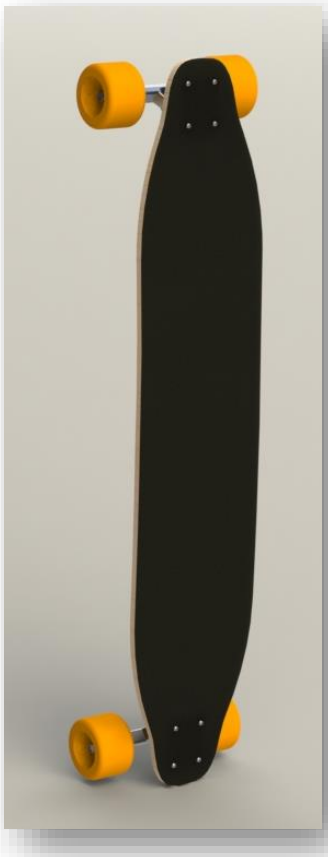
ME 5240 CAD and Manufacturing
Section 01
Final Project

Product: Longboard

By: Oscar Chen



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Functionality & Design Requirements

A longboard is a form of transportation used by many to travel short distances to reach a destination. It can withstand some beatings and is able to be ridden for many miles within its lifetime. It utilizes four free rolling wheels on a specially made wooden deck.

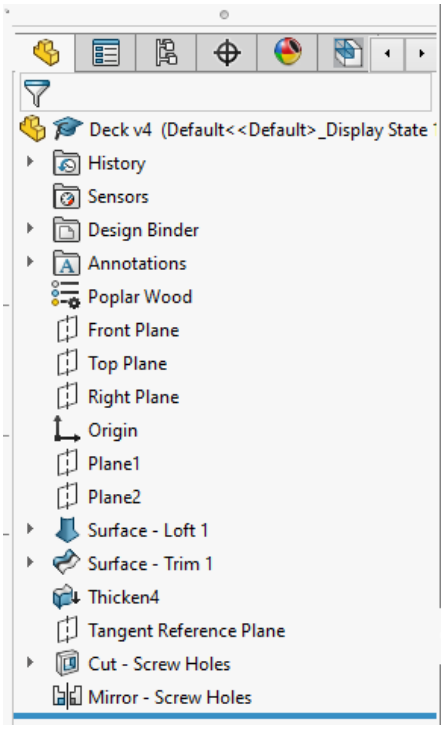
This longboard assembly includes 41 components, 10 of which are unique components. These unique components are the deck, baseplate, trucks, wheels, bushing, bushing cap, risers, screw, screw bolt, and hex nut. Each component of the assembly serves an important role. The wooden deck is the main platform where users stand on the longboard. The baseplate, trucks, bushing, and bushing caps go hand and hand together to allow for a secure and pleasant carving experience when leaning on the longboard. The riser is meant to elevate and separate the trucks from the deck. Finally, the screw, screw bolt, and hex nut are responsible for keeping certain components in place and connected.

This Solidworks assembly utilized many concepts and features, such as surfacing, extrudes, chamfers, fillets, revolves, and many more. There were three components that were focused on in this project: the wooden deck, the baseplate, and the trucks. These three components are vital to the longboard's overall composition. The deck required levels of surfacing and extruded cuts. The baseplate required complex sketching as well as thoughtful extruded cuts. The trucks required lots of thoughtfully placed fillets and boss extrusions. This paper will discuss in detail the ways to create these important parts.

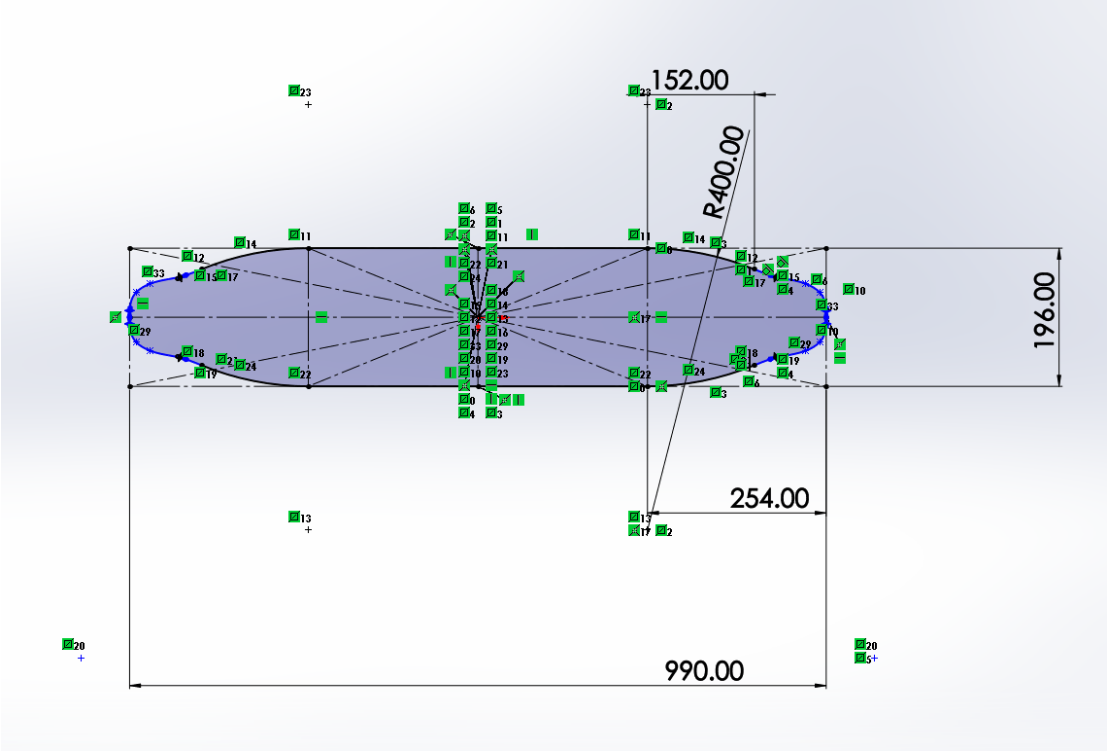
All dimensions are in mm. The materials used for all the parts are Poplar Wood for the deck, requiring custom input of material selection, ABS plastic for the risers, polyurethane for the wheels and bushings, 7075-T6 Plate (SS) for the trucks and baseplate, and Cast Carbon Steel for the screw. DISCLAIMER, the screw used in this project sourced from McMaster while every other component was self-modeled.

Instructions 1: Wooden Deck

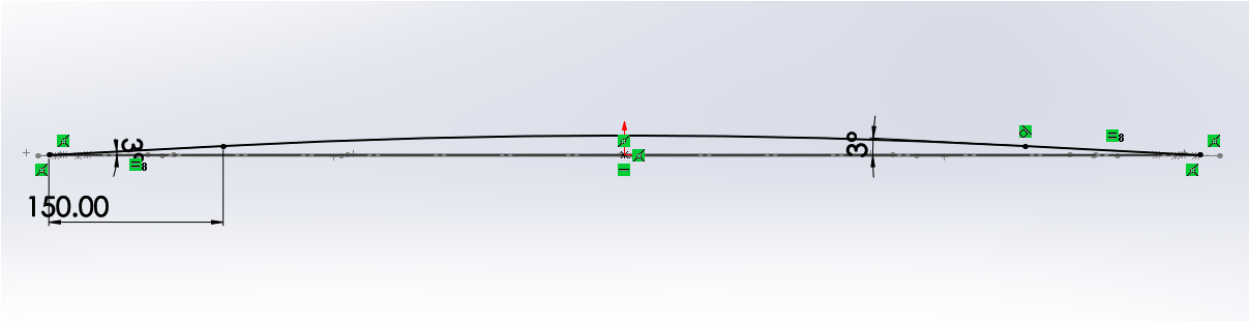
Feature Manager Design Tree

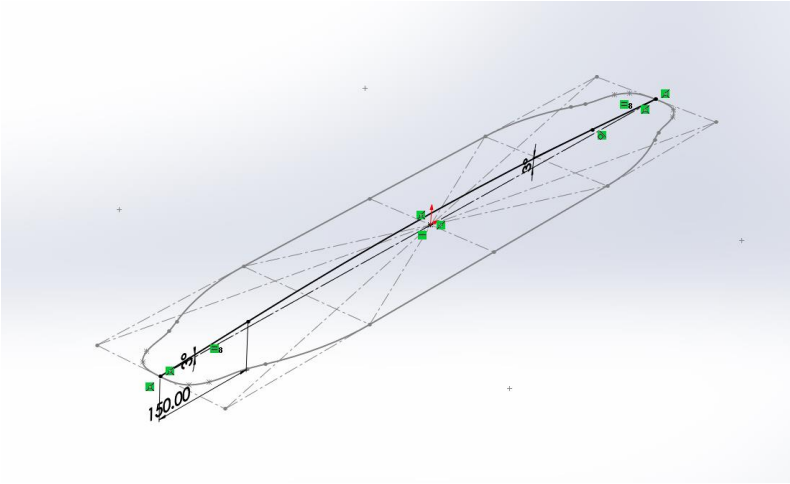


1. **Sketch 1:** Create sketch shown on top plane to get top view shape of board.

