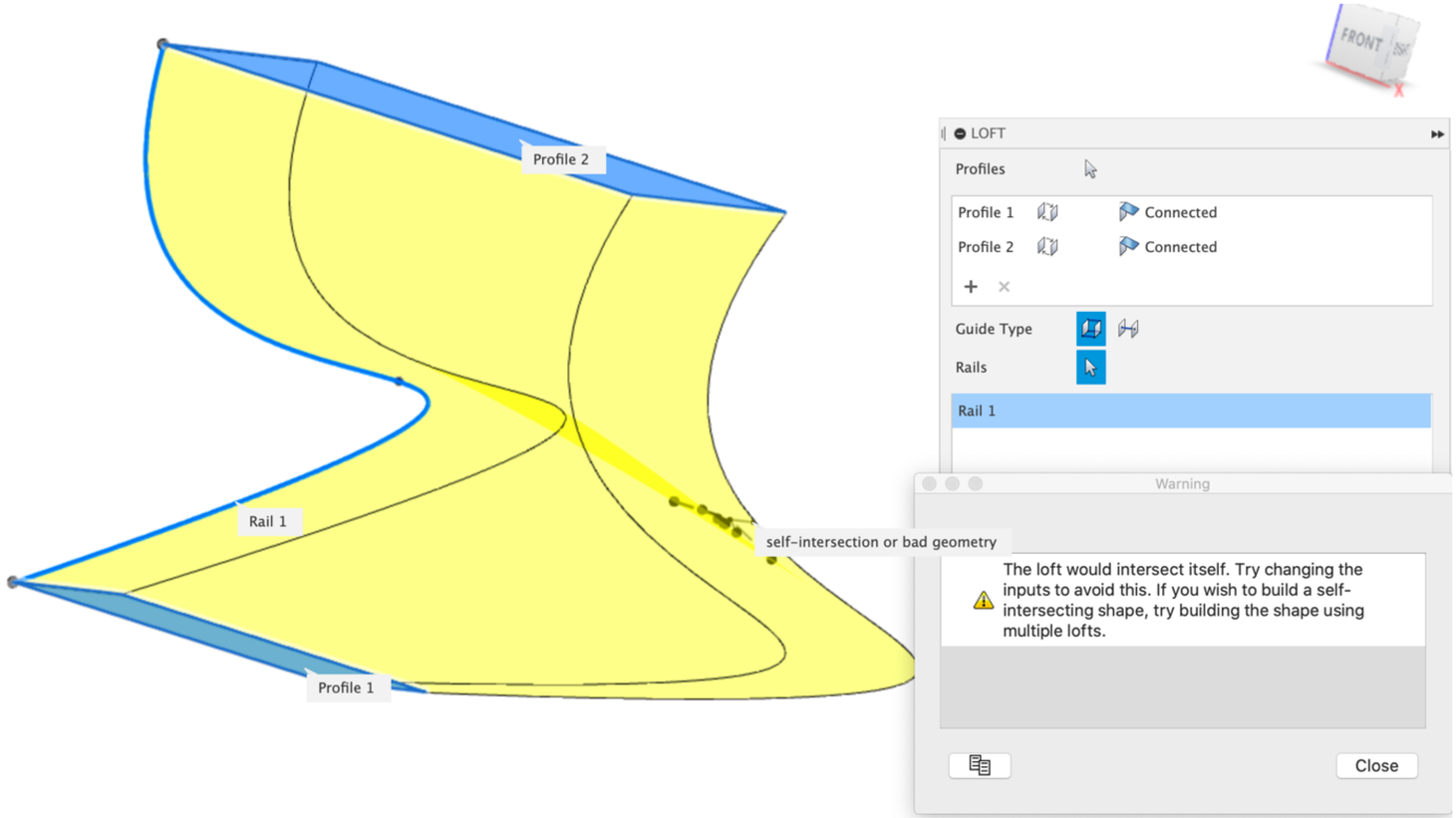
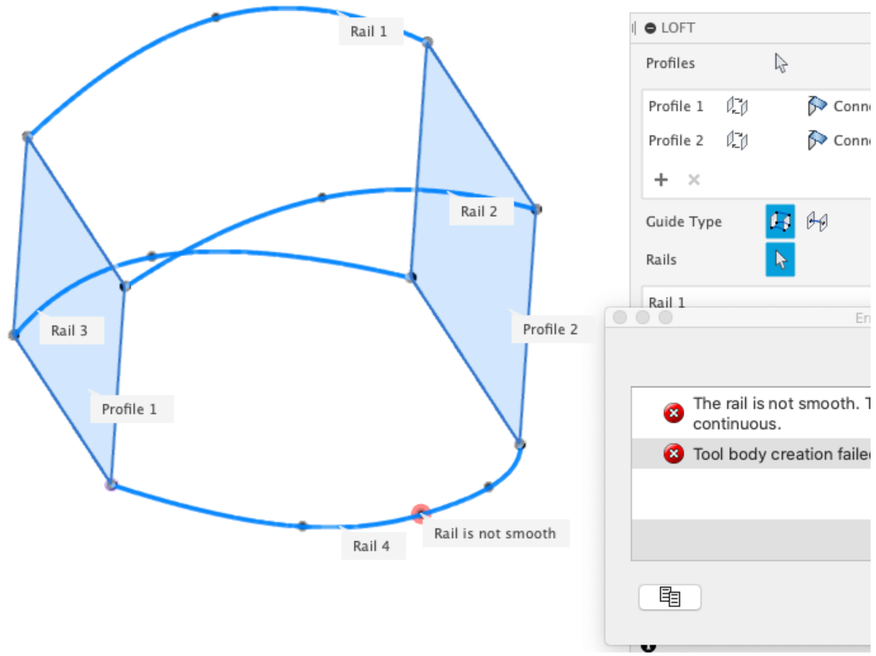
Fixing Loft Self Intersections

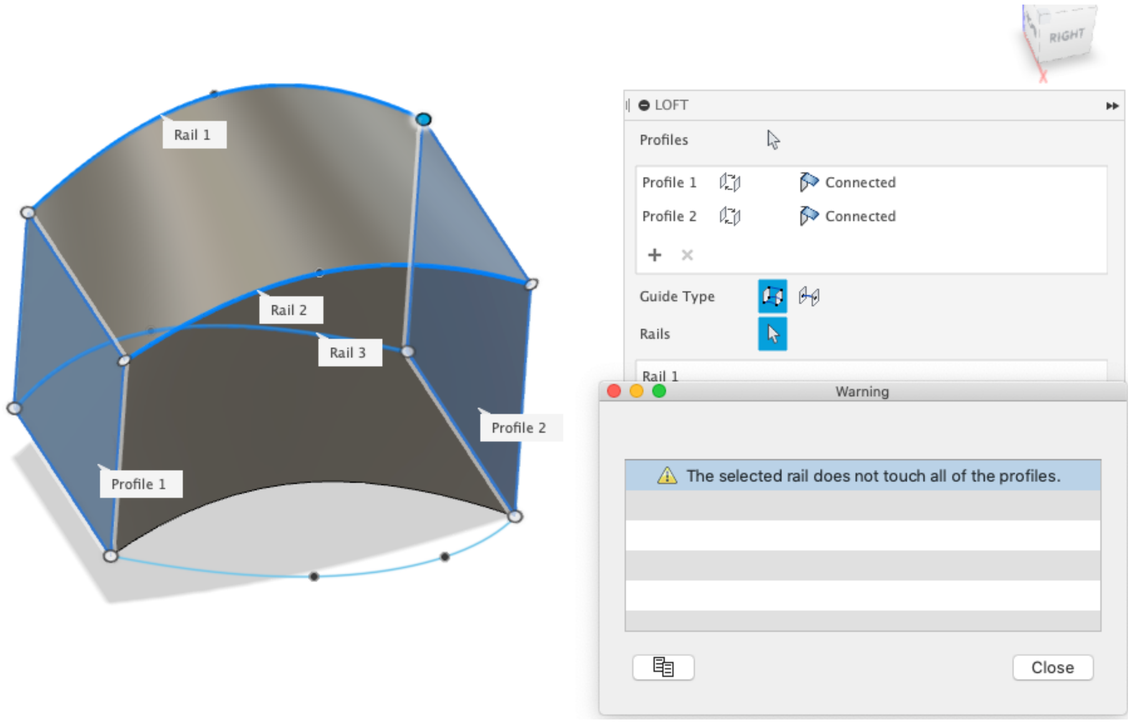
- **Modify the profiles/rails to correct the self-intersection**



Fixing Loft Rail Failures

- For tangency failures, add tangent constraint
- For intersection errors, find the point of non-intersection, add constraints





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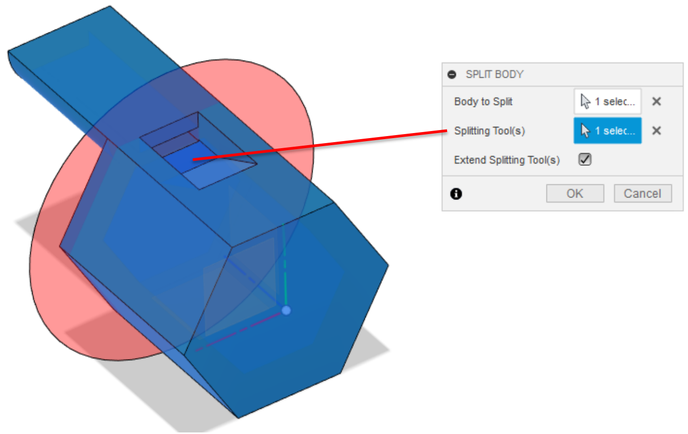
Combine/Join/Cut/Intersect Geometry Failures

