A CAD Style Guide

Travis Schuh

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SPARTAN ROBOTICS

Goal: There are lots of ways to make the same CAD model, share some of the differences and some stylistic choices that I prefer

- Show how can get to the same model with different ways
- What are the benefits of having clean style
- Capturing the essence of the part (design intent)
- How do you reference different parts together
- Making things easy to update
- Tips and tools for working quickly

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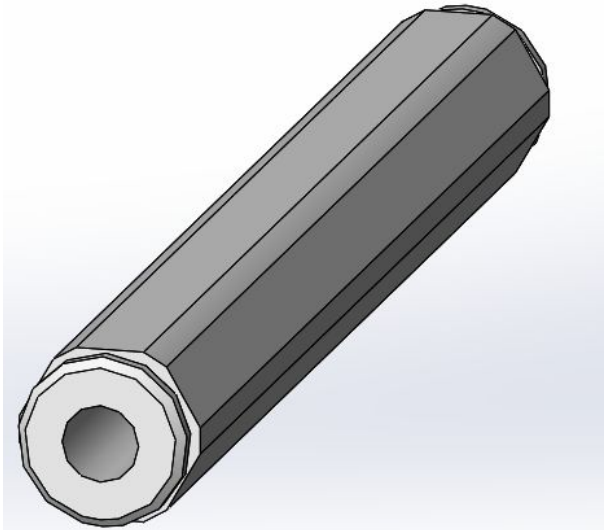
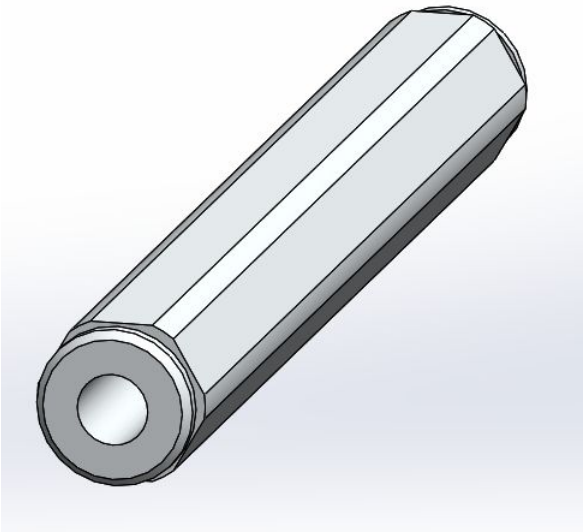
What is the Difference?





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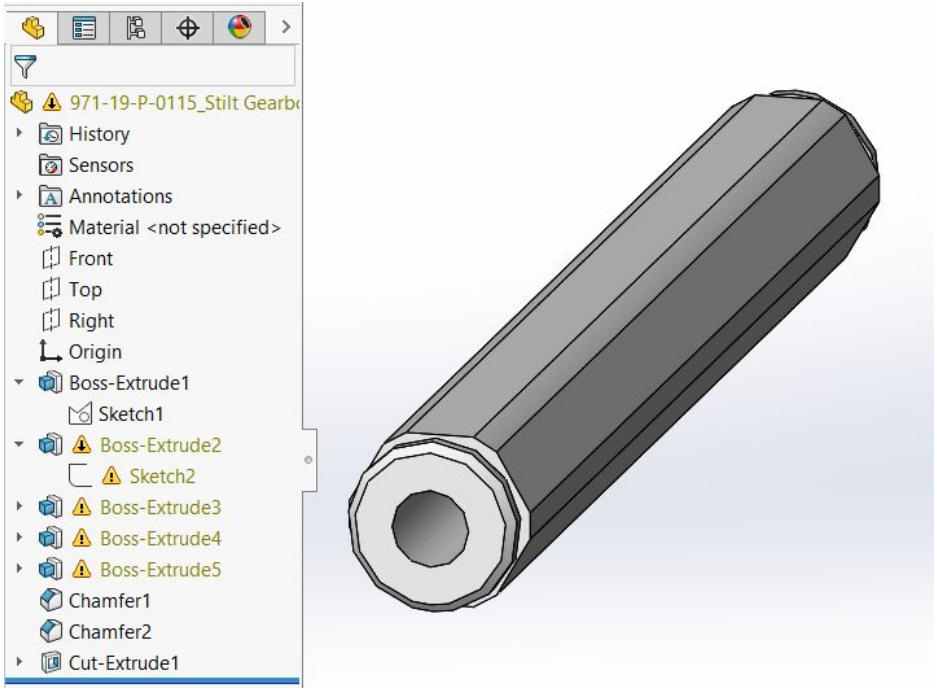

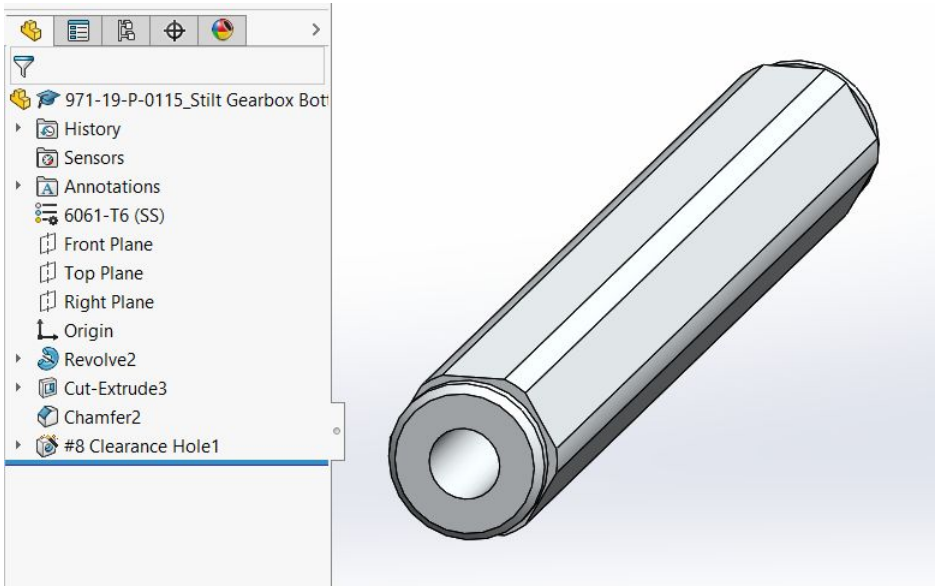

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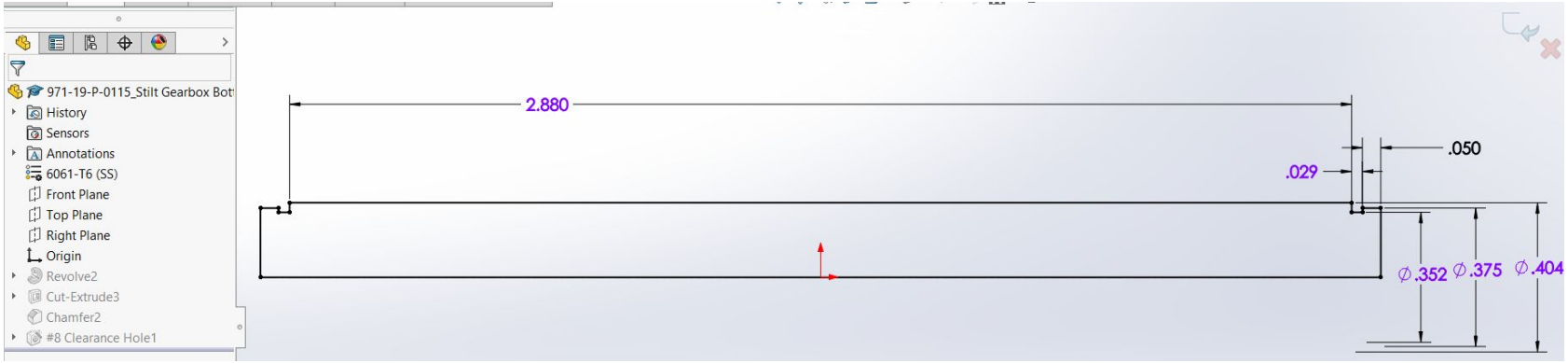

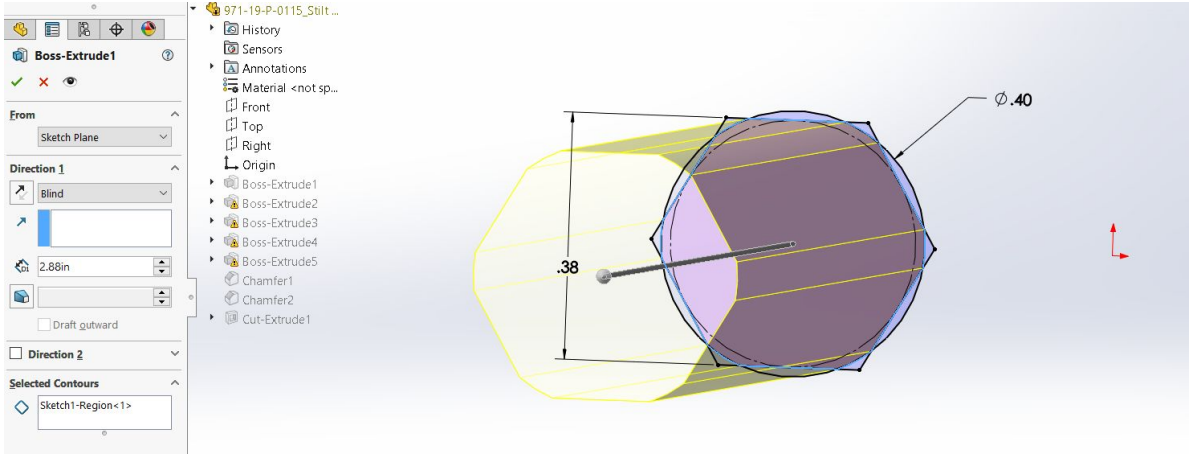

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Outline

- Capturing Design Intent
- Making Models Easy to Update
- Creating Robust References
- Tips and Tools for Working Quickly

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Capturing Design Intent

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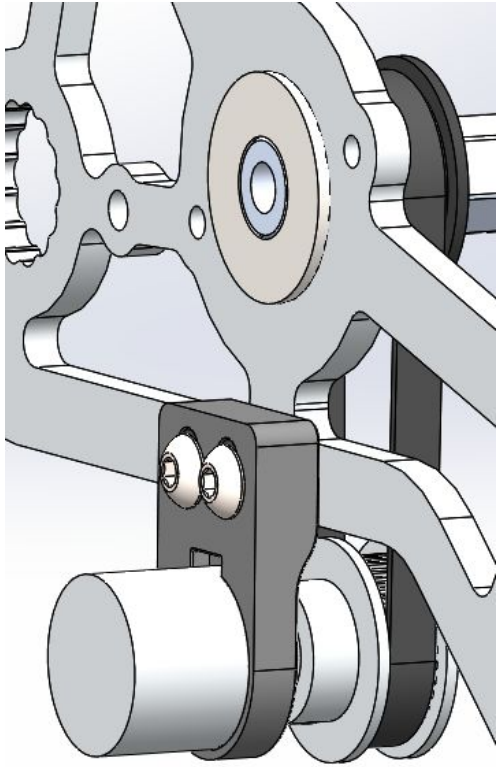
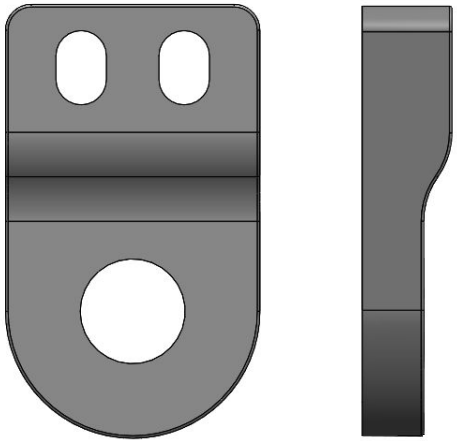
Start with the feature/s that captures the design essence

1) Hold the potentiometer at the right belt pitch spacing
2) Hold the pulley in alignment





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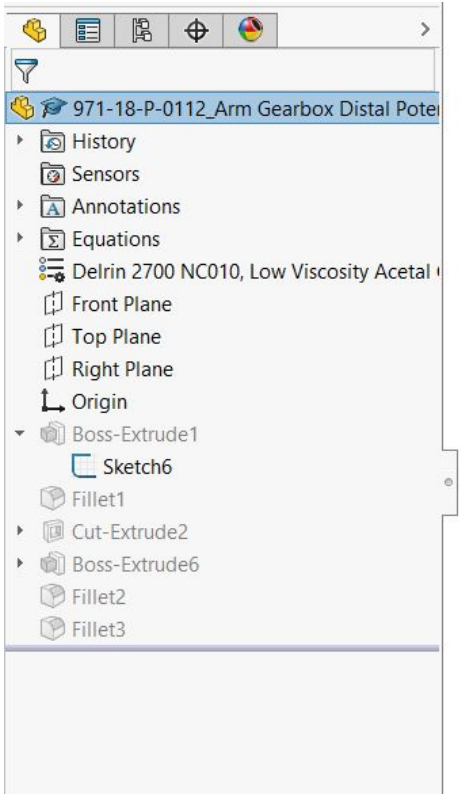

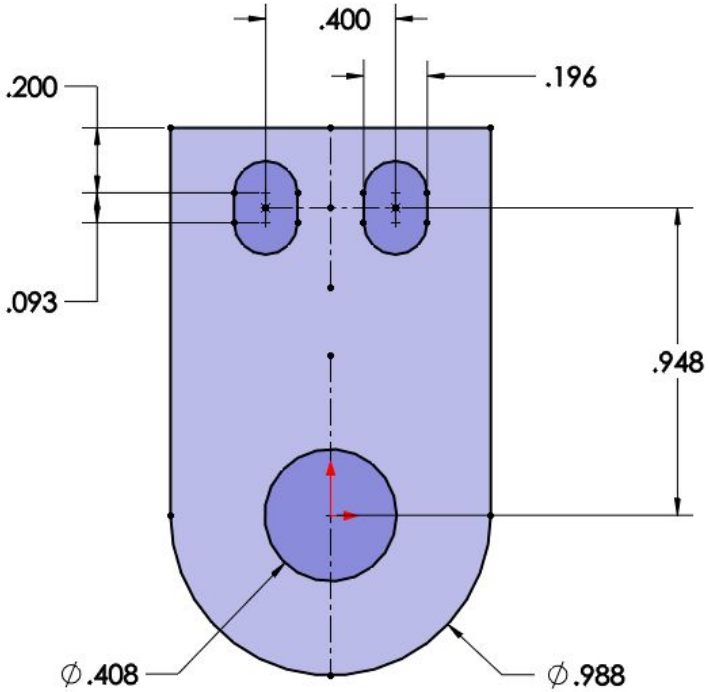

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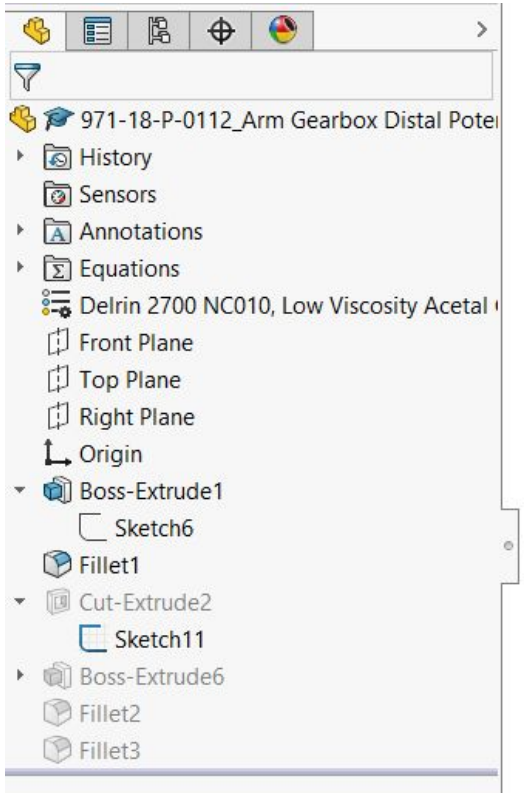

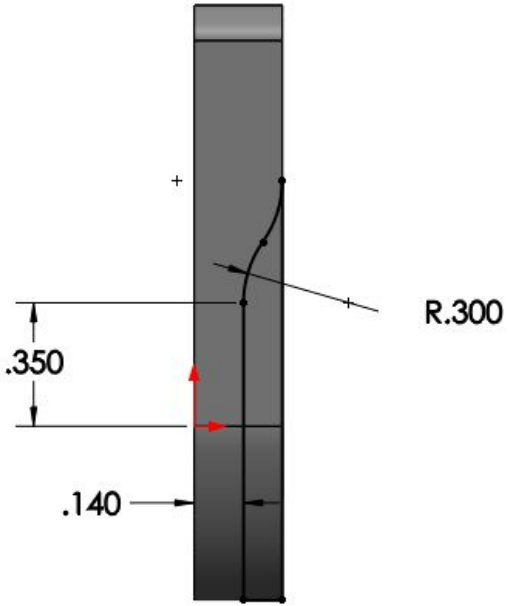

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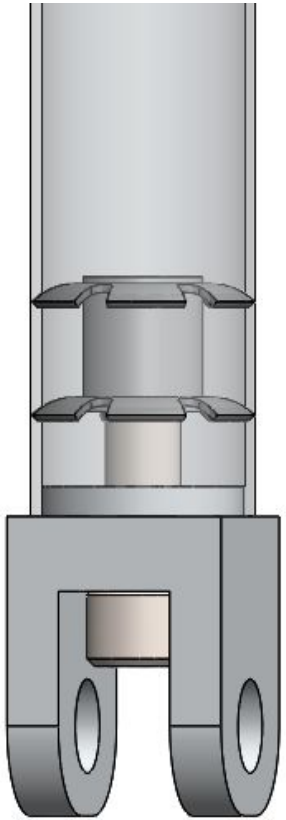
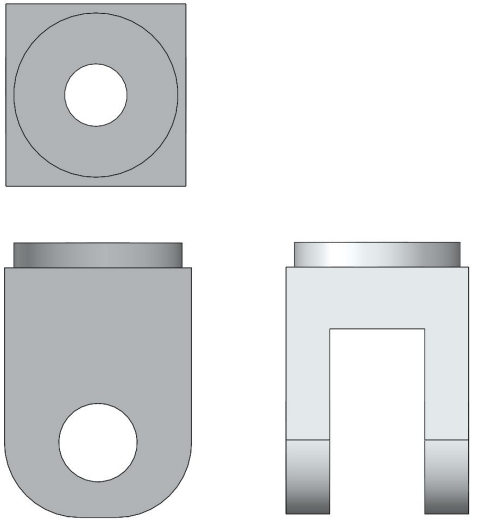
Start with the feature/s that captures the design essence

