

A CAD Style Guide

Travis Schuh

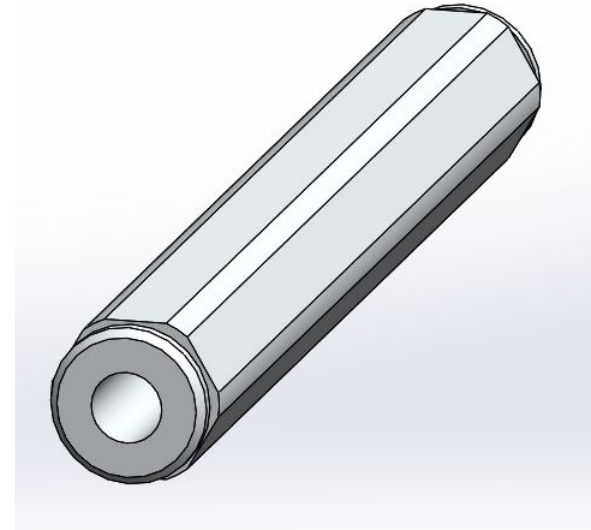
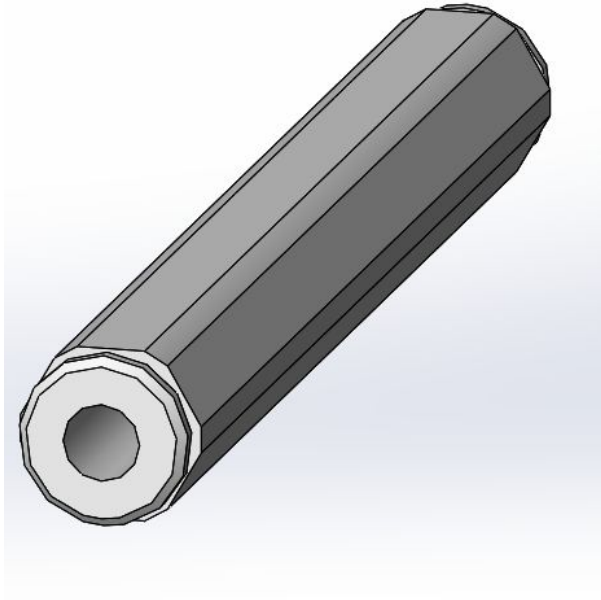


Goal: There are lots of ways to make the same CAD model, share some of the differences and some stylistic choices that I prefer

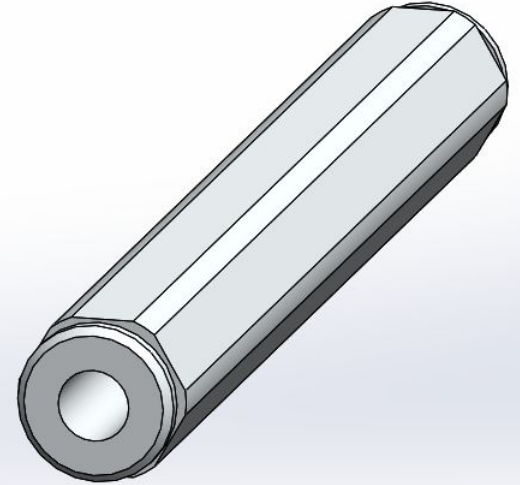
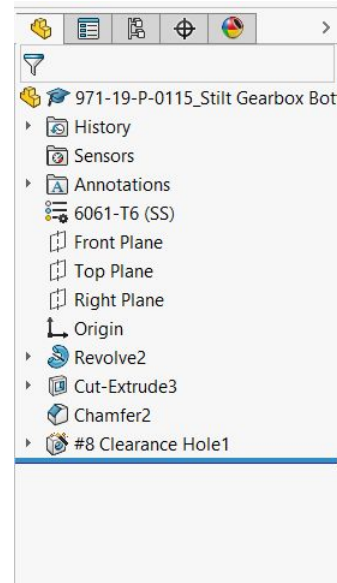
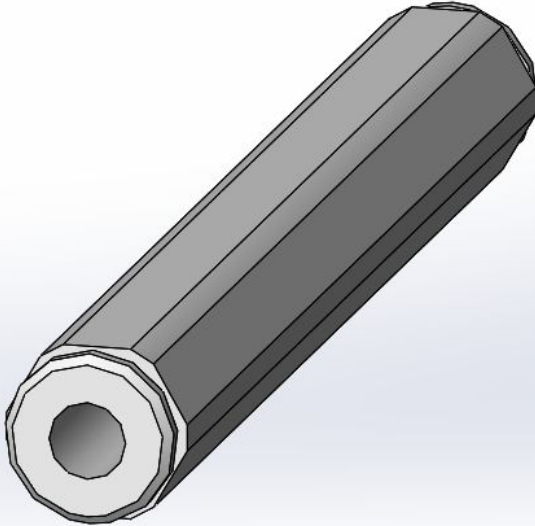
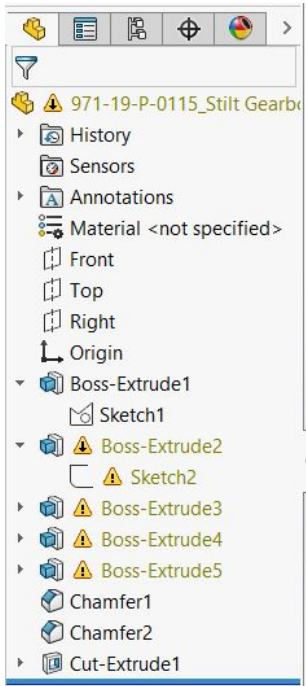
- Show how can get to the same model with different ways
- What are the benefits of having clean style
- Capturing the essence of the part (design intent)
- How do you reference different parts together
- Making things easy to update
- Tips and tools for working quickly



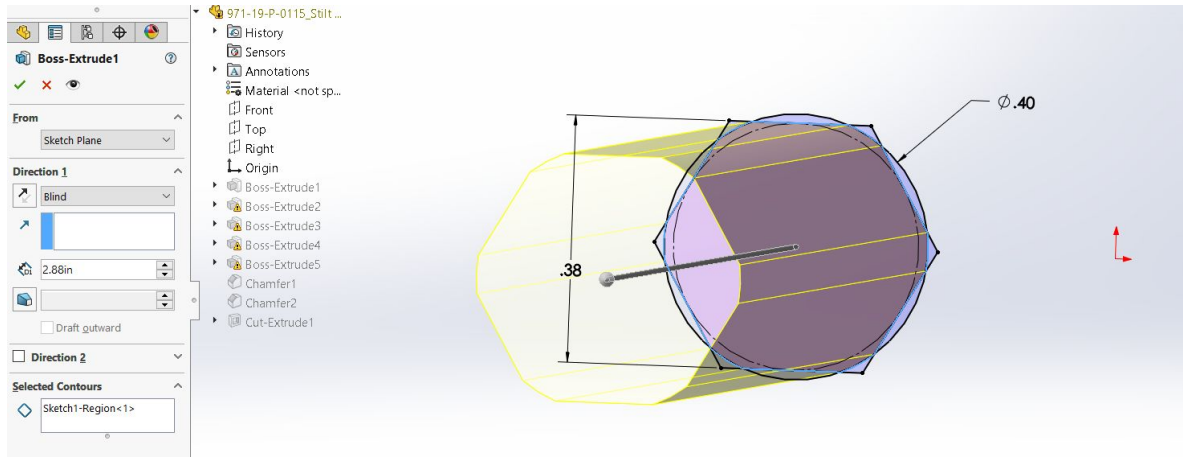
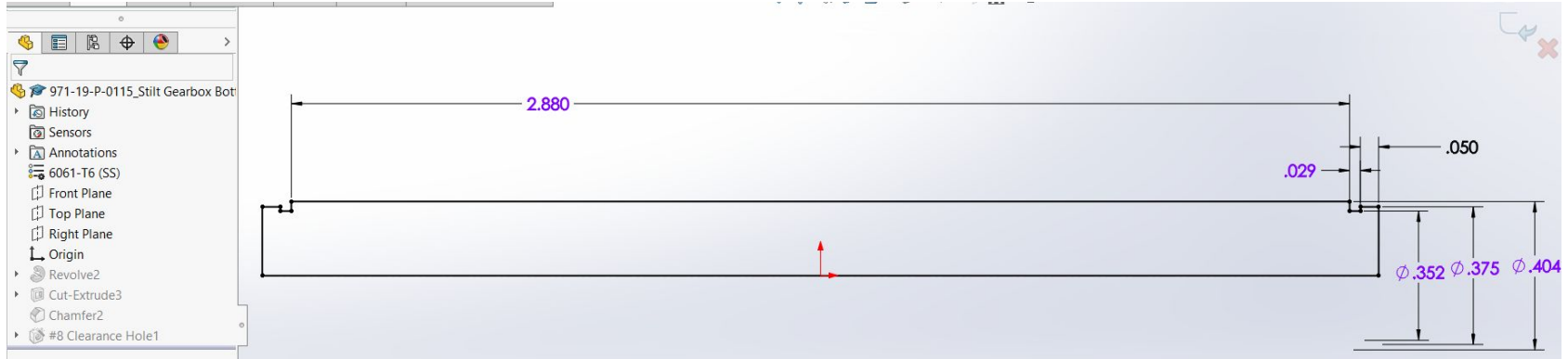
What is the Difference?



What is the Difference?



What is the Difference?



Outline

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

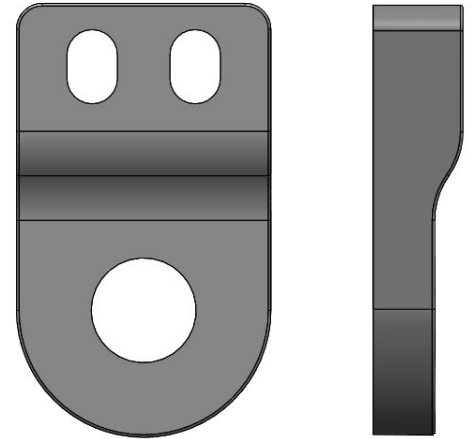
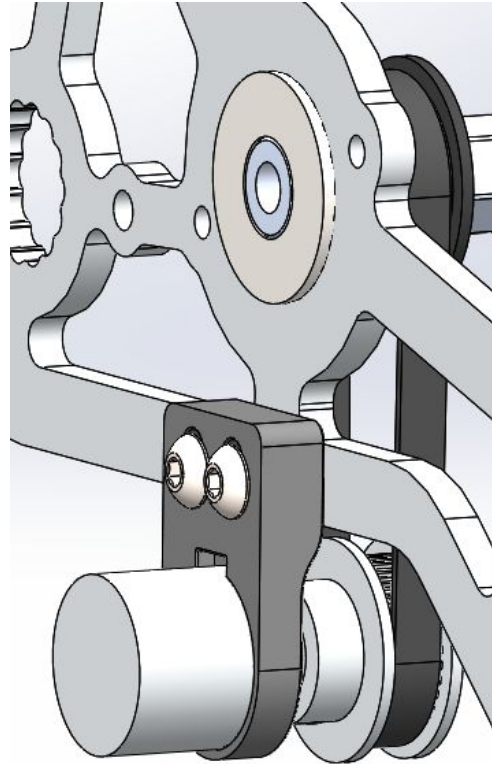


Capturing Design Intent

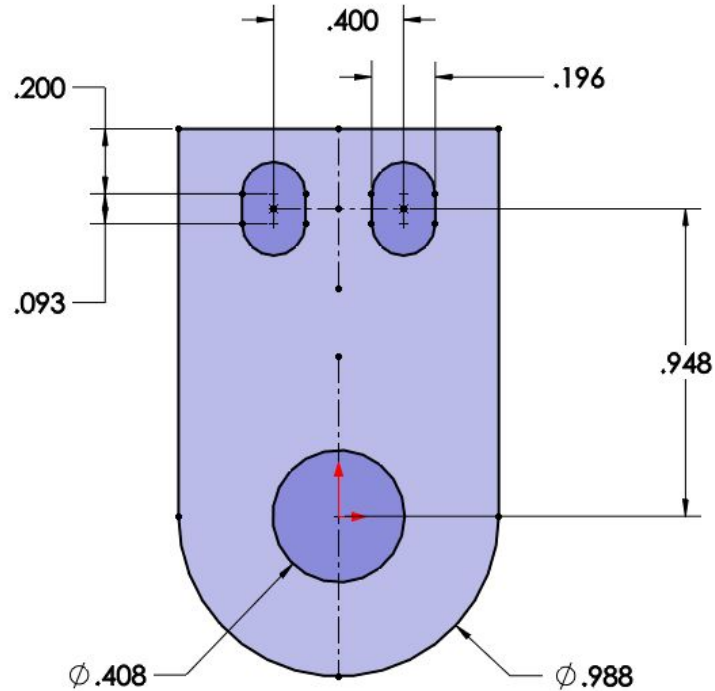
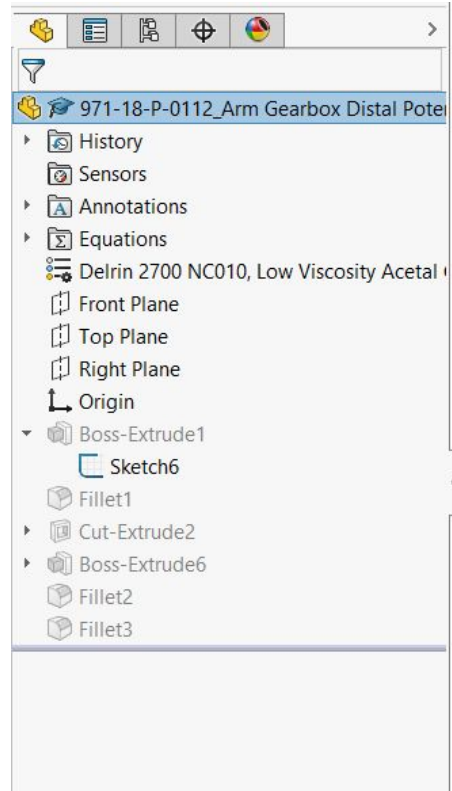


Start with the feature/s that captures the design essence

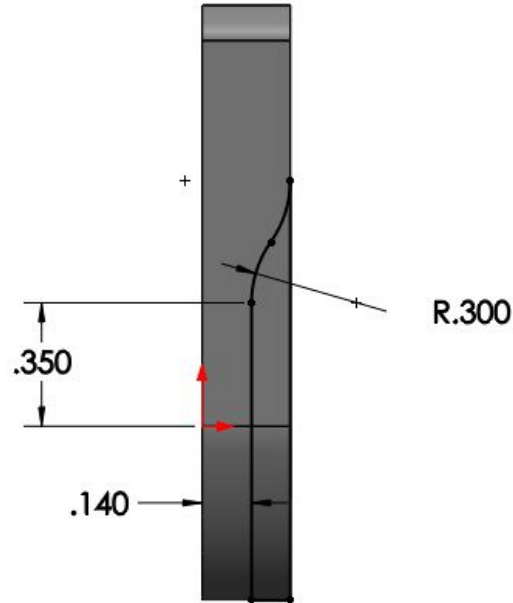
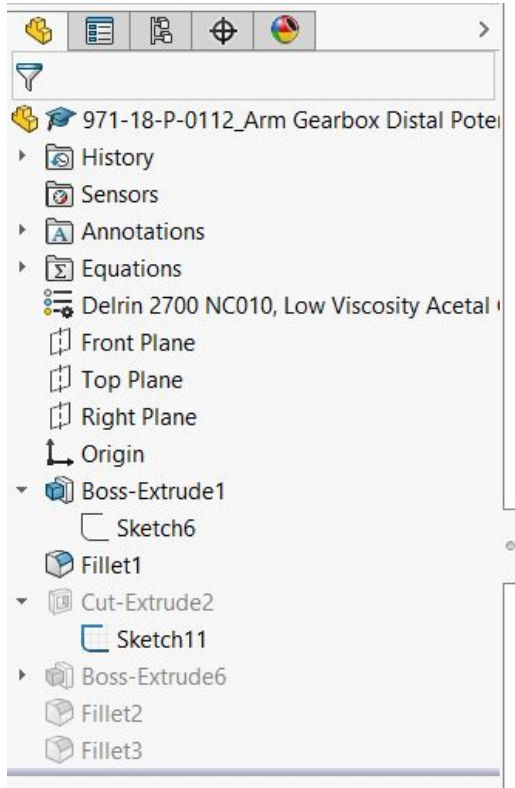
- 1) Hold the potentiometer at the right belt pitch spacing
- 2) Hold the pulley in alignment