- **Near coincident geometry**
  - **Split Body example:**



Using face coincident to other faces fails

- **Other examples of errors**
  - **Combine fails:**

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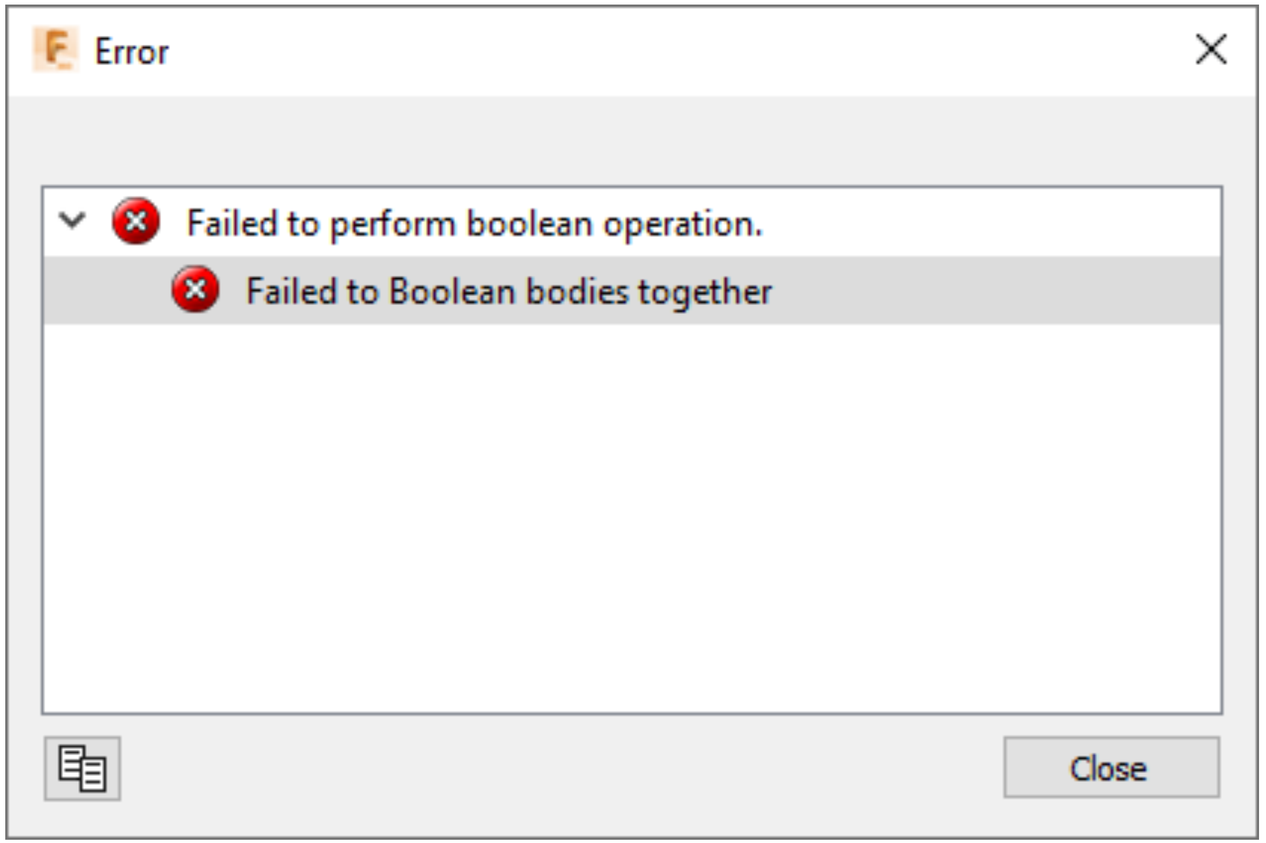
Combine/Join/Cut/Intersect Geometry Failures



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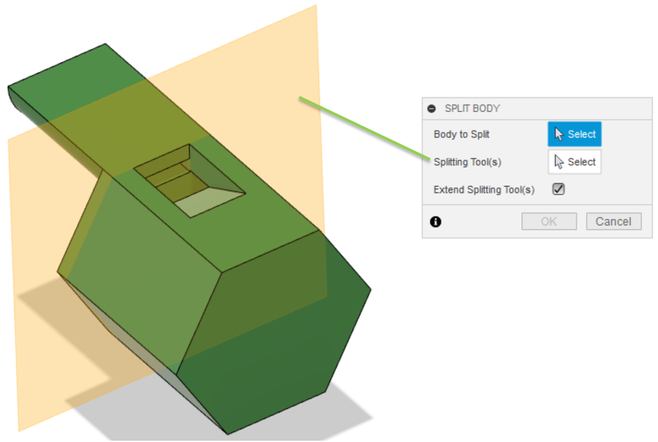
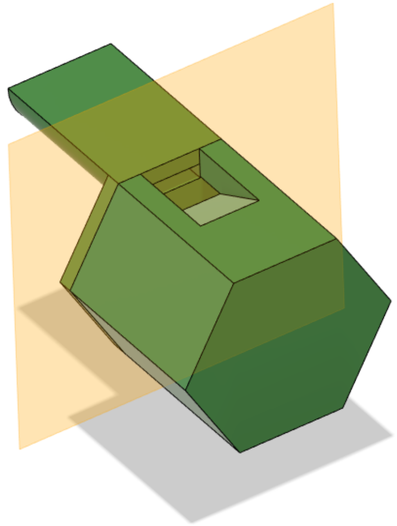
Fixing Combine Failures

- **Avoid or fix any “near coincidences” in the geometry**
- **Make sure there are clear overlaps between target and tool**
  - Especially with spline geometry – planes, cylinders, etc. are usually OK