1) Form a pivot point
2) Clearance for a mounting bolt
3) Locate to the tube





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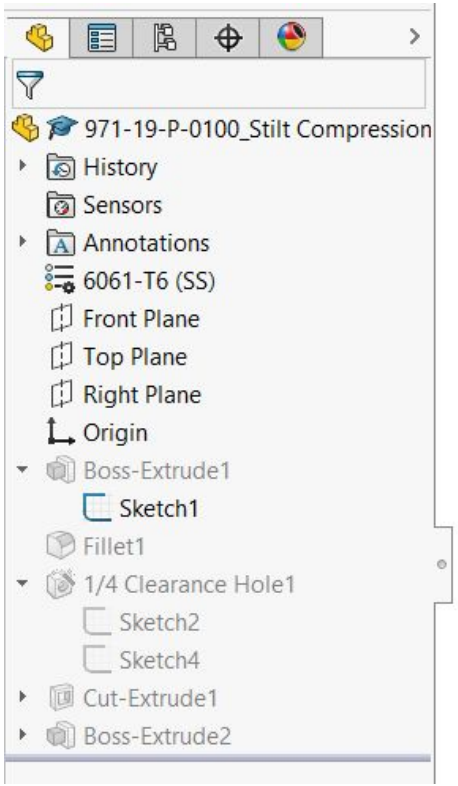

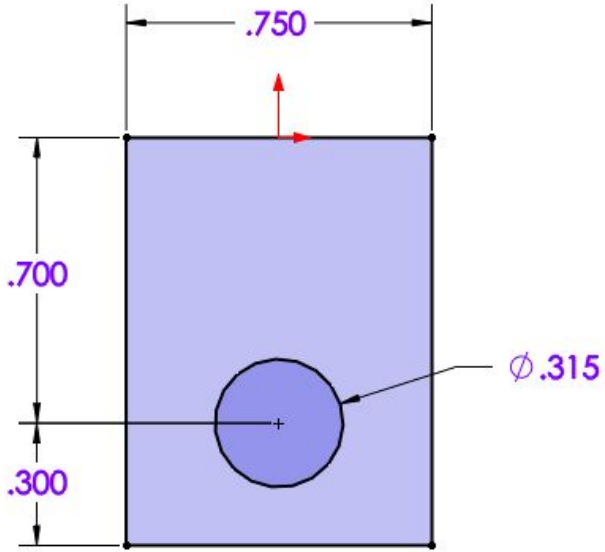

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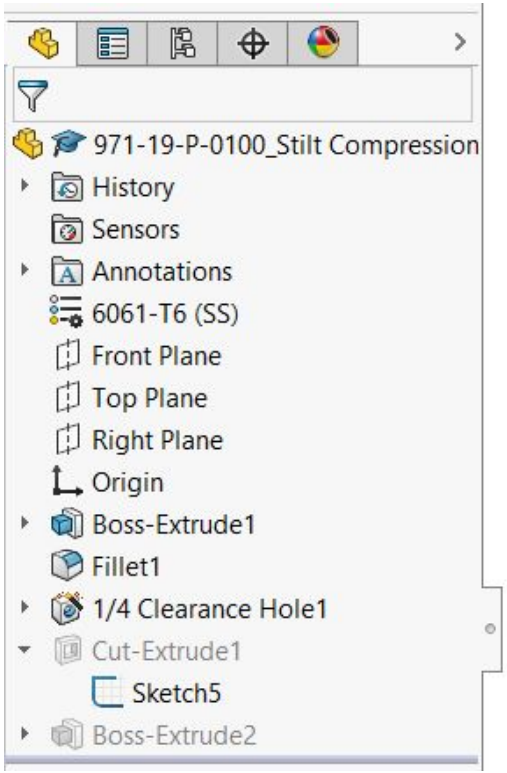

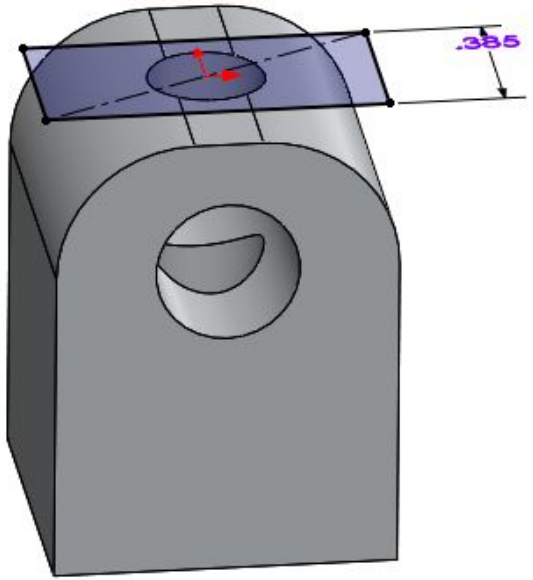

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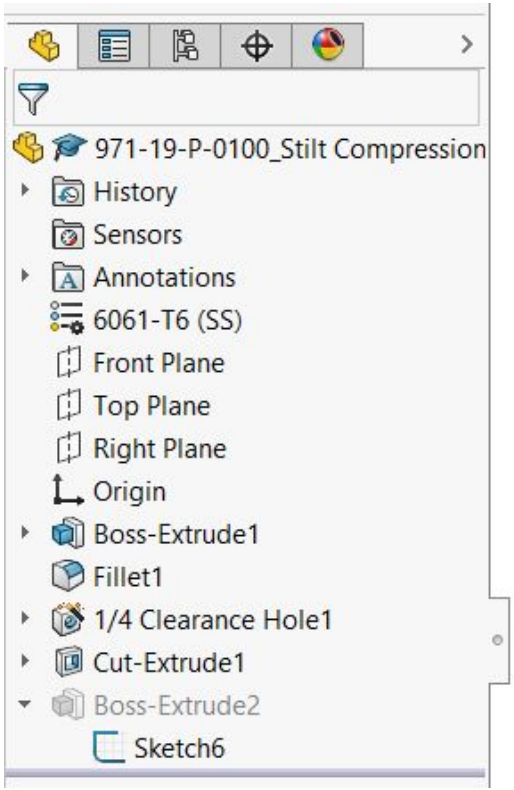

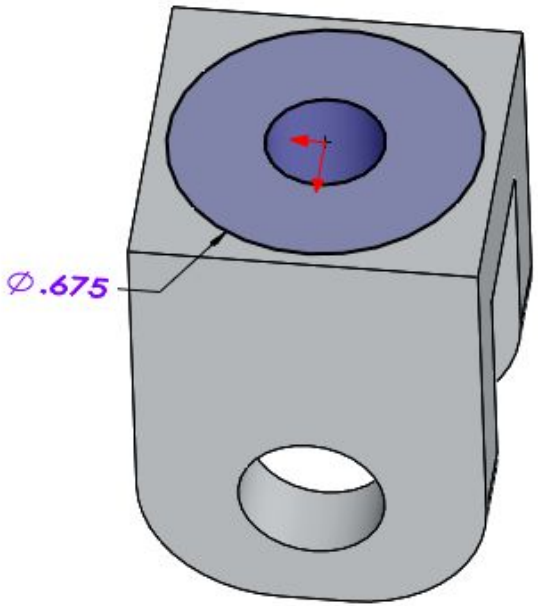

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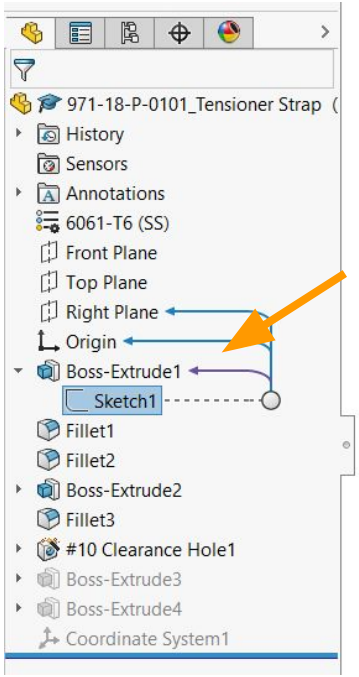

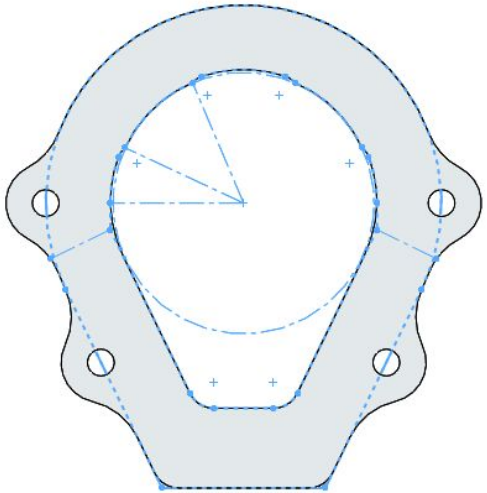

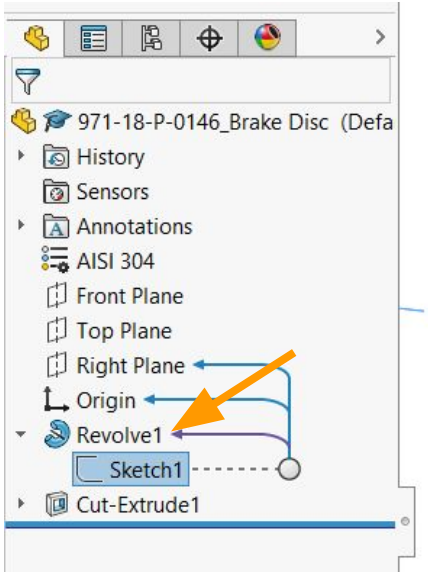

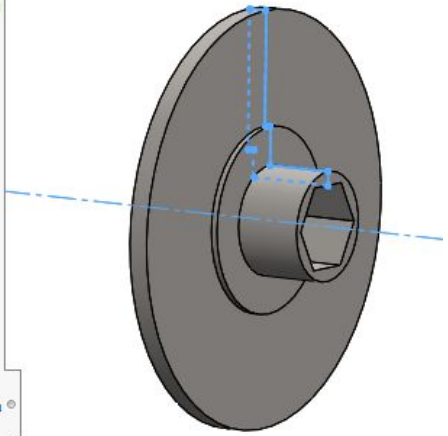

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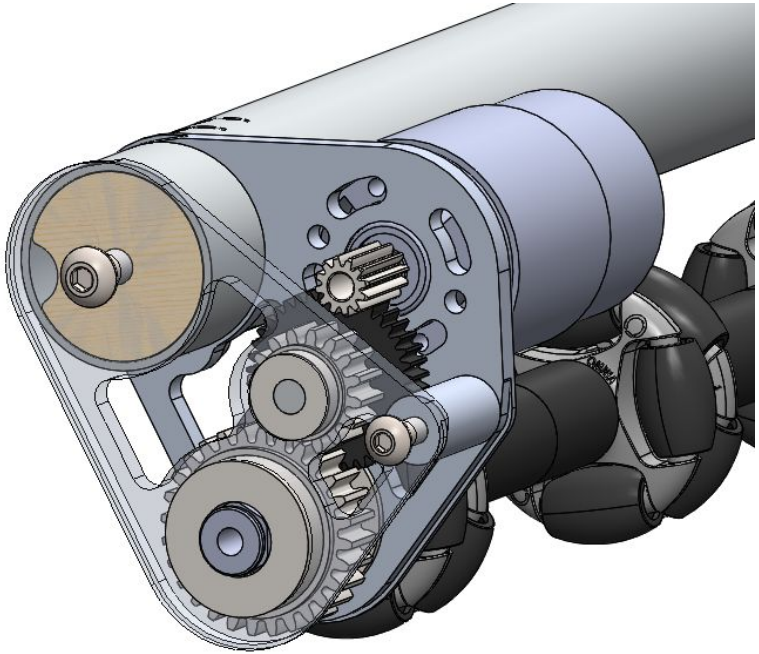
Try to capture intertwined design features in 1 sketch

- Structural front tube
- Motor, wheel, tubes packed in a tight space
- Constrained by gear spacing



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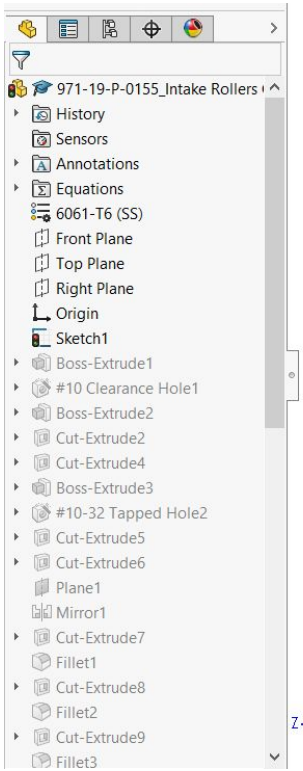

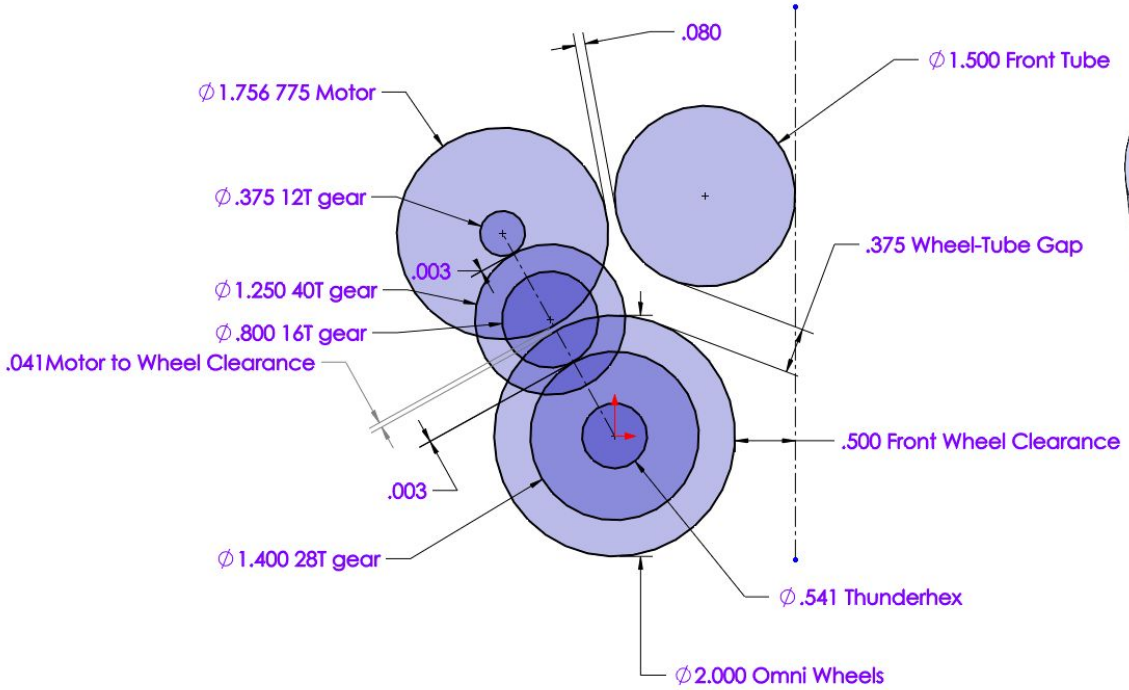

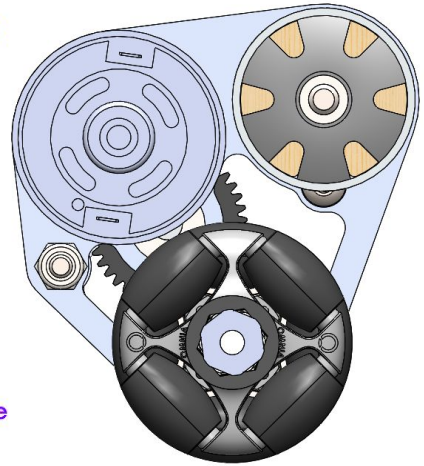

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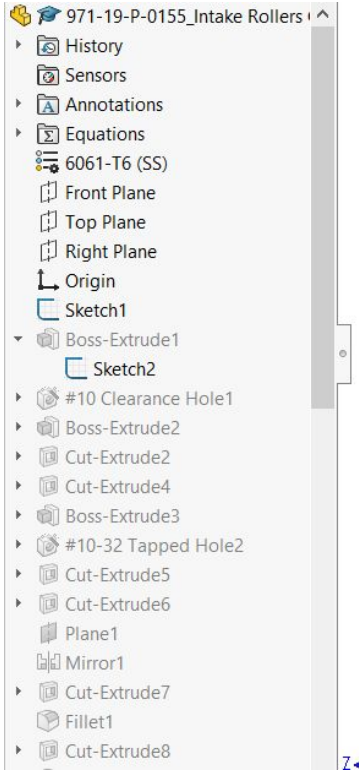