Start with the feature/s that captures the design essence

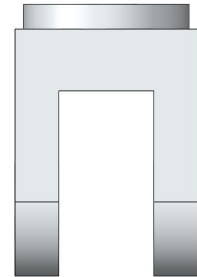
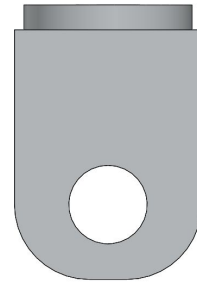
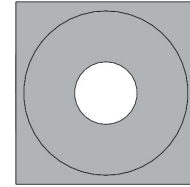
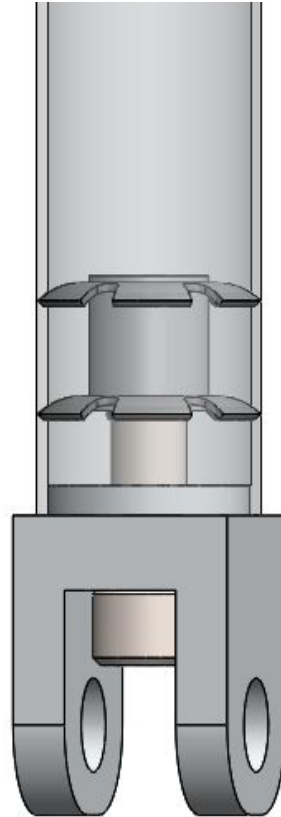


Start with the feature/s that captures the design essence

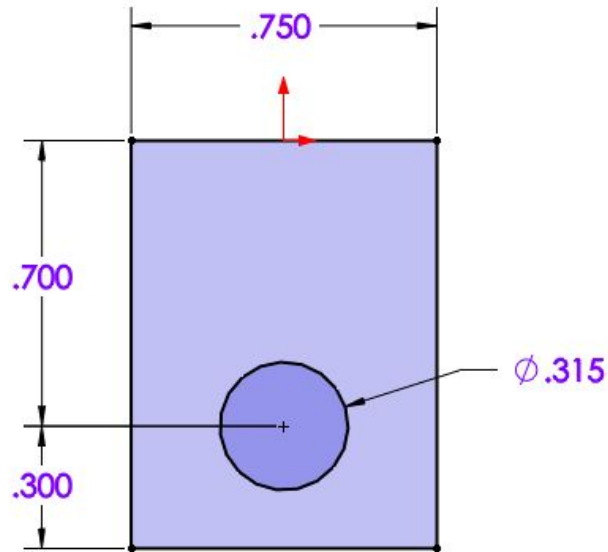
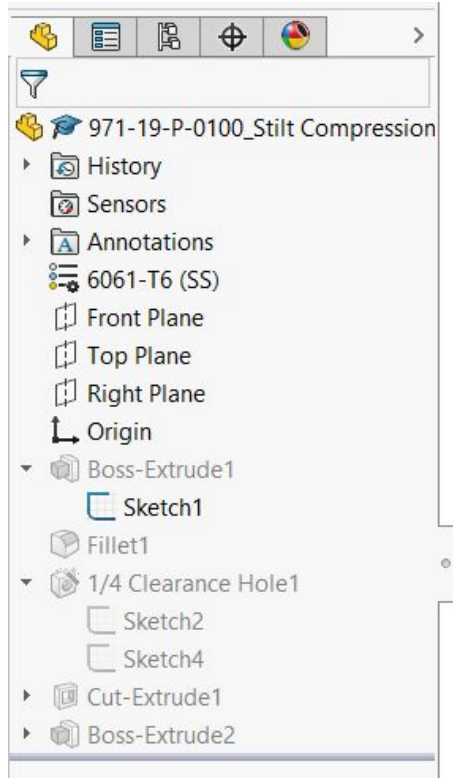


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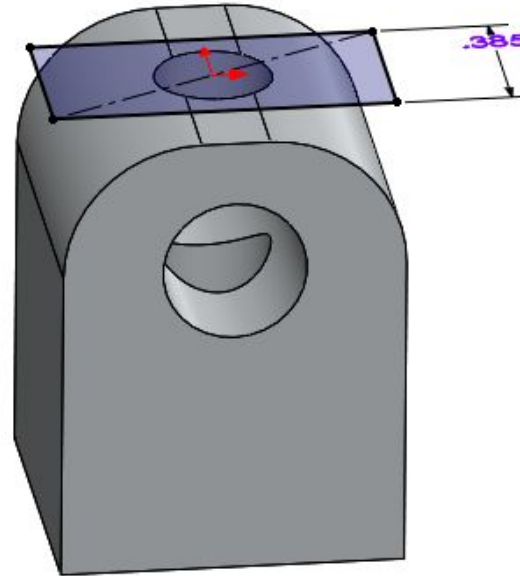
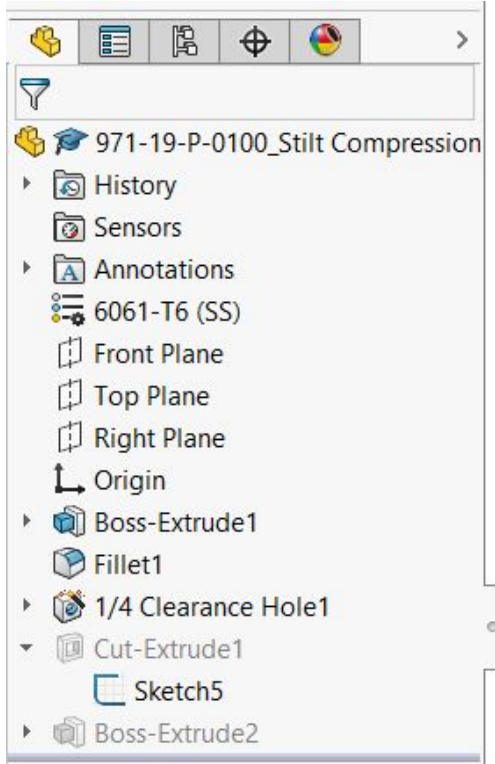
- 1) Form a pivot point
- 2) Clearance for a mounting bolt
- 3) Locate to the tube



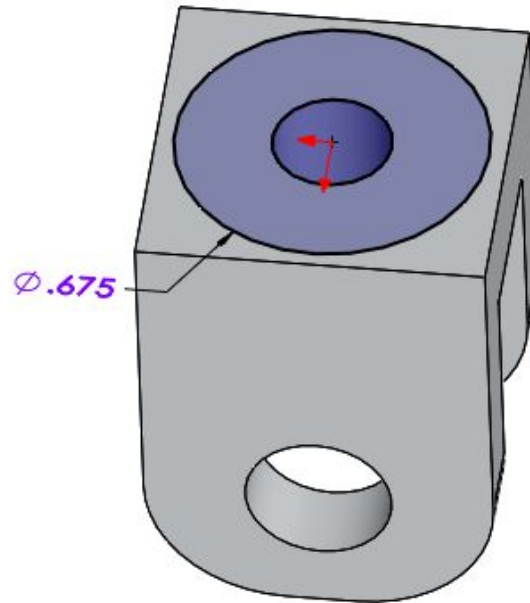
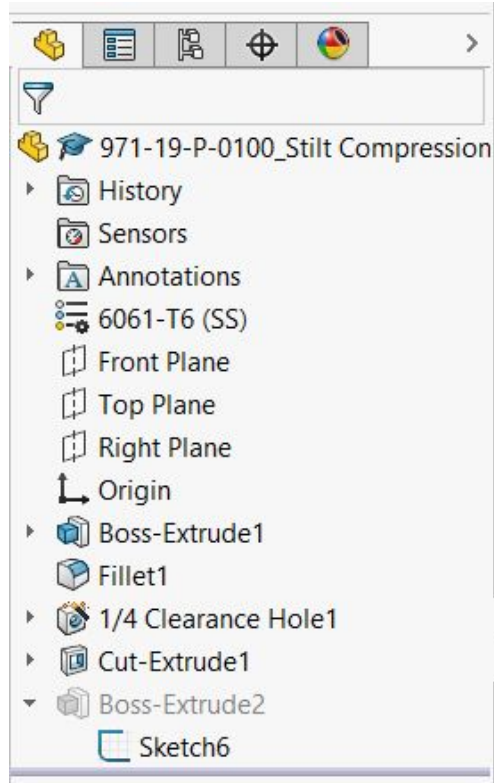
Start with the feature/s that captures the design essence



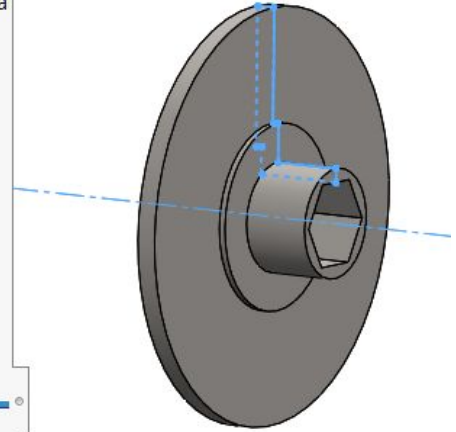
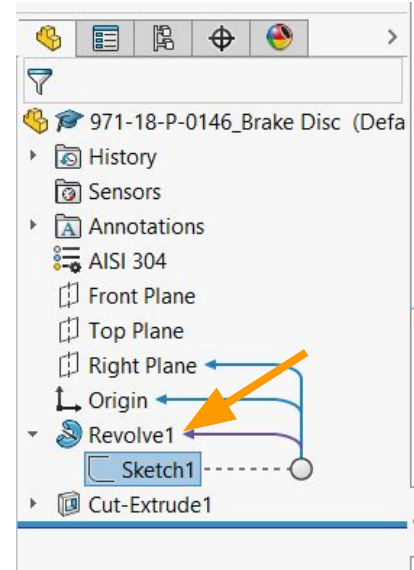
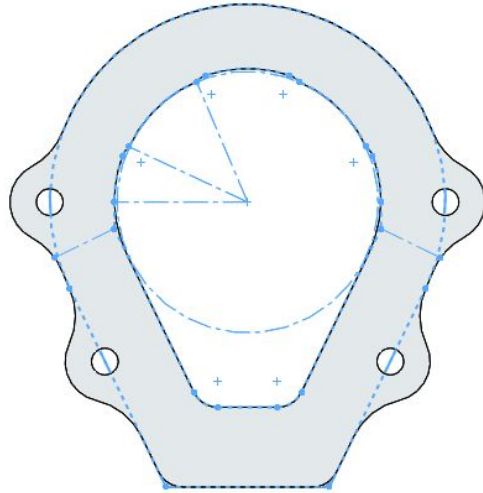
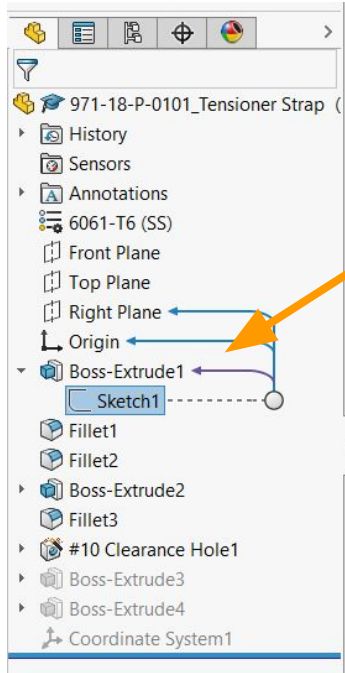
Start with the feature/s that captures the design essence



Start with the feature/s that captures the design essence

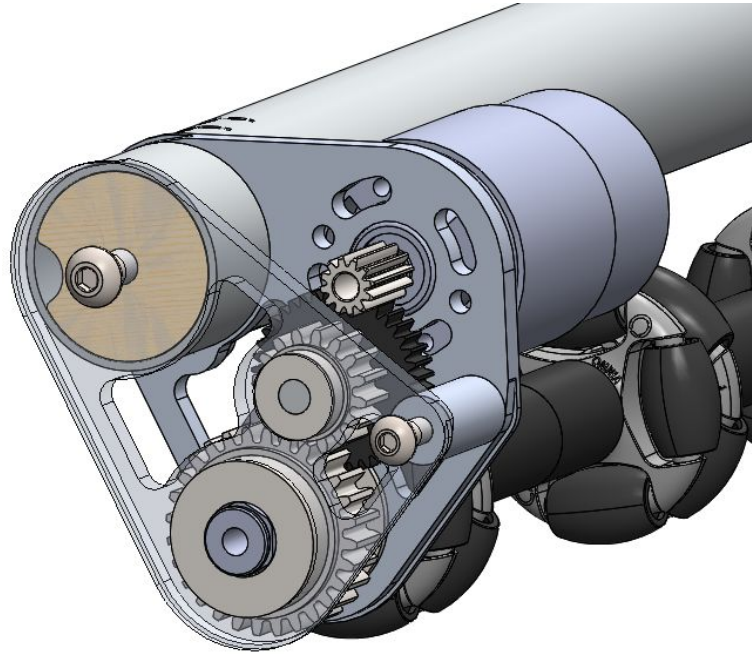


Start with the feature/s that captures the design essence

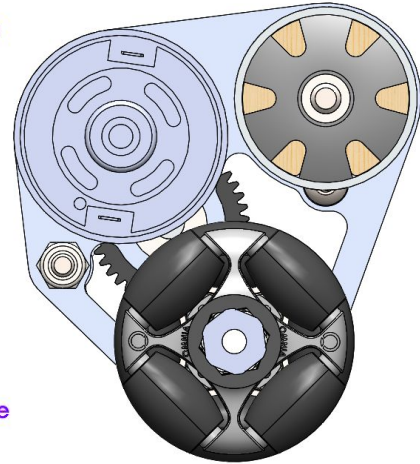
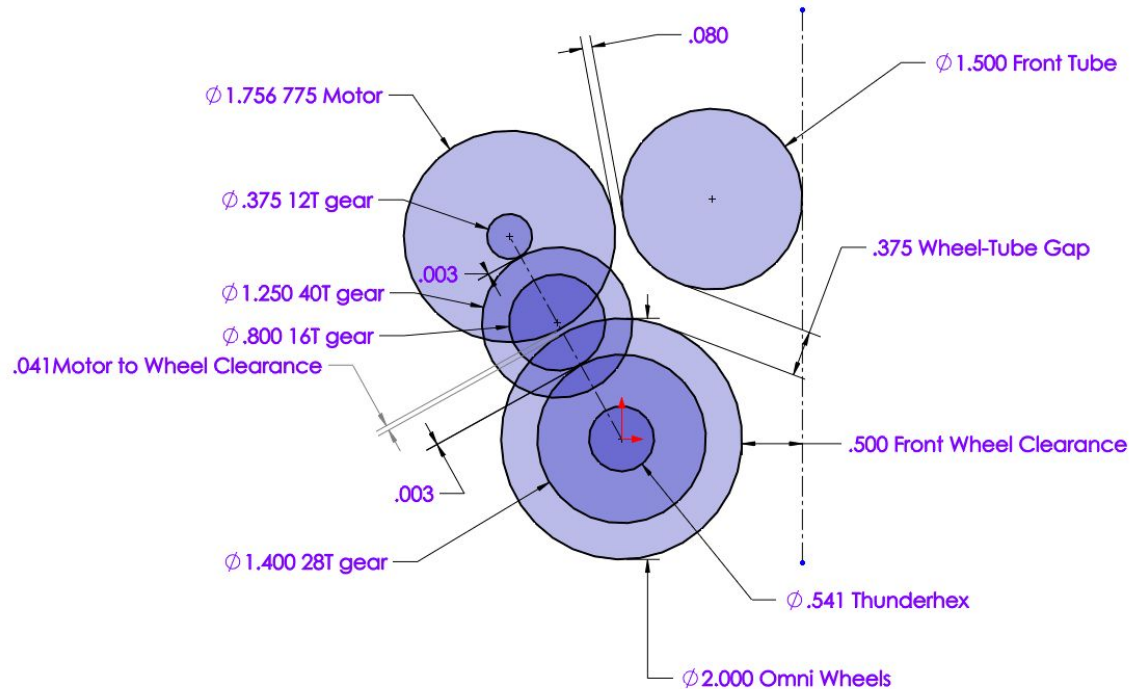
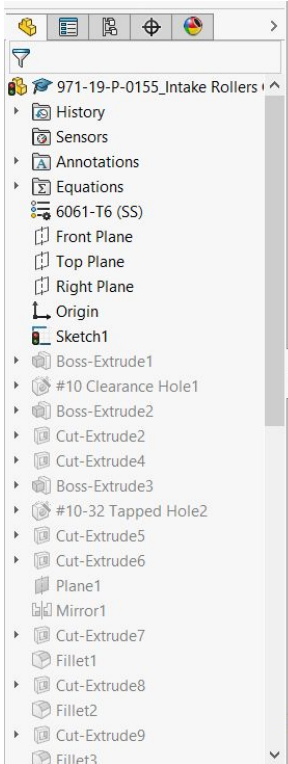