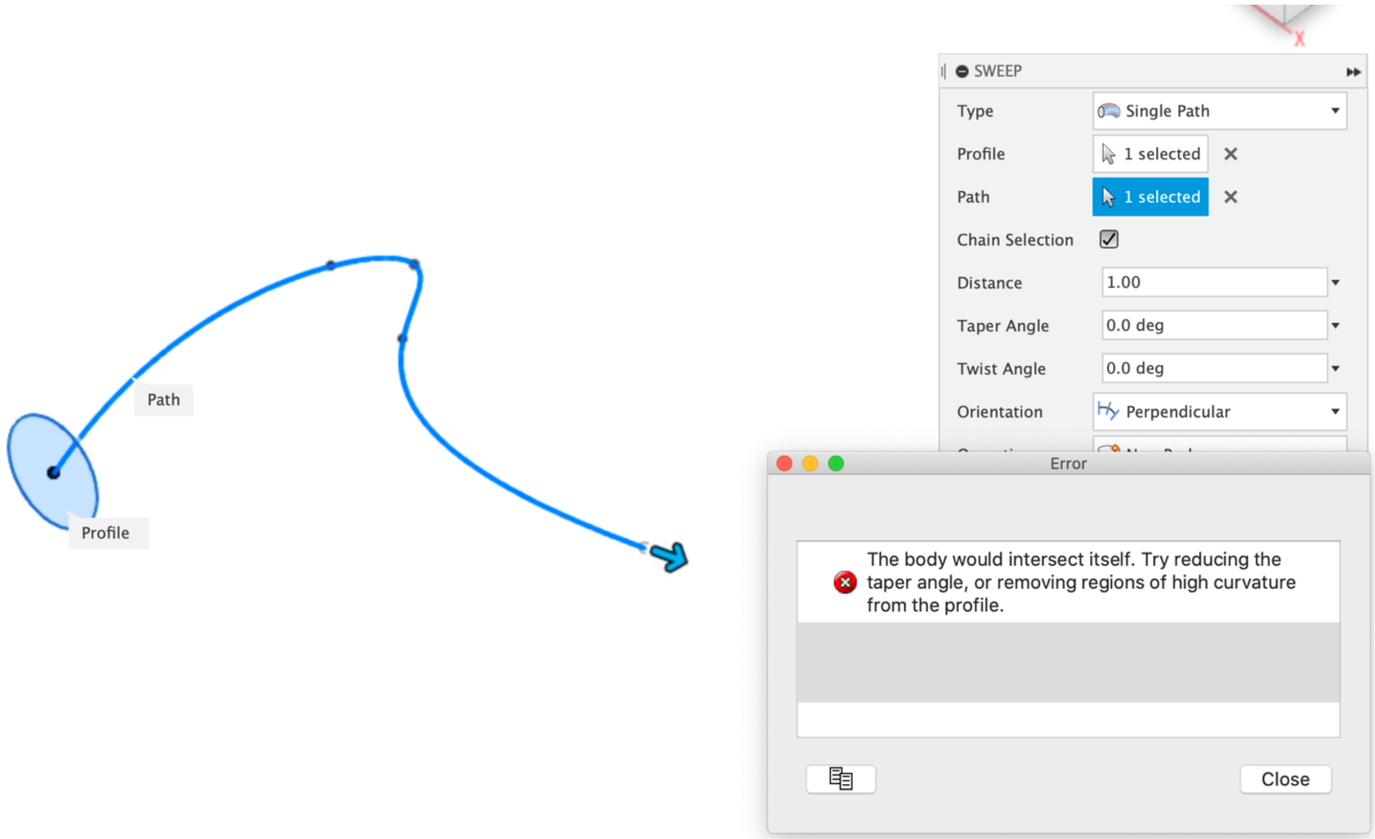




Using a plane does not fail

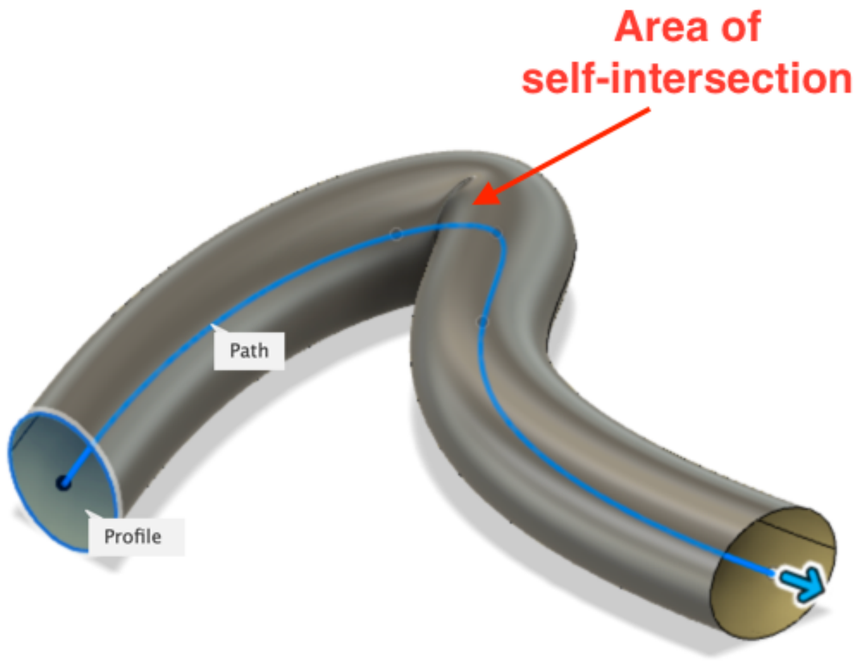
Sweep Geometry Failures

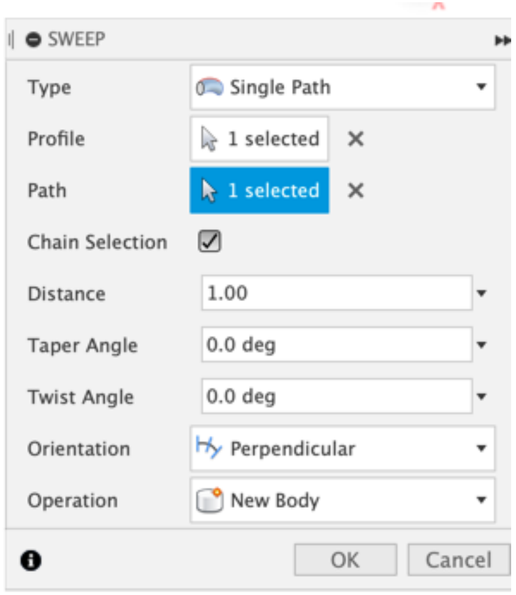
- **Self-intersecting geometry (again…)**



Fixing Sweep Geometry Failures

- **Reduce curvature, or profile size**
- **Cheat and use surface sweep**





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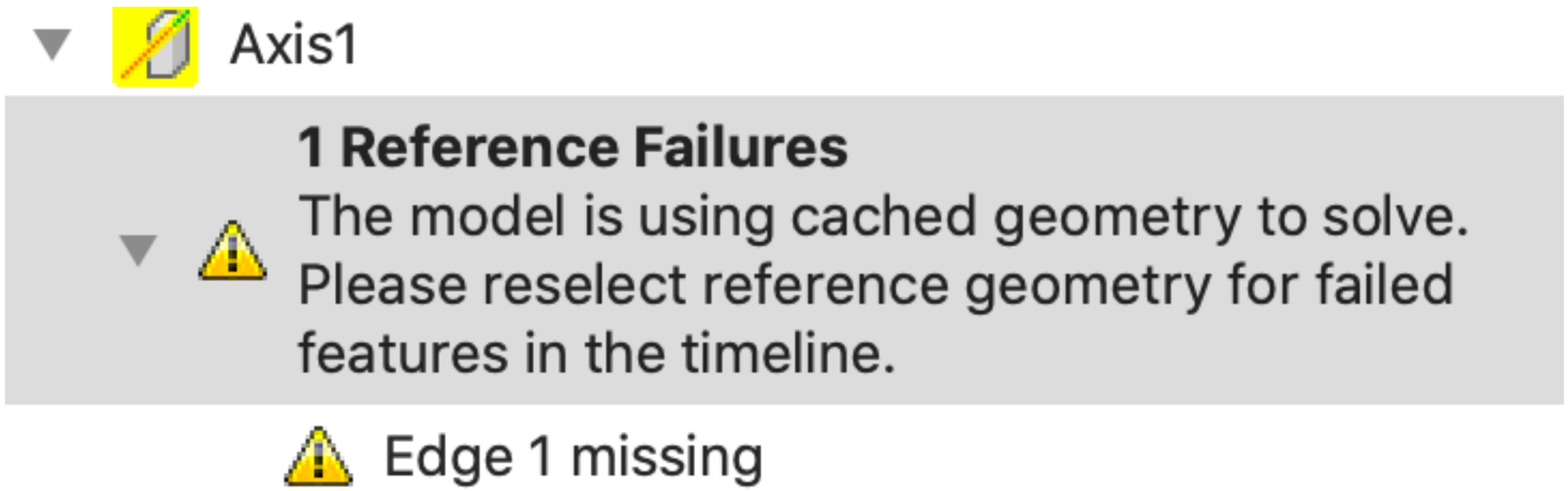
Dependency Modeling Failures



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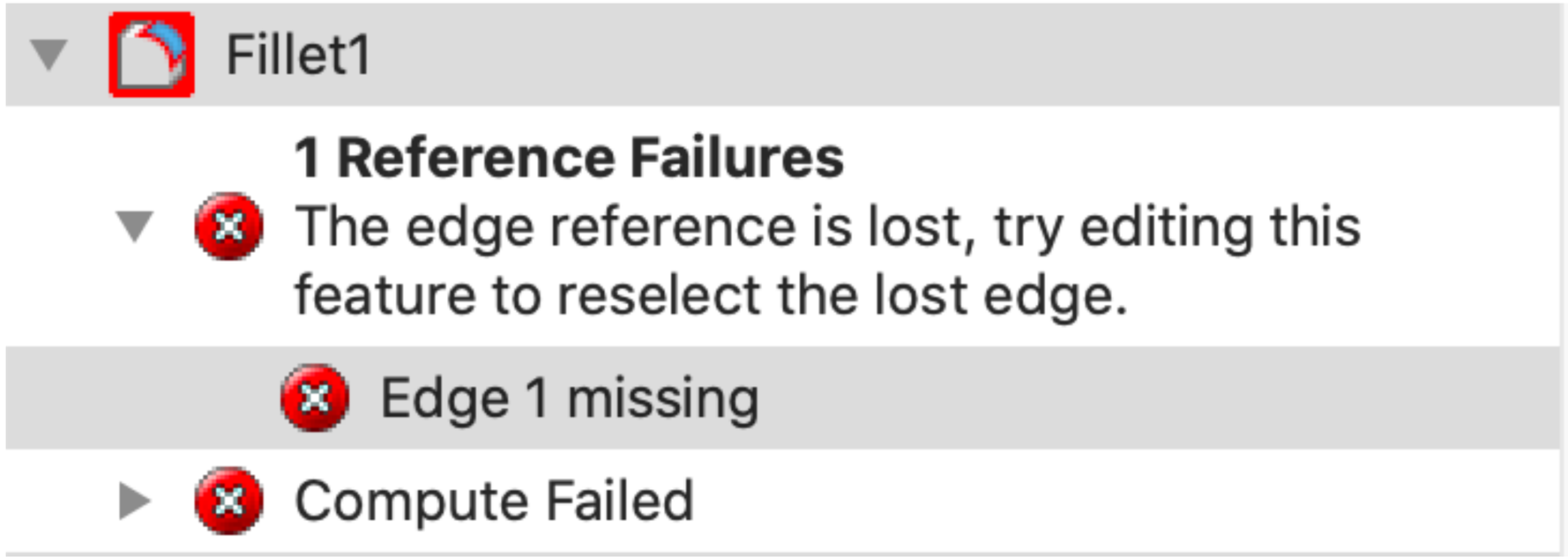