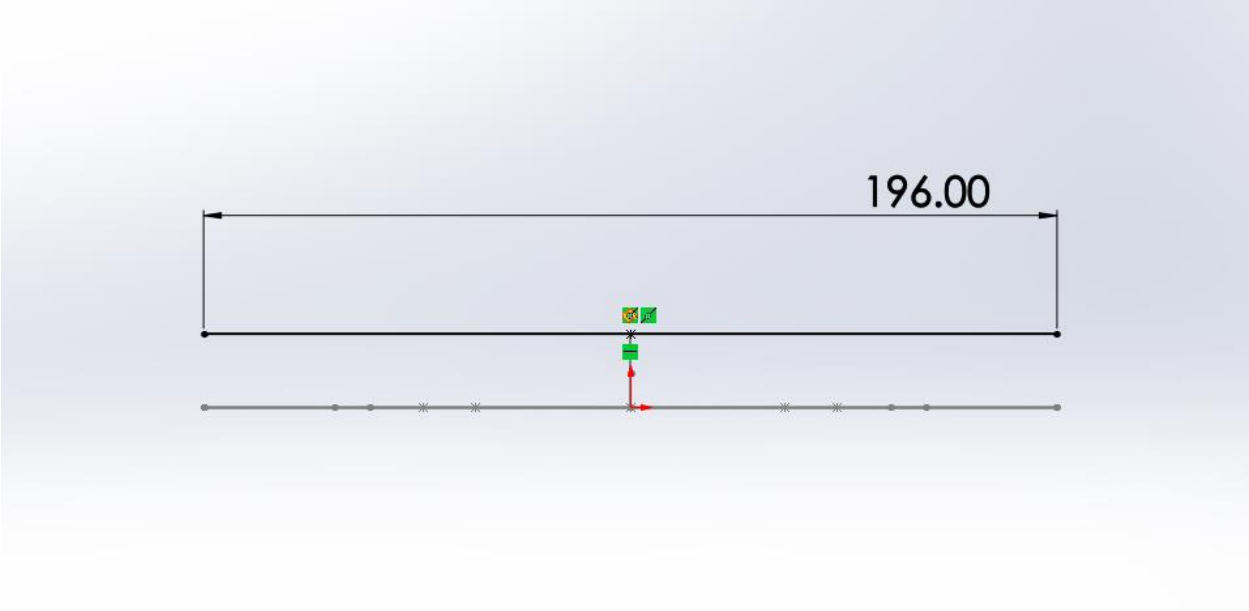


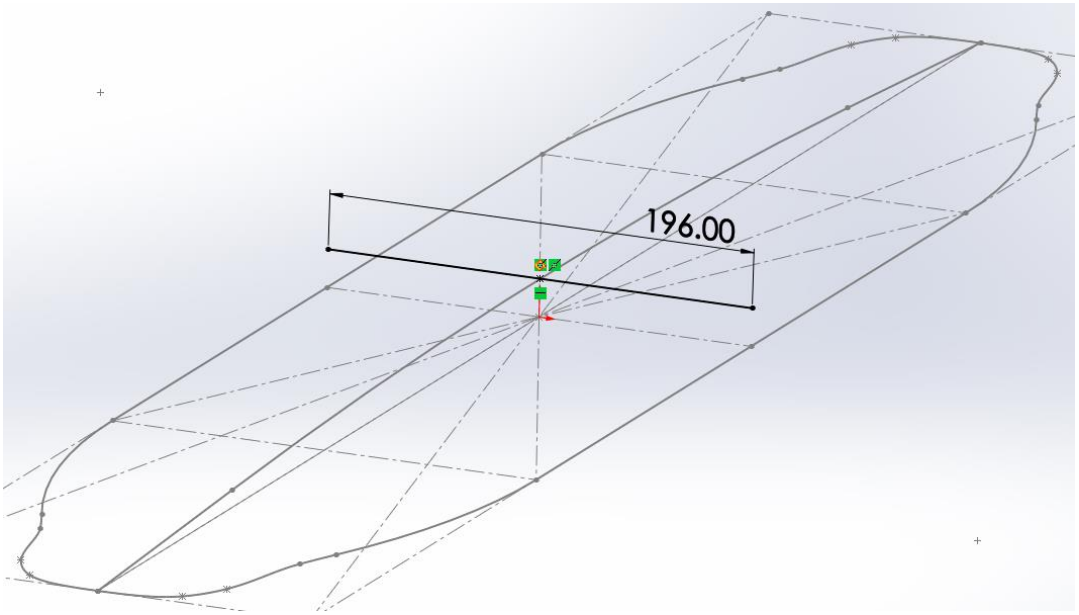
2. **Sketch 2**: Create sketch shown on right plane, connecting the ends of the sketch 1 and creating the curve of the longboard



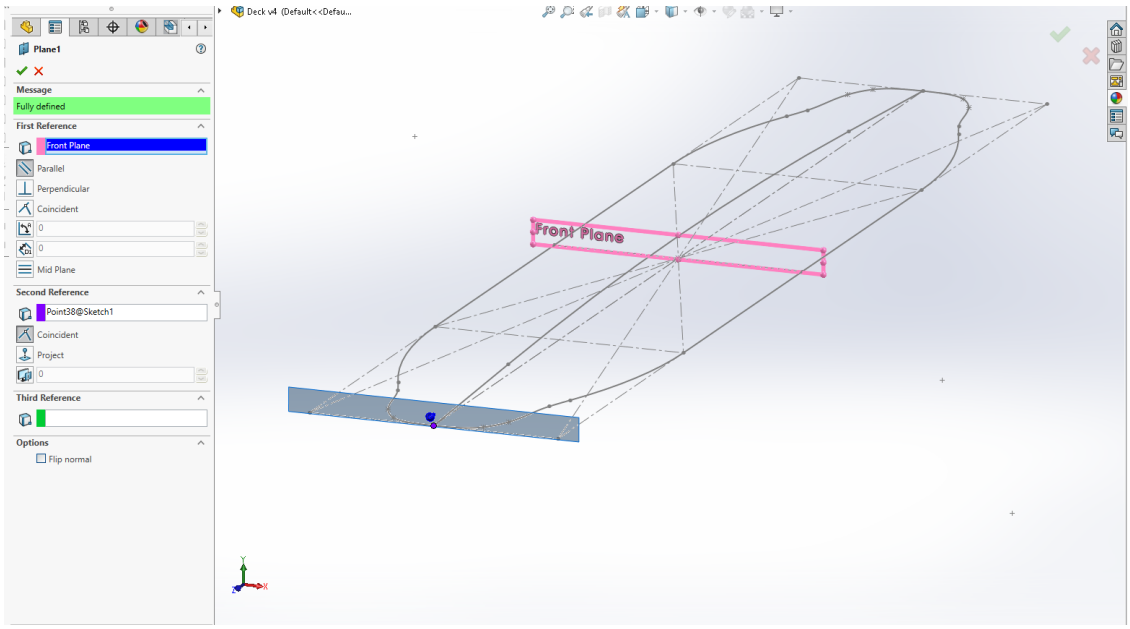


3. **Sketch 3**: Create sketch on front plane. Make **pierce relation** to sketch 2

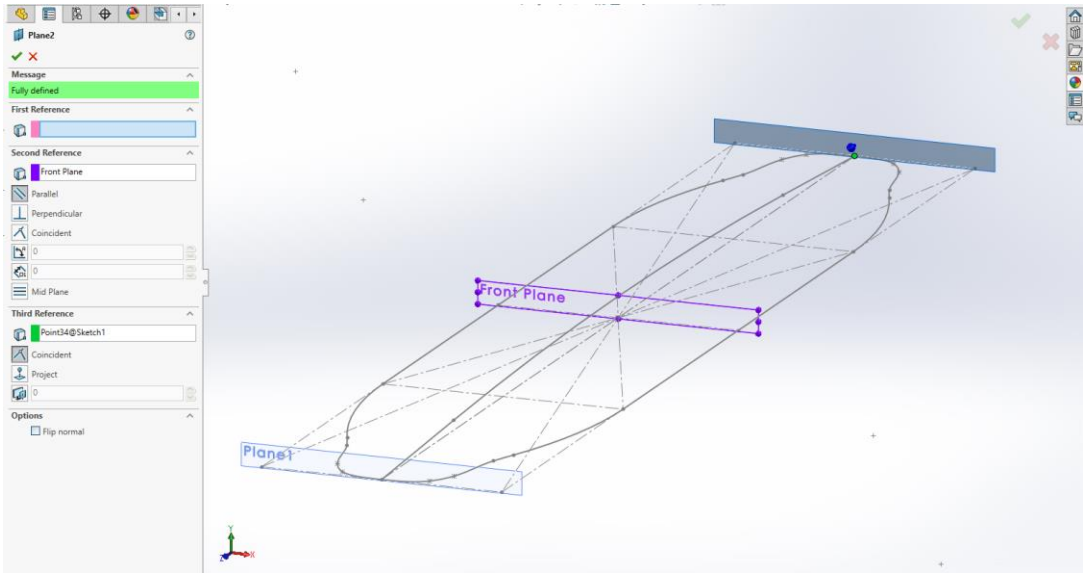




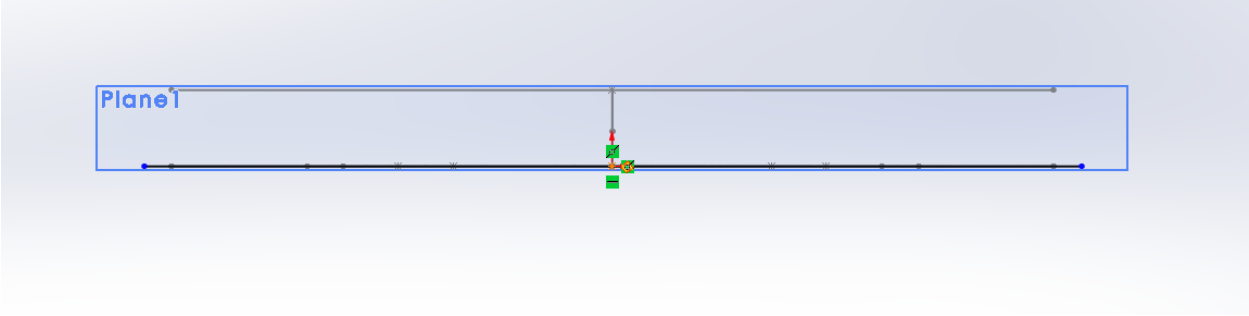
4. **Plane 1**: Create reference plane 1, parallel to front plane, coincident to furthest point in sketch 1.