Try to capture intertwined design features in 1 sketch

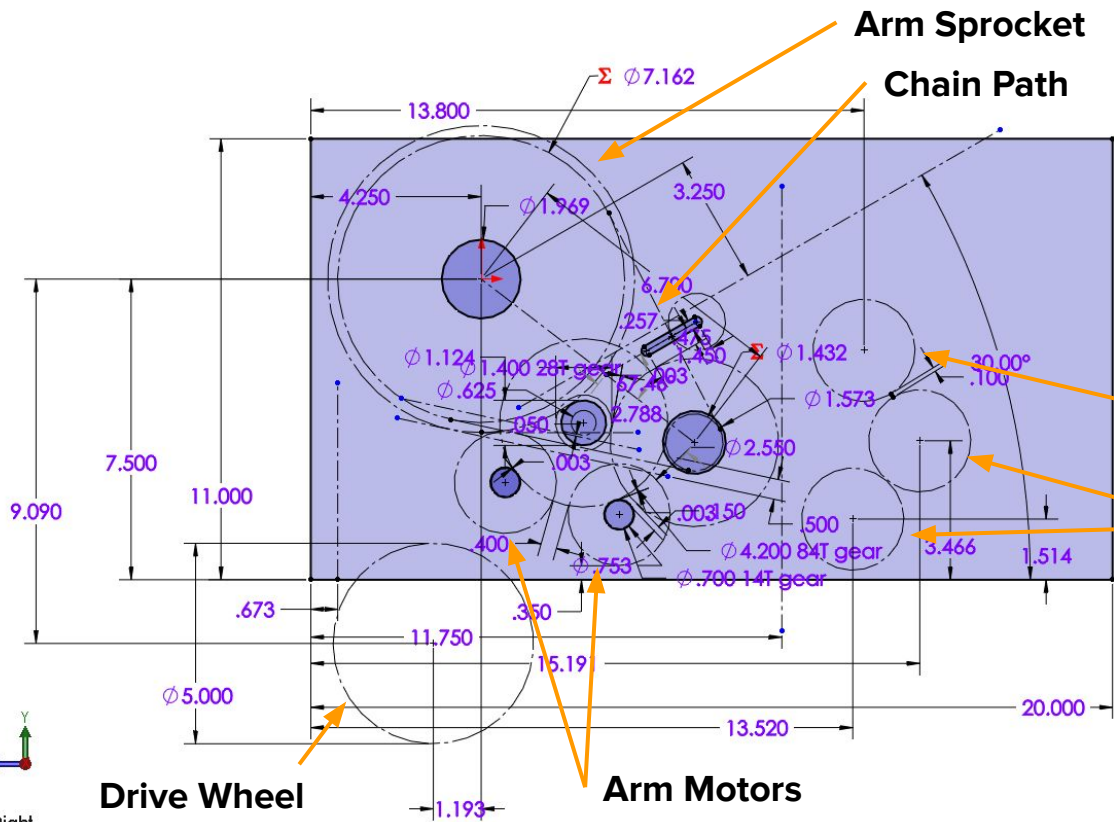
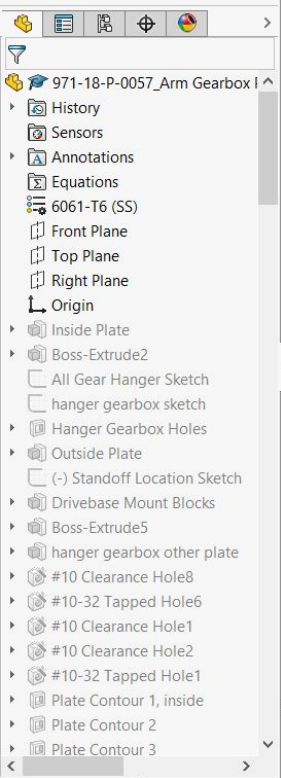
- Structural front tube
- Motor, wheel, tubes packed in a tight space
- Constrained by gear spacing



Try to capture intertwined design features in 1 sketch

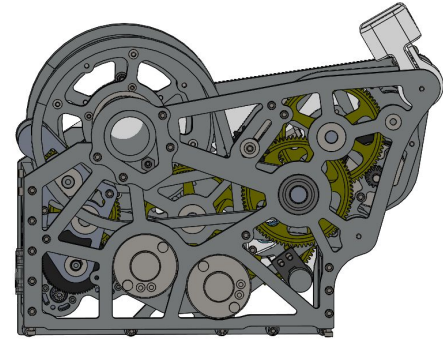


Try to capture intertwined design features in 1 sketch



Arm Sprocket

Chain Path

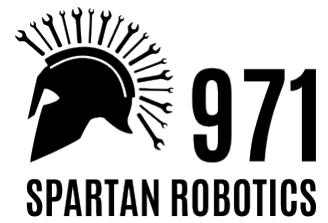


Arm Motor

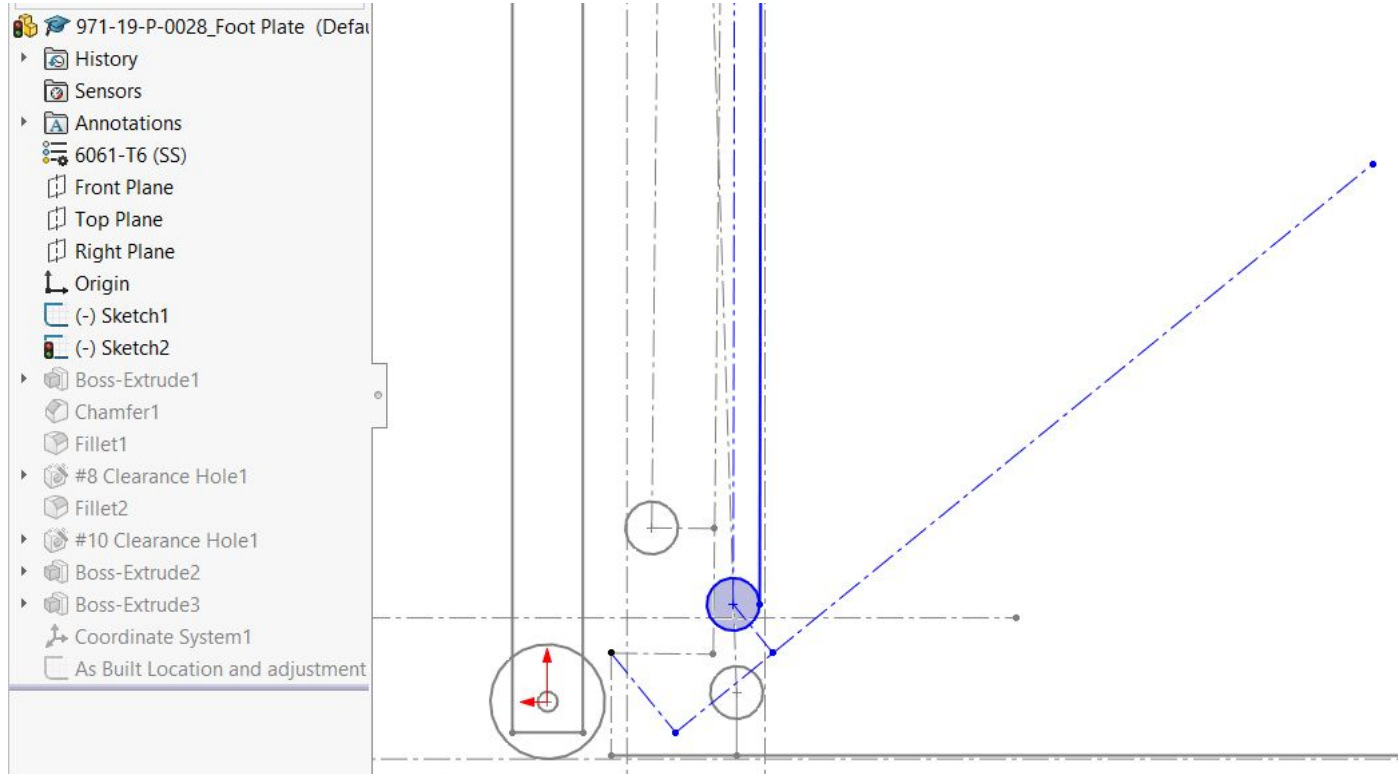
Drivetrain Motors

Drive Wheel

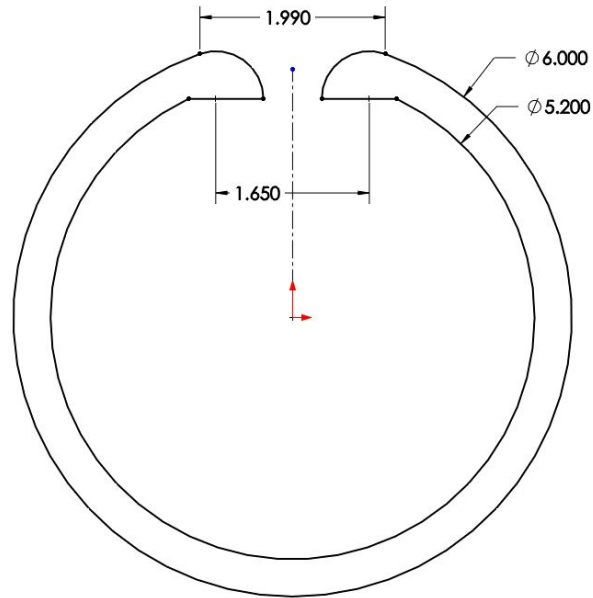
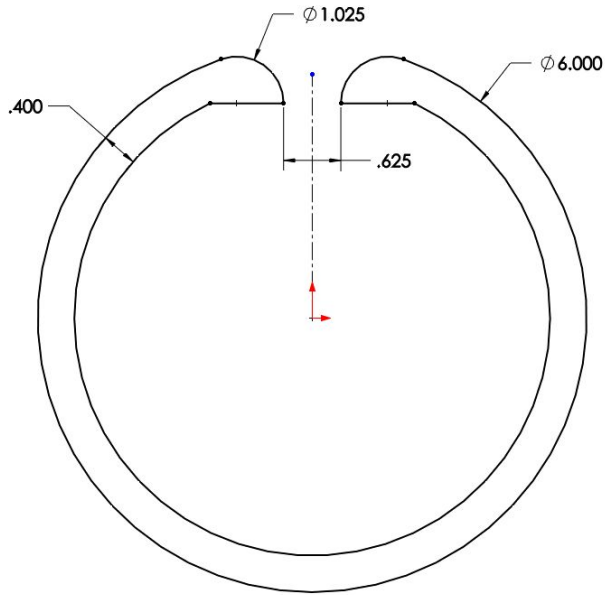
Arm Motors



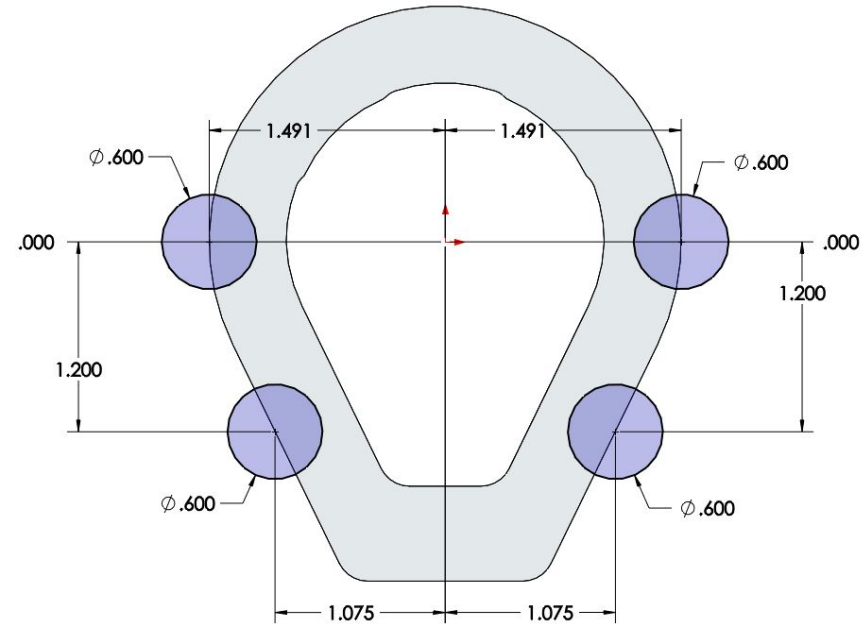
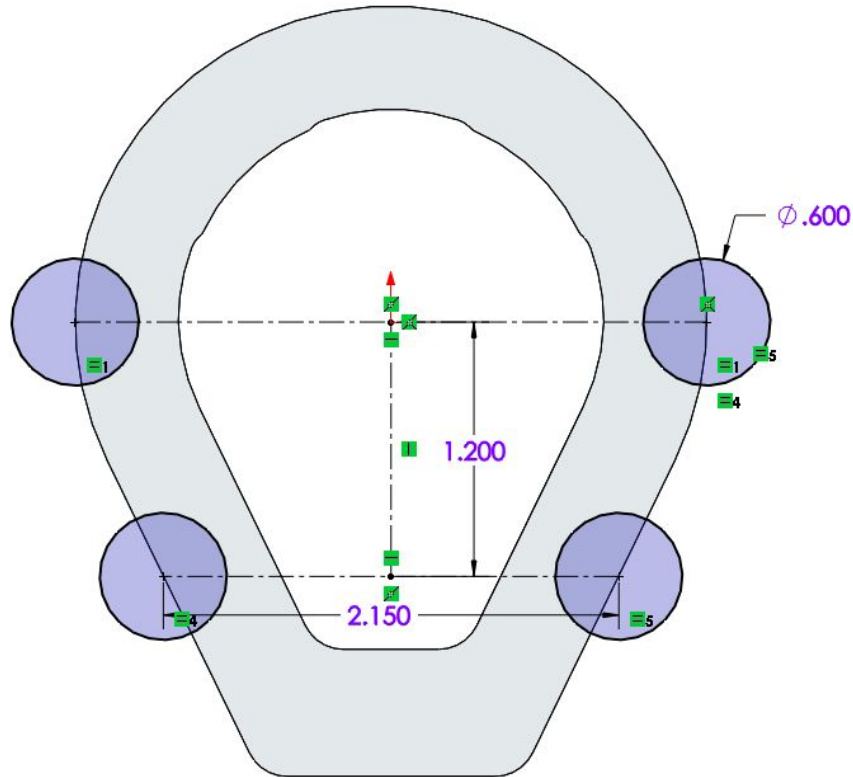
Try to capture intertwined design features in 1 sketch



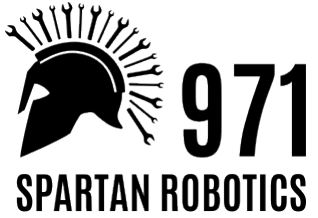
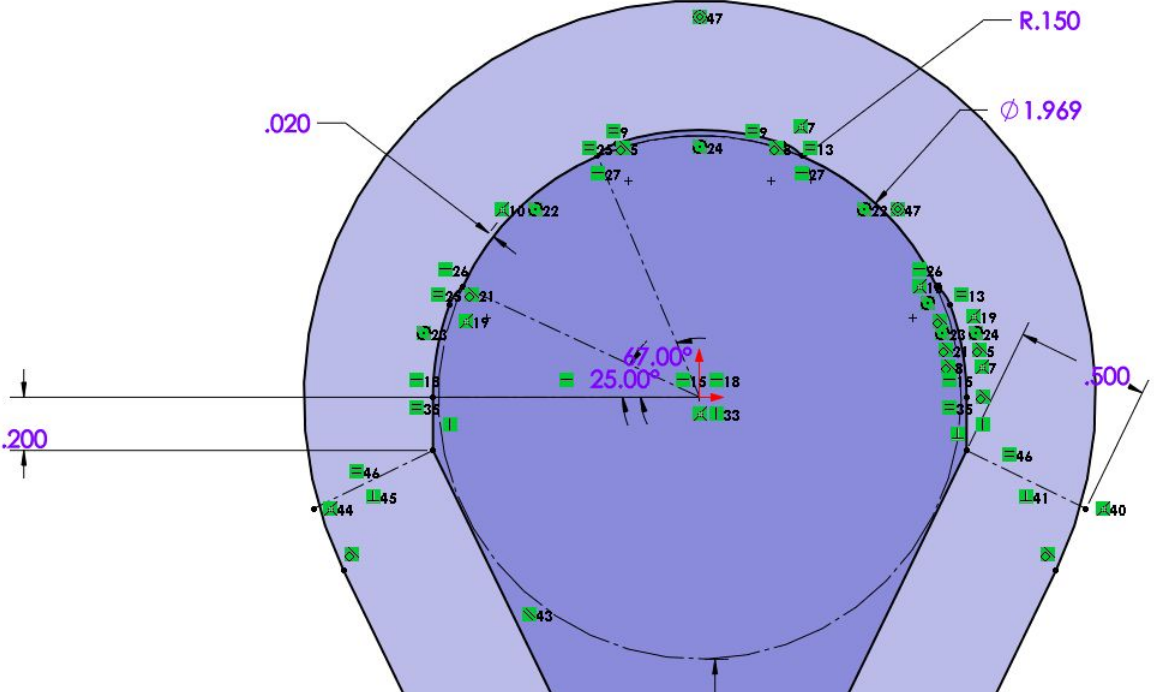
Choose dimensions based on what you care to control