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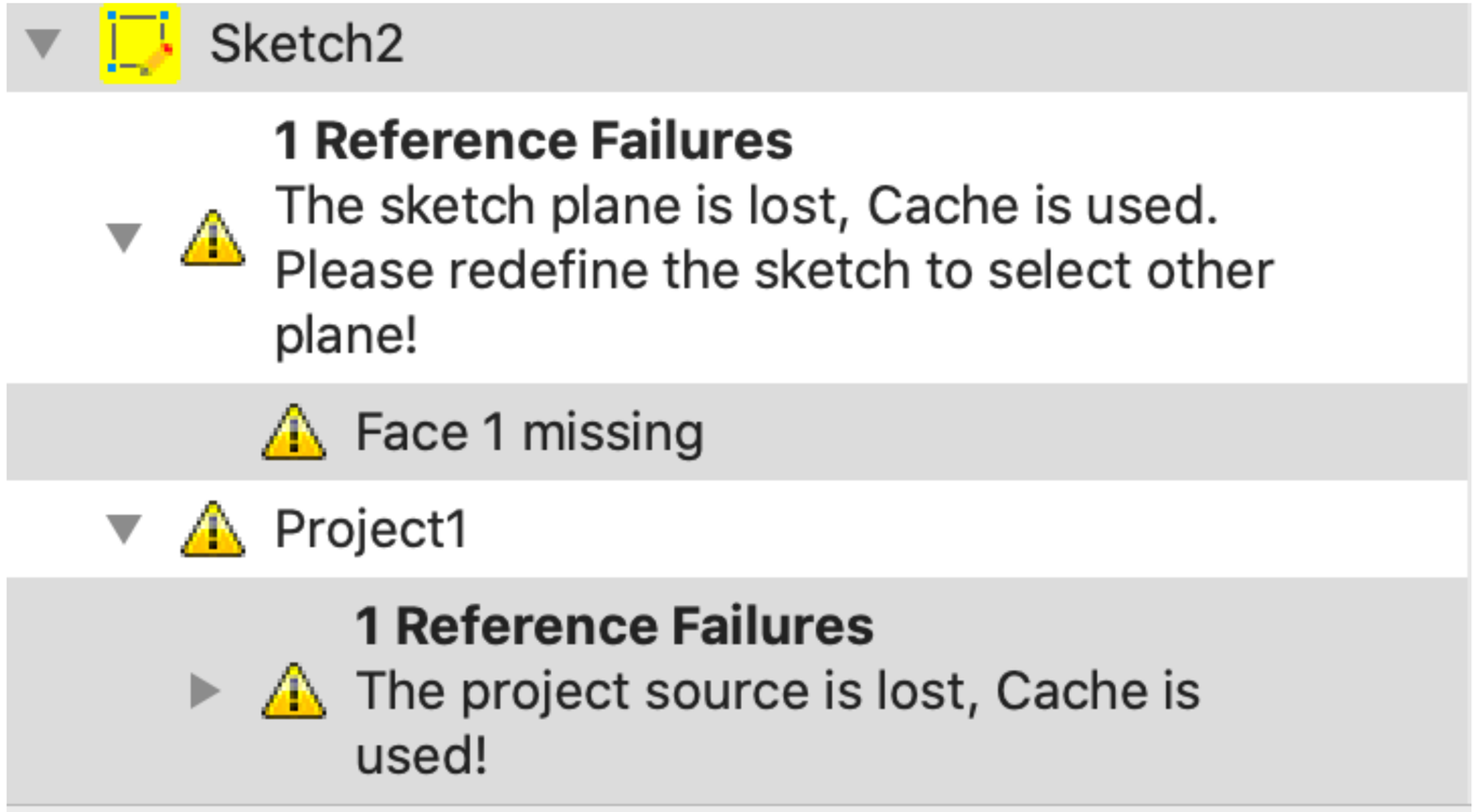
Dependency Modeling Failures



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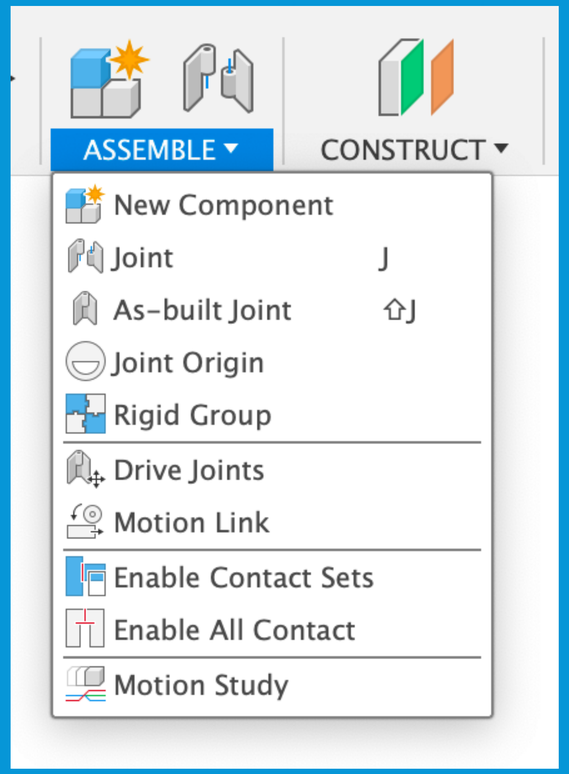
Fixing Modeling Dependency Failures

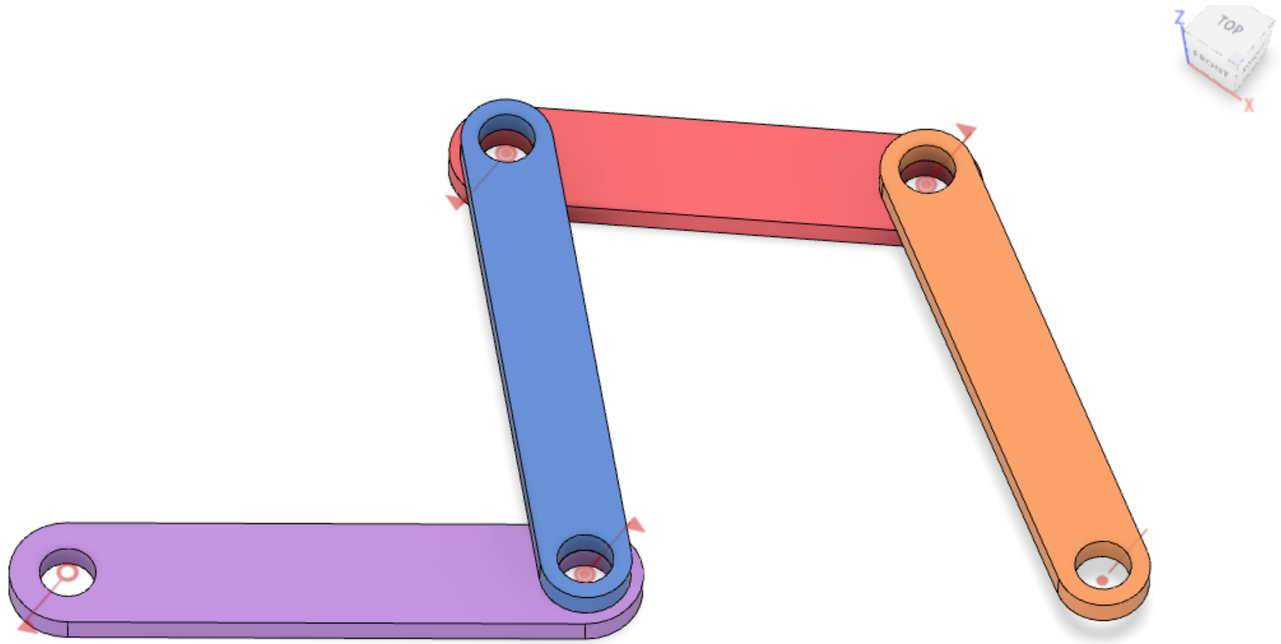
- **Undo the edit that caused it**
  - Find another approach to achieve the same thing
  - Edit at the end of the Timeline
- **Use Edit Feature to re-select the failed reference**
- **Special case: Sketch plane dependency failure**
  - Use Redefine Sketch Plane

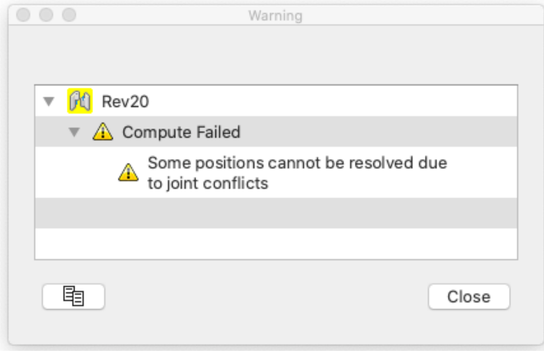
Fixing Assembly Errors



Joint Failures

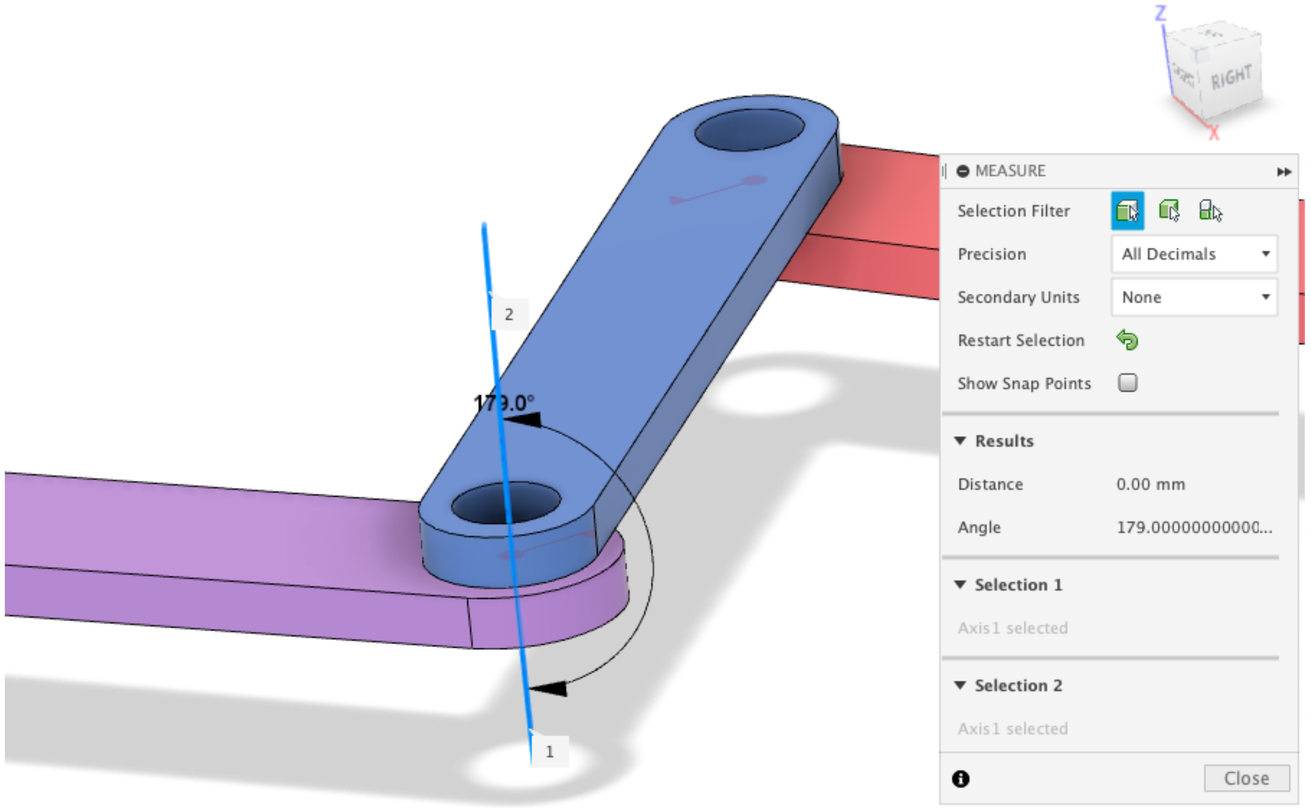
- **Most common joint errors are caused by modeling inaccuracies**