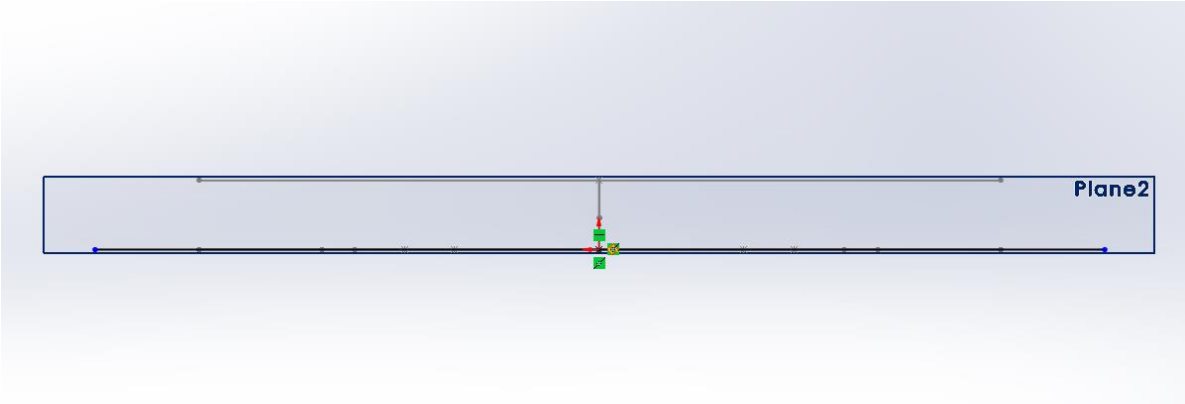
5. **Plane 2:** Create reference plane 2, like reference plane 1 in the opposite direction



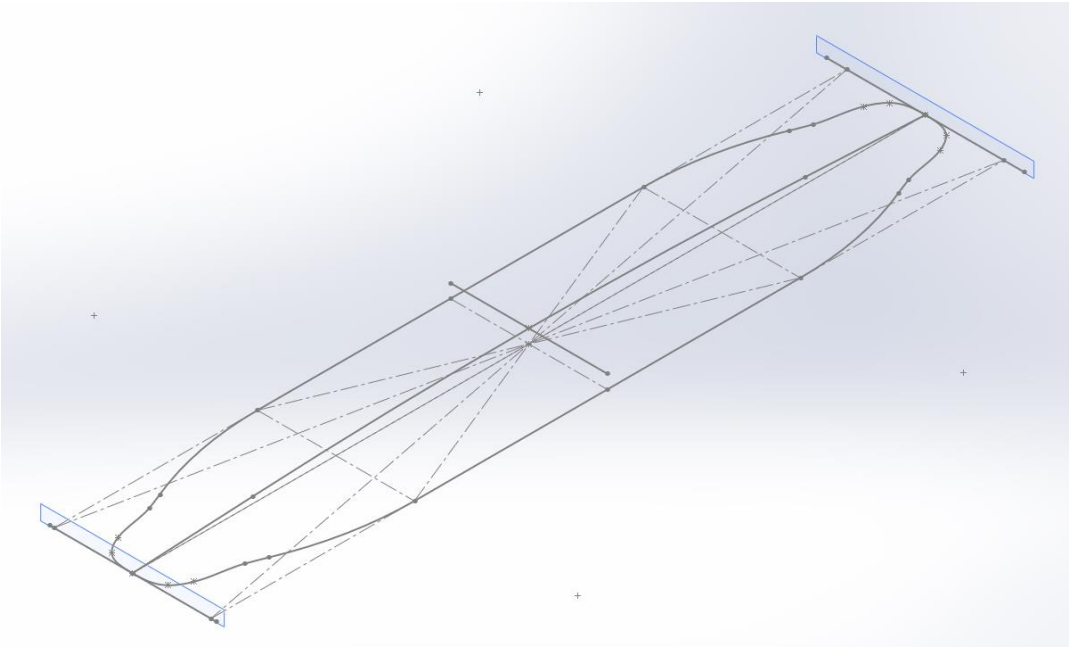
6. **Sketch 4**: Create sketch on plane 1. Create midpoint line long enough to cover the width of sketch 1. Make **Pierce** relation to sketch 2



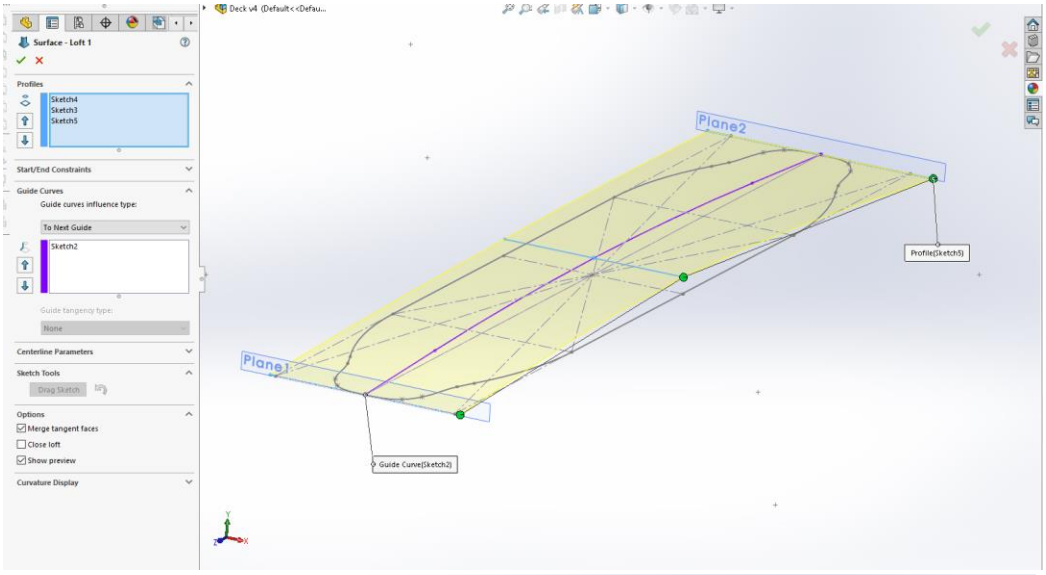
7. **Sketch 5**: Create sketch on plane 2 like sketch 4