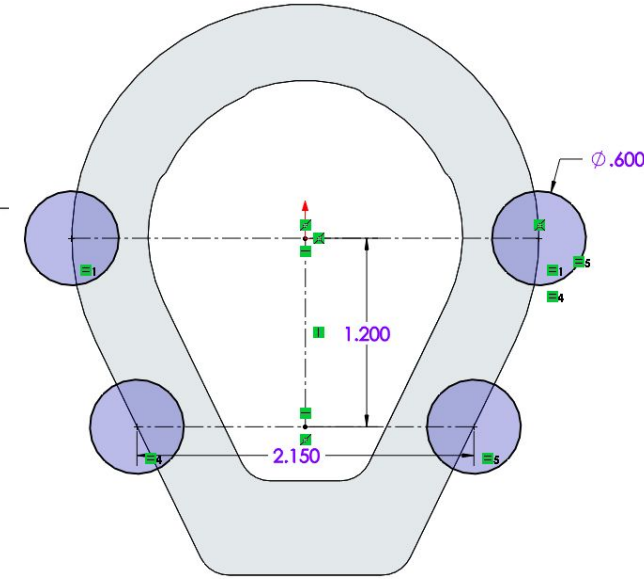
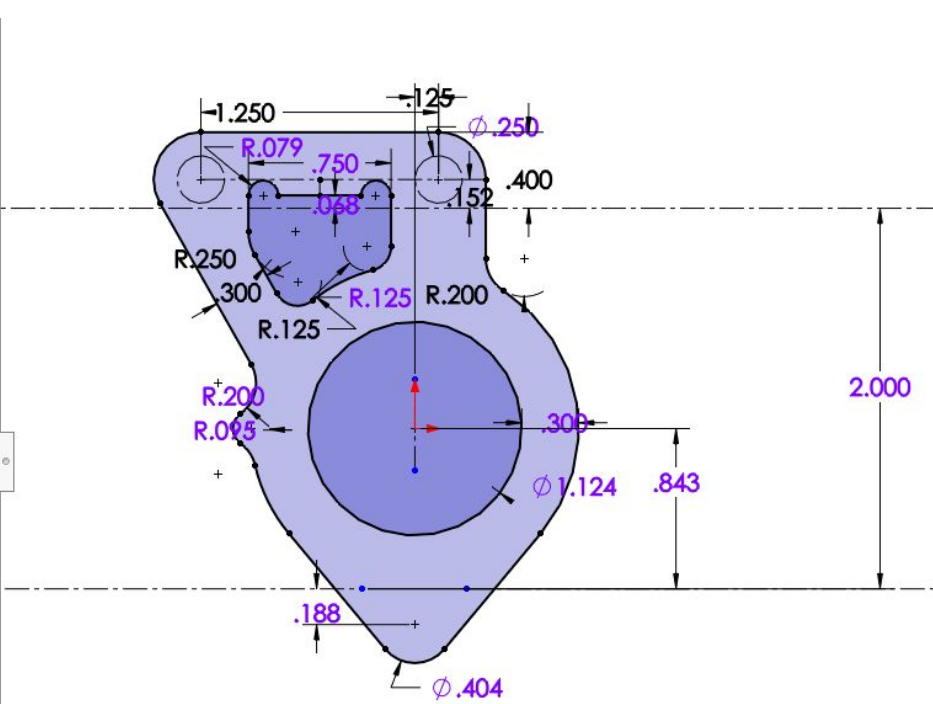
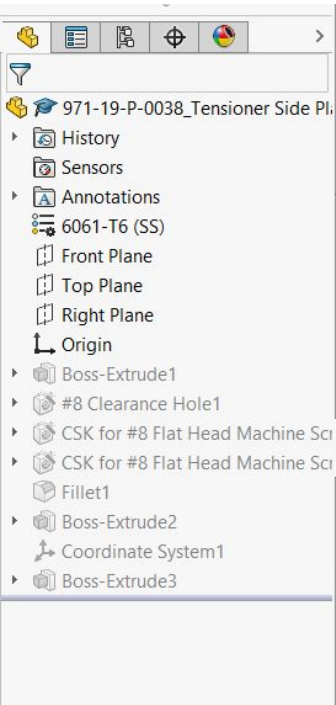
Use relationships to capture design intent



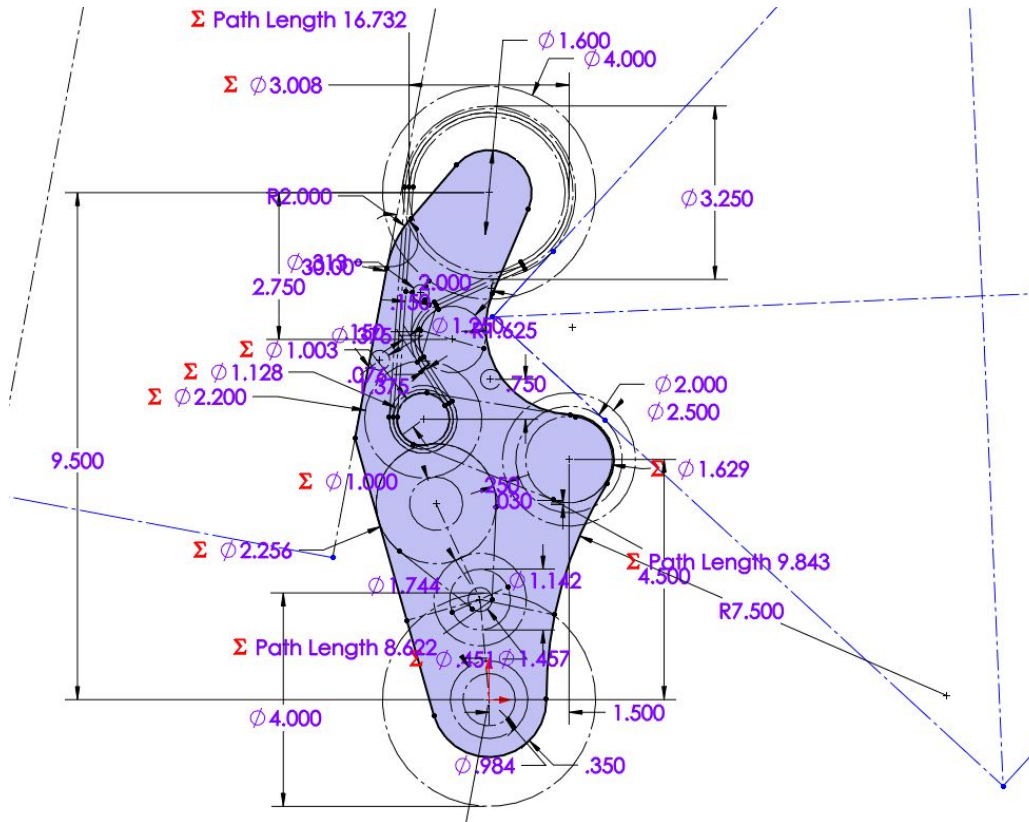
Use relationships to capture design intent



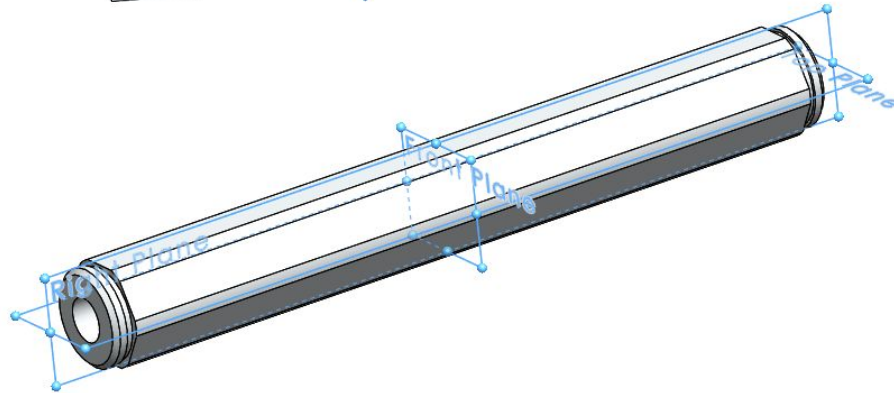
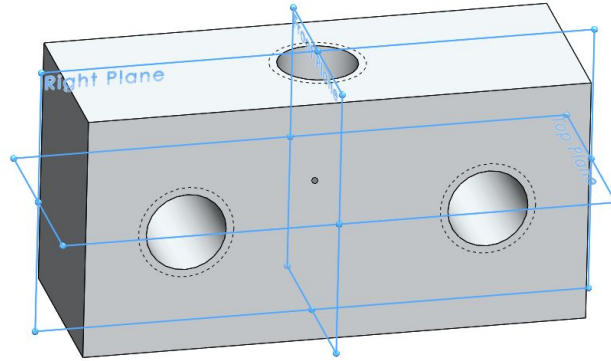
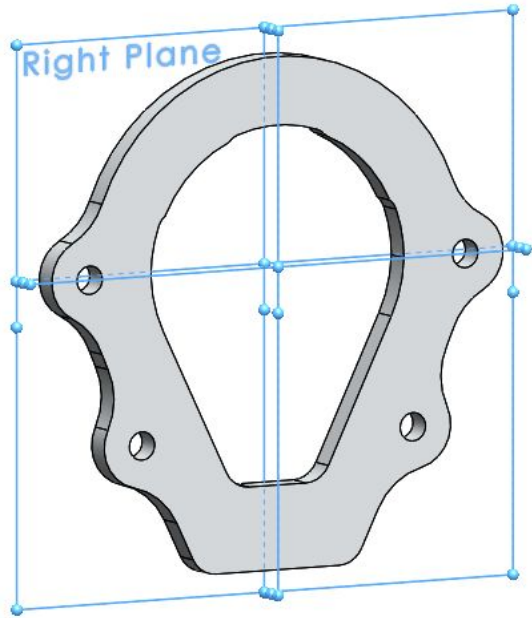
Use construction geometry



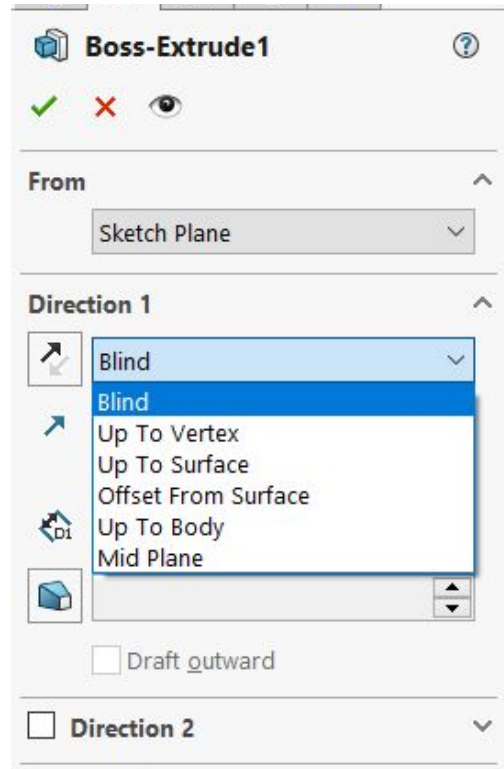
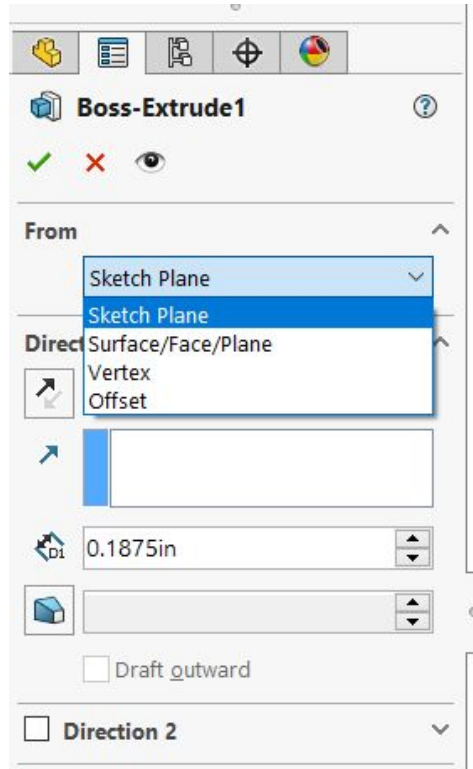
Use construction geometry



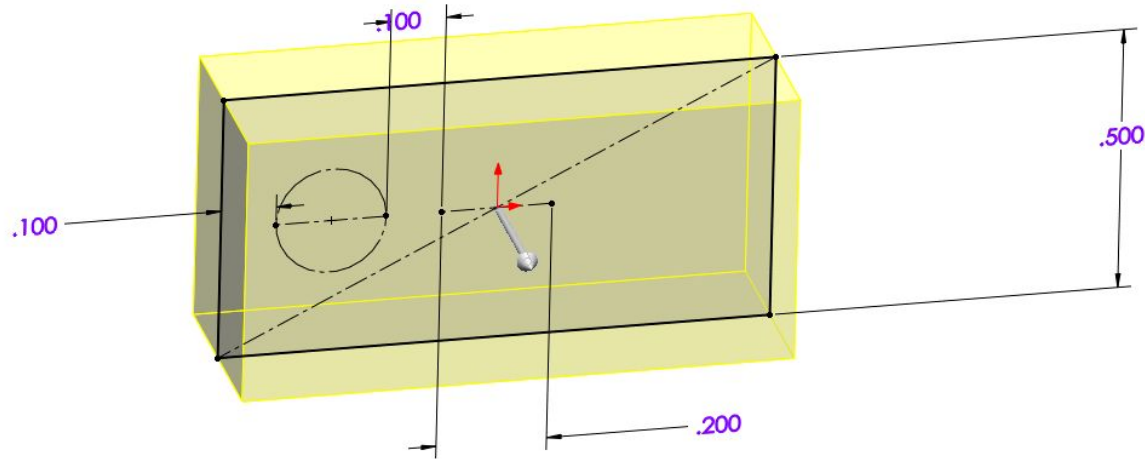
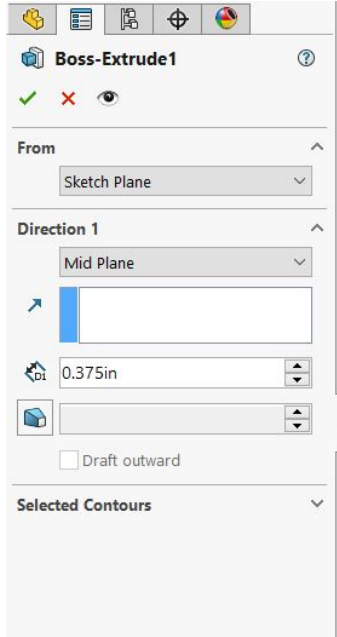
Place the origin in a logical spot (take advantage of symmetry)



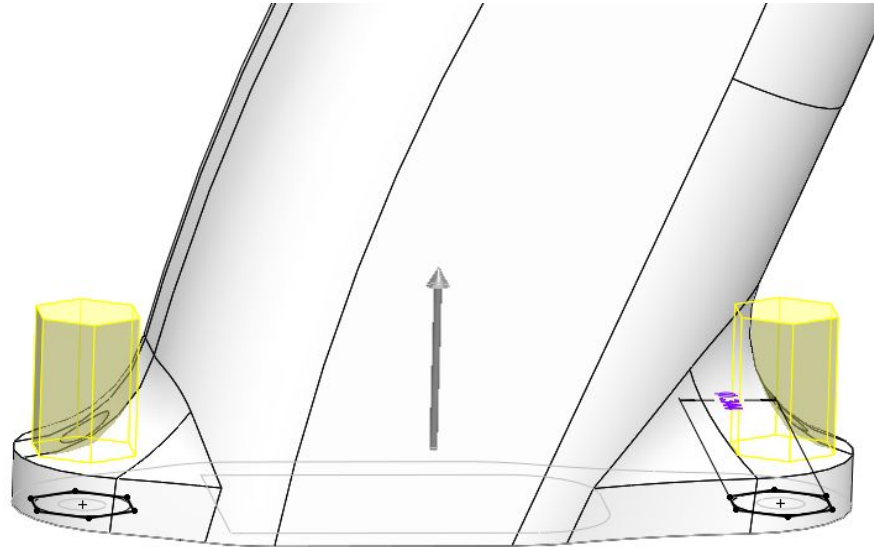
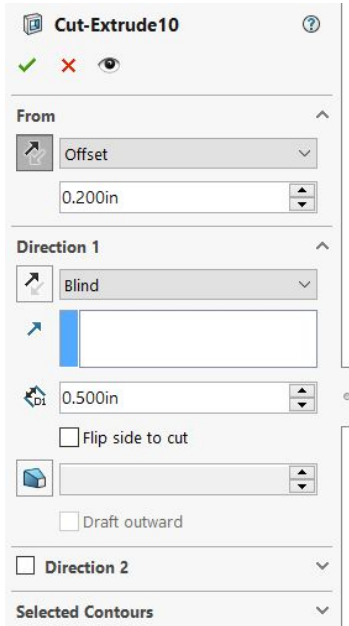
Use start and end conditions for extrudes



Use start and end conditions for extrudes



Use start and end conditions for extrudes



Use appropriate arc conditions for dimensioning to circles

The image displays a SolidWorks CAD interface with a 3D model of a mechanical assembly. The model consists of several overlapping circular components. Dimensions are applied to these components, with callouts indicating specific values and conditions:

- .080**: Dimension for the gap between two circles.
- Ø 1.500 Front Tube**: Dimension for the diameter of a circular feature.
- .375 Wheel-Tube Gap**: Dimension for the gap between a wheel and a tube.
- .500 Front Wheel Clearance**: Dimension for the clearance between a wheel and a front component.
- Ø .541 Thunderhex**: Dimension for the diameter of a circular feature.
- .003**: Dimension for a small gap or offset.
- .500**: Dimension for a specific offset or distance.