Fixing Joint Failures

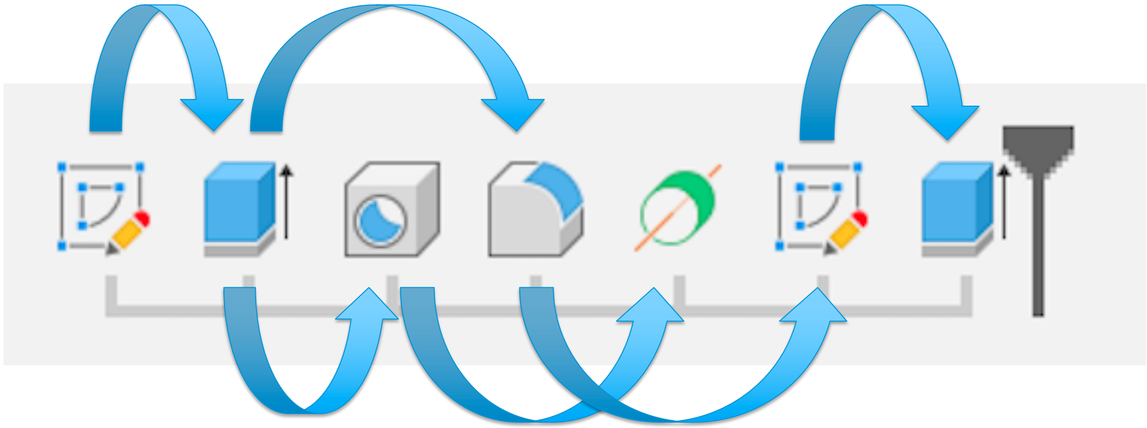
- Find areas of inaccurate modeling and fix them
- Add degrees of freedom to joints



Strategies to Prevent Errors From Happening

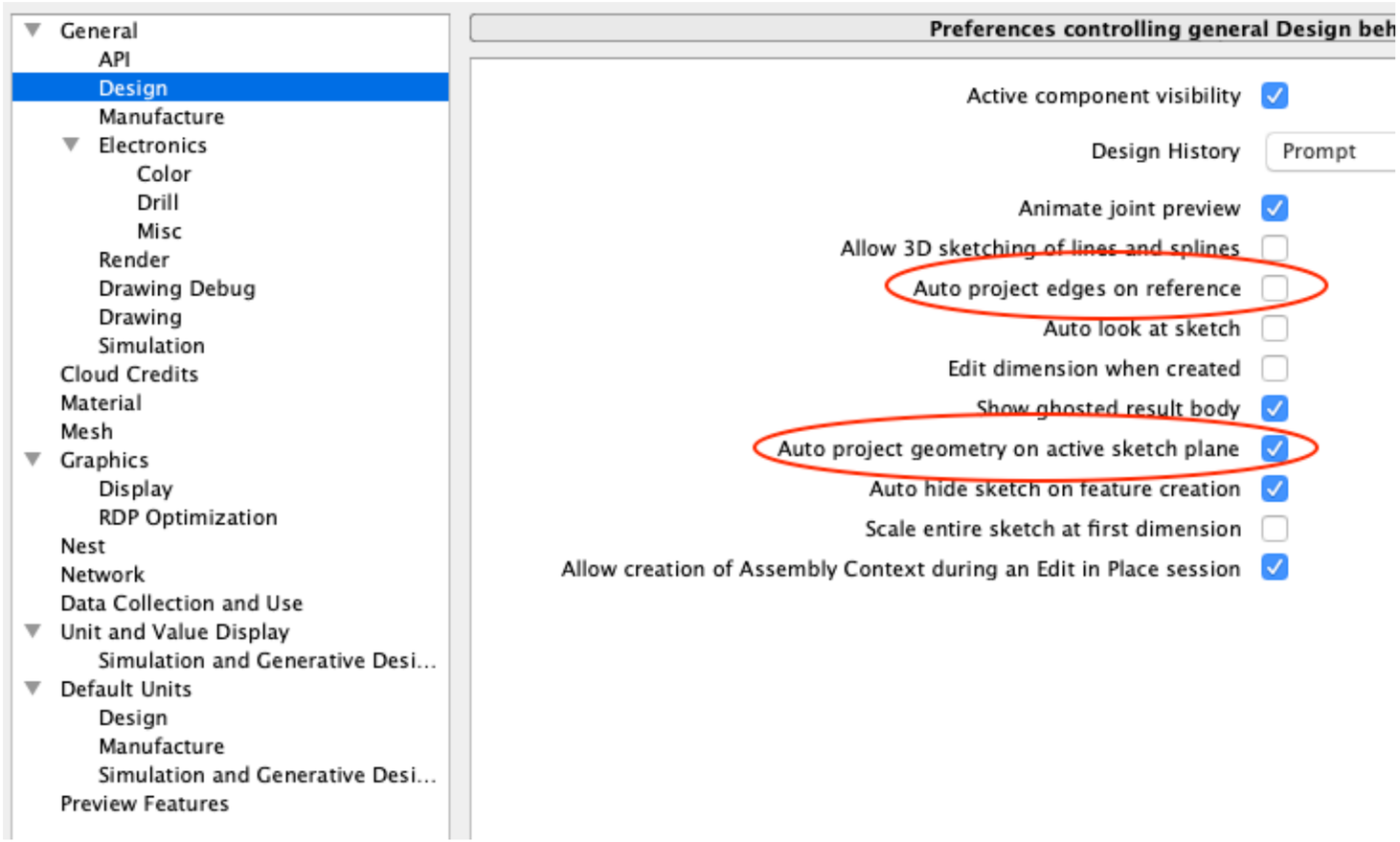
Dependency Management

- **Minimize unnecessary dependencies**
- **Choose the most stable dependency possible**
- **Be careful when editing sketches**
- **Use parameters instead of dependencies**



Minimize Unnecessary Dependencies

- Optimize preferences
- Be careful with sketch dimensions and constraints
- Use “To Object” sparingly

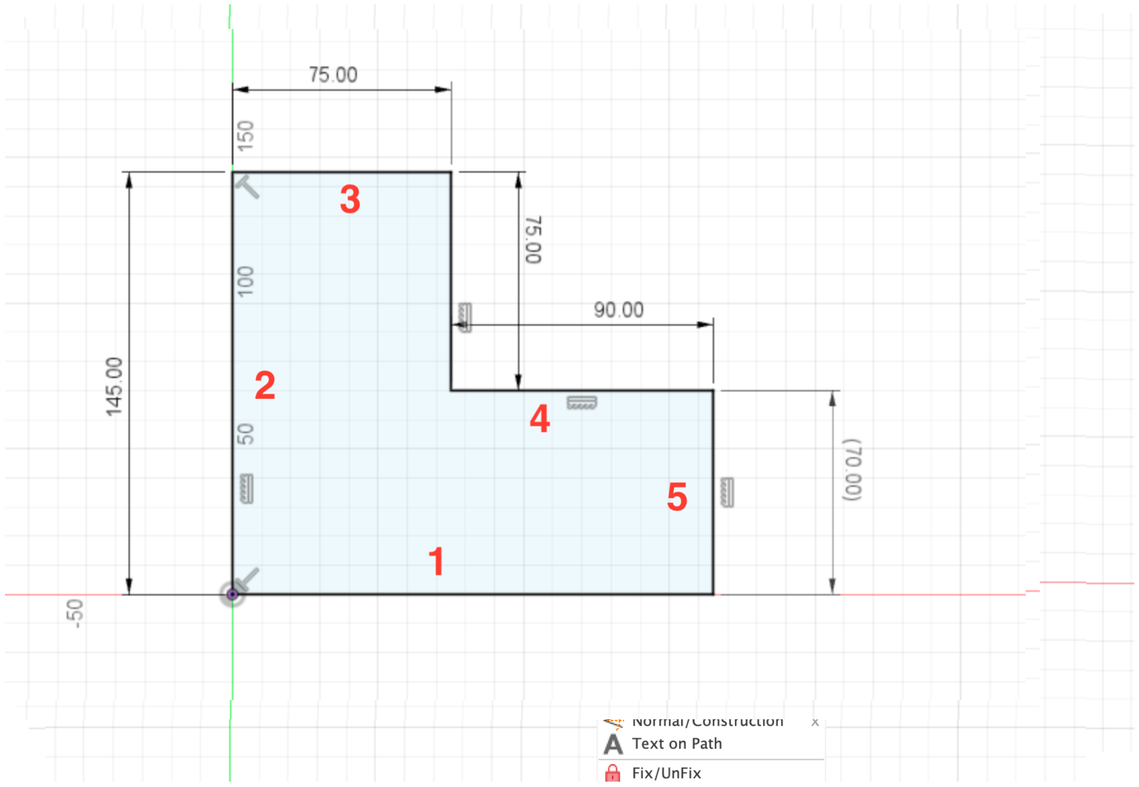


Choose the Most Stable Dependency

- **In decreasing order of stability under edit:**
  - Origin Work Geometry
  - Work Geometry that references Origin Work Geometry
  - Sketch Geometry
  - Solid/Surface Dependencies:
    - Body
    - Face
    - Edge
    - Vertex