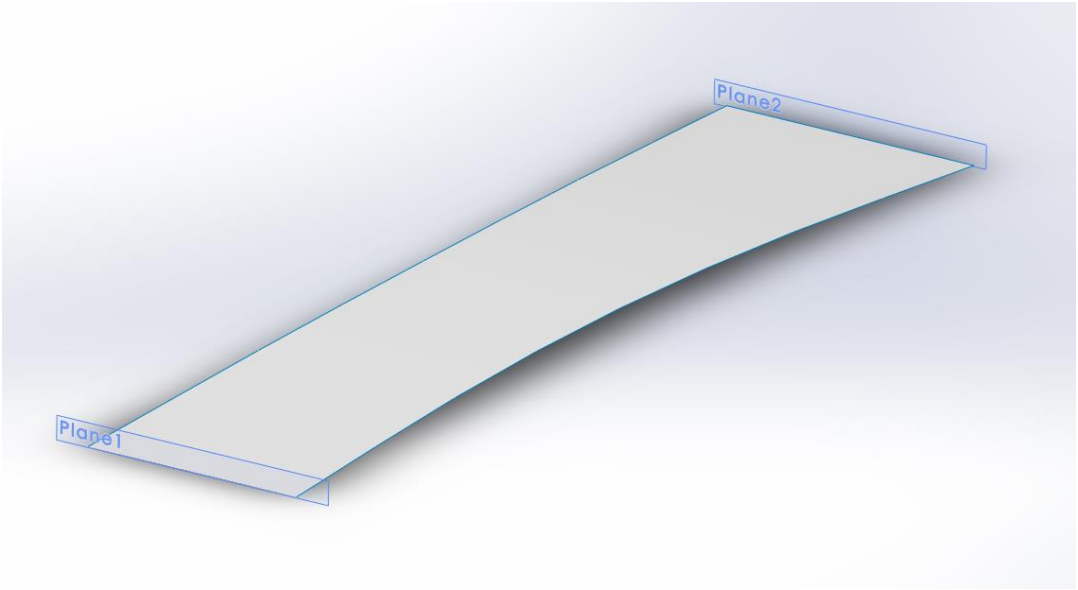


Note, your part should look like this at this step

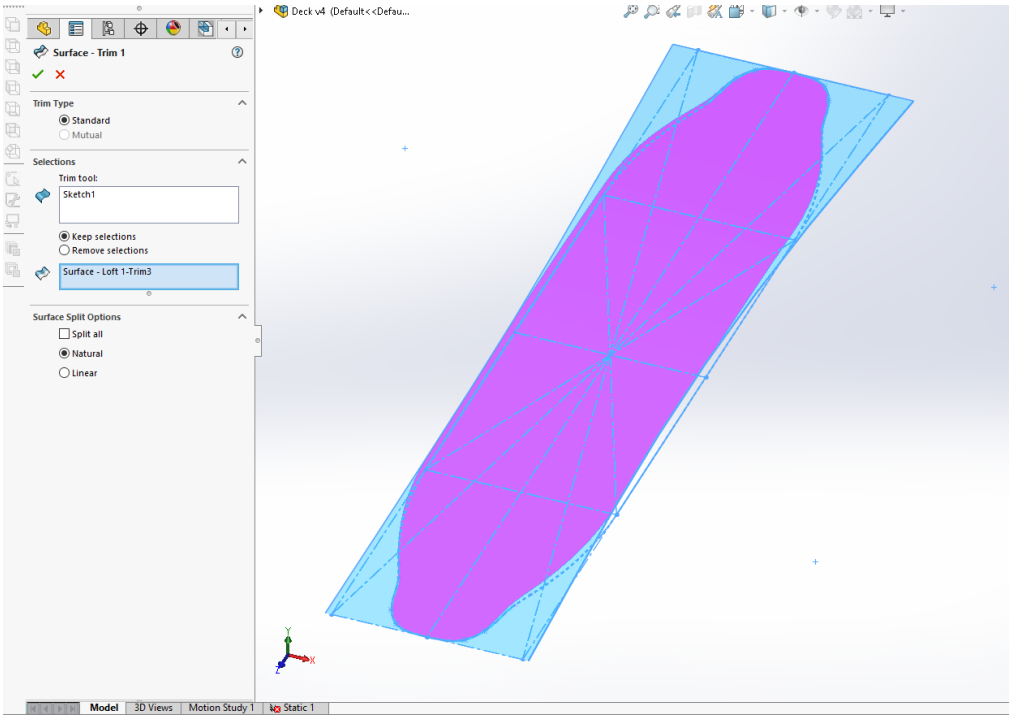


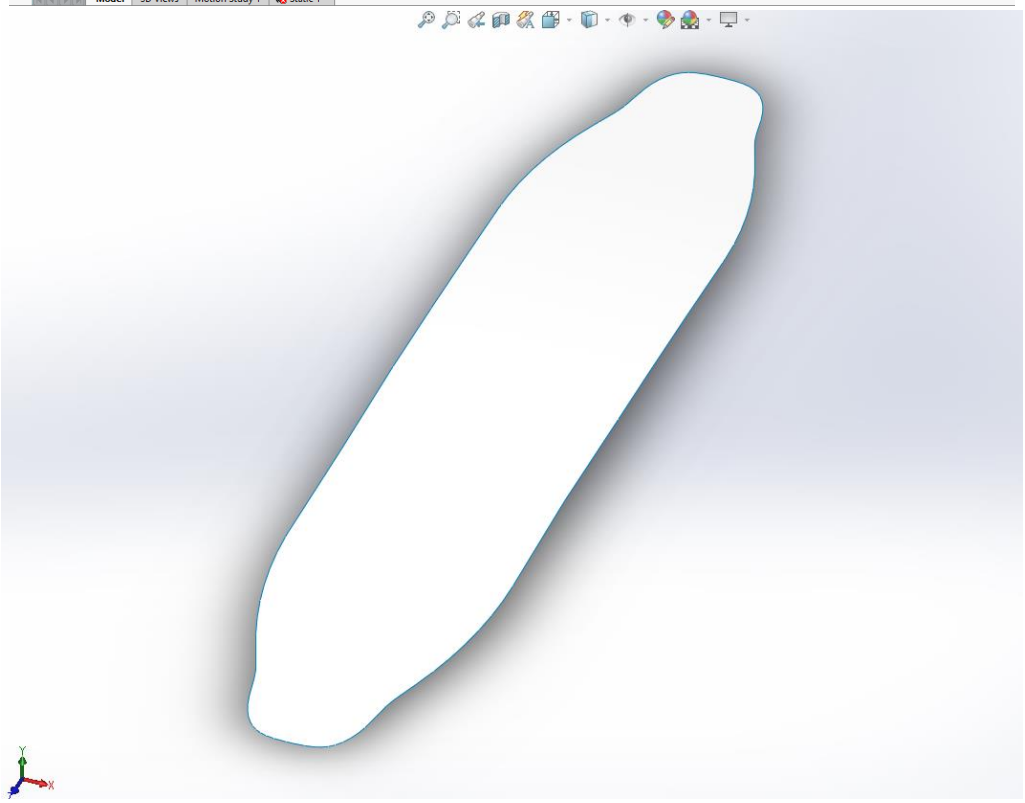
8. **Surface – Loft 1**: Create a surface loft with sketches 4, 5, and 6 for the profile and sketch 2 as the guide curve.



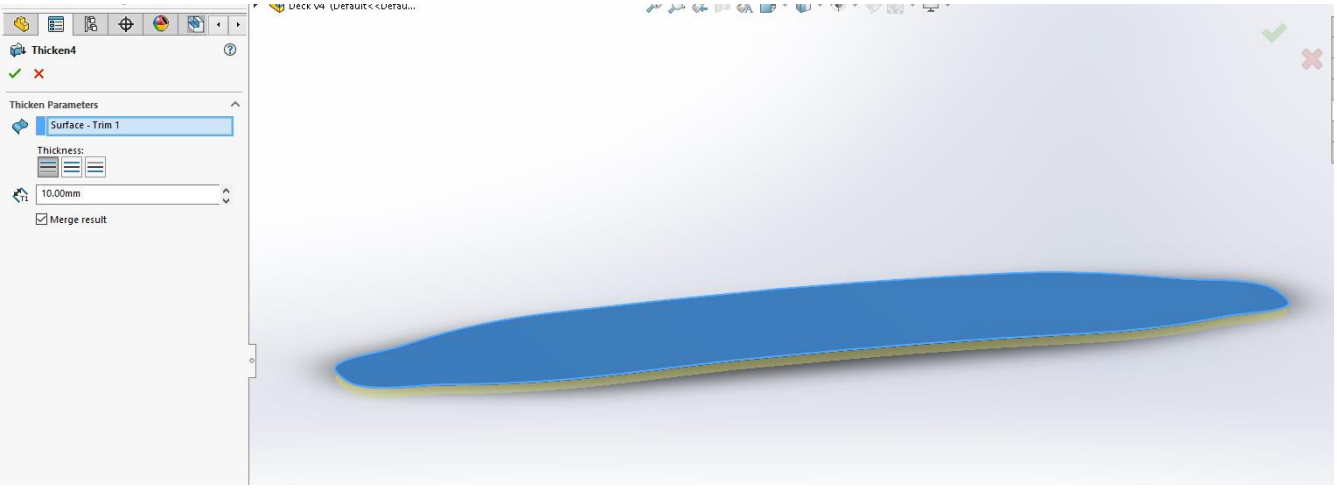


9. **Surface – Trim 1**: Use surface trim, selecting sketch 1 as trim tool and surface loft 1 as the selection.

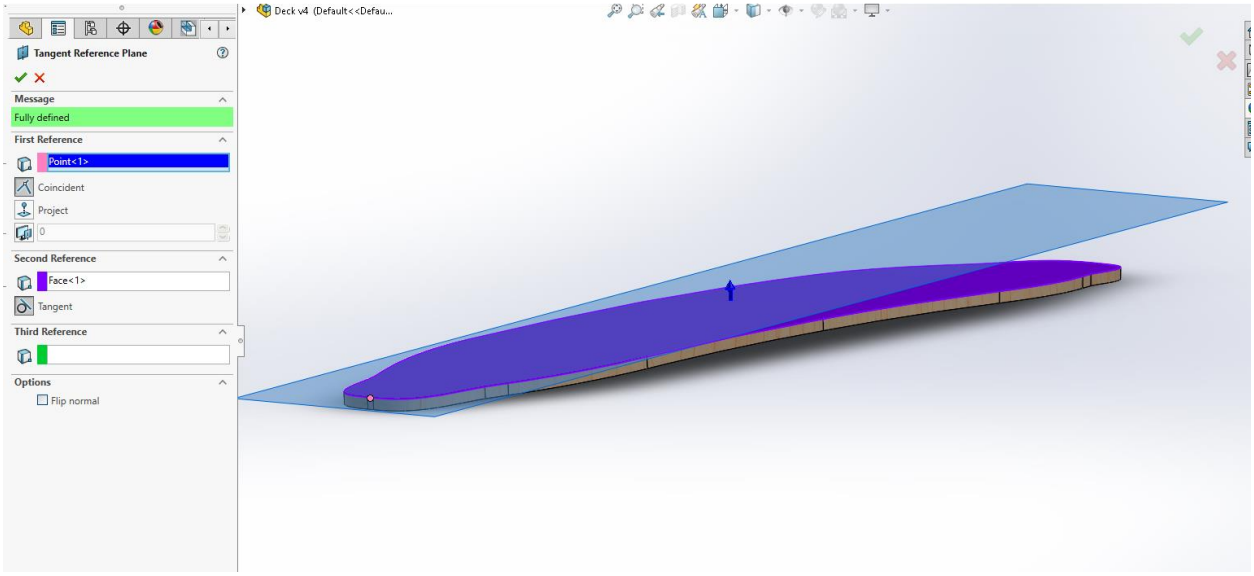




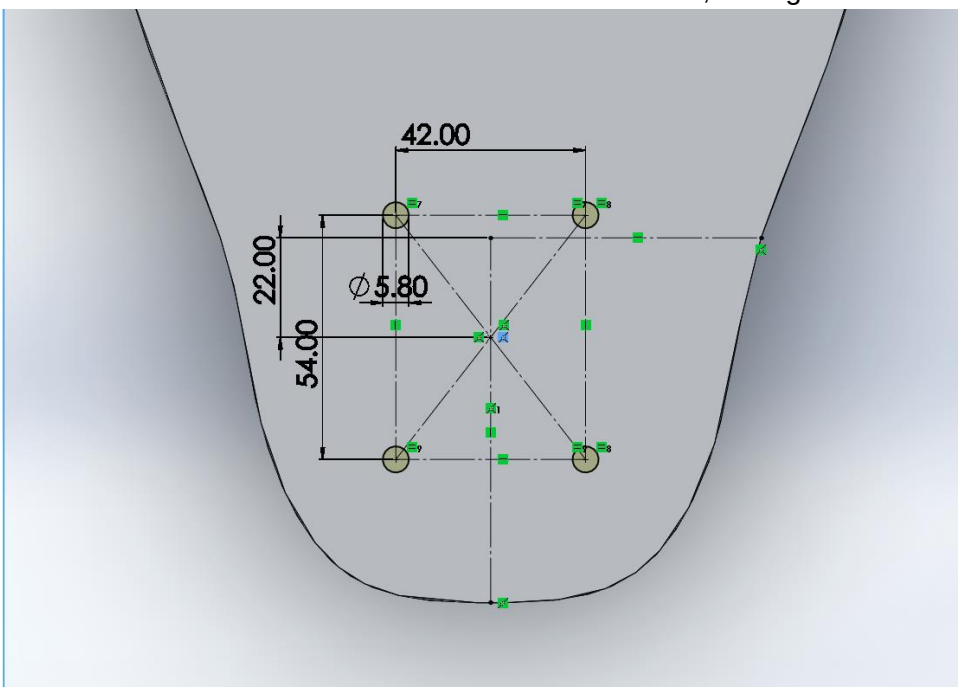
10. **Surface – Thicken 1:** Thicken surface, input 10mm.