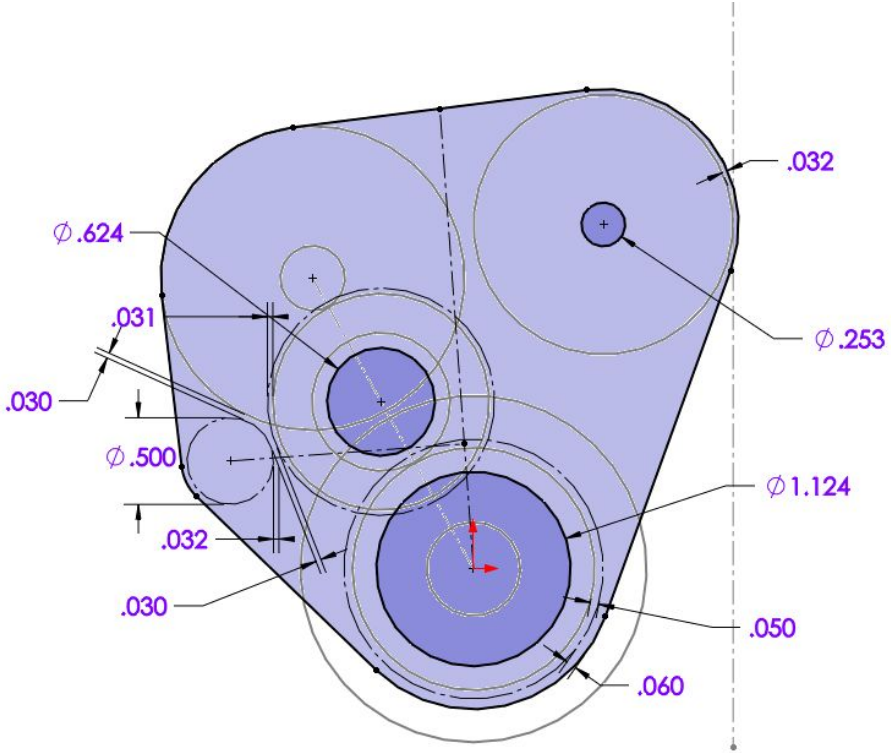

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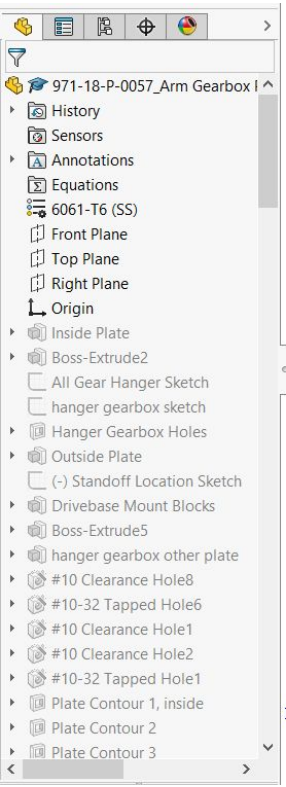

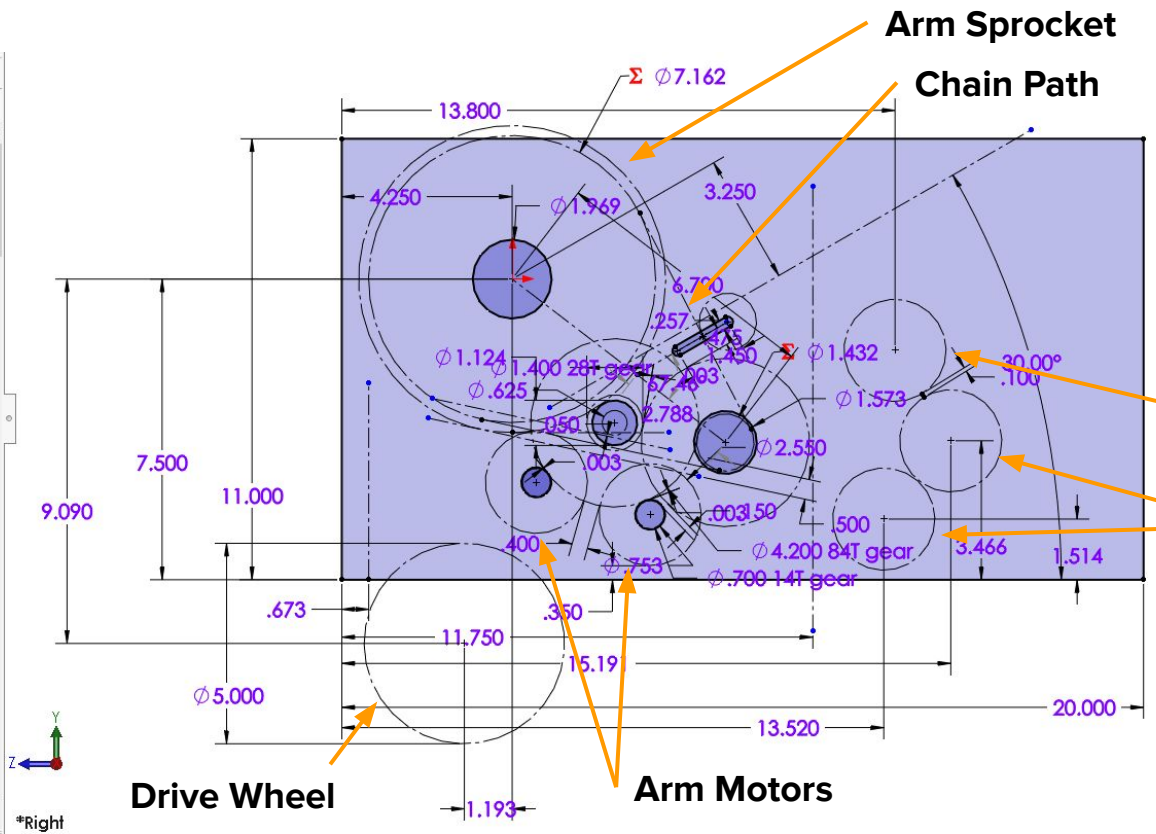

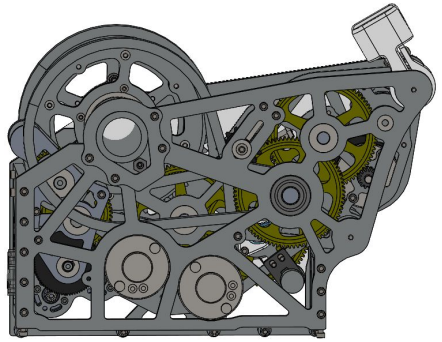

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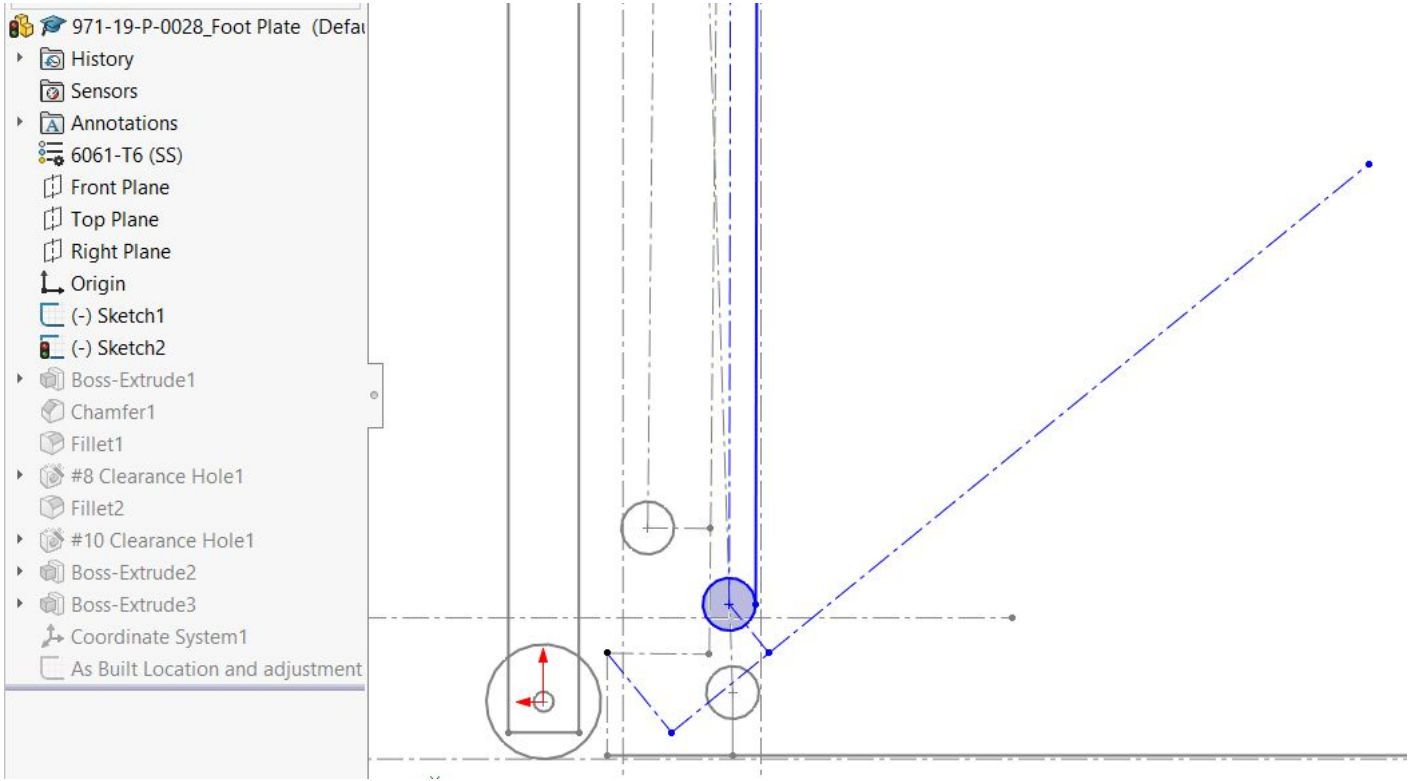

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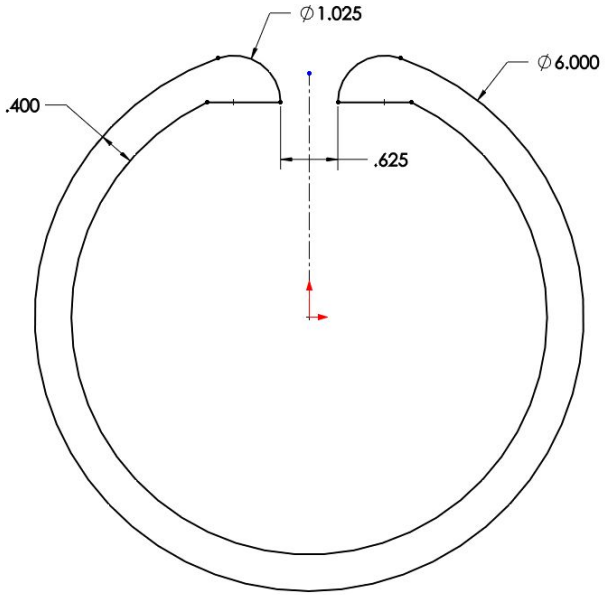
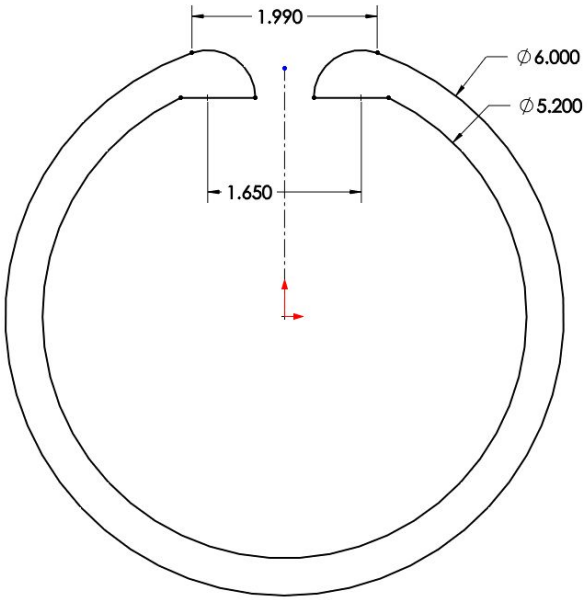
Choose dimensions based on what you care to control





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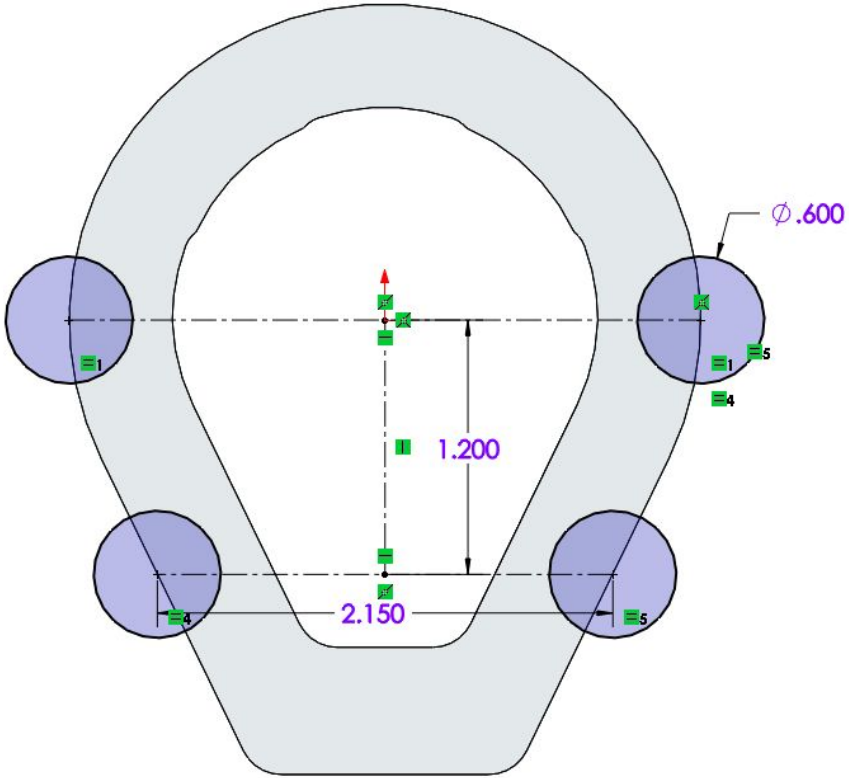
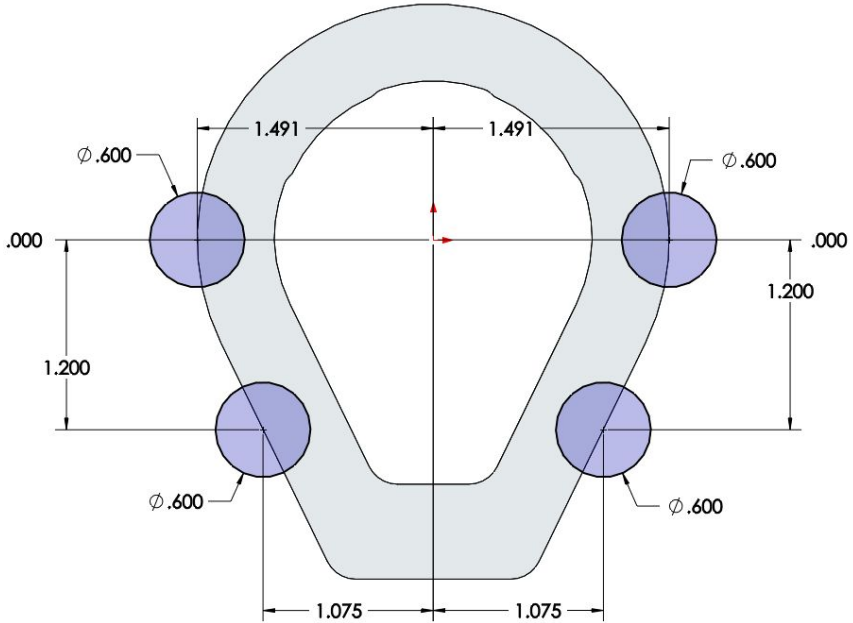
Use relationships to capture design intent





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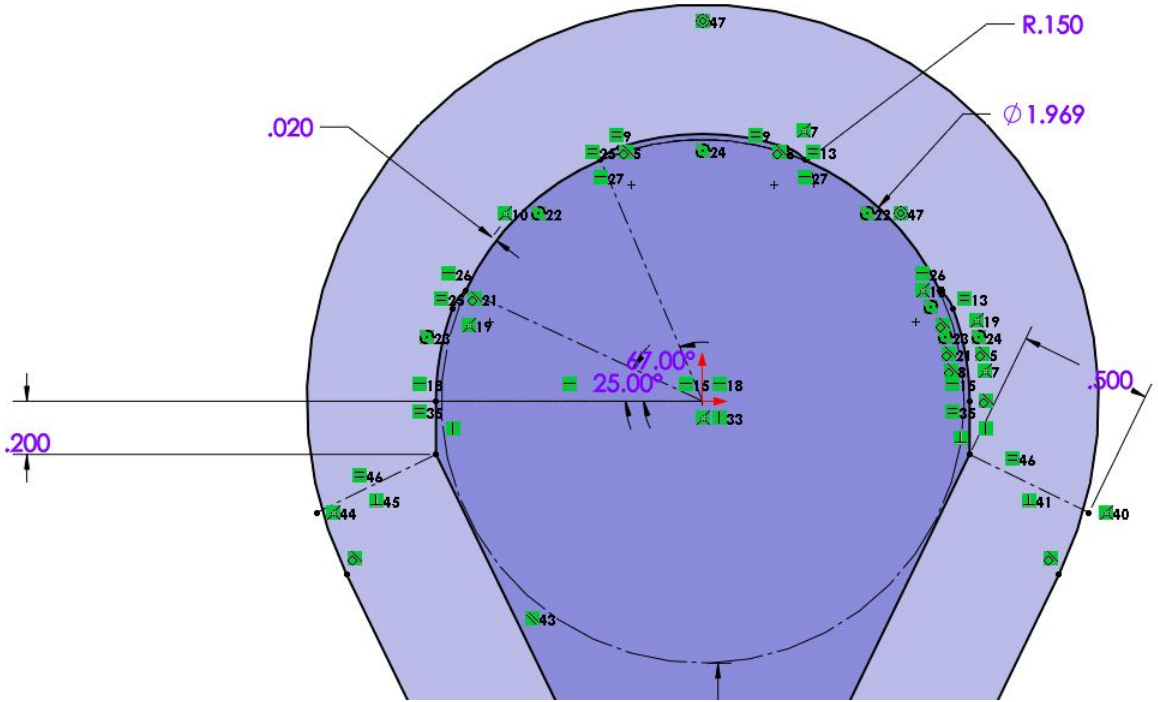