Be Careful When You Edit Sketches

- The entire entity tracking system in Fusion is based on sketch object IDs
- Deleting and re-drawing a sketch curve will get a new ID
- <u>Edit</u> consumed sketches when possible, don't delete
- Be aware of some modification commands' effects
  - Fillet, Trim



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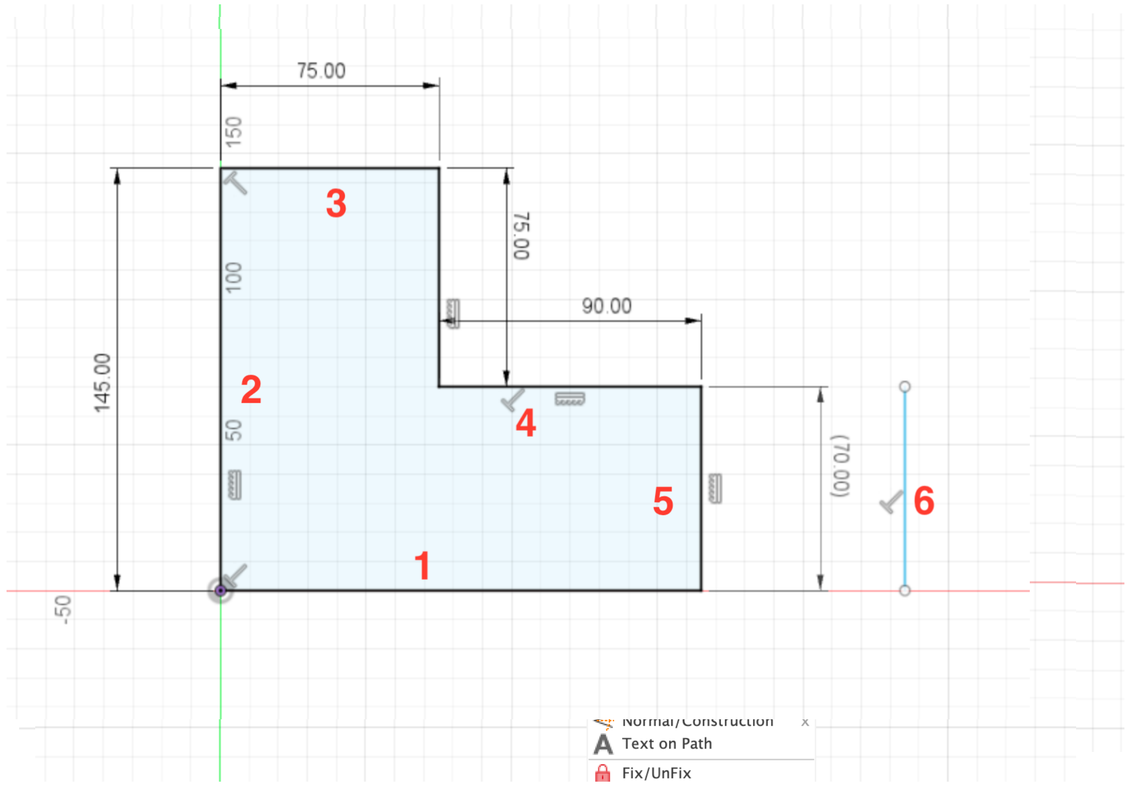

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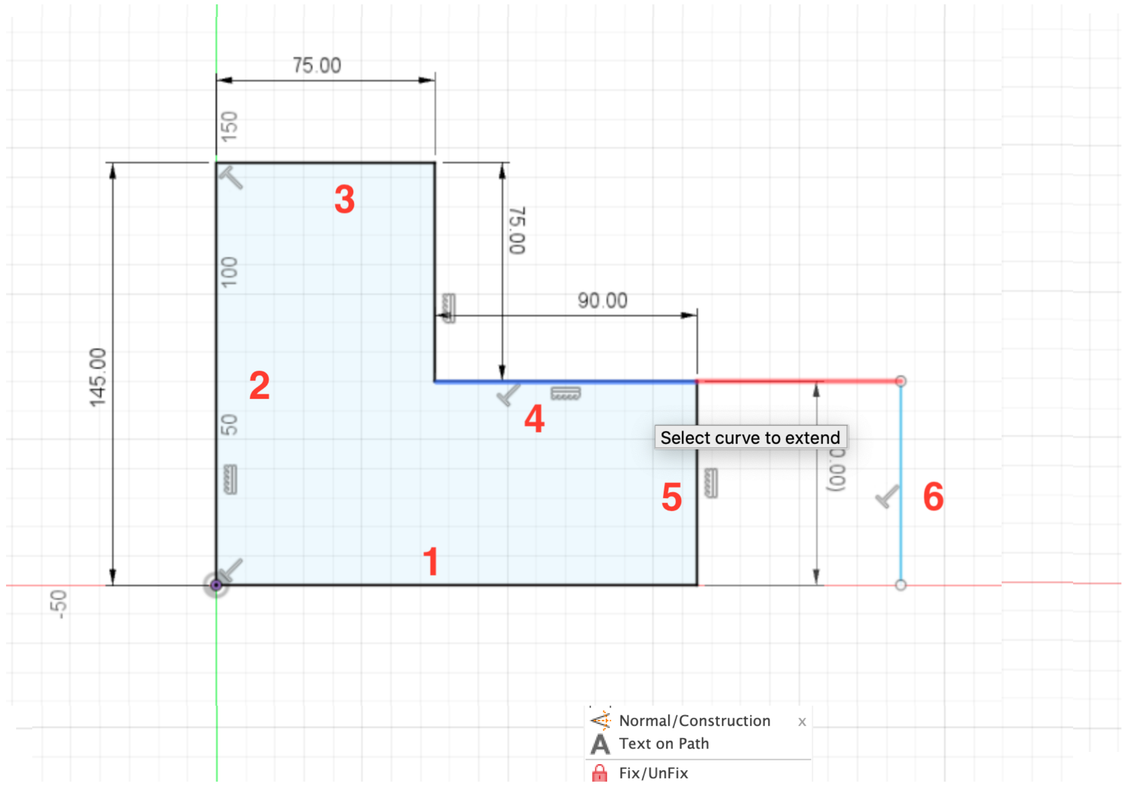

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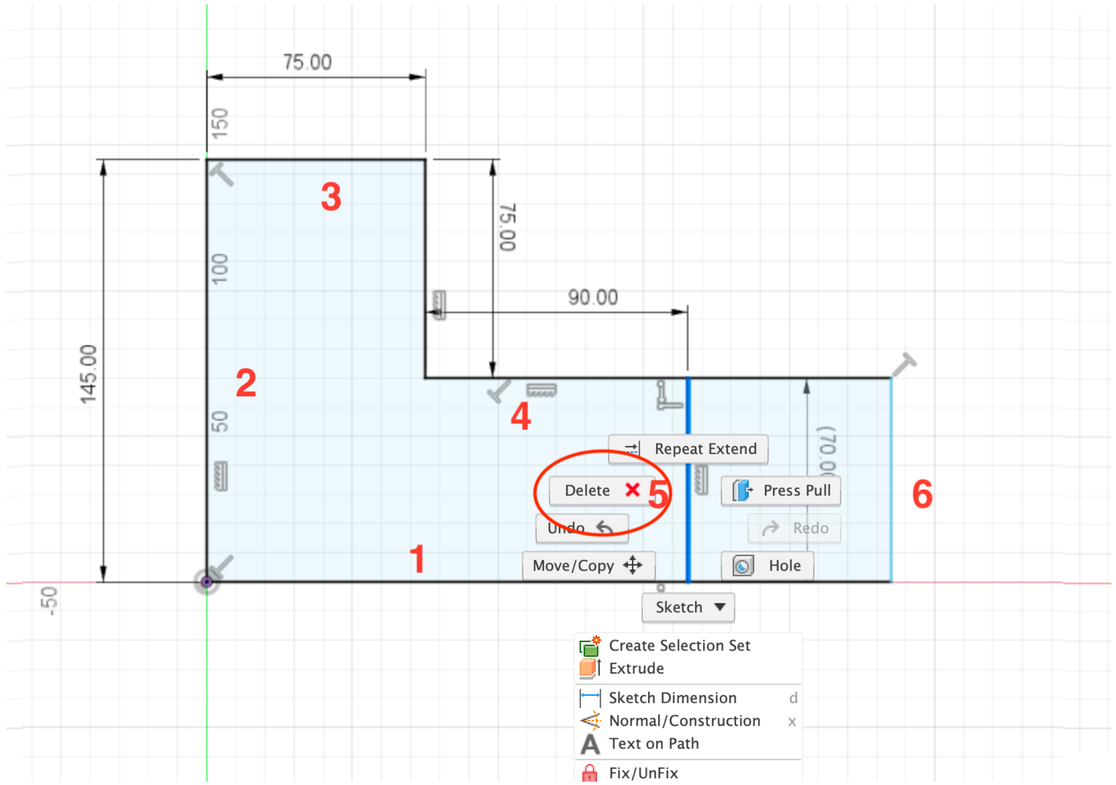