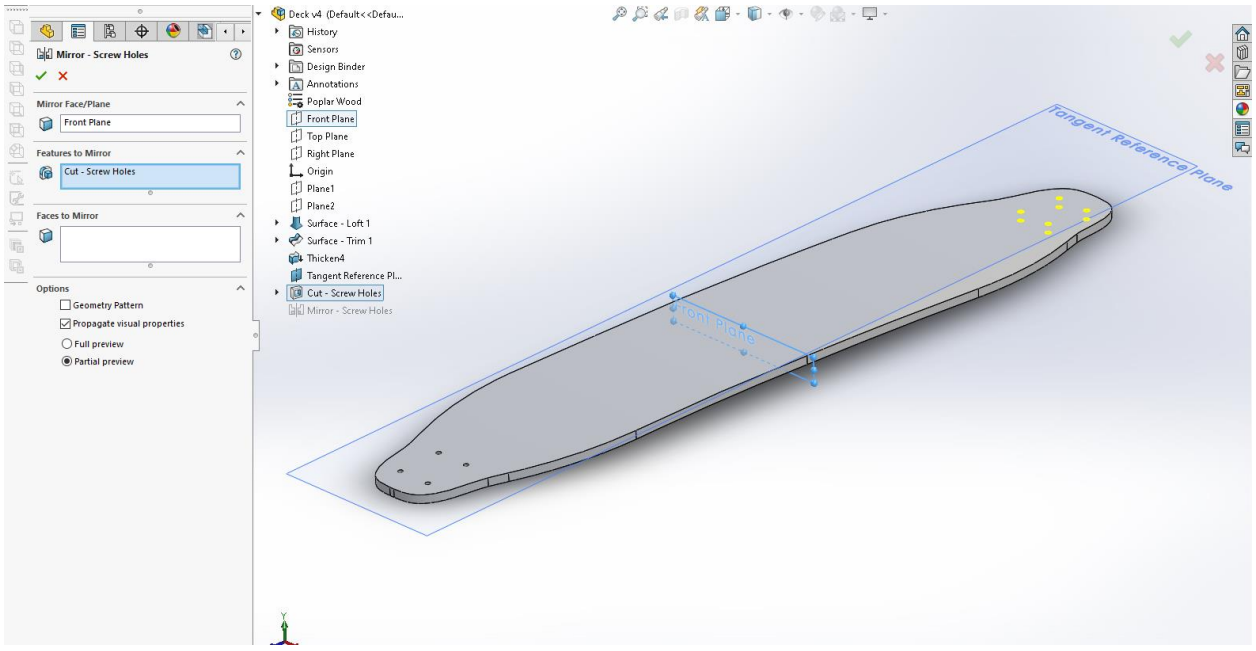
11. **Tangent Reference Plane:** Select end point and make a reference plane tangent from top surface



12. **Cut – Screw Holes:** Create sketch below and extrude cut, through-all

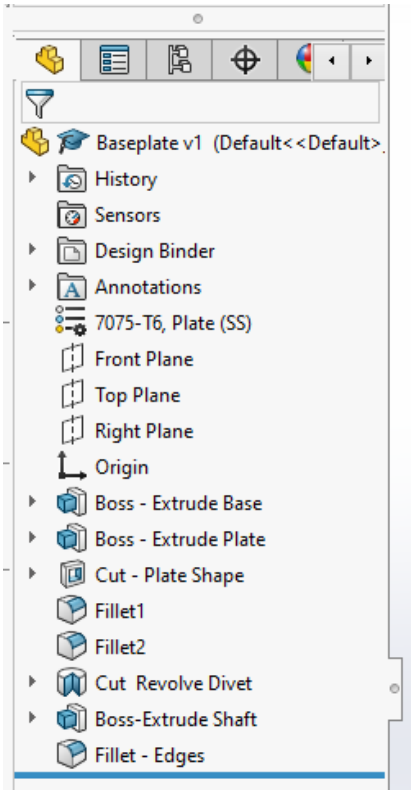


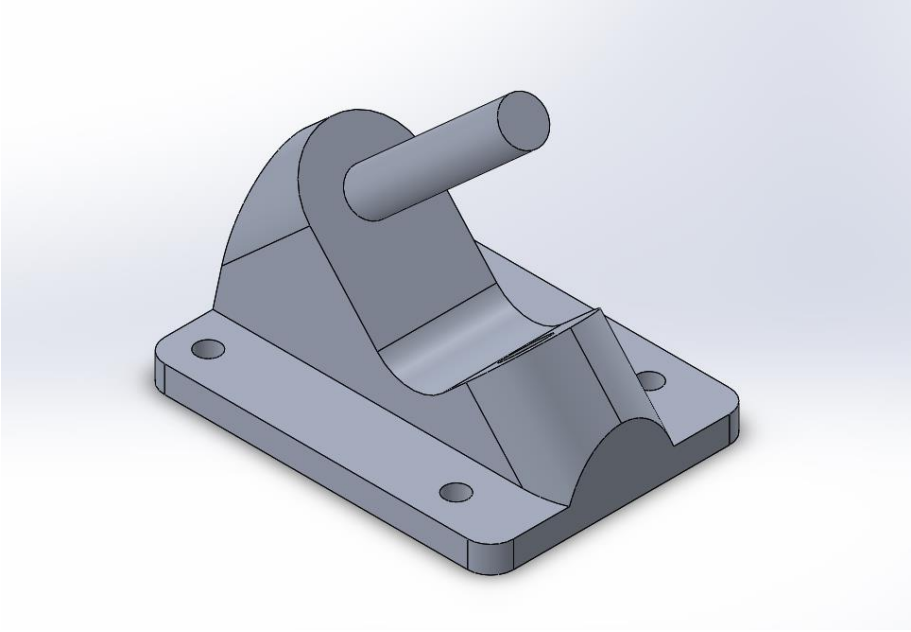
13. **Mirror – Screw Holes:** Use mirror feature to mirror the extrude cut, using the front place as the mirror plane.