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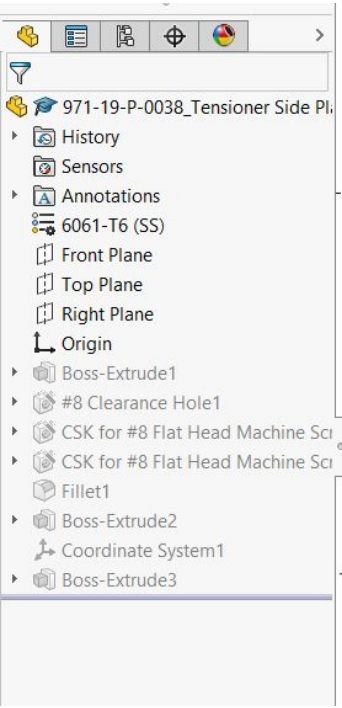
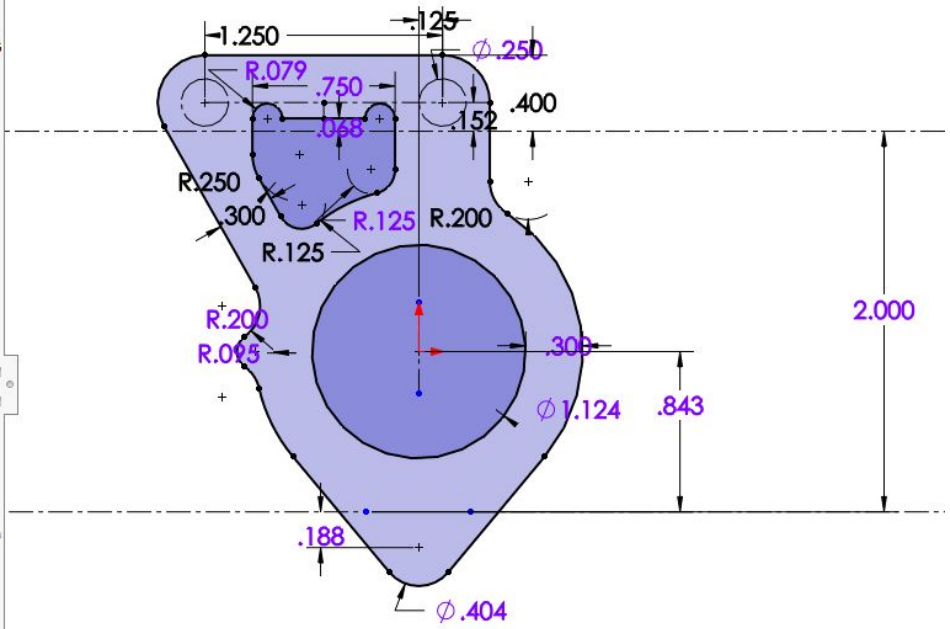
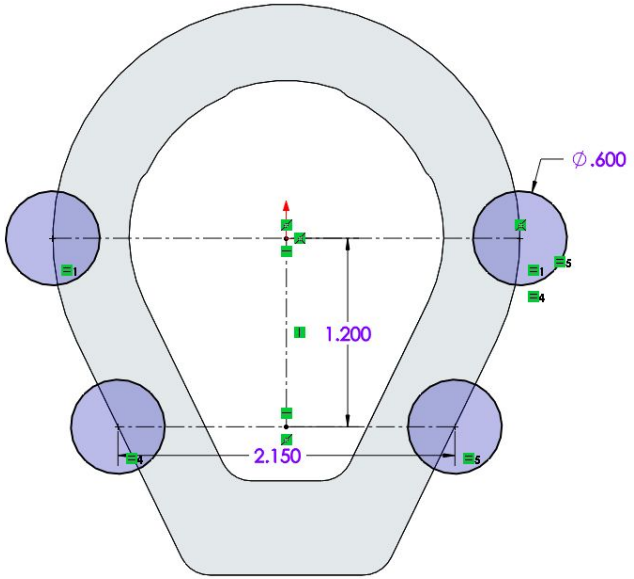
Use construction geometry







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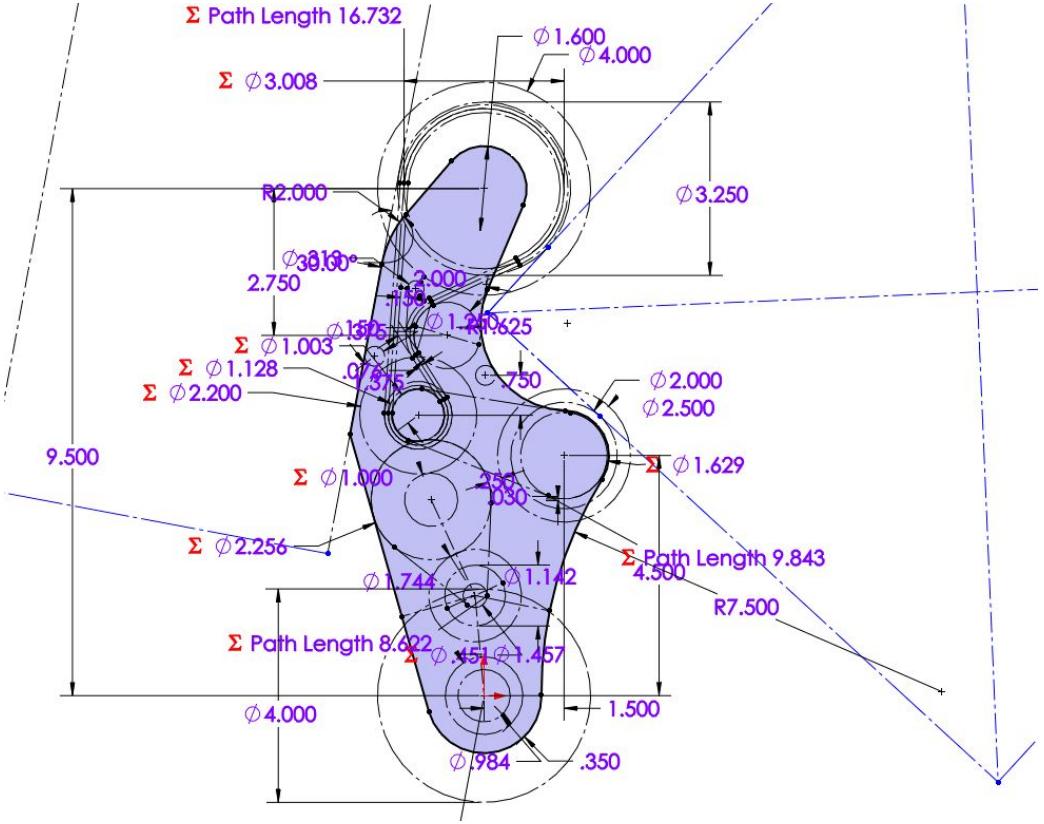

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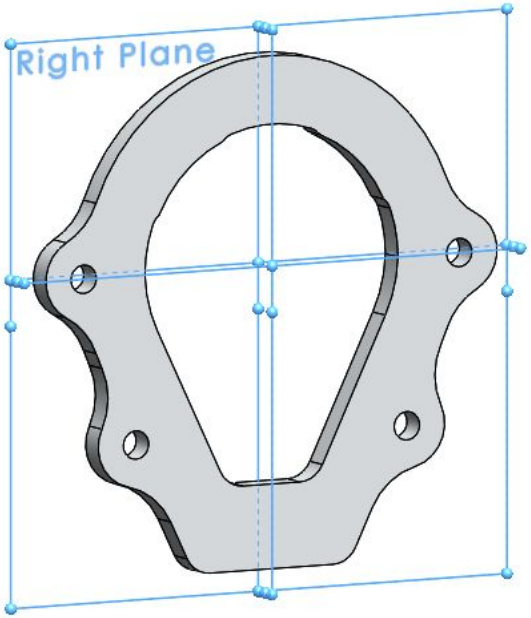
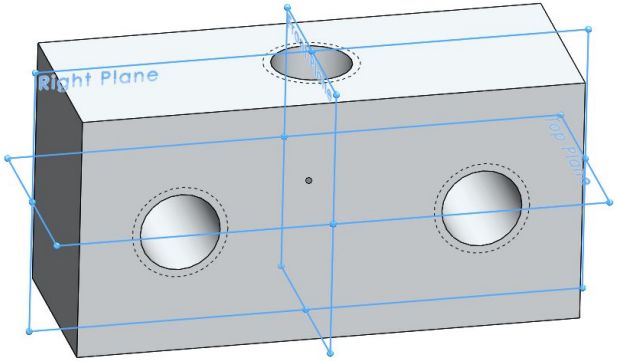
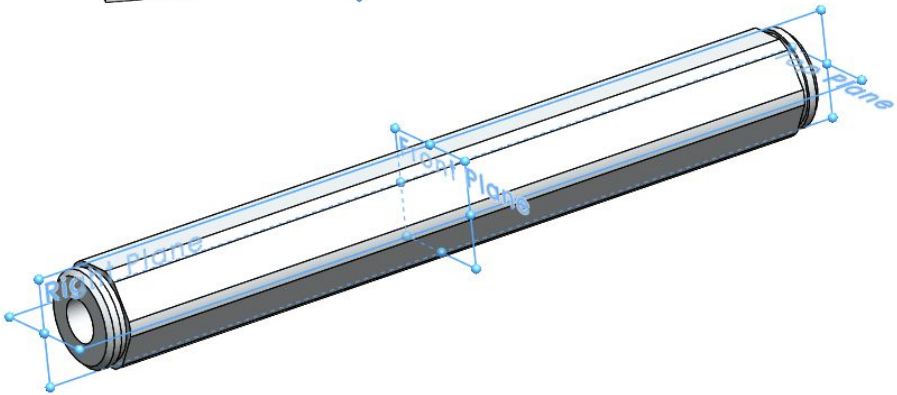
Place the origin in a logical spot (take advantage of symmetry)







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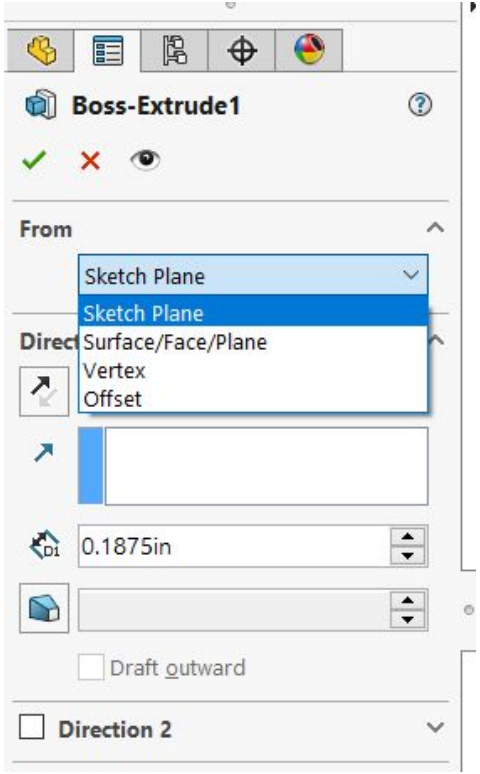
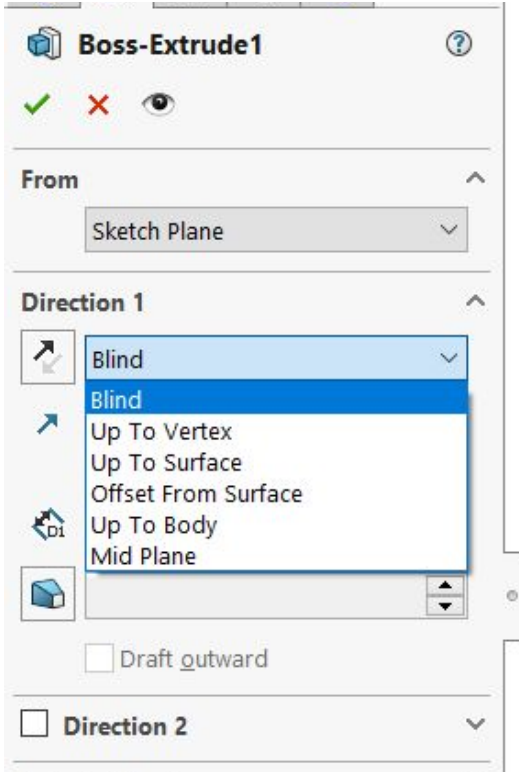
Use start and end conditions for extrudes





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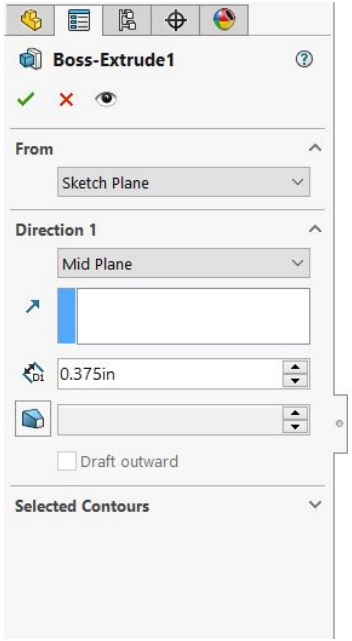

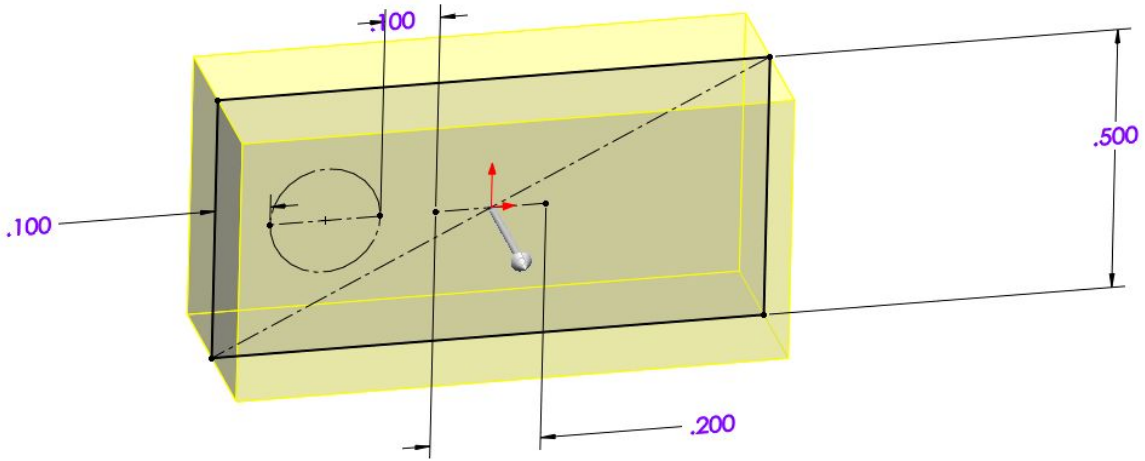

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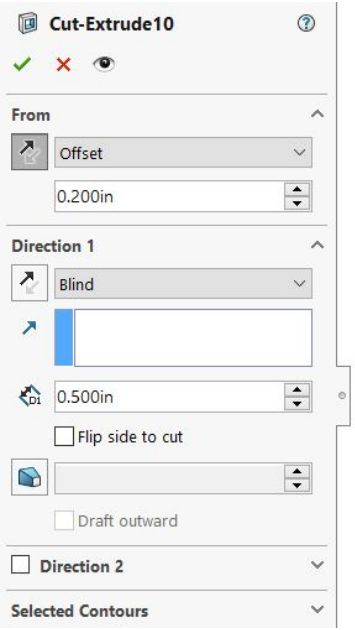

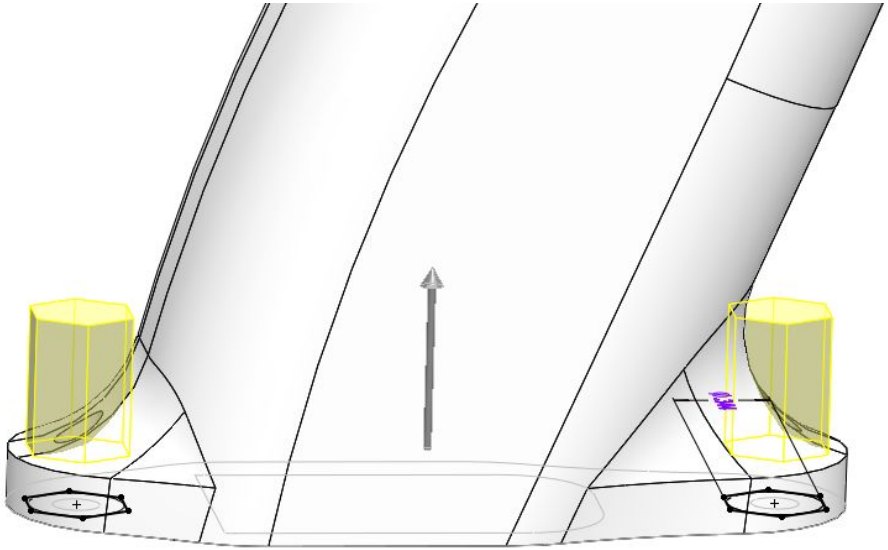

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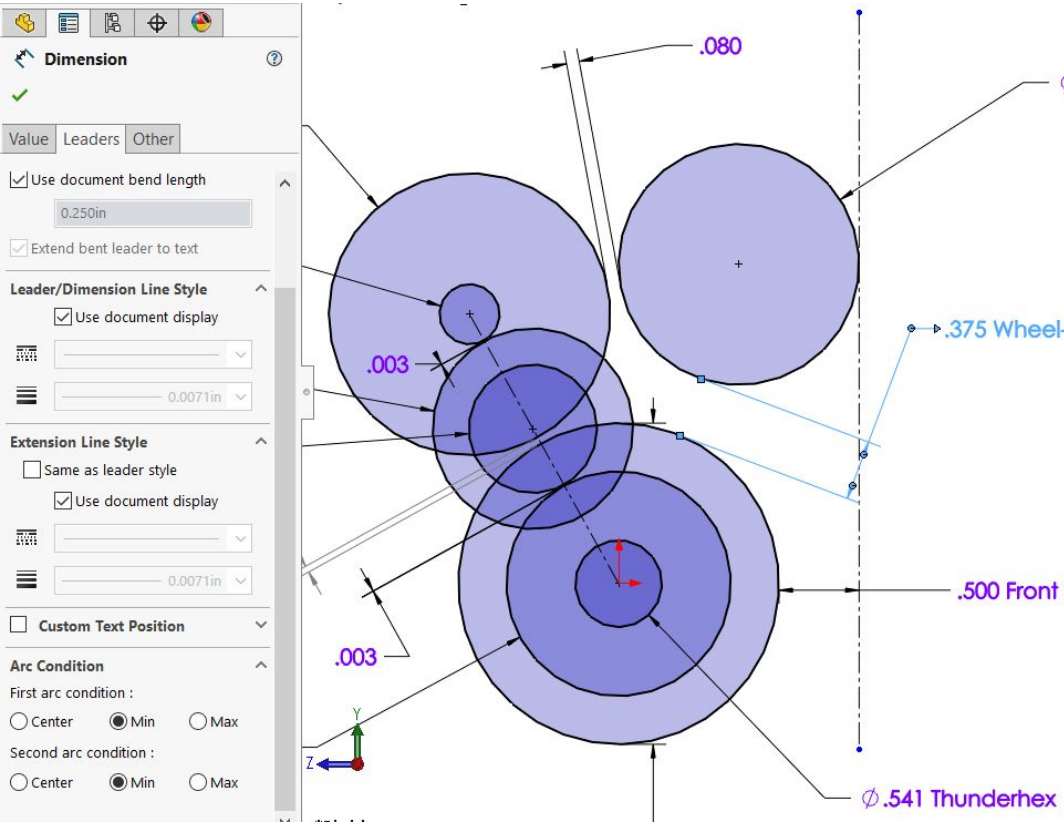
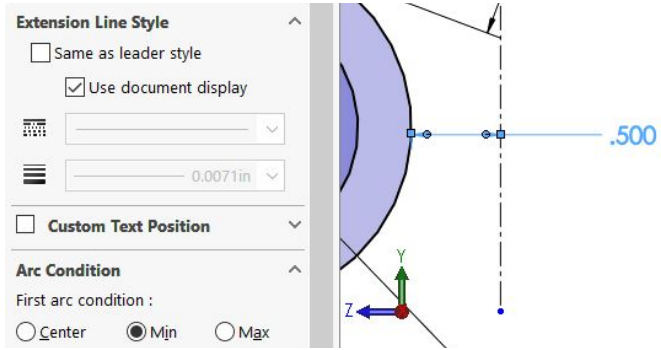
Use appropriate arc conditions for dimensioning to circles