The software interface includes several panels and settings:

- Dimension Panel**: Shows options for "Value", "Leaders", and "Other". It includes checkboxes for "Use document bend length" (set to 0.250in) and "Extend bent leader to text".
- Leader/Dimension Line Style**: Includes "Use document display" and line style selection.
- Extension Line Style**: Includes "Use document display" and line style selection.
- Arc Condition**: Shows "First arc condition" and "Second arc condition" with radio buttons for "Center", "Min", and "Max". The "Min" option is selected for both.

A detailed inset on the right shows a close-up of a circular arc being dimensioned. It highlights the "Extension Line Style" and "Arc Condition" settings. The "Arc Condition" is set to "Min", and the dimension value is ".500". A coordinate system (X, Y, Z) is shown at the bottom of the inset.

Capturing Design Intent - Summary

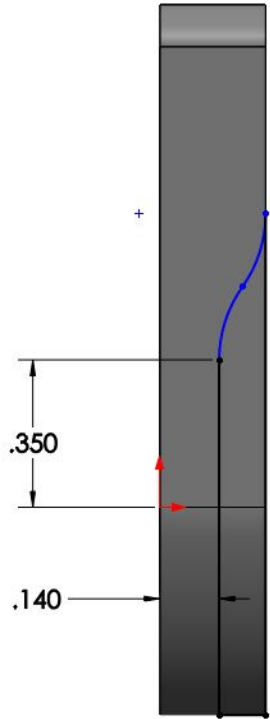
- Start with the feature/s that captures the design essence
- Try to capture intertwined design features in 1 sketch
- Choose dimensions based on what you care to control
- Use relationships to capture design intent, relationships often do a better job than dimensions
- Use construction lines
- Place 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



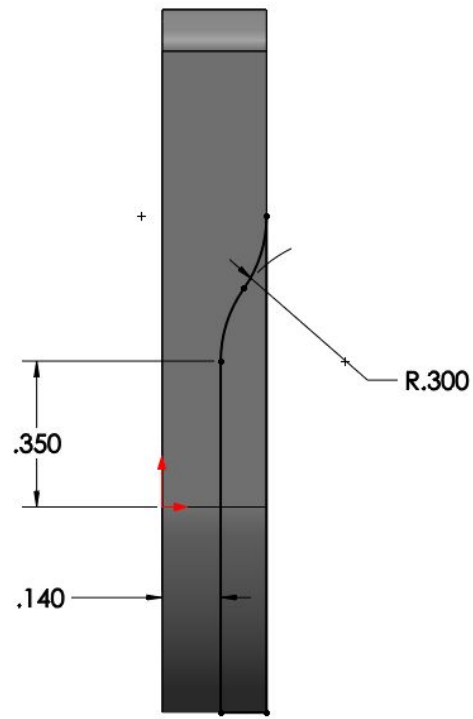
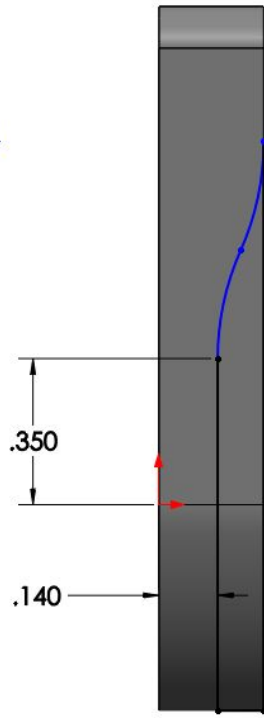
Making Models Easy to Update



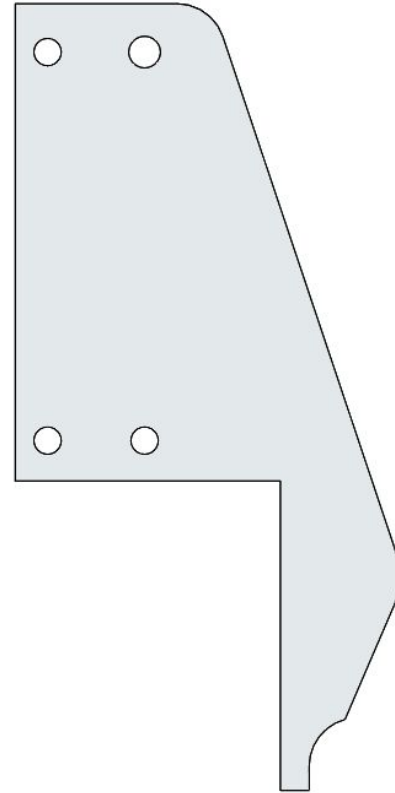
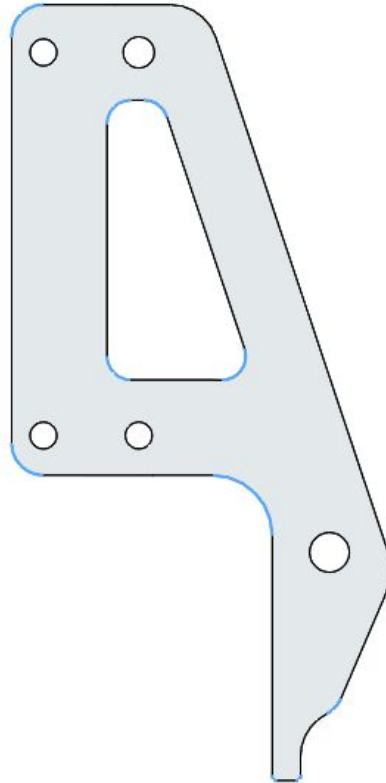
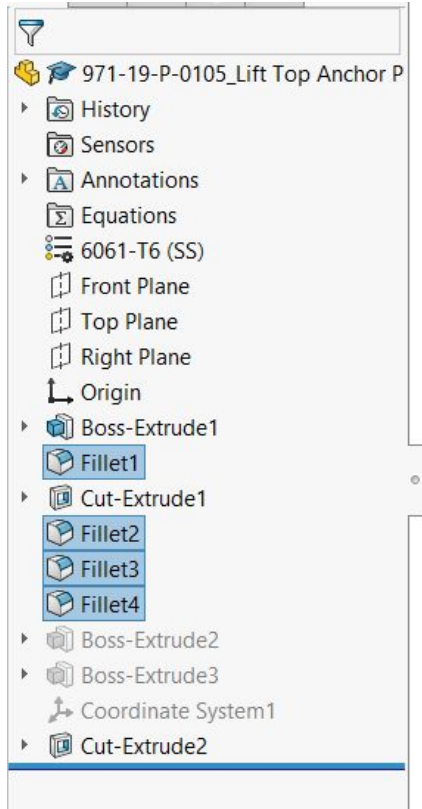
All sketches constrained



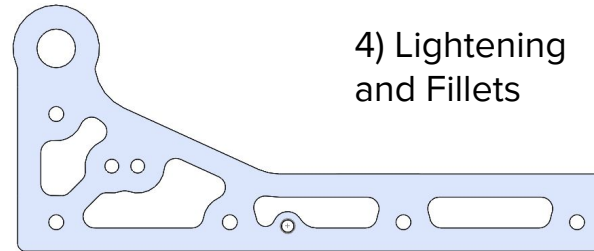
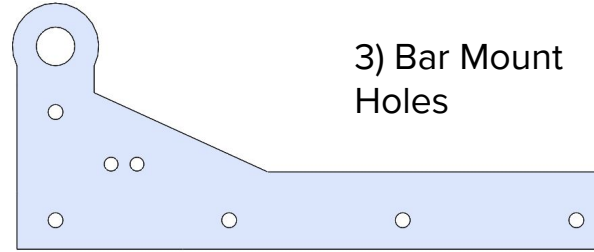
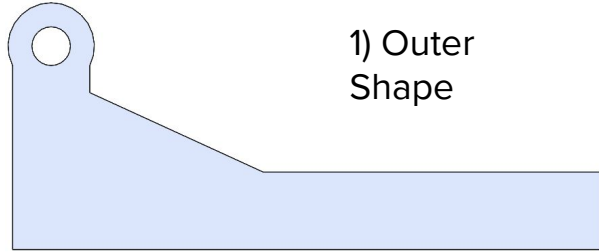
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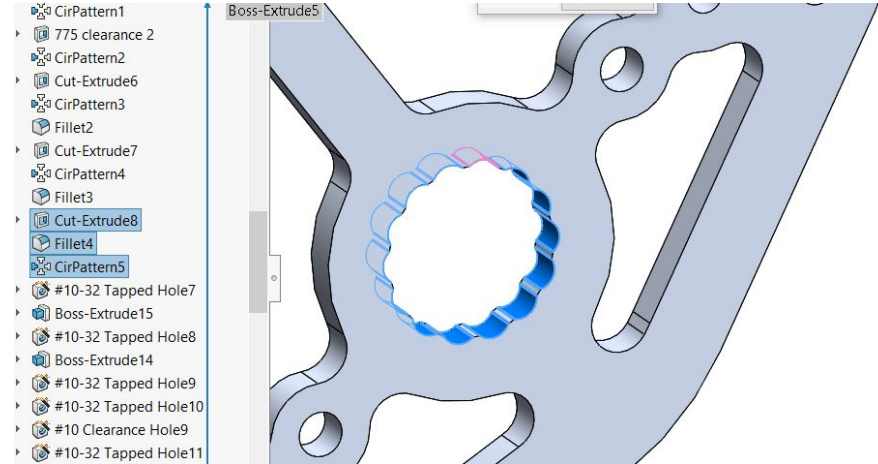
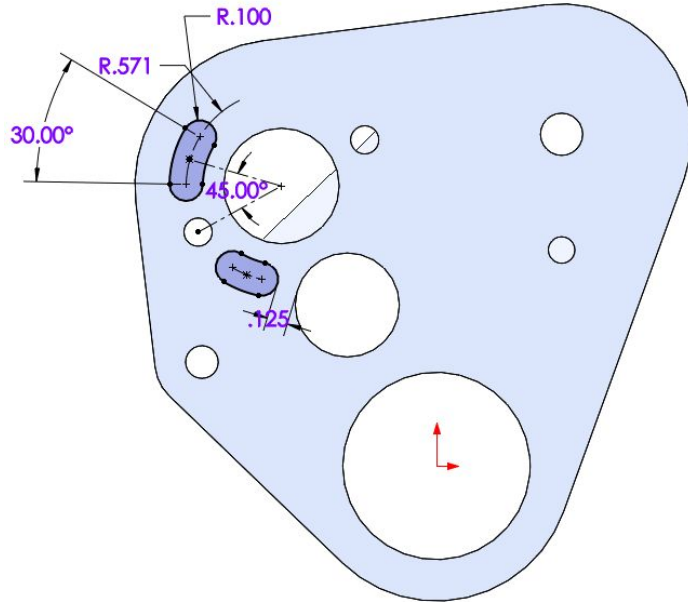
Filet in features rather than sketches



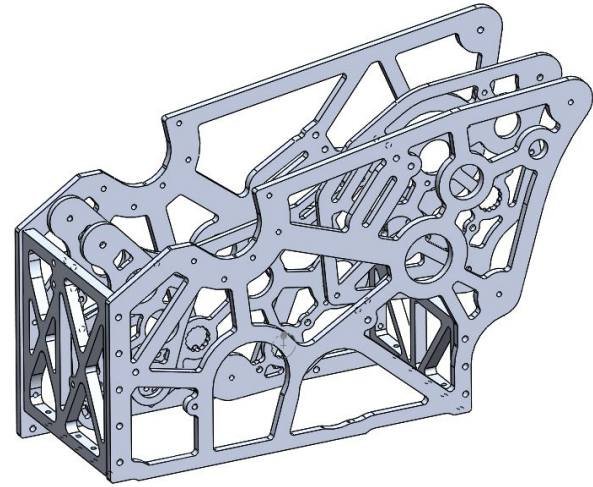
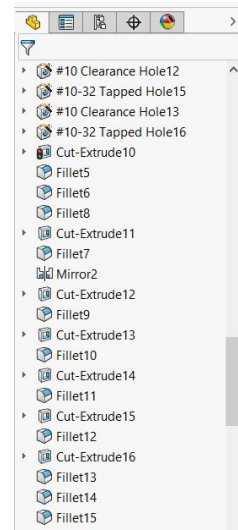
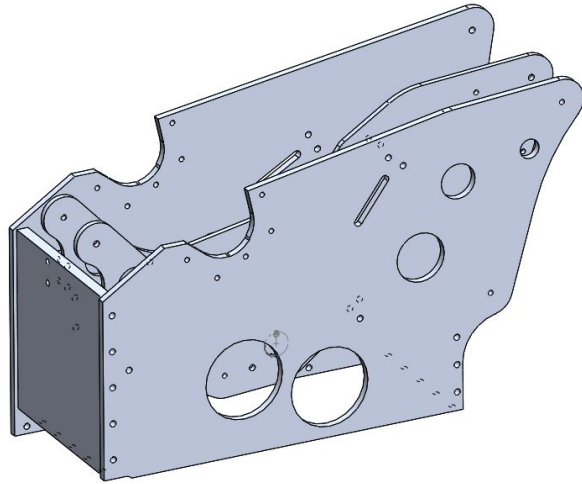
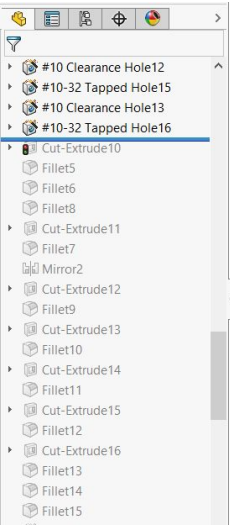
Split un-related items into multiple features



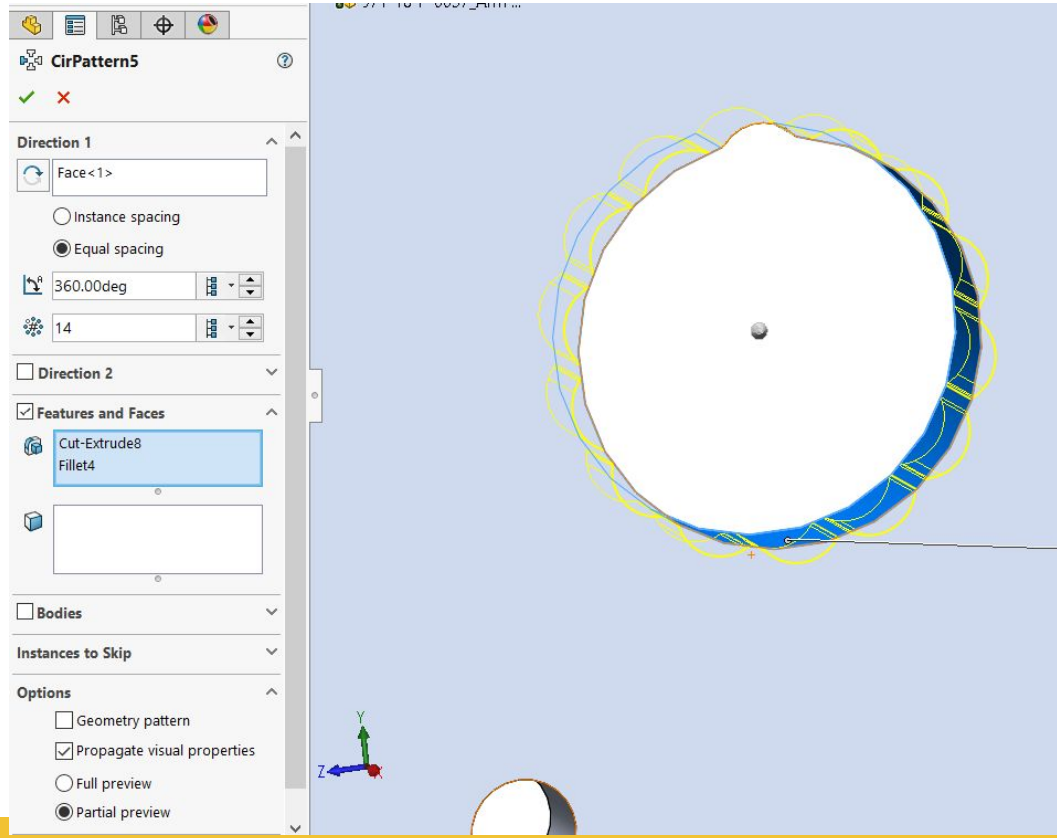
Split un-related items into multiple features