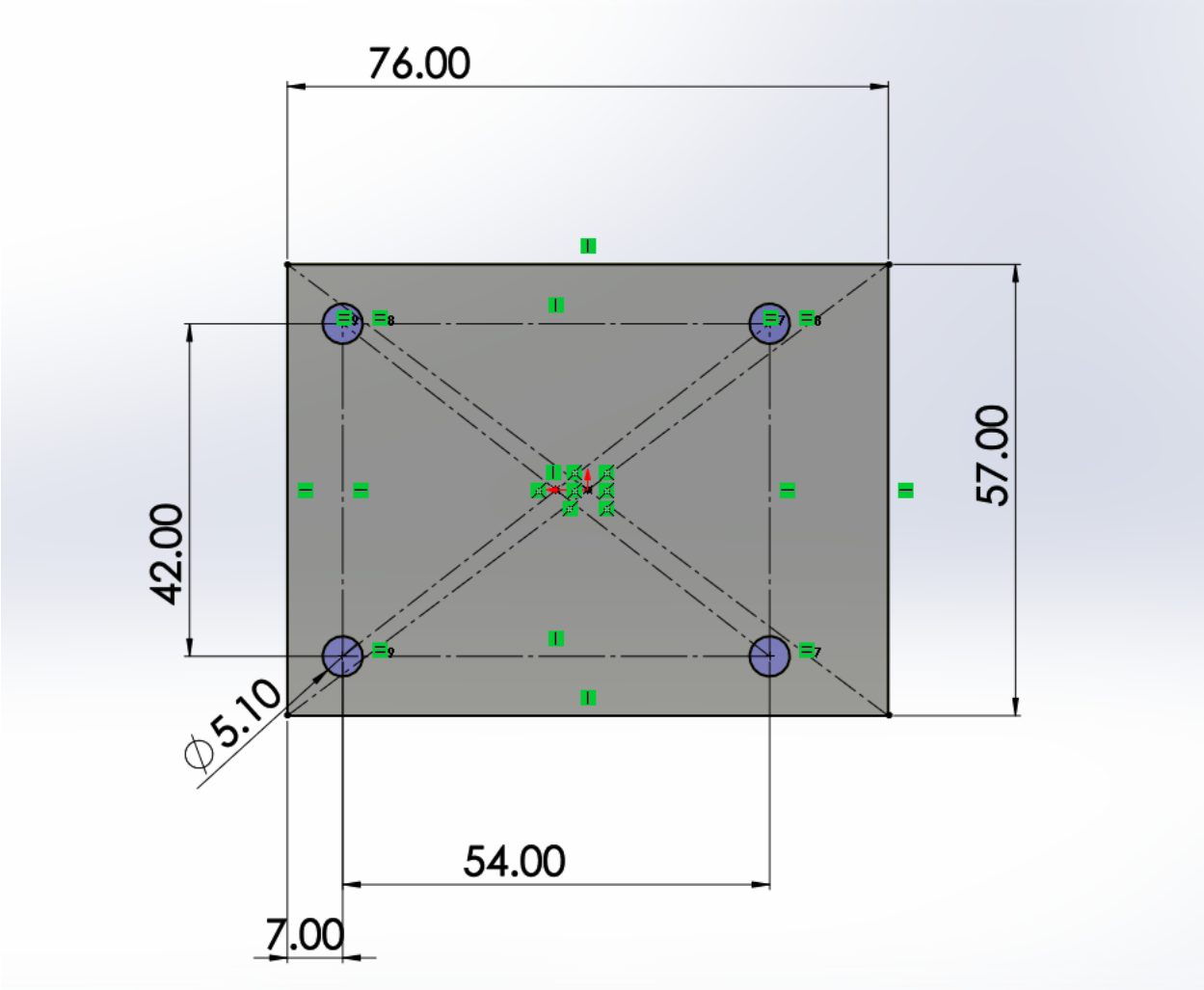
Instructions 2: Baseplate

Feature Manager Design Tree

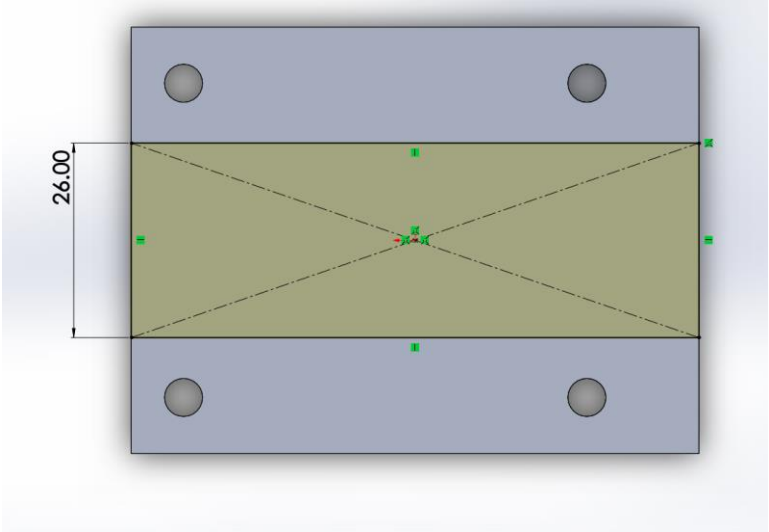




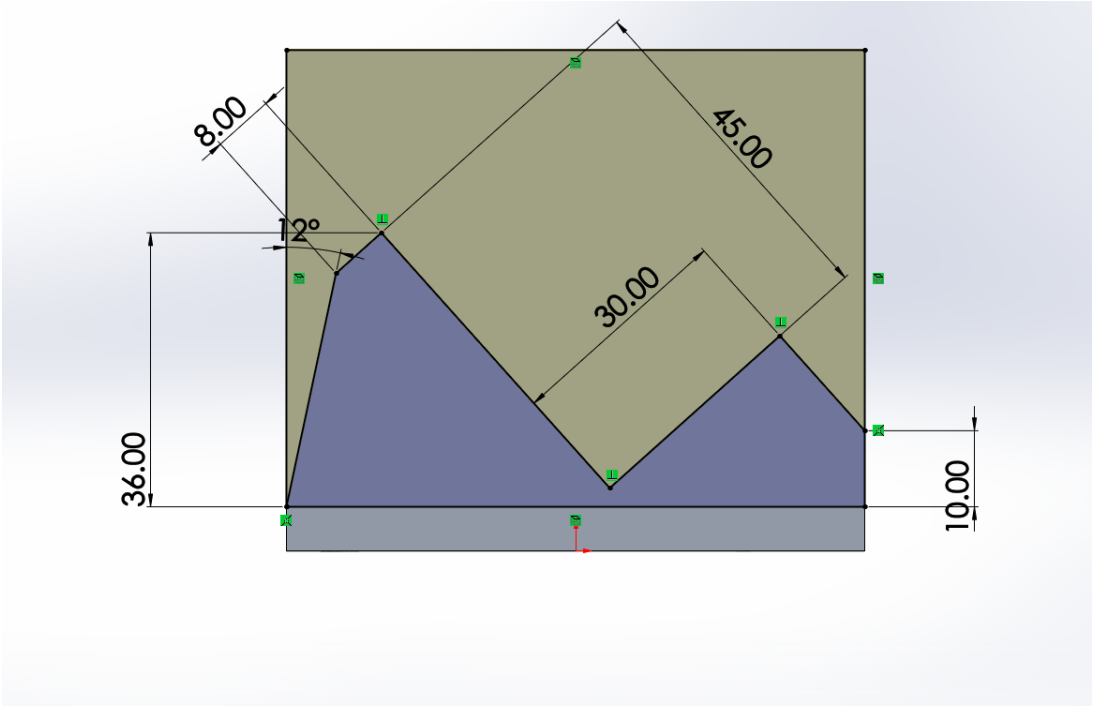
1. **Boss – Extrude Base**: Create sketch on top plane and extrude 5.80mm



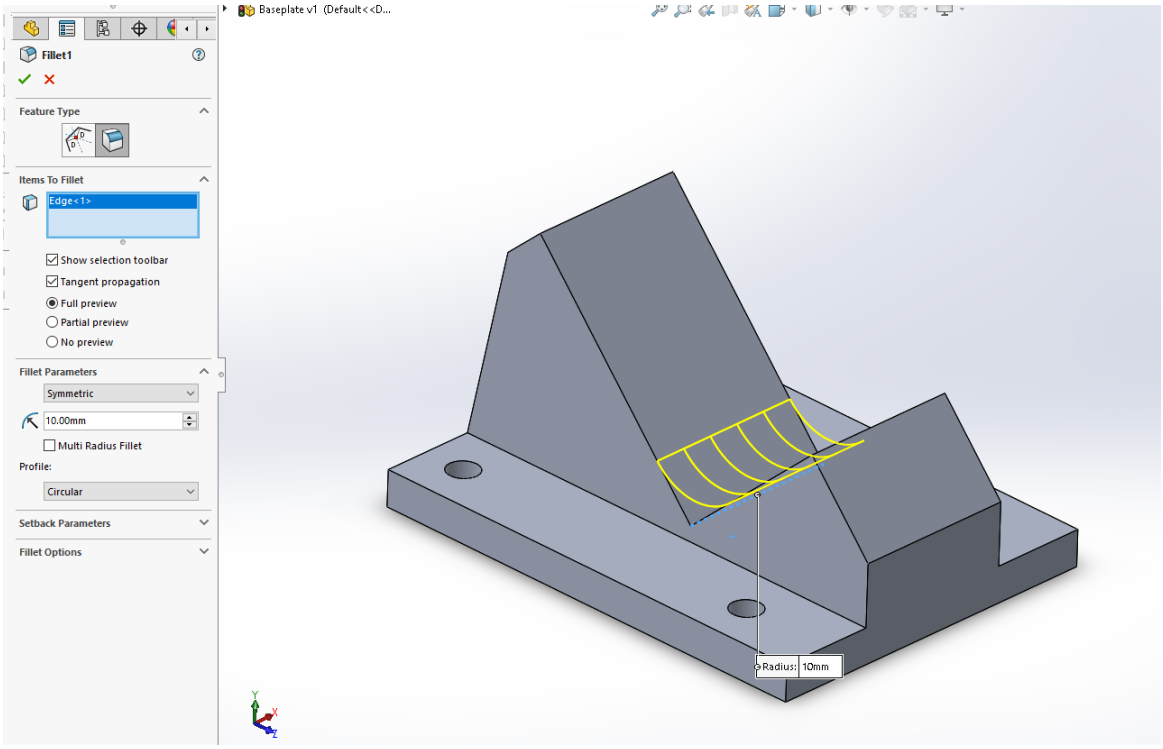
2. **Boss – Extrude Plate:** Create sketch on top of extrude base and extrude 60.00mm



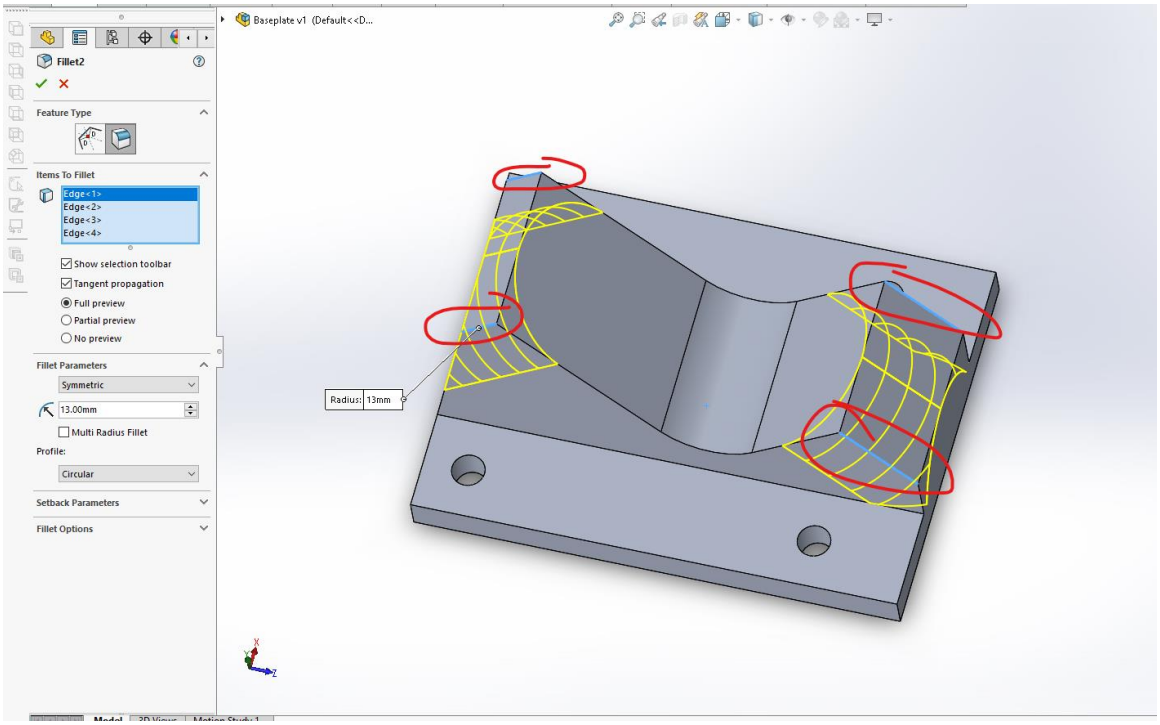
3. **Cut – Plate Shape**: Create sketch on edge of boss plate and cut through-all