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Capturing Design Intent - Summary

- Start with the feature/s that captures the design essence
- Try to capture intertwined design features in 1 sketch
- Choose dimensions based on what you care to control
- Use relationships to capture design intent, relationships often do a better job than dimensions
- Use construction lines
- Place the origin in a logical spot (take advantage of symmetry)
- Use of start and end conditions for extrudes
- Use appropriate arc conditions for dimensioning to circles

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Making Models Easy to Update

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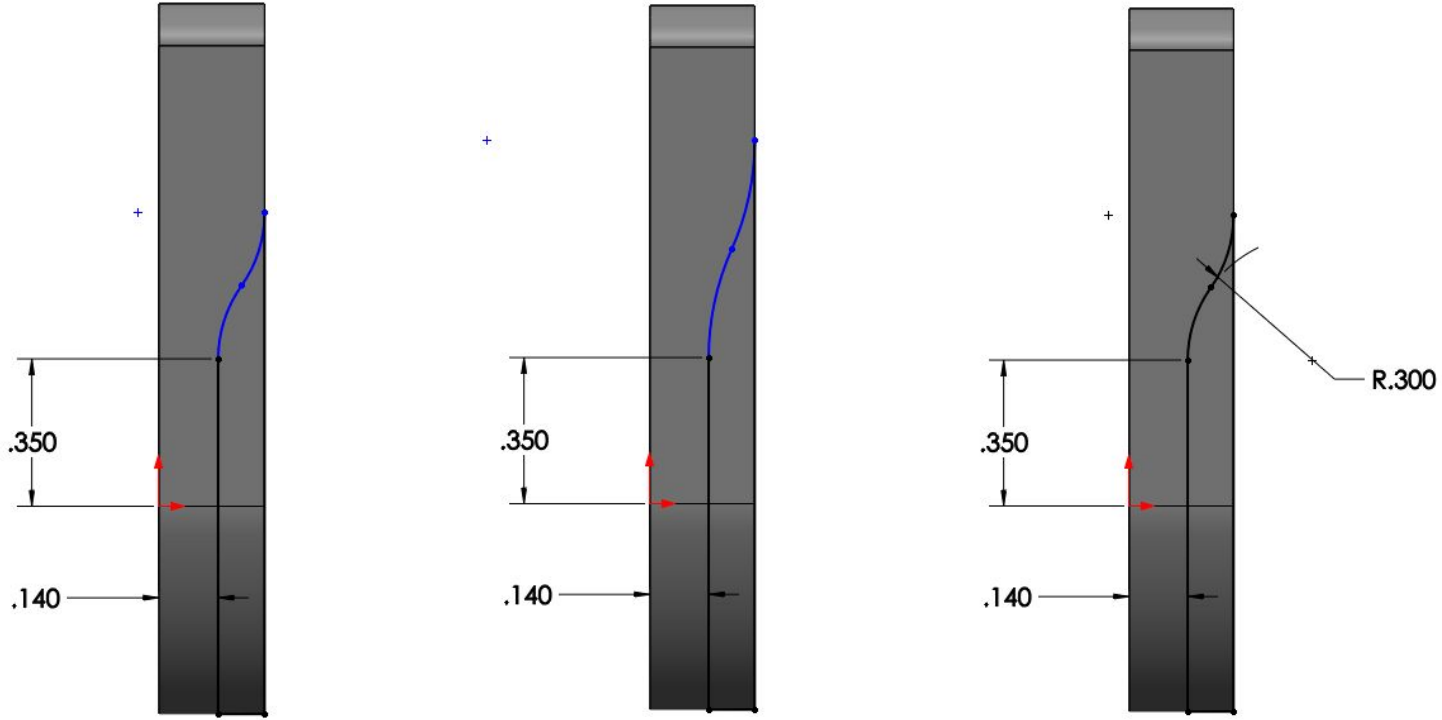
All sketches constrained



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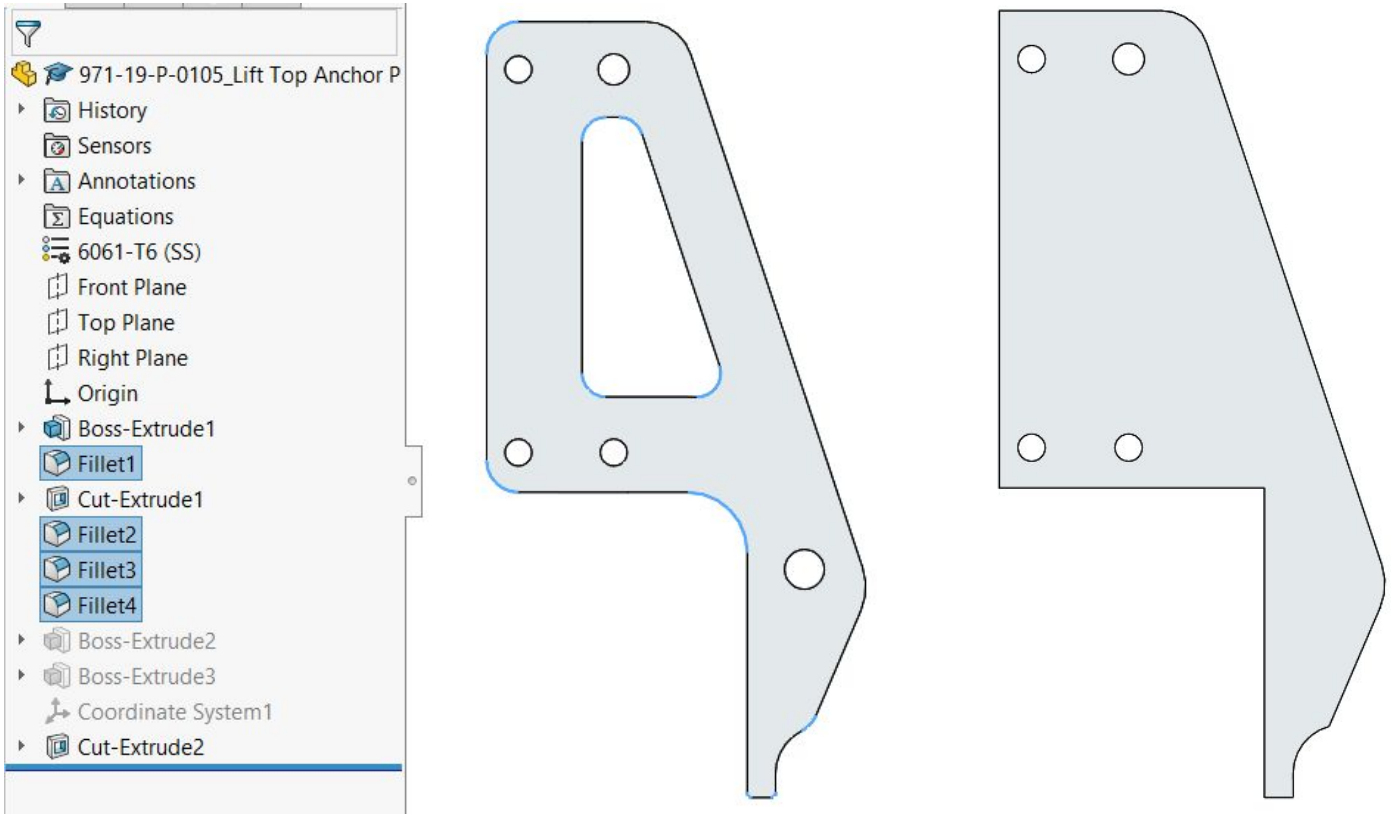
Filet in features rather than sketches



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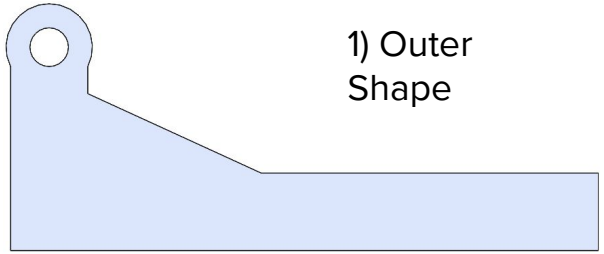
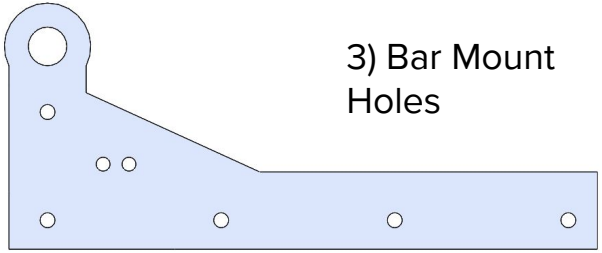
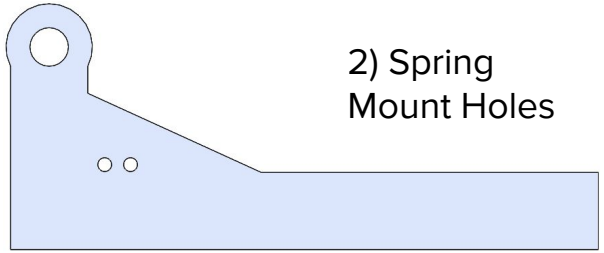
Split un-related items into multiple features



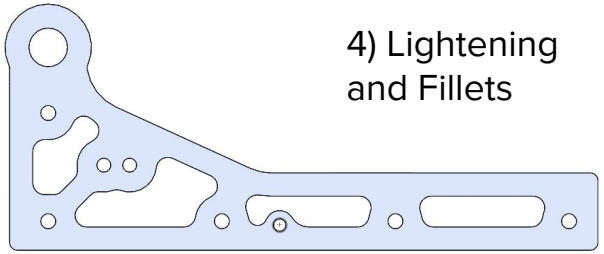
1) Outer Shape



3) Bar Mount Holes



2) Spring Mount Holes



4) Lightening and Fillets

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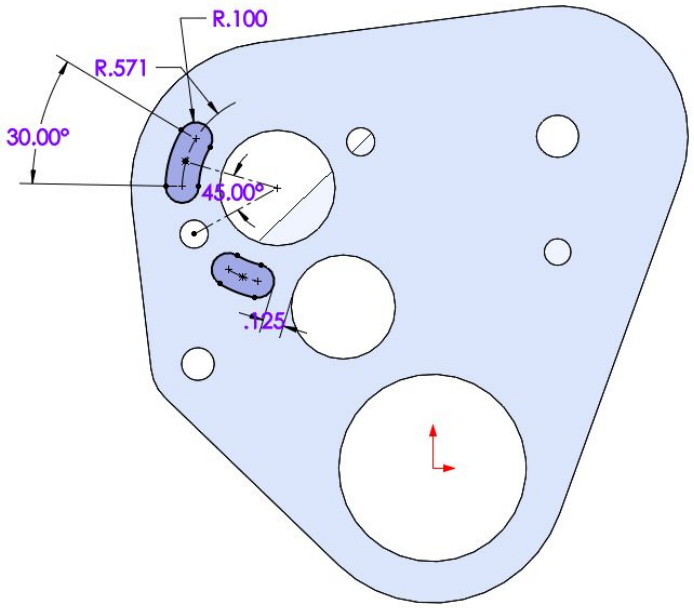
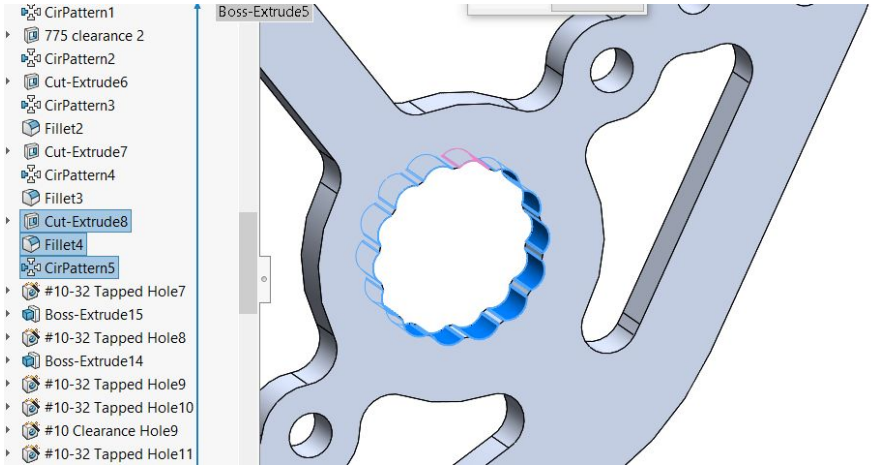
Split un-related items into multiple features





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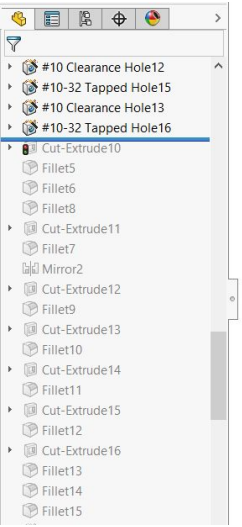
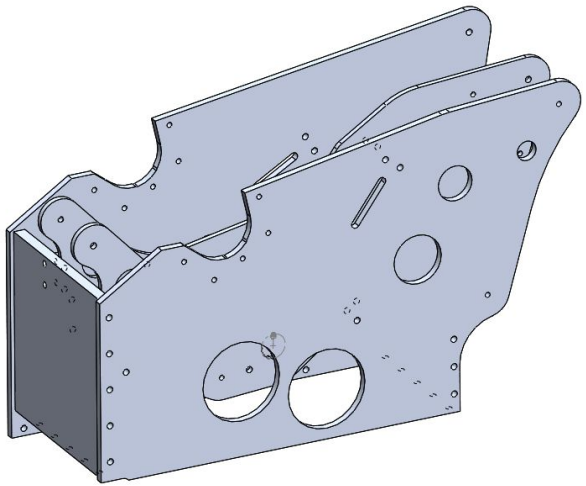
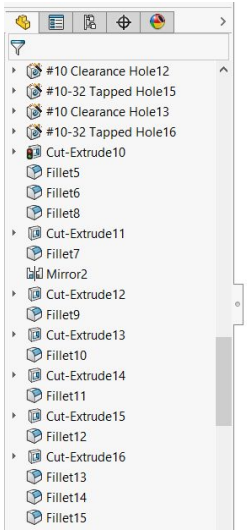
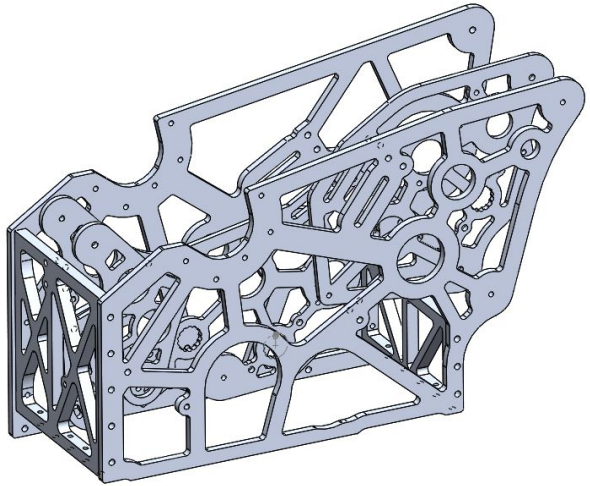
Lightening goes last









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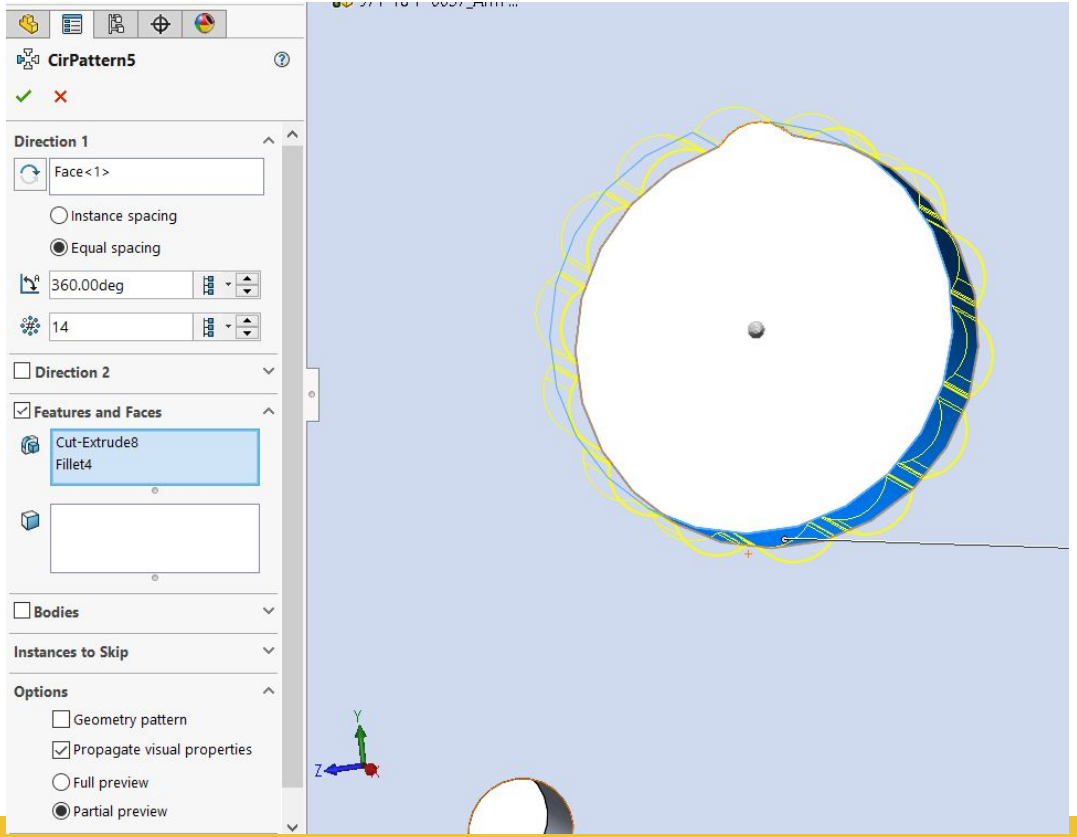
Mirrors and linear patterns are better as features than sketches