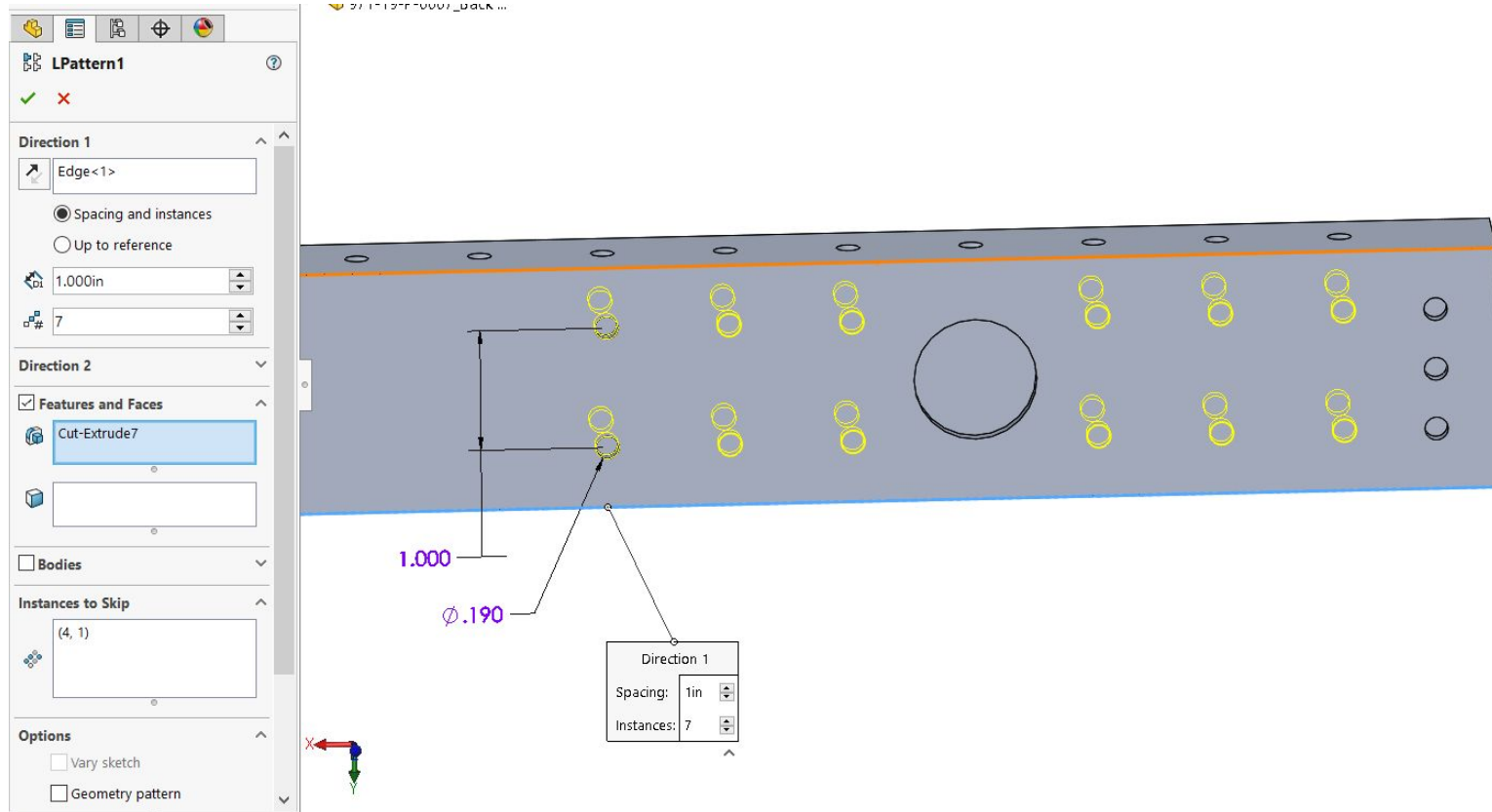
Lightening goes last



Mirrors and linear patterns are better as features than sketches



Mirrors and linear patterns are better as features than sketches



Mirrors and linear patterns are better as features than sketches

Curve Driven Pattern

✓ ✗

Direction 1

Line6@Sketch3

6

Equal spacing

0.100in

Curve method:

Transform curve

Offset curve

Alignment method:

Tangent to curve

Align to seed

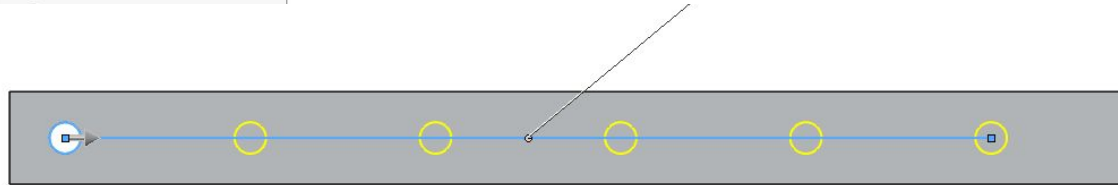
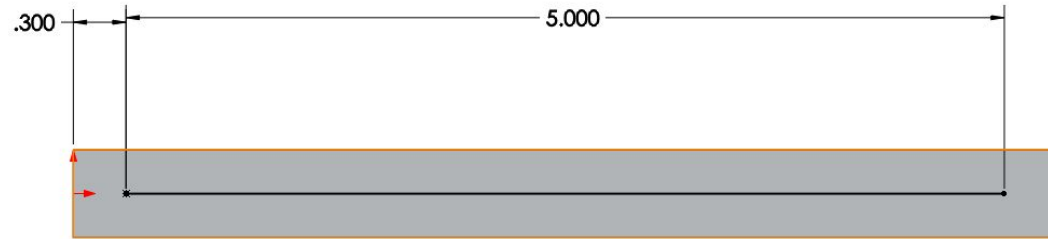
Face normal:

Direction 2

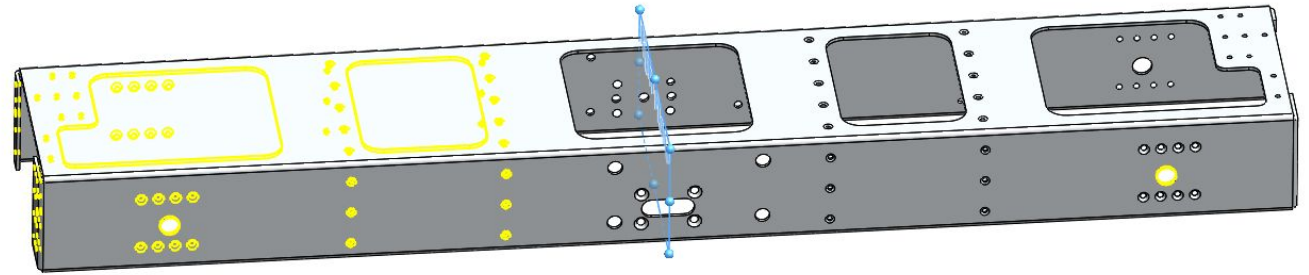
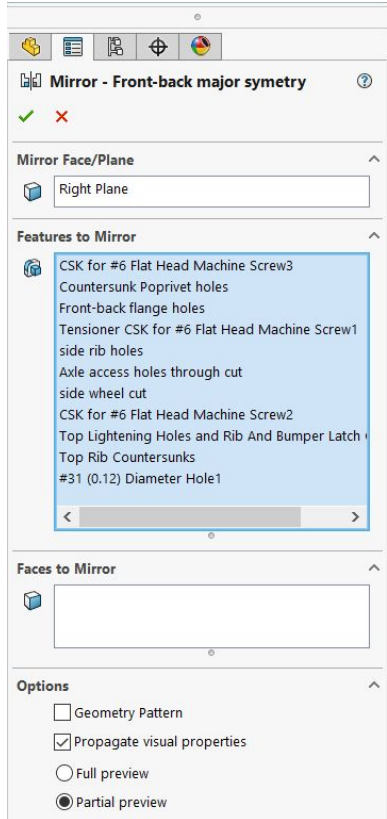
Features and Faces

#8 Clearance Hole1

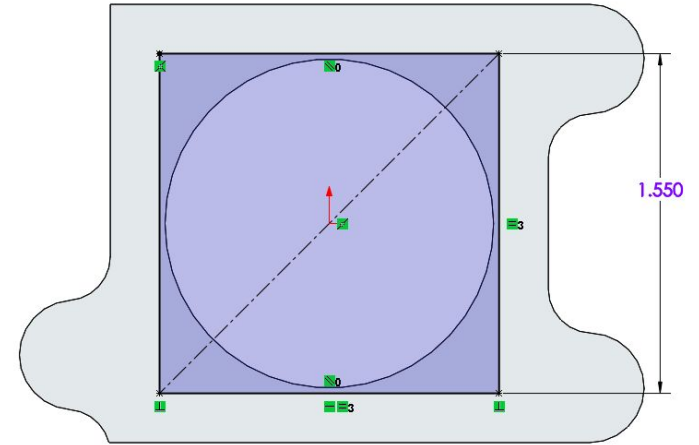
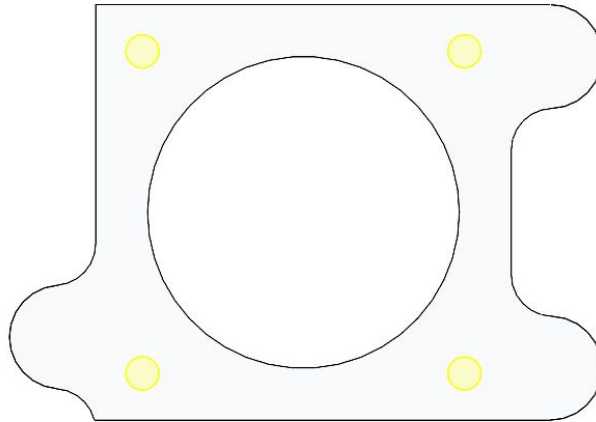
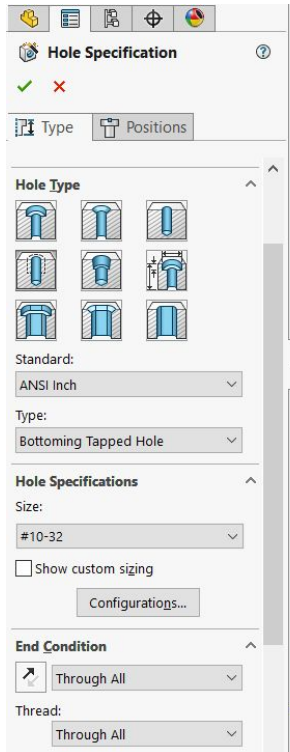
- 6061-T6 (SS)
- Front Plane
- Top Plane
- Right Plane
- Origin
- Boss-Extrude1
- Sketch2
- #8 Clearance Hole1
 - Sketch3
 - Sketch4



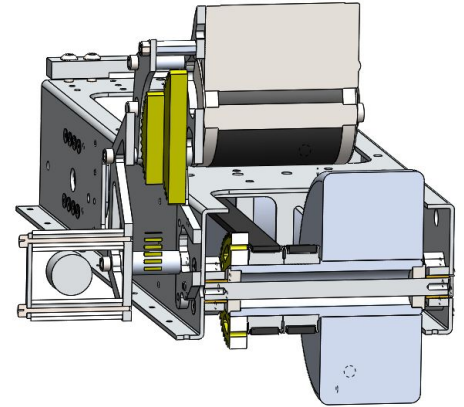
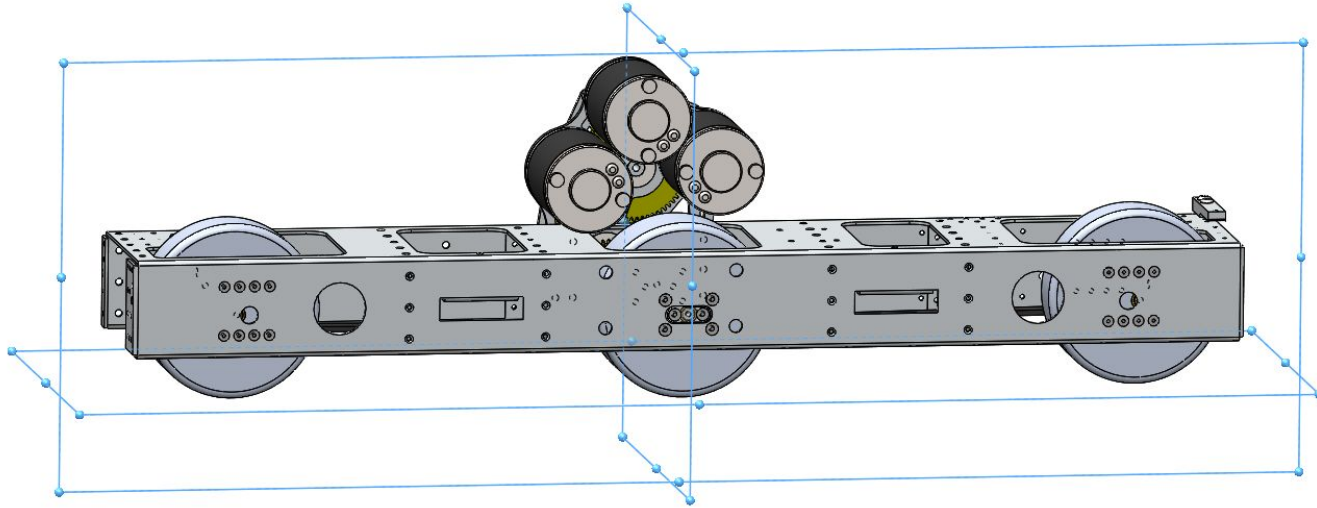
Mirrors and linear patterns are better as features than sketches



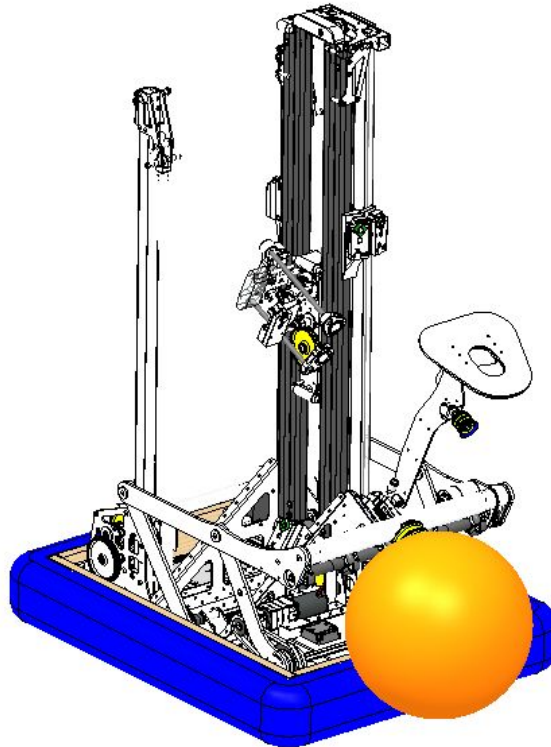
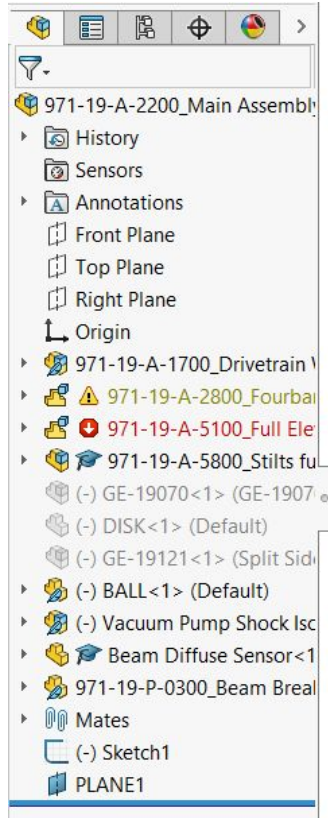
Use Hole Wizard when possible