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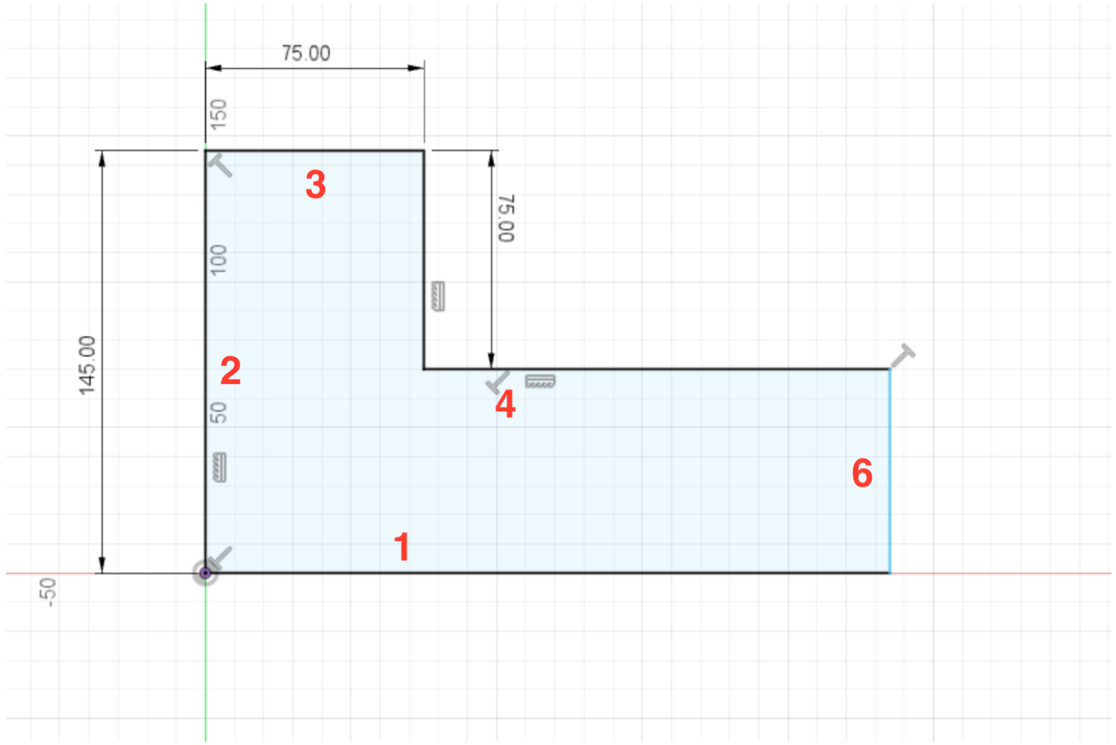

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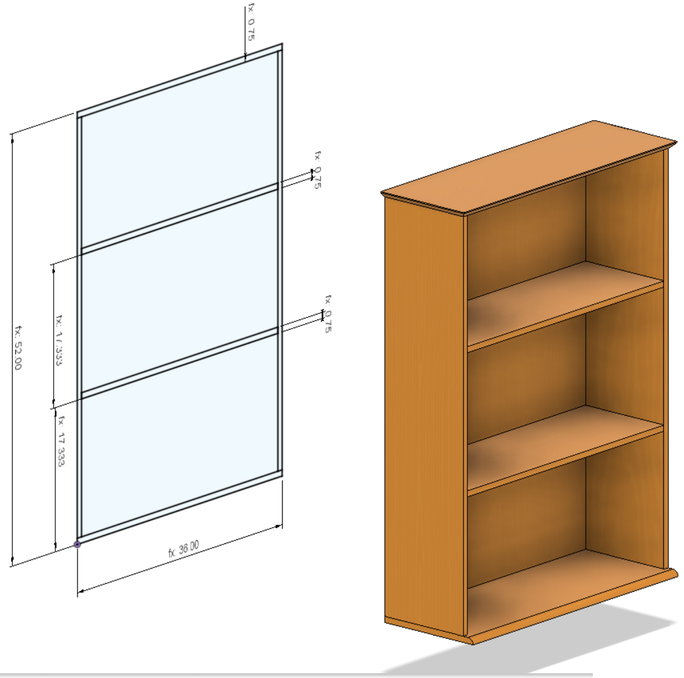
Using Parameters Instead of Dependencies

- You can avoid geometric dependencies with parameters
- E.g. instead of “To Object” Extrude, use parameters to enforce geometry matches up

Parameters

Parameter	Name	Unit	Expression	Value	Comments
Favorites					
User Parameter	TALL	in	52 in	52.00	OVERALL HEGHT
User Parameter	WIDE	in	36 in	36.00	OVERALL WIDTH
User Parameter	DEPTH_OF_SHELF	in	12 in	12.00	USABLE SHELF DEPTH
User Parameter	THICKNESS	in	0.75 in	0.75	THICKNESS OF PANELS

OK



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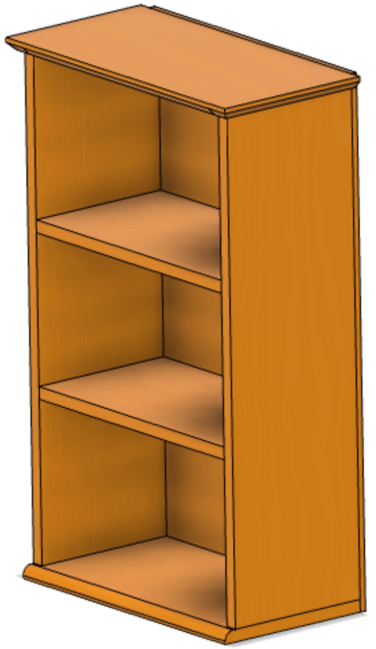
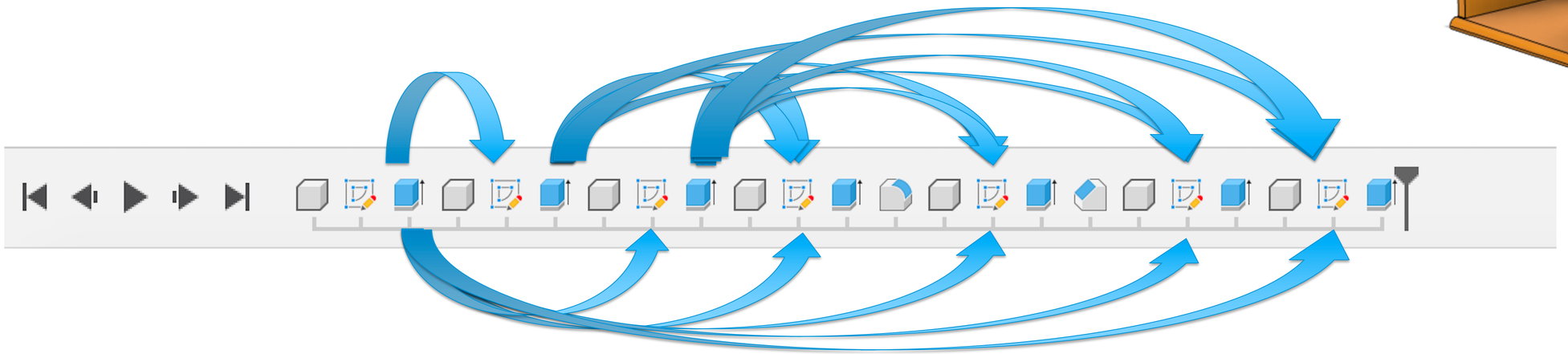
Bookshelf With Dependencies

- This version uses lots of geometric dependencies
- Each of those is a possible dependency failure under edit