971 SPARTAN ROBOTICS

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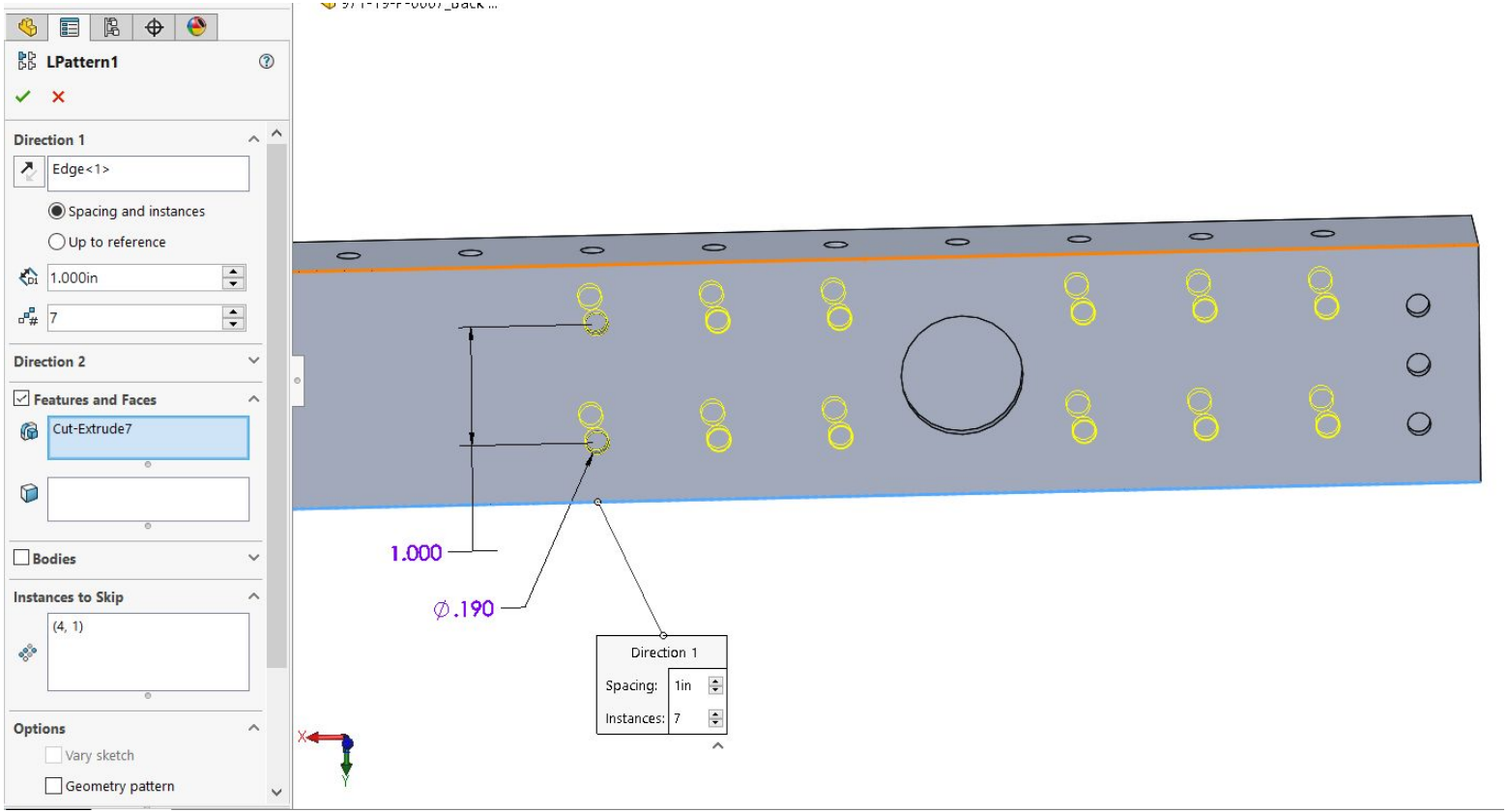

971 SPARTAN ROBOTICS

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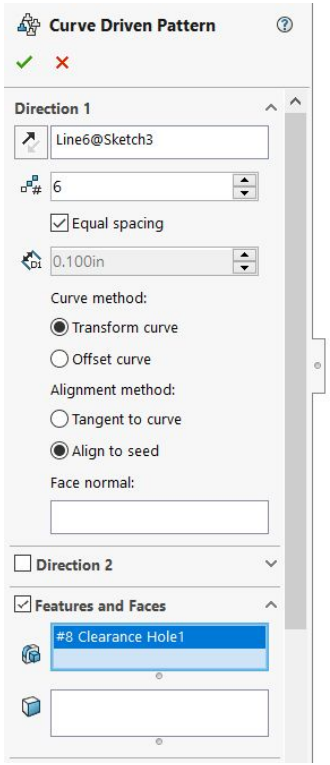

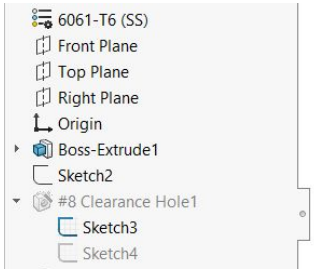

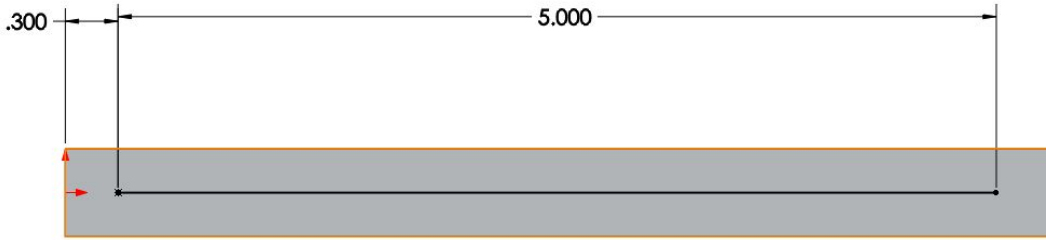

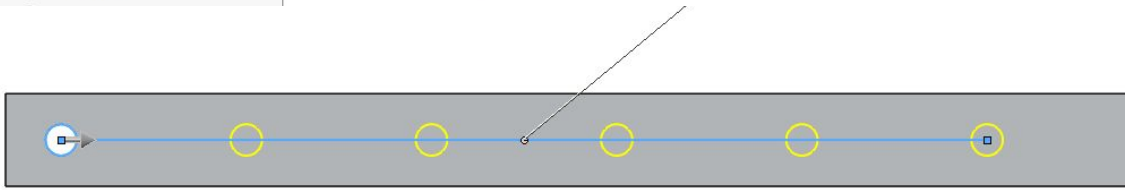

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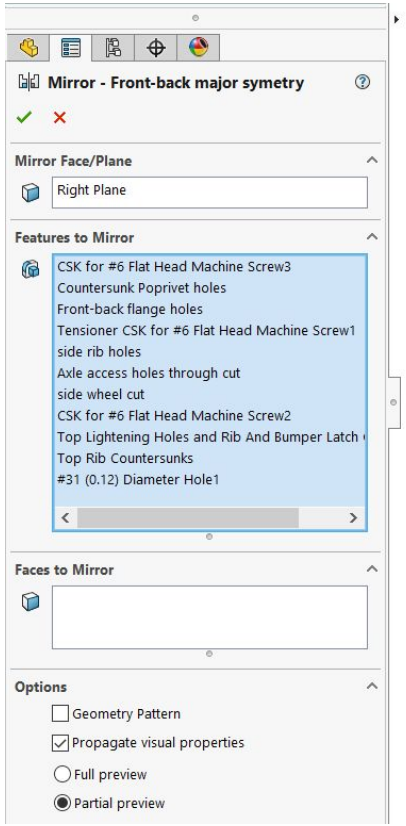
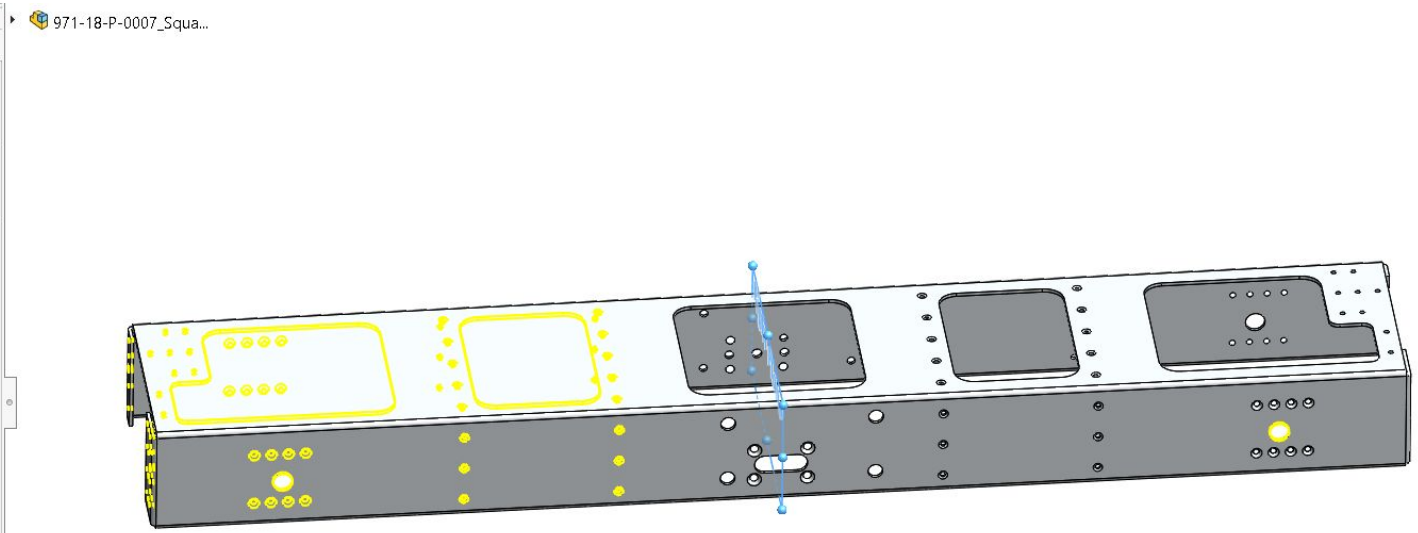
Mirrors and linear patterns are better as features than sketches





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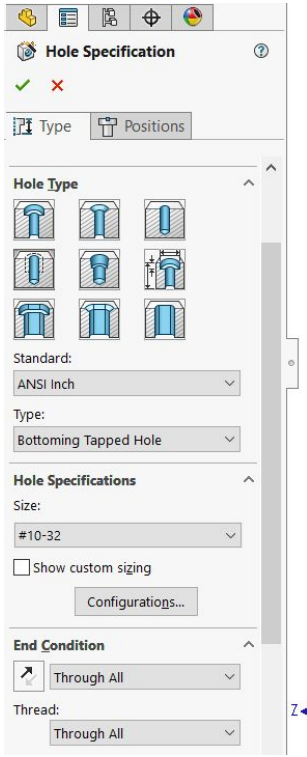
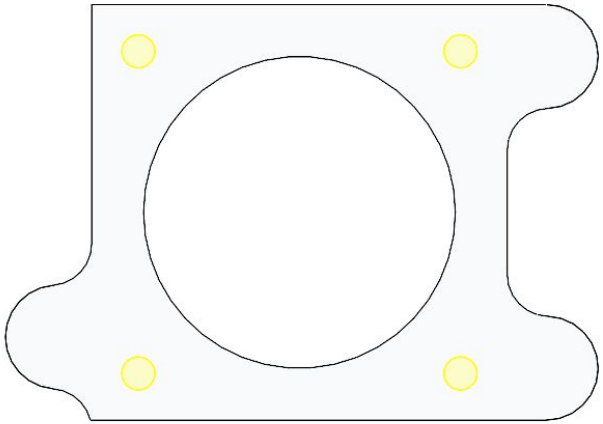
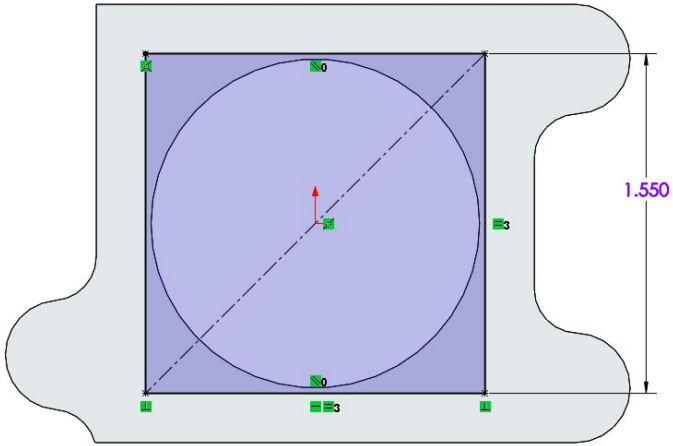
Use Hole Wizard when possible







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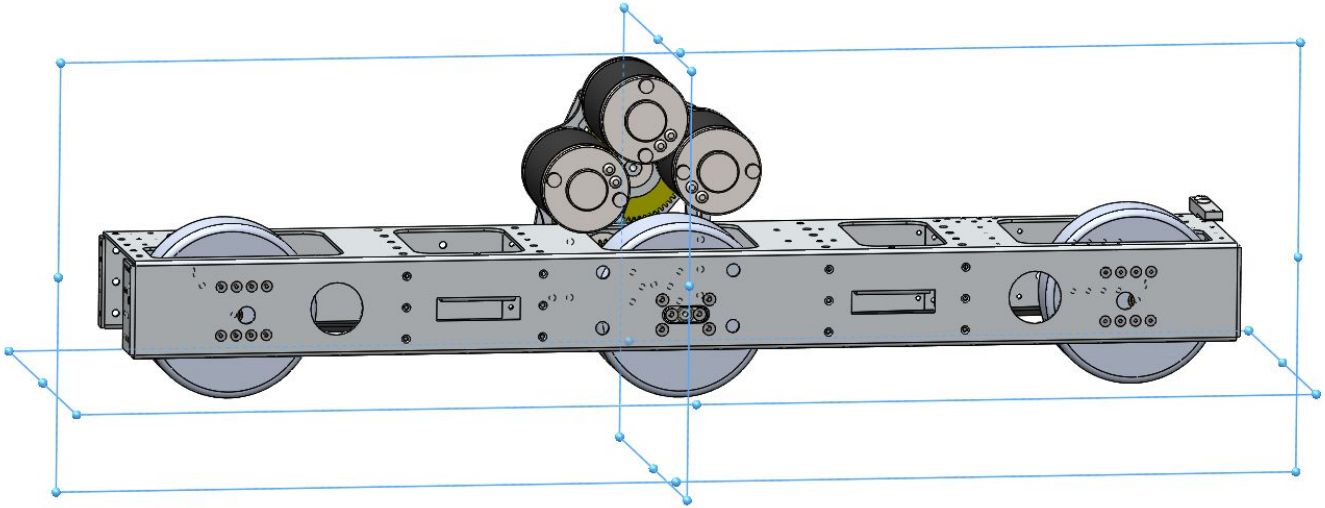
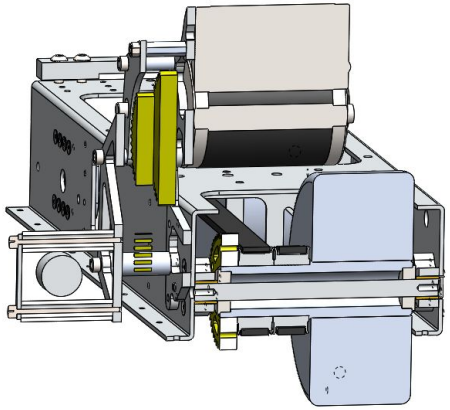
Origin and planes should be in logical spots in assemblies





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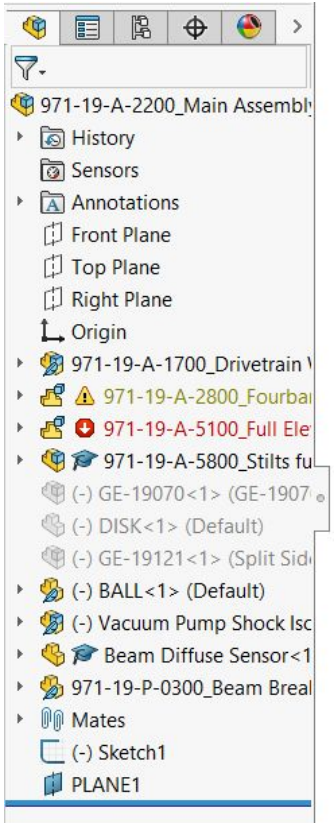
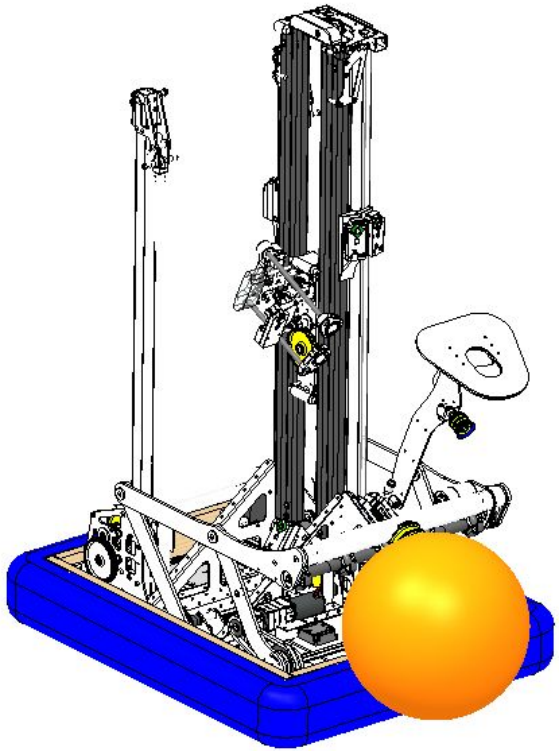
Fix broken references and mates when you find them





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Making Models Easy to Update - Summary

- All sketches constrained
- Fillets in features rather than sketches (unless key to geometric layout)
- Split un-related items into multiple features
- Lightening goes last
- Mirrors and linear patterns are better as features rather than sketches
- Use hole wizard when possible
- Origin and planes should be in logical spots in assemblies also (drop the first part in fixed to origin, mate origin to origin for location constraint)
- Fix broken references and mates when you find them

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Creating Robust References

The Problem:

How do you make a bunch of parts in a complex assembly all line up?