Origin and planes should be in logical spots in assemblies



Fix broken references and mates when you find them



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



Creating Robust References



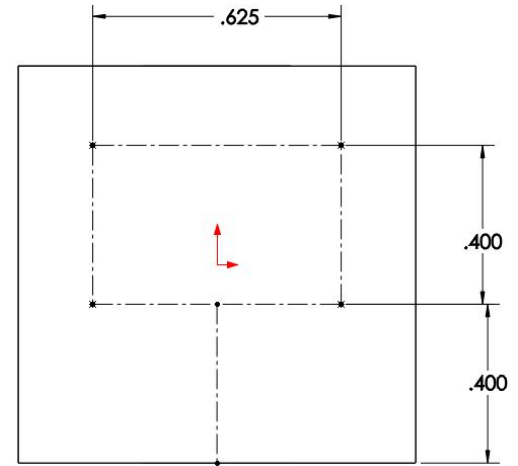
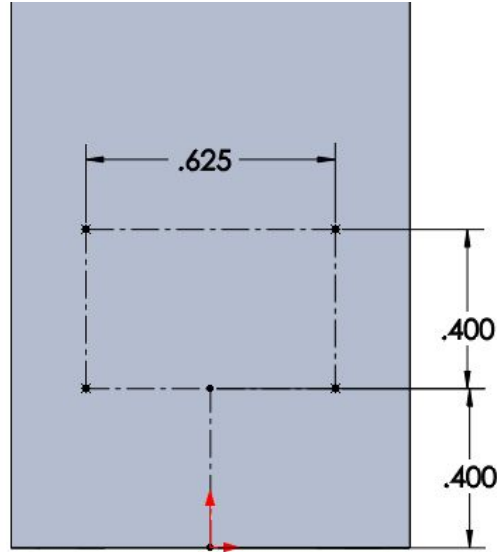
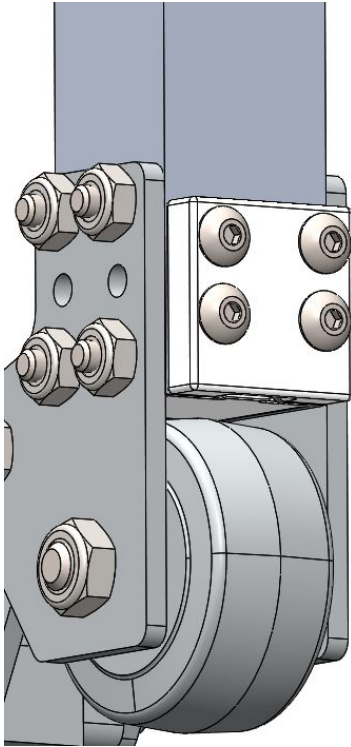
The Problem:

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

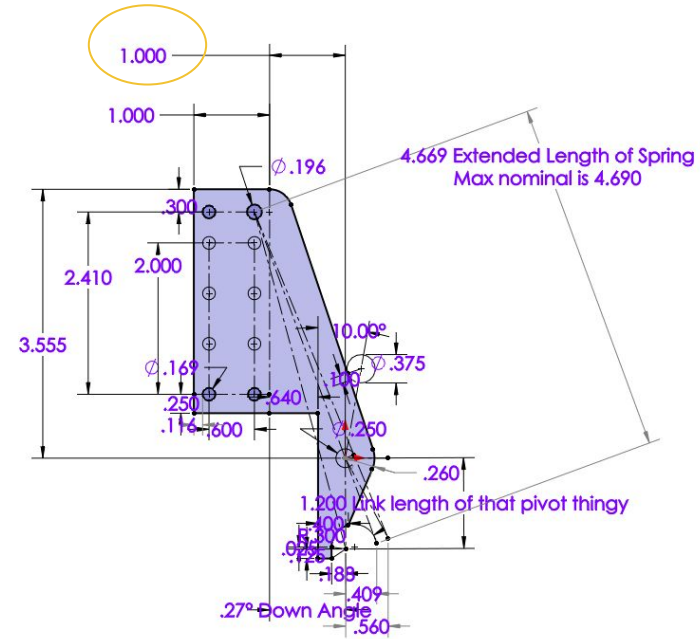
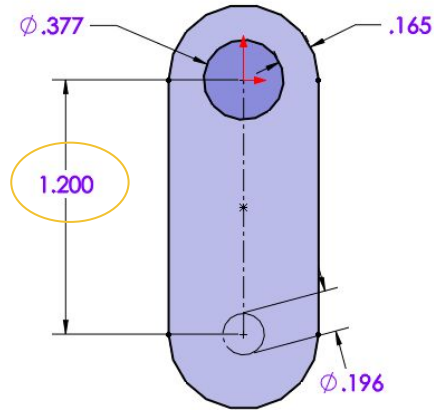
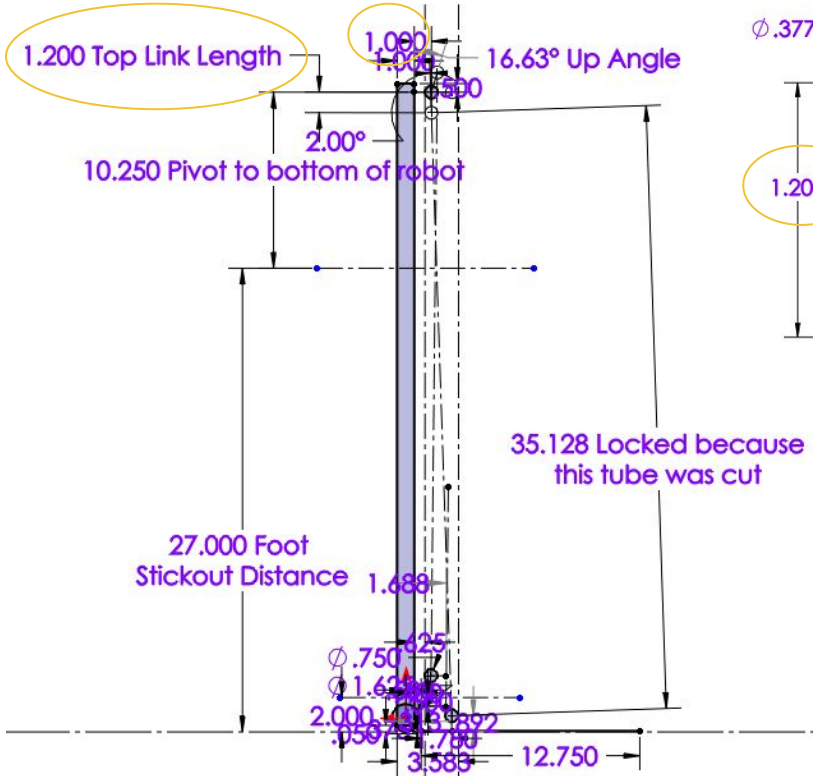
- Easy to create
- Easy to update/maintain



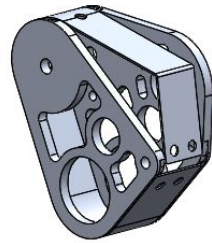
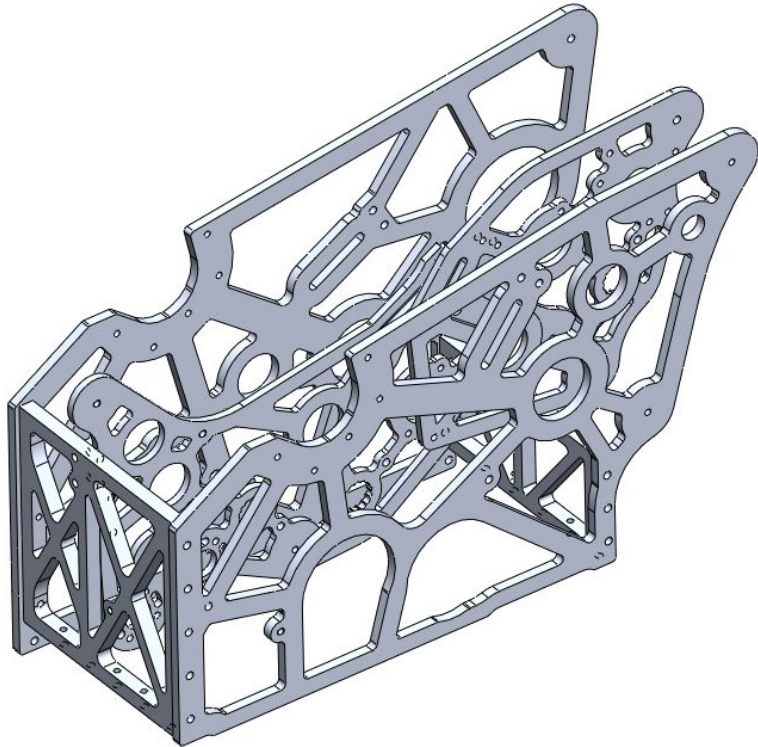
Updating by hand



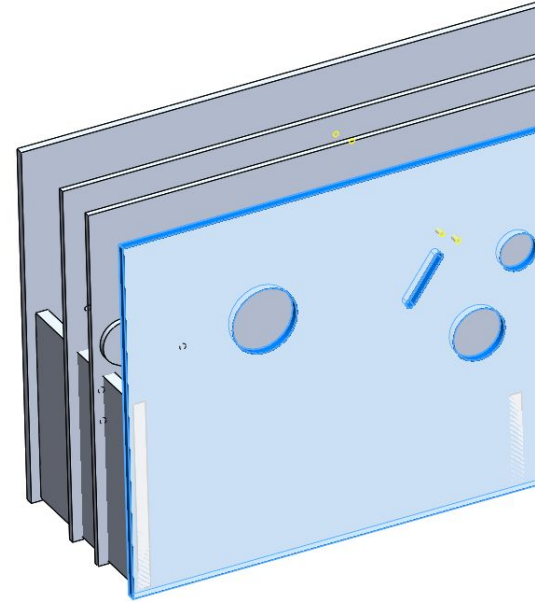
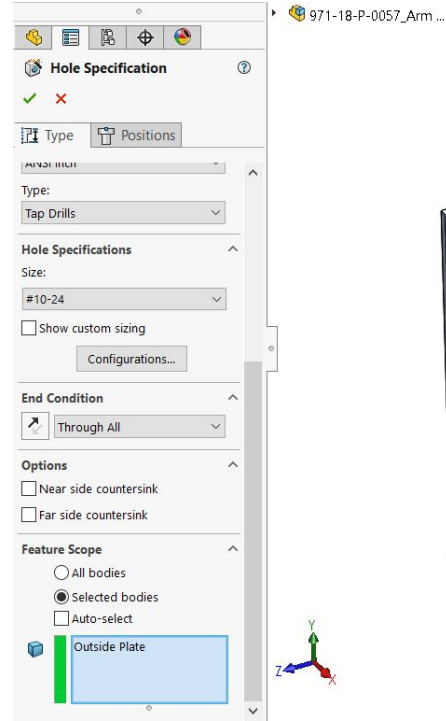
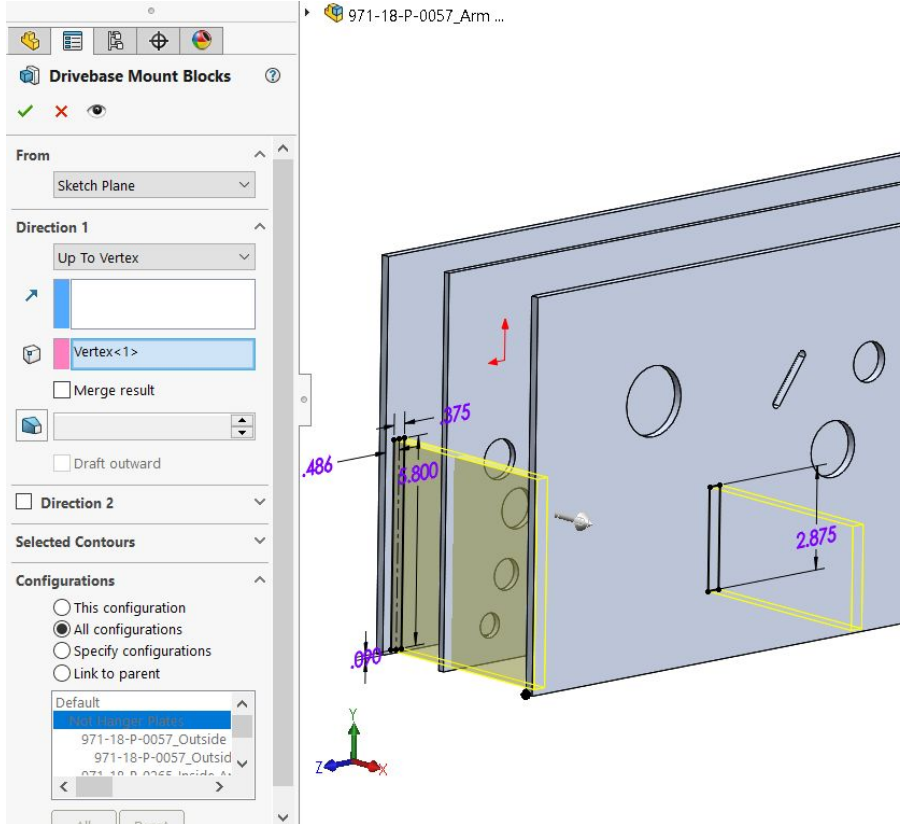
Updating by hand



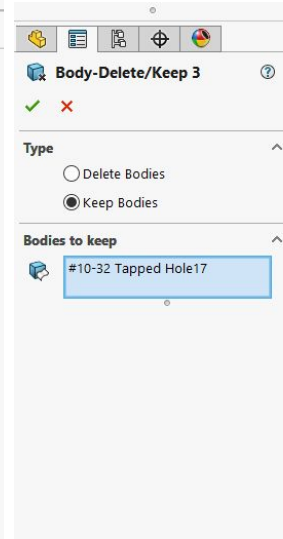
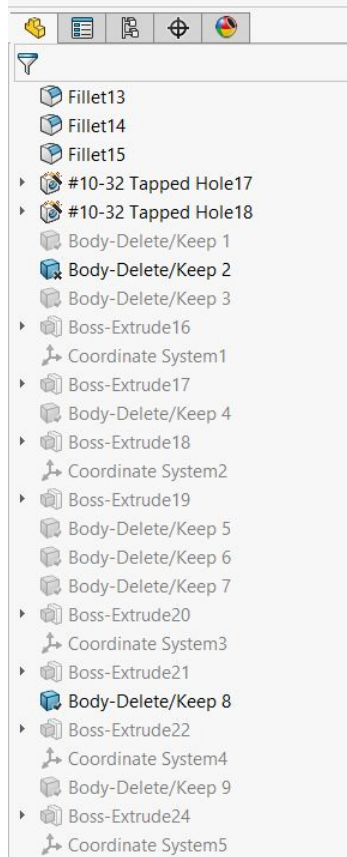
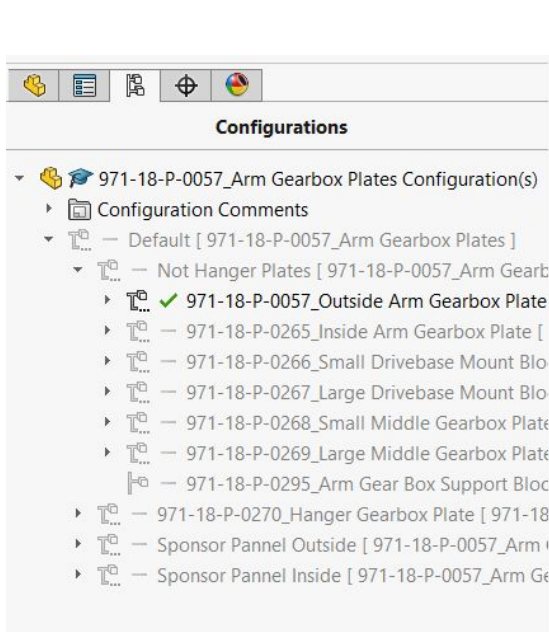
Multi-Bodied Parts