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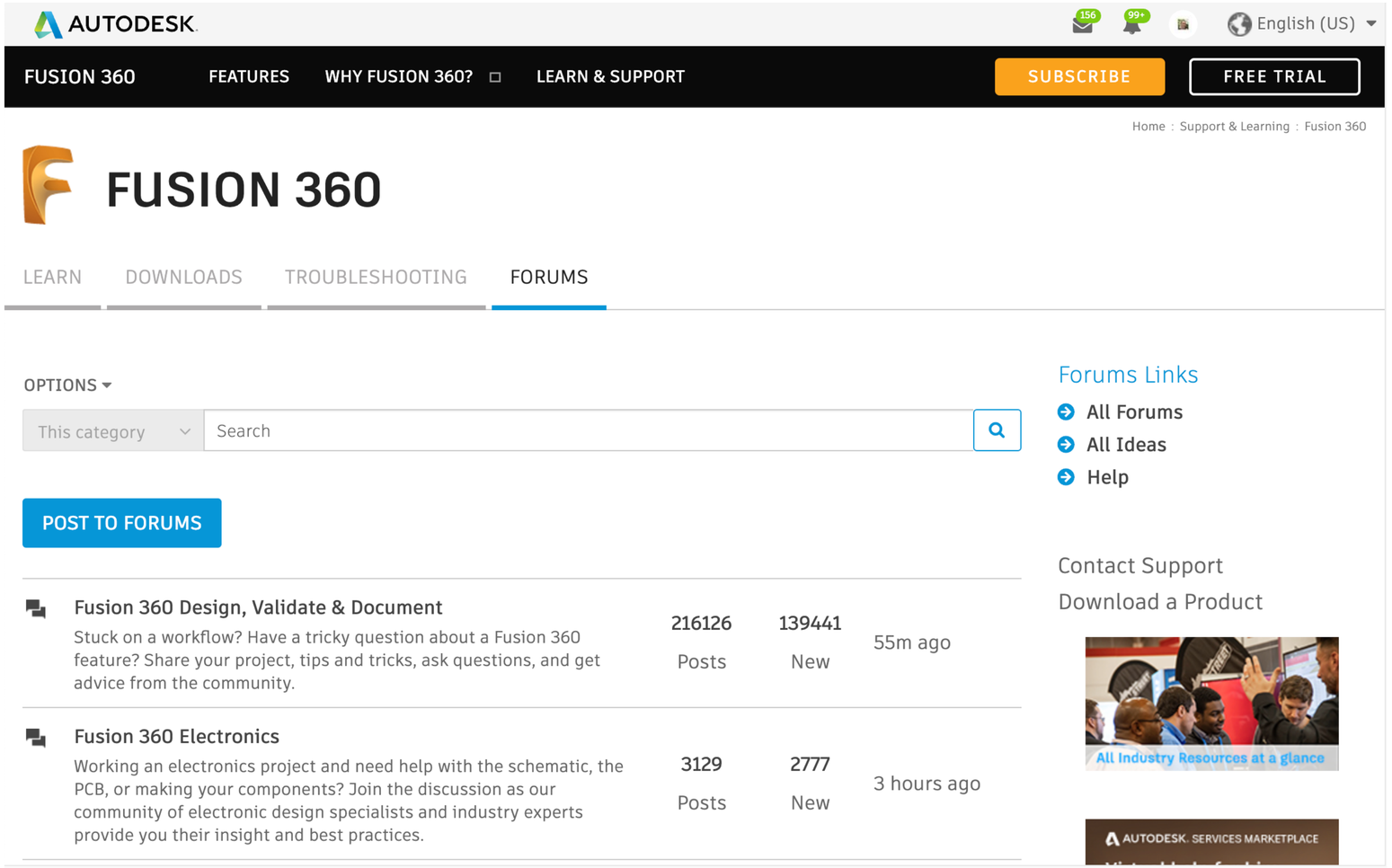
Resources

- Forums



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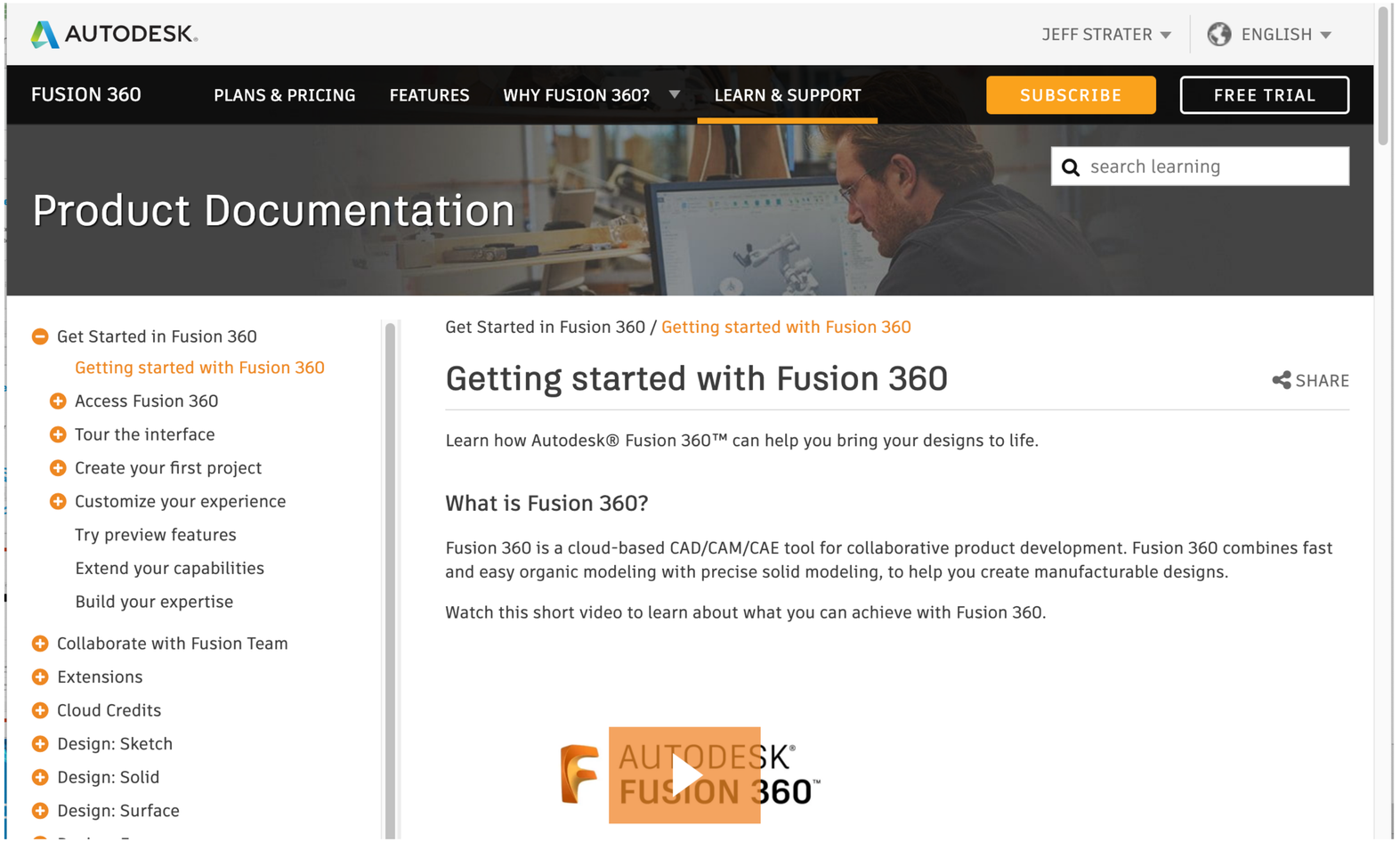
Resources

- Forums
- Learning and Documentation



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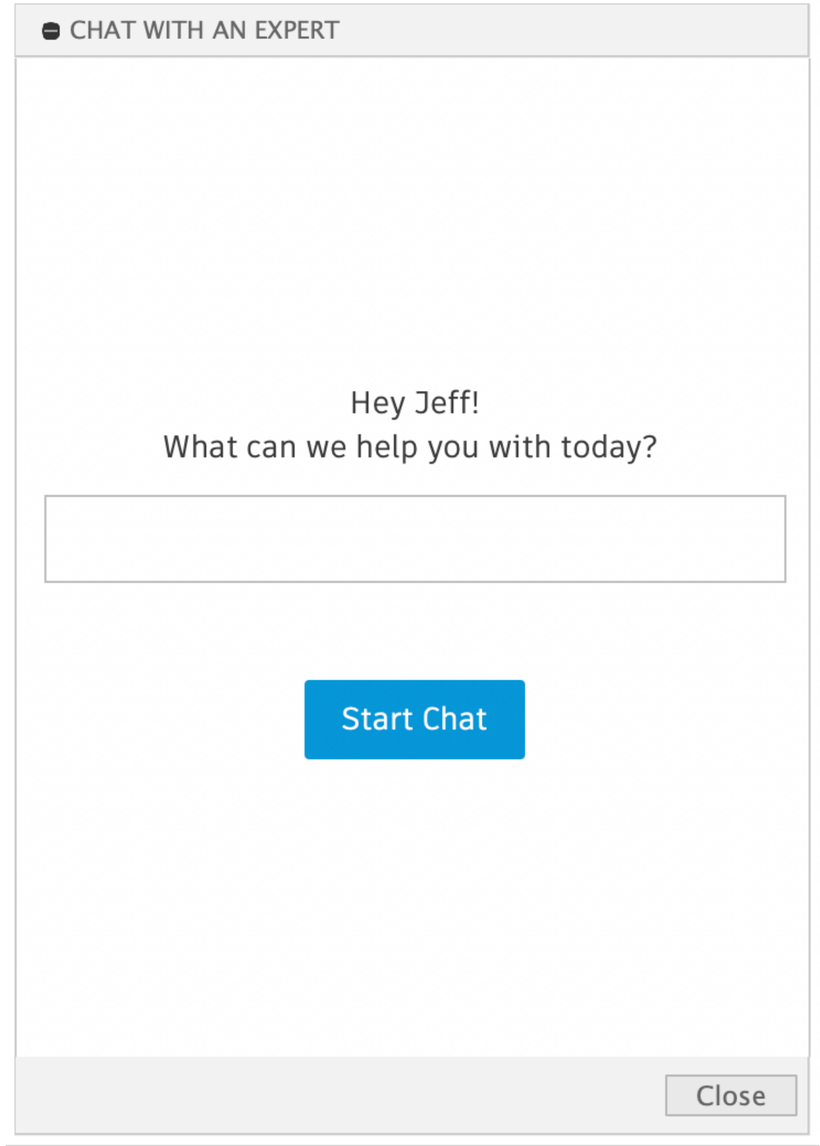
Resources

- **Forums**
- **Learning and Documentation**
- **Chat**



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Resources

- **Forums**
- **Learning and Documentation**
- **Chat**
- **Support (Commercial only)**