- Easy to create
- Easy to update/maintain

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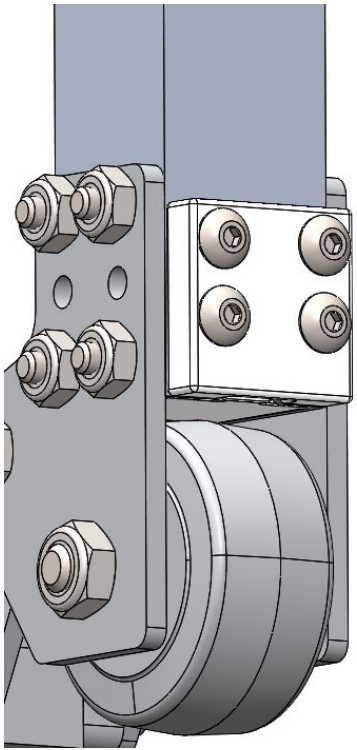
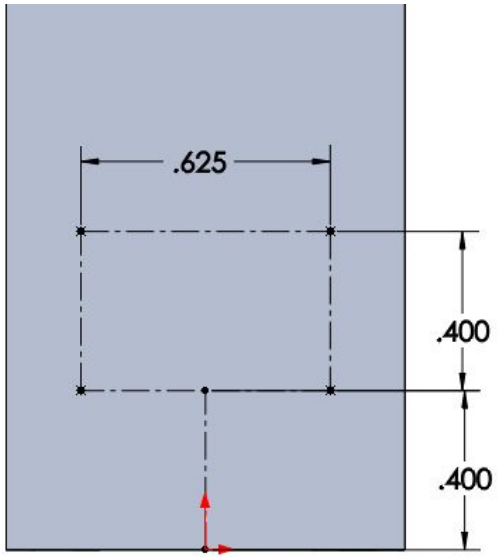
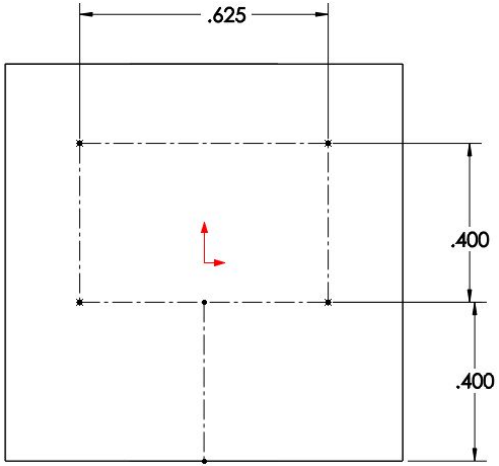
Updating by hand







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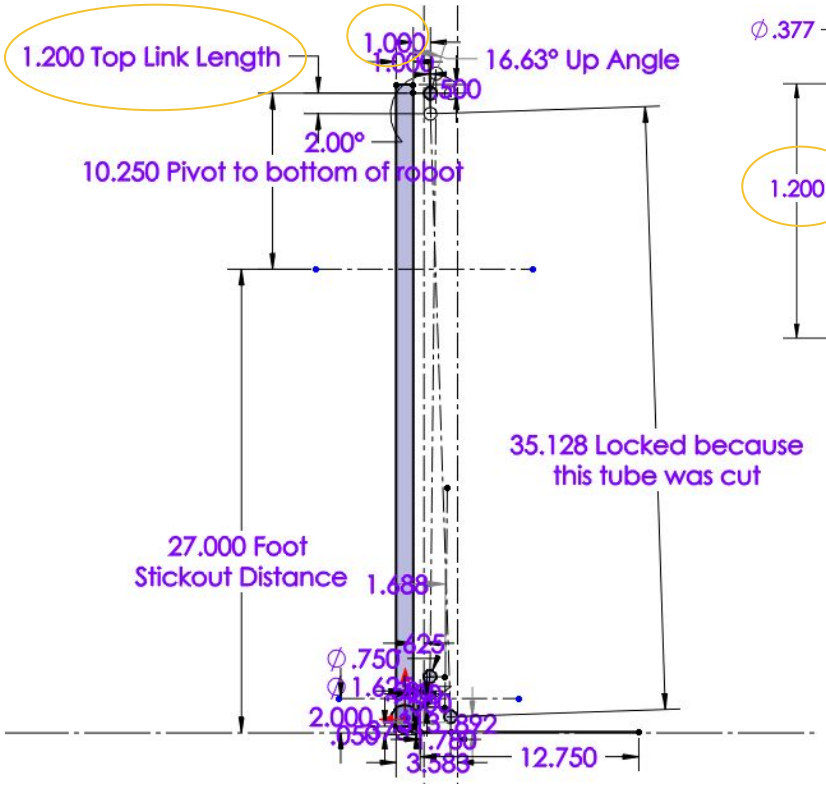
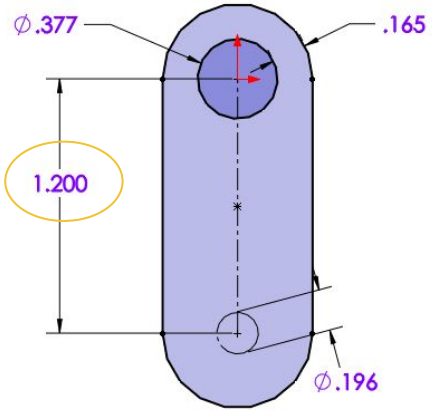
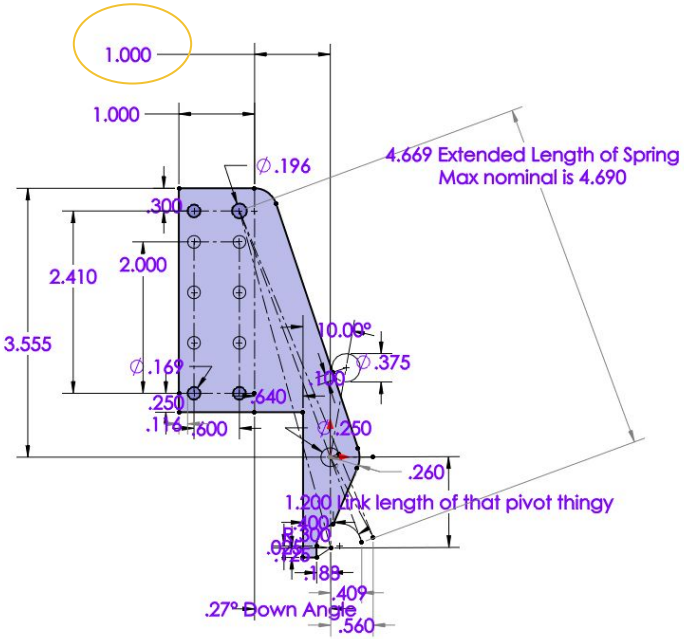
Updating by hand







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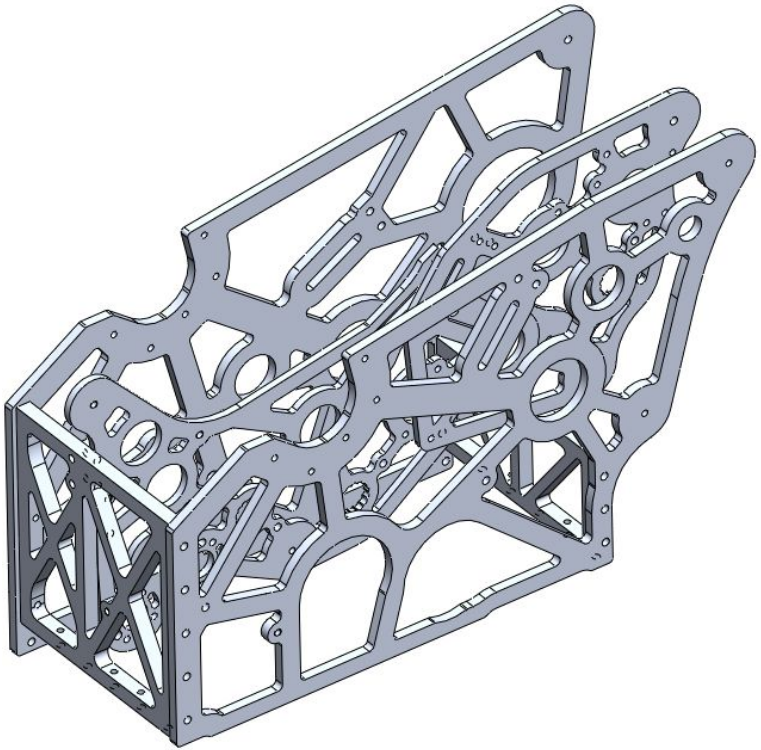
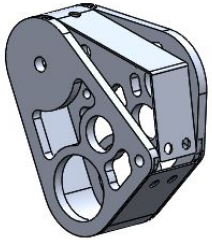
Multi-Bodied Parts





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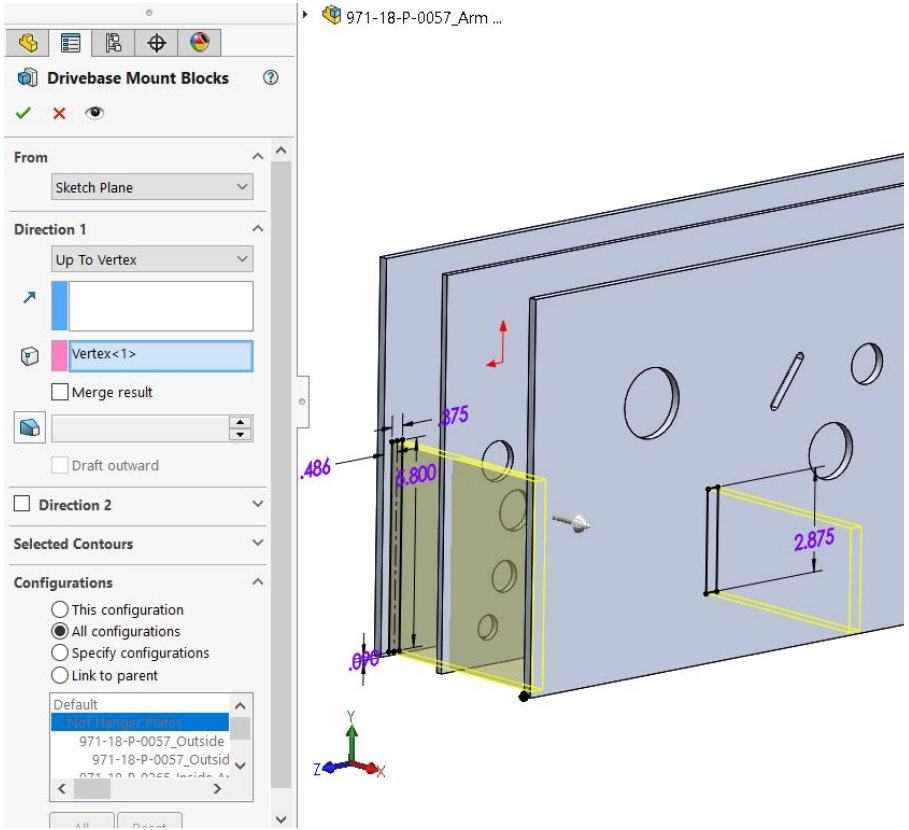
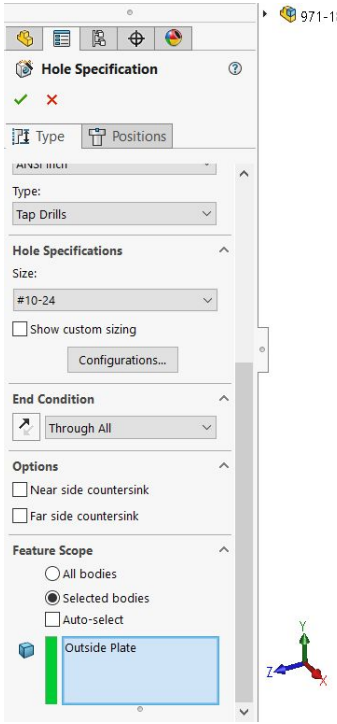
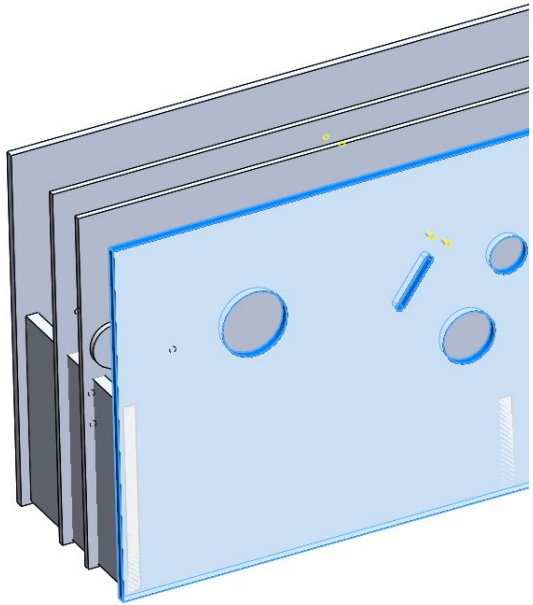
Multi-Bodied Parts







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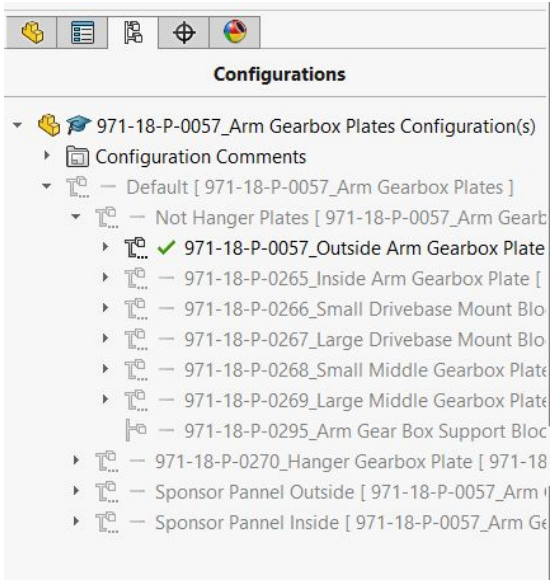
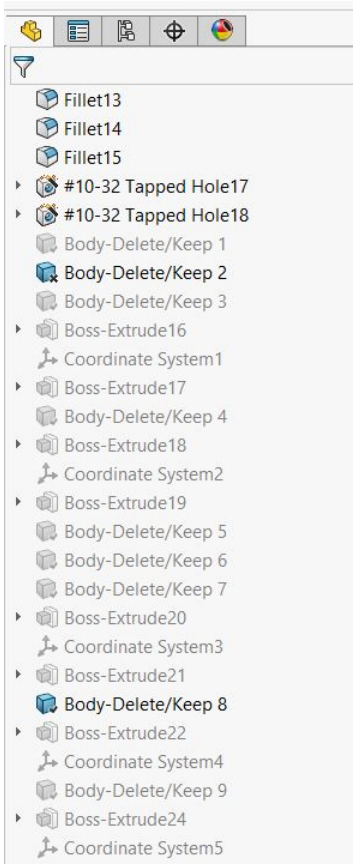
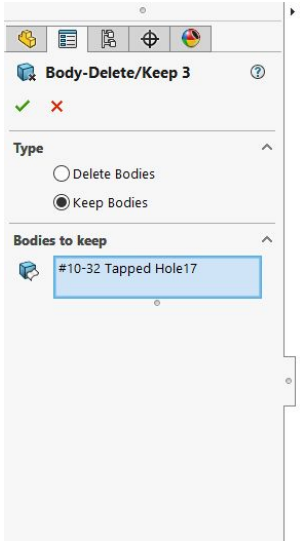
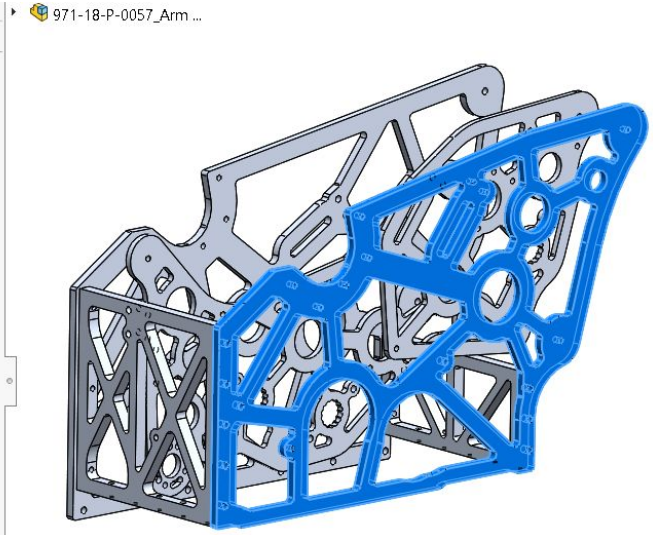
Multi-Bodied Parts