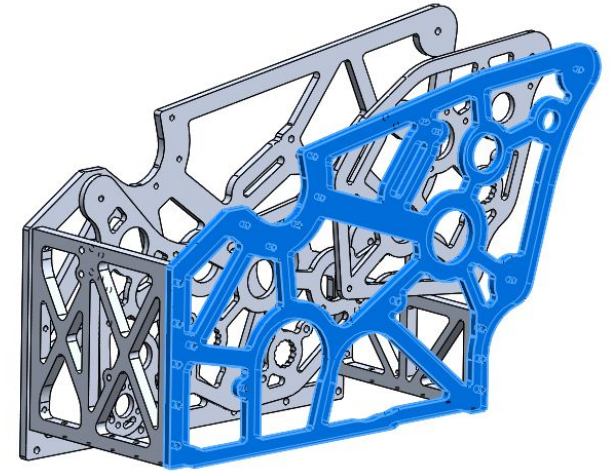
Multi-Bodied Parts



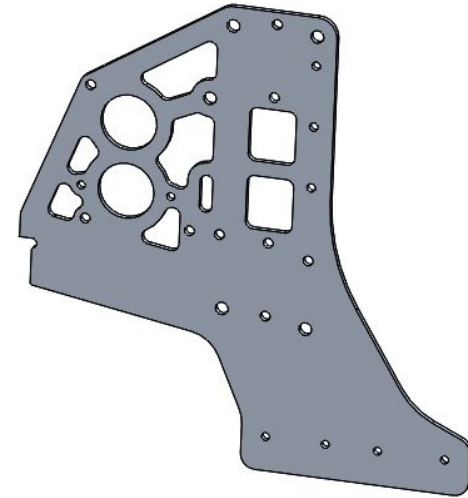
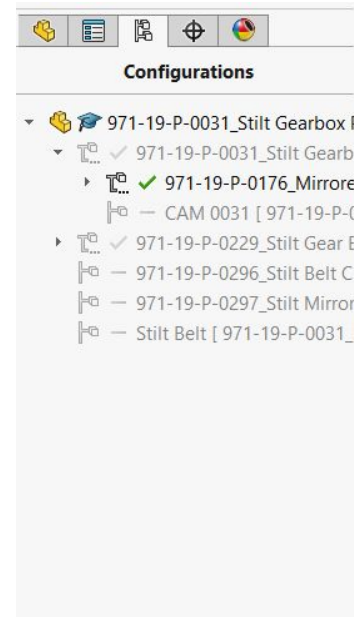
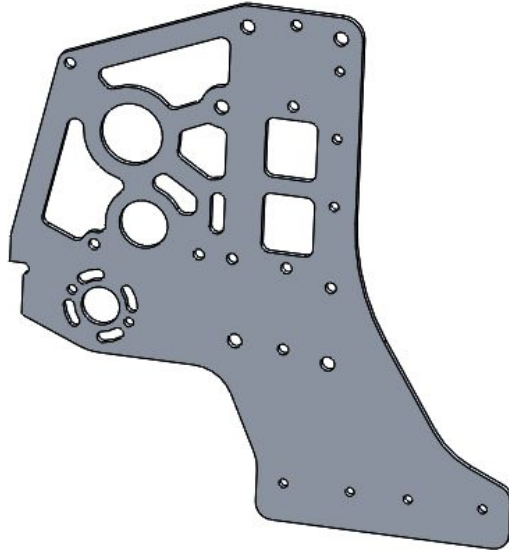
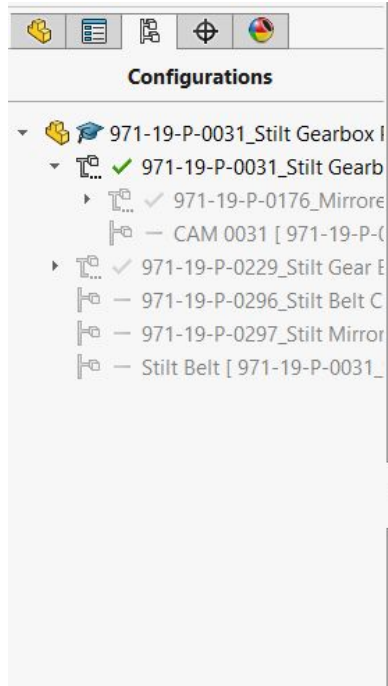
Multi-Bodied Parts



971-18-P-0057_Arm ...



Configurations



Solutions I have tried

	Pros	Cons
Multi-Bodied Parts	<ul style="list-style-type: none">- References contained in 1 part- Easy to see everything at once	<ul style="list-style-type: none">- Models get large and complicated- Hard to split into drawings
Updating by Hand	<ul style="list-style-type: none">- Parts stand alone- Quick for simple interfaces	<ul style="list-style-type: none">- Not automatic
Configurations	<ul style="list-style-type: none">- Parts stand alone	<ul style="list-style-type: none">- Hard to manage changes to configurations correctly for complex parts
In-context features	<ul style="list-style-type: none">- Fast to do	<ul style="list-style-type: none">- Hard to debug problems- Unwieldy/fragile assemblies- Hard to separate out parts
Master part with split bodies	<ul style="list-style-type: none">- All interface points captured in one model	<ul style="list-style-type: none">- Hard to collaborate across multiple people- Easy for links to break- Hard to version
Equation Linked Dimensions	<ul style="list-style-type: none">- Automatically updates	<ul style="list-style-type: none">- Doesn't always work- Tedious
Layout sketch blocks	<ul style="list-style-type: none">- One source of reference	<ul style="list-style-type: none">- Complex sketch, doesn't update well

Tips and Tools for Working Quickly



Learn to use shortcut keys

Customize

Toolbars | Shortcut Bars | Commands | Menus | Keyboard | Mouse Gestures | Customization

Category: All Commands

Show: Commands with Keyboard Shortcuts

Search for:

Category	Command	Shortcut(s)	Search Shortcut
Tools	Line..	L	l
Tools	Point..	P	
Tools	Centerline..	K	
Tools	Offset Entities..	Shift+Y	o
Tools	Convert Entities..	Y	
Tools	Trim..	T	tr
Tools	Extend..	Ctrl+T	
Tools	Smart..	D	
Tools	Ordinate..	Shift+D	
Tools	Measure..	N,Q	
Tools	Mass Properties..	Shift+Q	
Help	Welcome to SOLIDWORKS..	Ctrl+F2	
Help	SOLIDWORKS Help..	H	
Help	Community Forum..	O	
Others	Front	Ctrl+1	

Description

Print List... Copy List

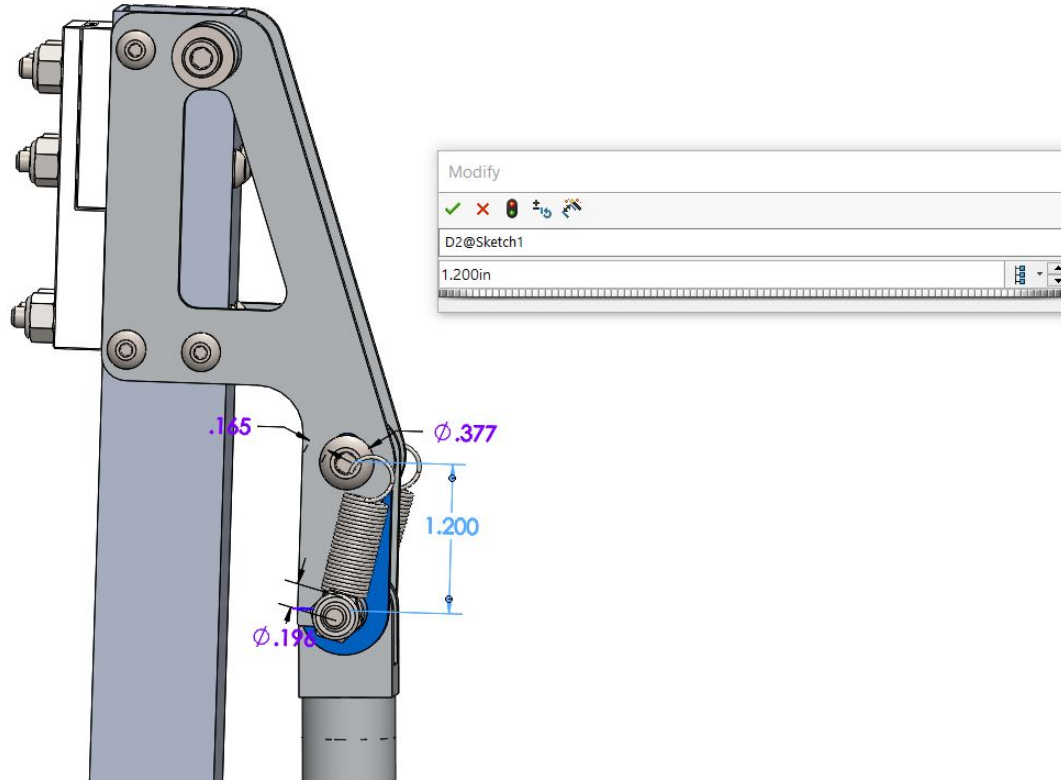
Reset to Defaults

Remove Shortcut

OK Cancel Help

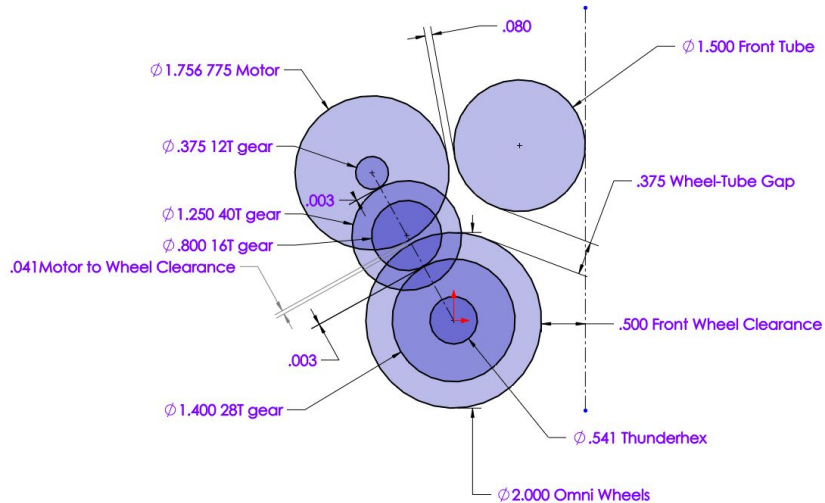
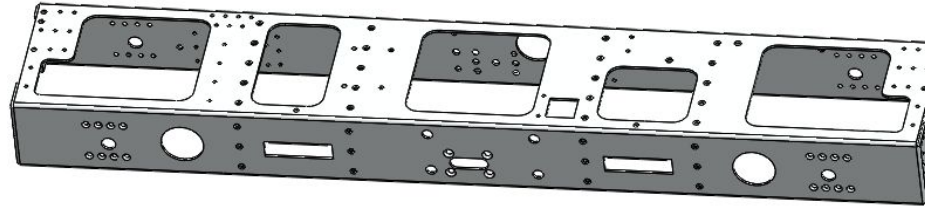


Double click on faces to update dimensions

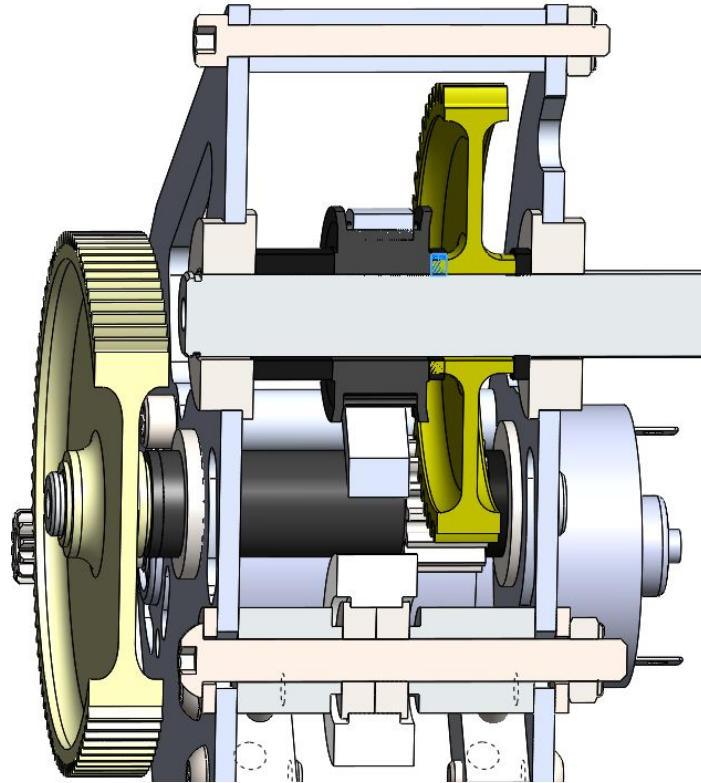


Label features and dimensions

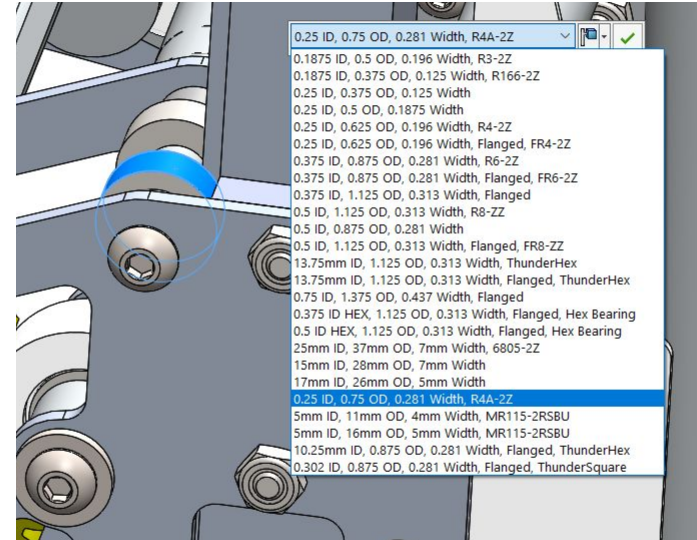
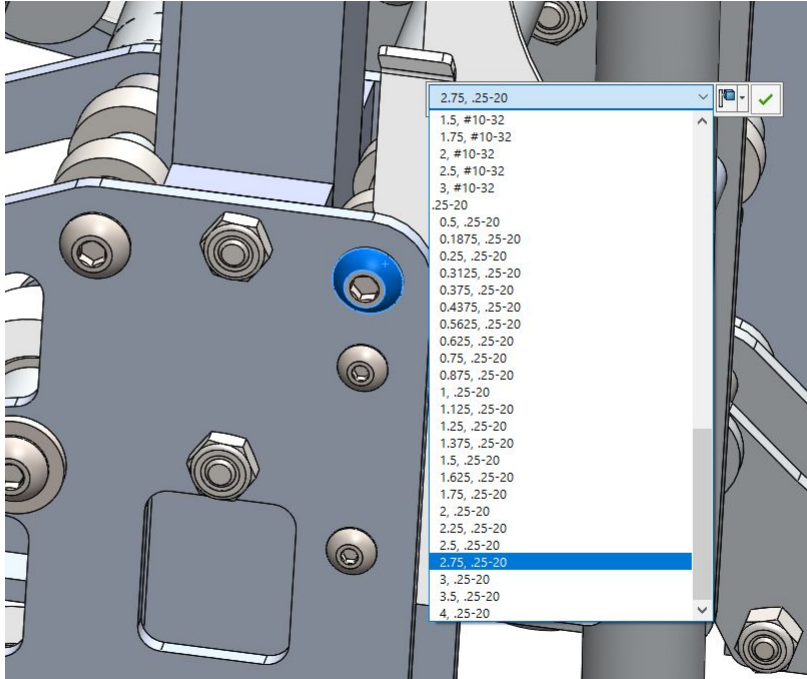
- Top edge flange
- Gearbox output Bearing Hole Cut
- Gearbox output Bearing Hole Fillet
- Edge-Flange14
- Edge-Flange12
- Tab1
- Tab2
- Cut-Extrude53
- Axle access holes through cut
- side wheel cut
- middle wheel cut
- Middle axle access window
- Outside mdl axle CSK for #10 Flat Head mic
- Inside 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 Sci
- CSK for #6 Flat Head Machine Screw2
- CSK for #6 Flat Head Machine Screw3
- Countersunk Poprivet holes
- Inner Lightening Holes



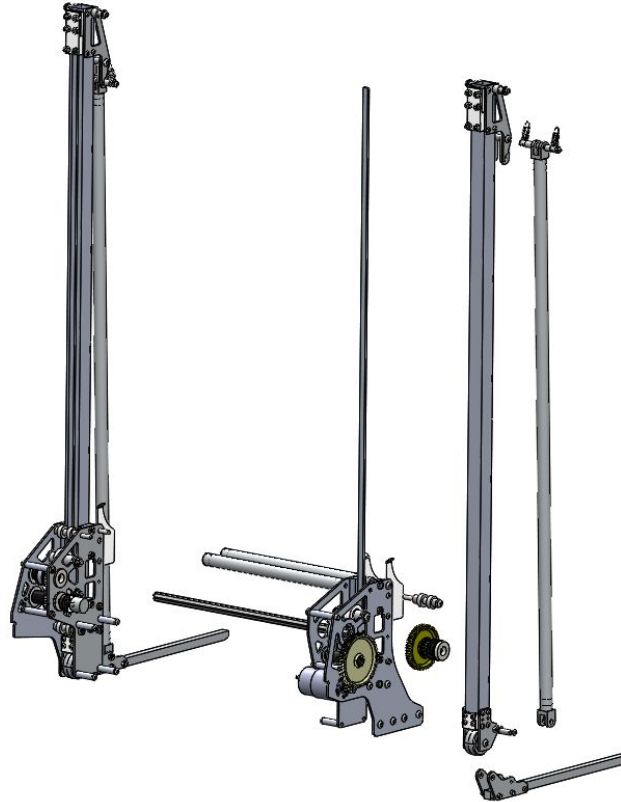
Use cross sections to check your work on shafts



Use part libraries for standard fasteners and parts



Segregate by assembly



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



Thank You!