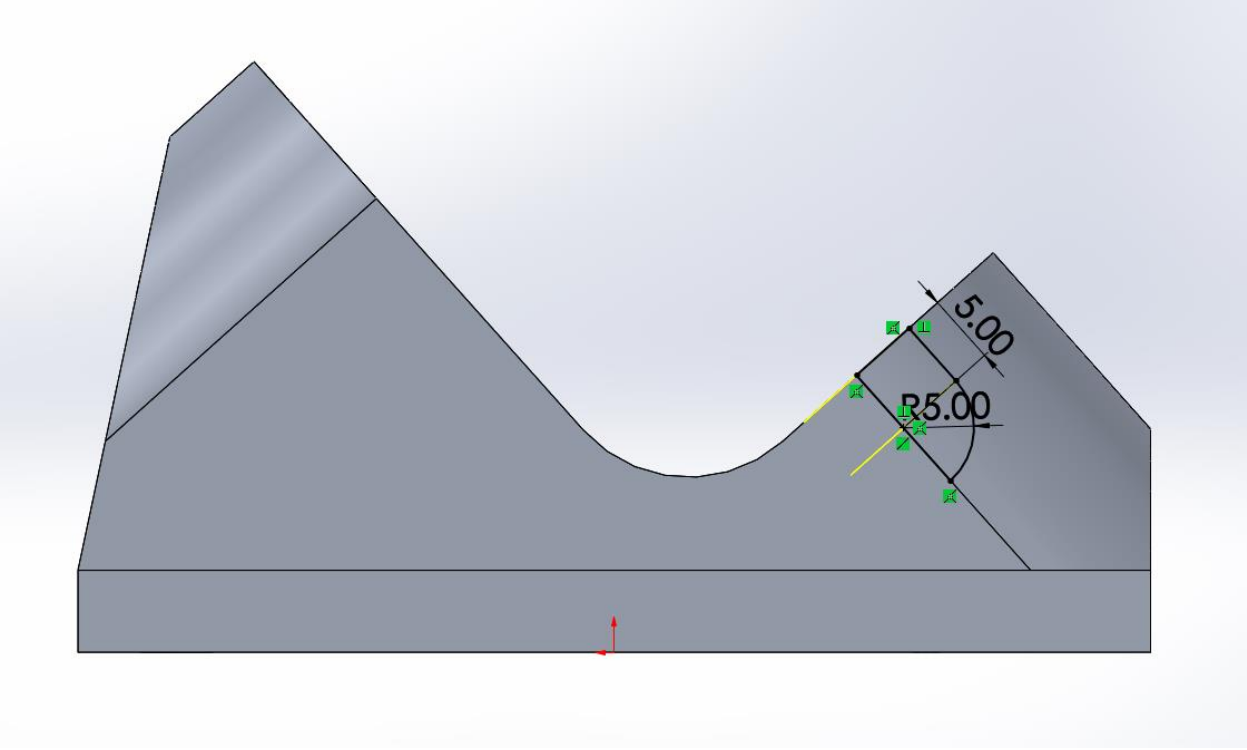
4. **Fillet 1**: Place a fillet in the middle. Enter 10mm



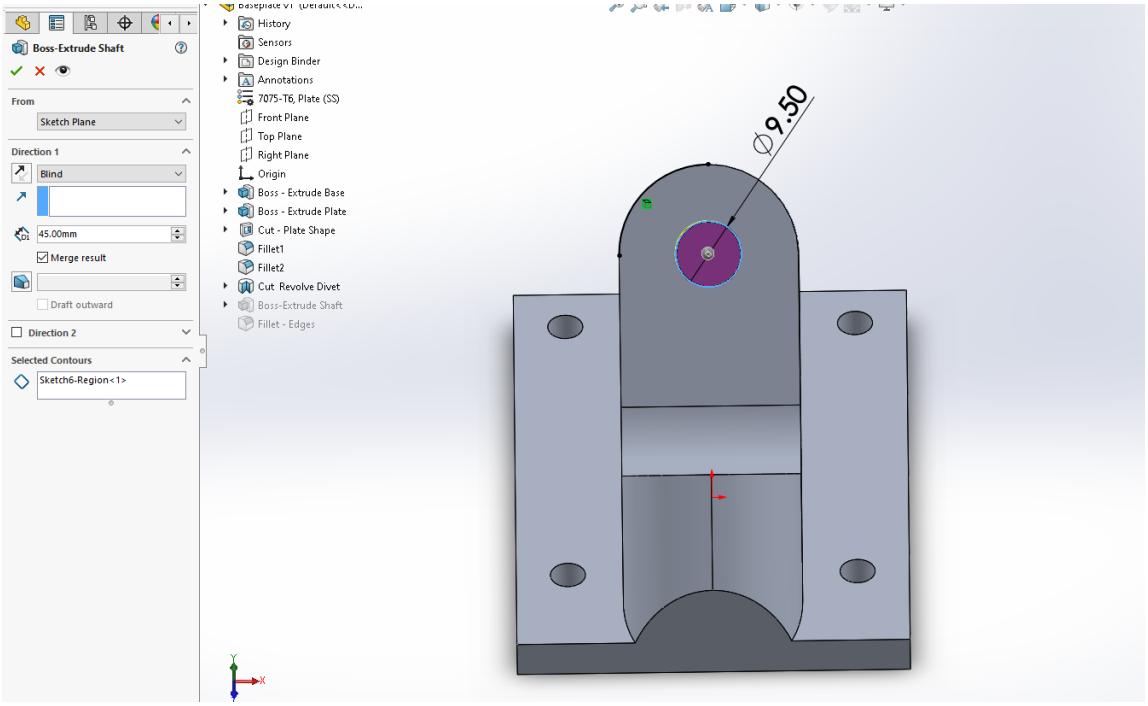
5. **Fillet 2**: Create a fillet selecting the four edges shown. Enter 13.00mm



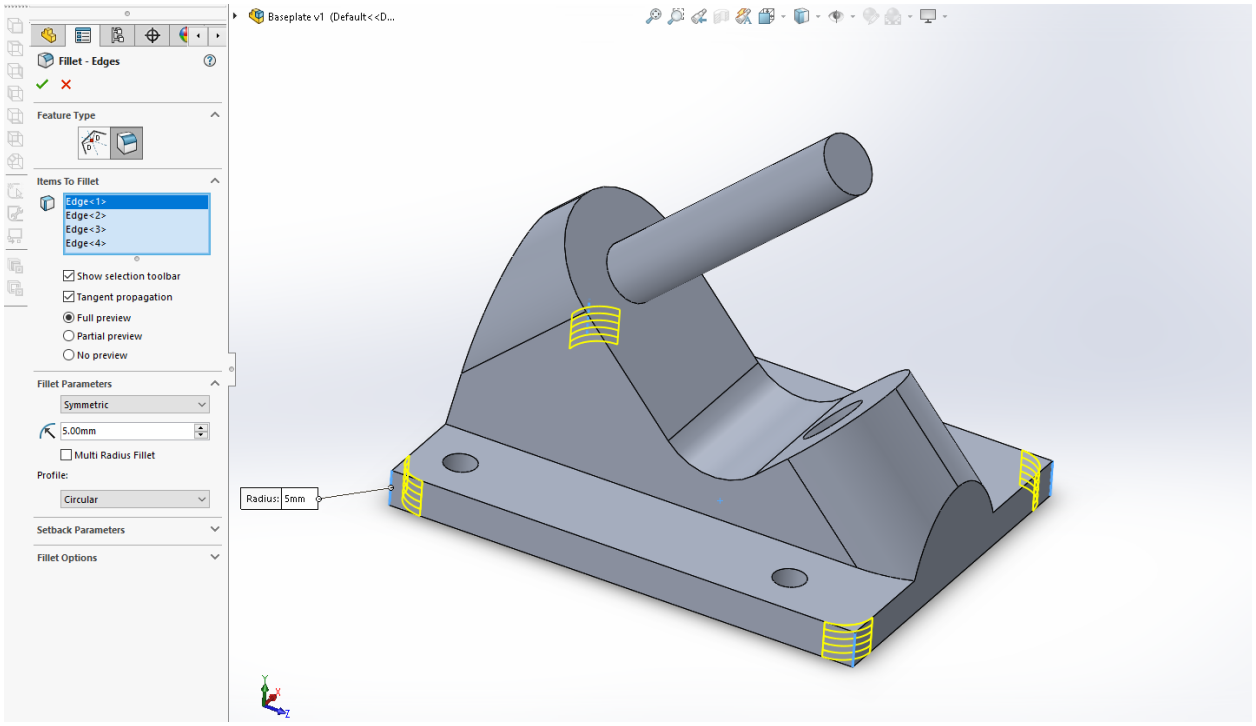
6. **Cut – Revolve Divot**: Create a sketch on the right plane. Perform a revolved cut



7. **Boss – Extrude Shaft**: Create sketch shown, concentric to fillet, and enter 45.00mm