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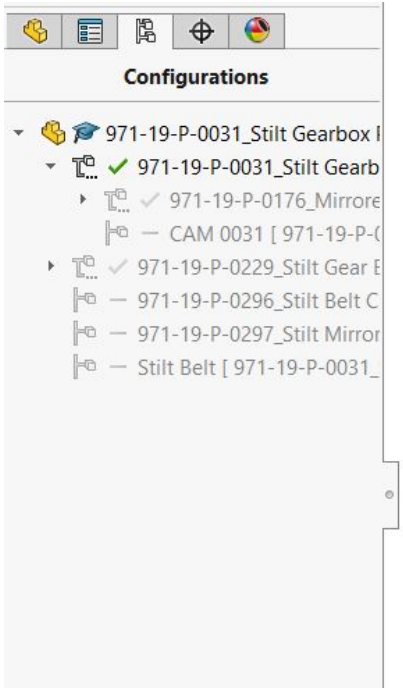
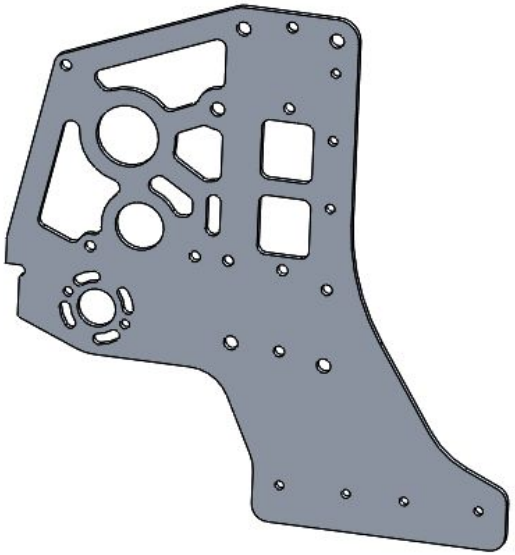
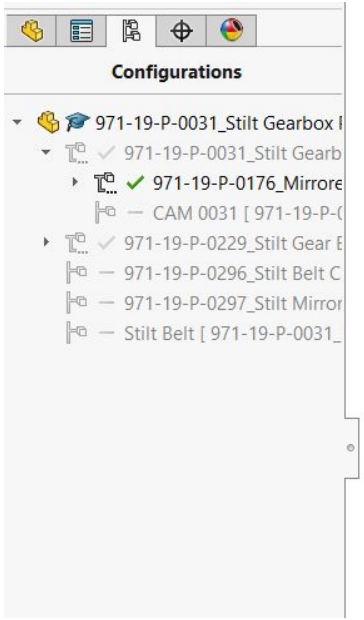
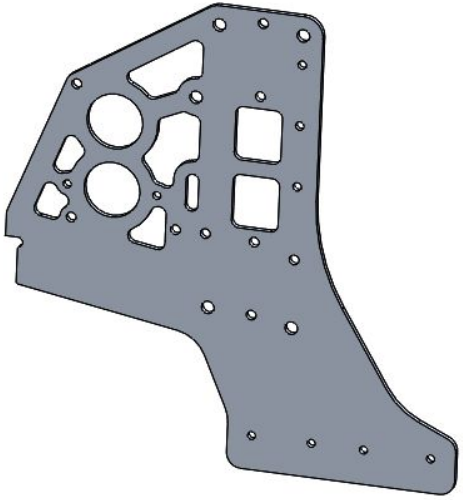
Configurations









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Solutions I have tried

	Pros	Cons
Multi-Bodied Parts	- References contained in 1 part - Easy to see everything at once	- Models get large and complicated - Hard to split into drawings
Updating by Hand	- Parts stand alone - Quick for simple interfaces	- Not automatic
Configurations	- Parts stand alone	- Hard to manage changes to configurations correctly for complex parts
In-context features	- Fast to do	- Hard to debug problems - Unwieldy/fragile assemblies - Hard to separate out parts
Master part with split bodies	- All interface points captured in one model	- Hard to collaborate across multiple people - Easy for links to break - Hard to version
Equation Linked Dimensions	- Automatically updates	- Doesn’t always work - Tedious
Layout sketch blocks	- One source of reference	- Complex sketch, doesn’t update well

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Tips and Tools for Working Quickly

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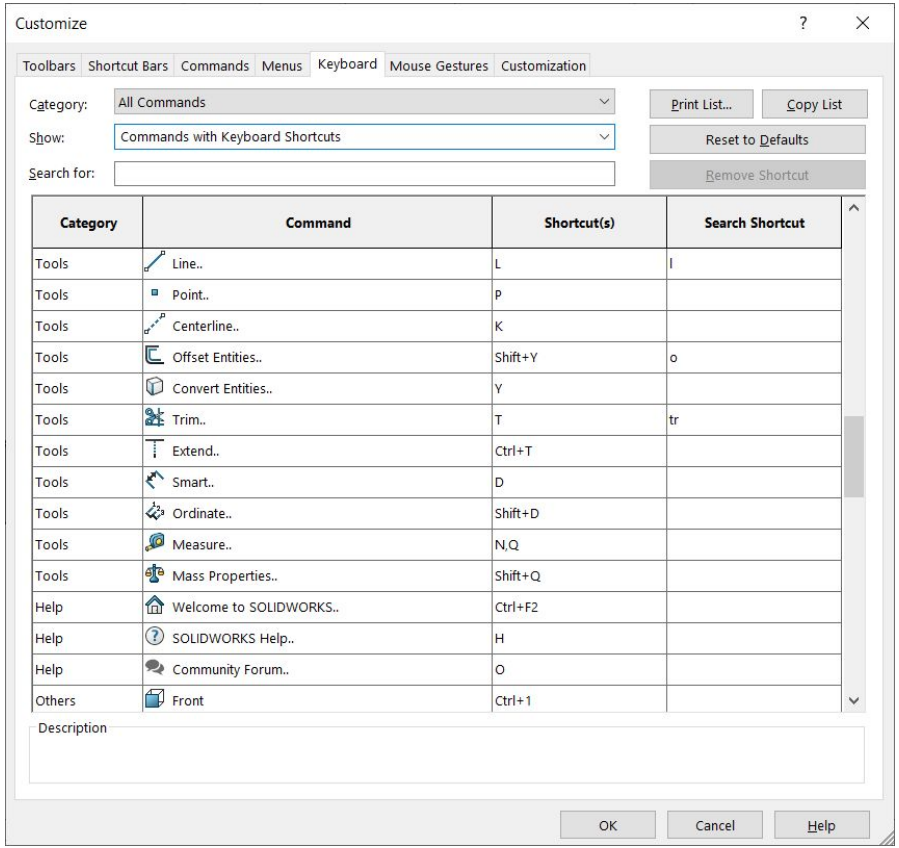
Learn to use shortcut keys



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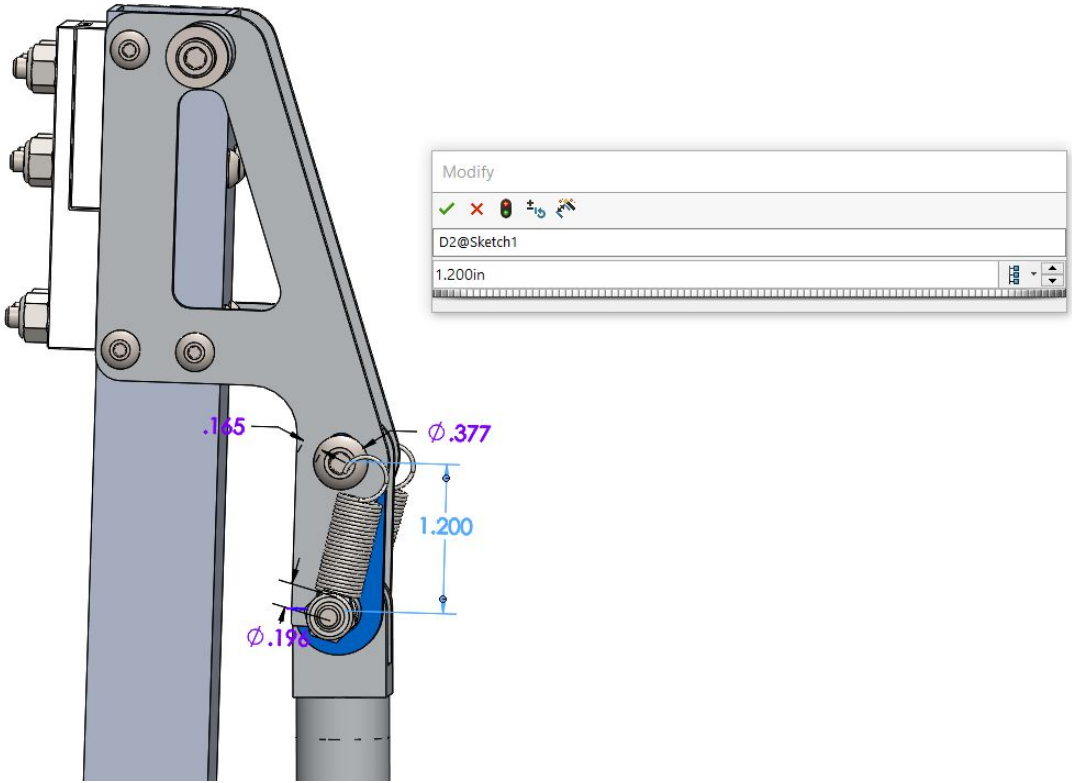
Double click on faces to update dimensions



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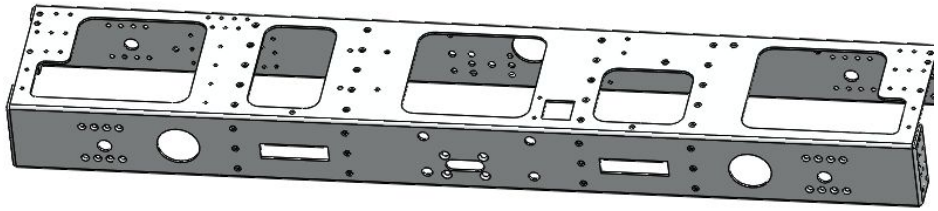
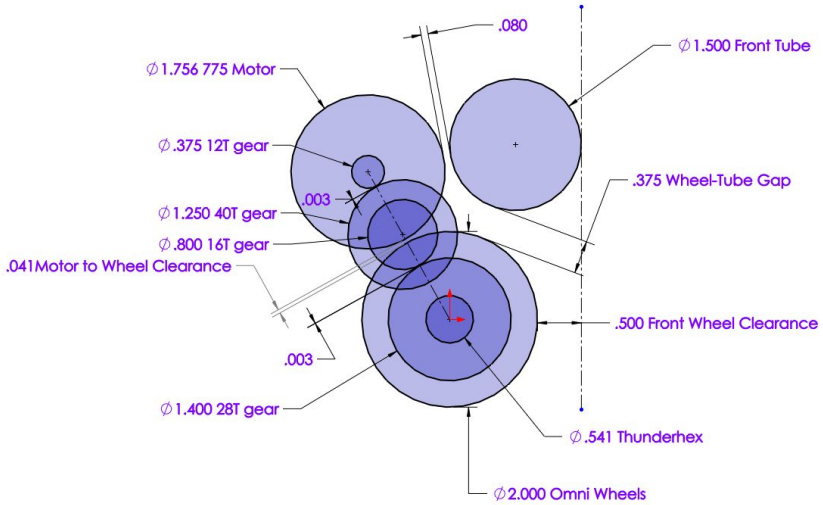
Label features and dimensions

- Top edge flange
- Gearbox output Bearing Hole Cut
- Gearbox output Bearing Hole Fillet
- Edge-Flange14
- Edge-Flange12
- Tab1
- Tab2
- Cut-Extrude53
- Axle access holes through cut
- side wheel cut
- middle wheel cut
- Middle axle access window
- Outside mdl axle CSK for #10 Flat Head mic
- Inside mdl axle CSK for #10 Flat Head Mach
- #10 (0.1935) Diameter Hole2
- Transmission Bolt Holes
- Transmission Bolt Clearance Holes
- Dowel Pin clearance holes
- Top Lightening Holes and Rib And Bumper
- side rib holes
- Bottom Mount Holes
- Front-back flange holes
- Sketch143
- Tensioner CSK for #6 Flat Head Machine Sc
- CSK for #6 Flat Head Machine Screw2
- CSK for #6 Flat Head Machine Screw3
- Countersunk Poprivet holes
- Inner Lightening Holes





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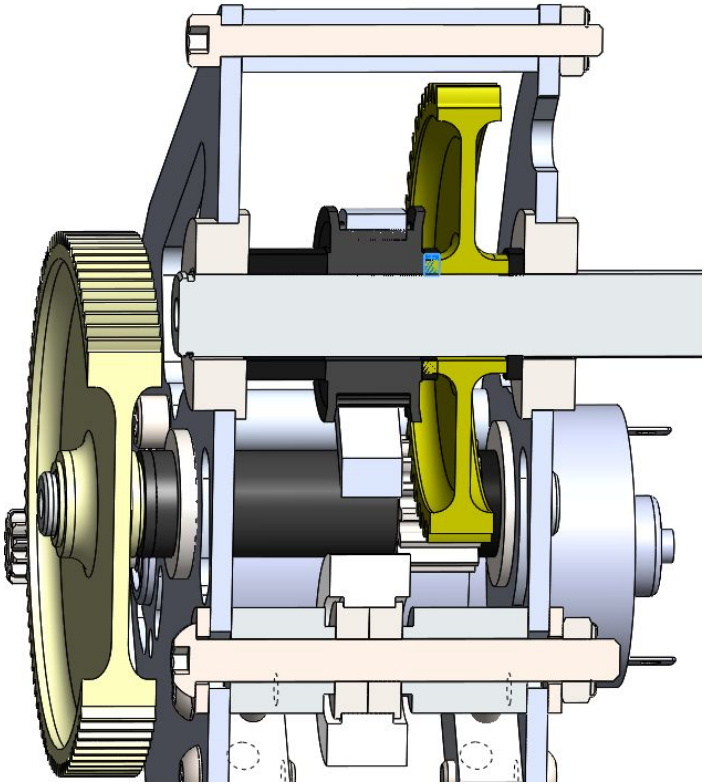
Use cross sections to check your work on shafts



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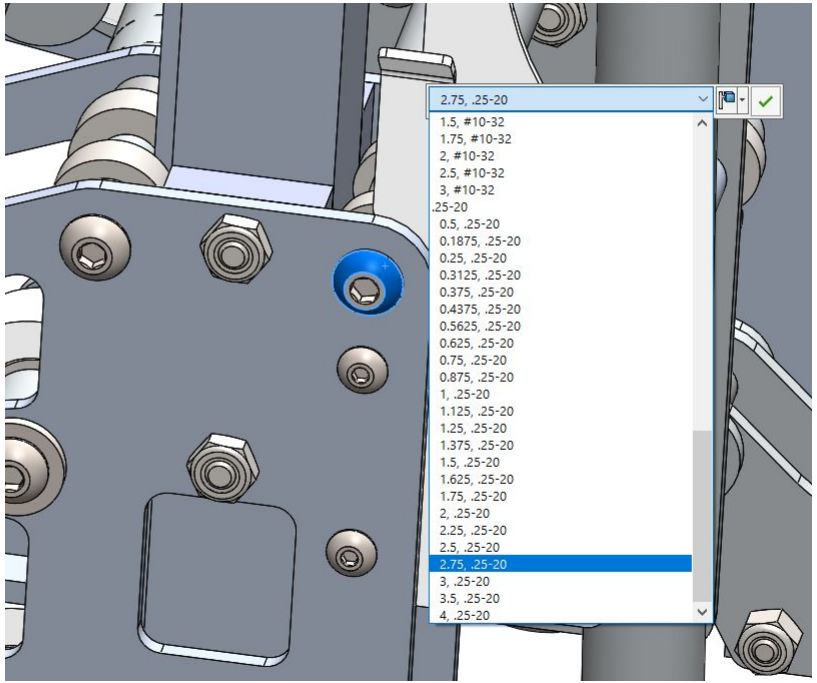
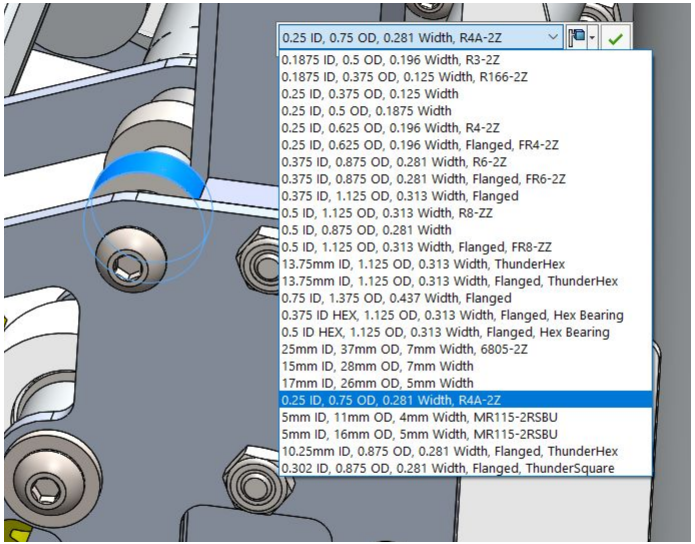
Use part libraries for standard fasteners and parts





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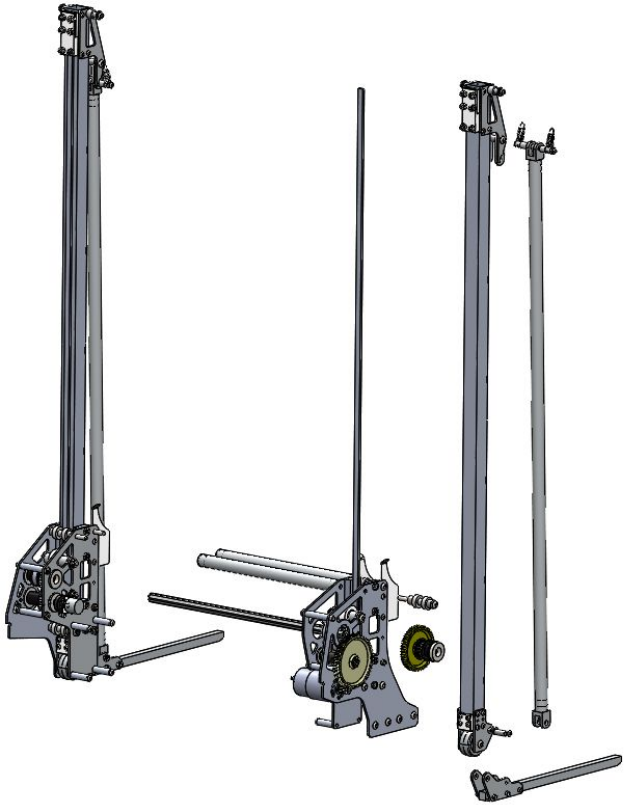
Segregate by assembly



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Tips and Tools for Working Quickly - Summary

- Learn and use shortcut keys
- Double click on faces to update dimensions
- Label features and dimensions for ease of re-interpreting
- Use cross-sections to check your work on shafts
- Use parts libraries for standard fasteners and parts
- Segregate by assemblies

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Thank You!

971
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