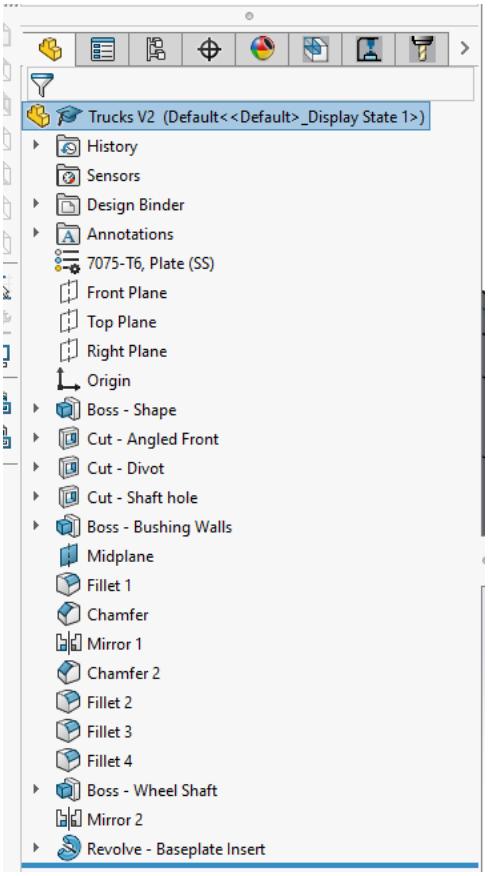


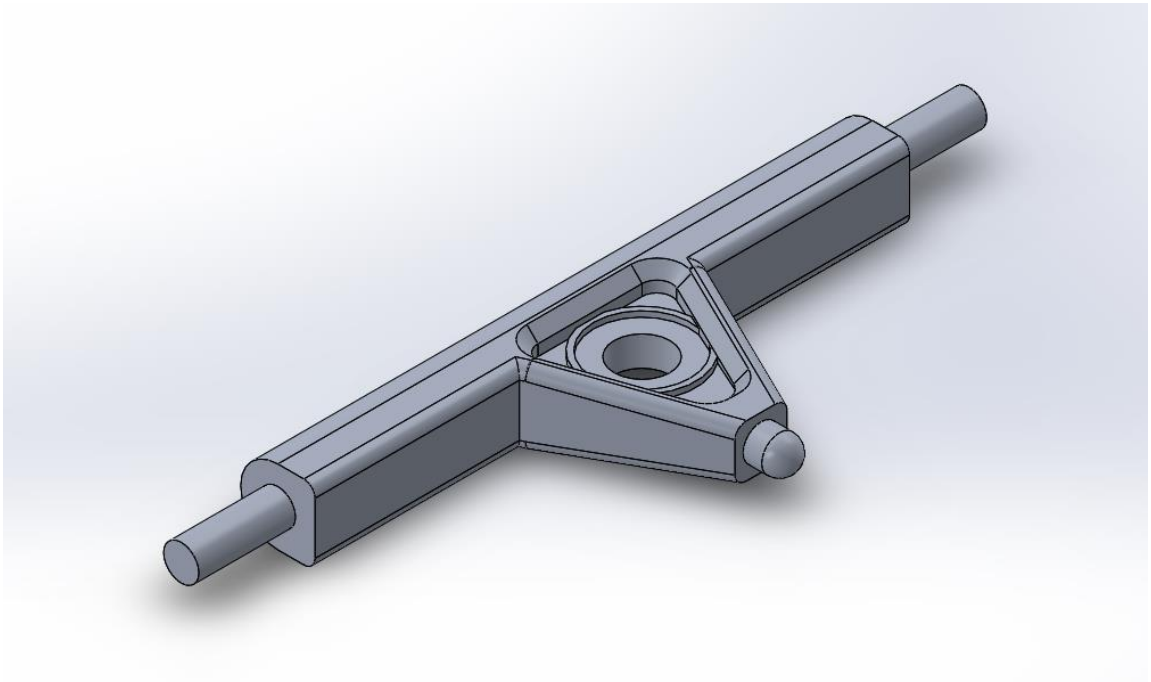
8. **Fillet - Edges**: Select four corners of base extrude and fillet. Enter 5.00mm



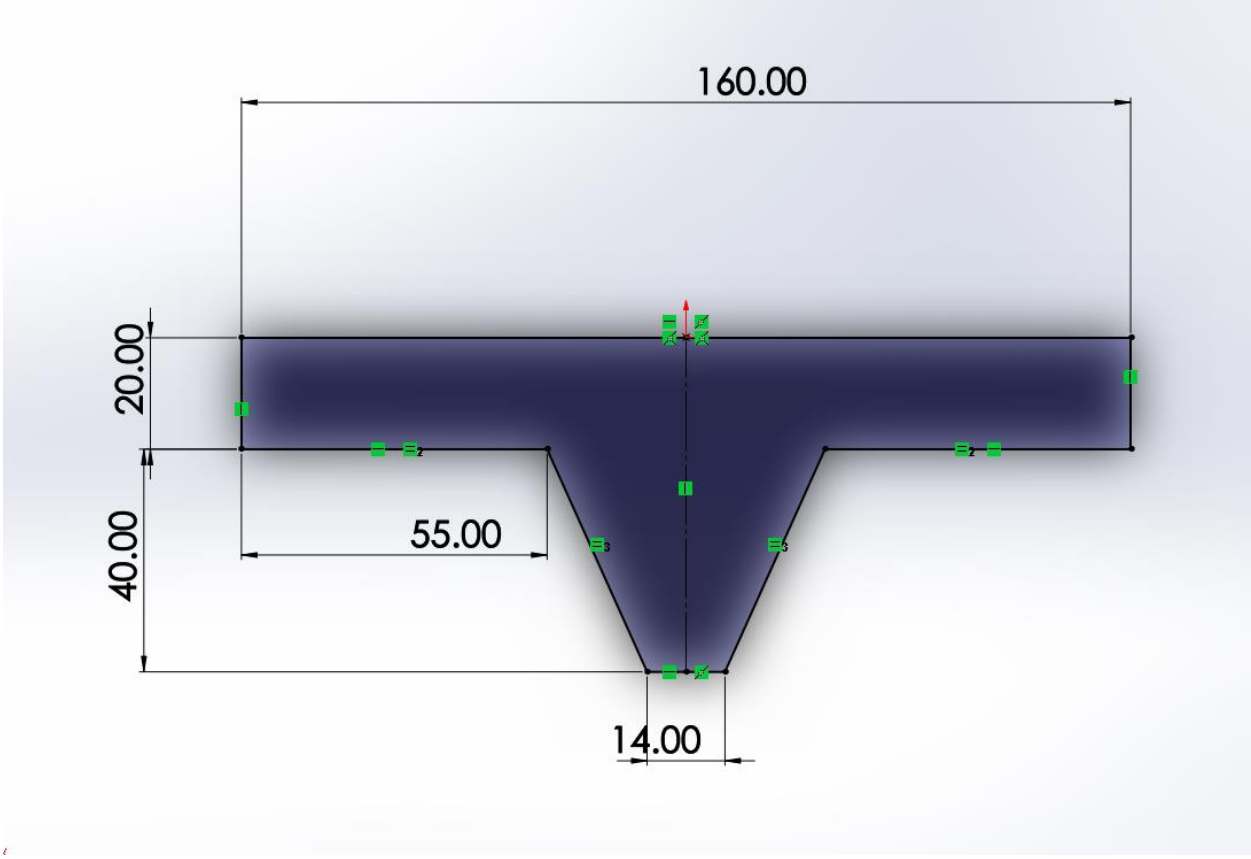
Instructions 3: Trucks

Feature Design Manager Tree

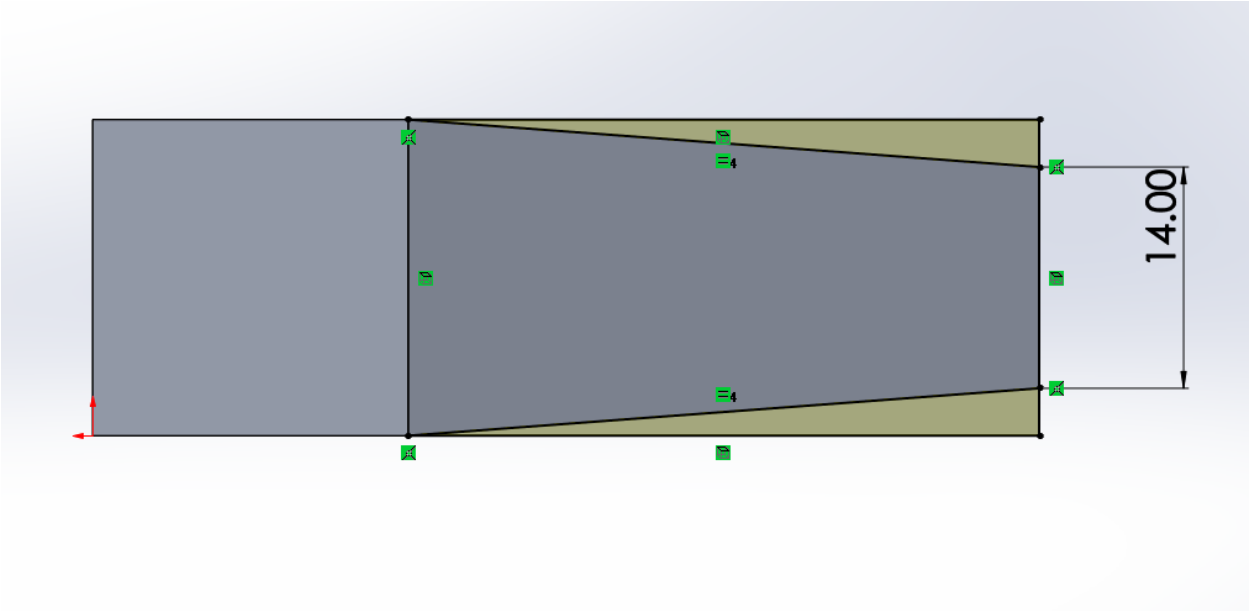




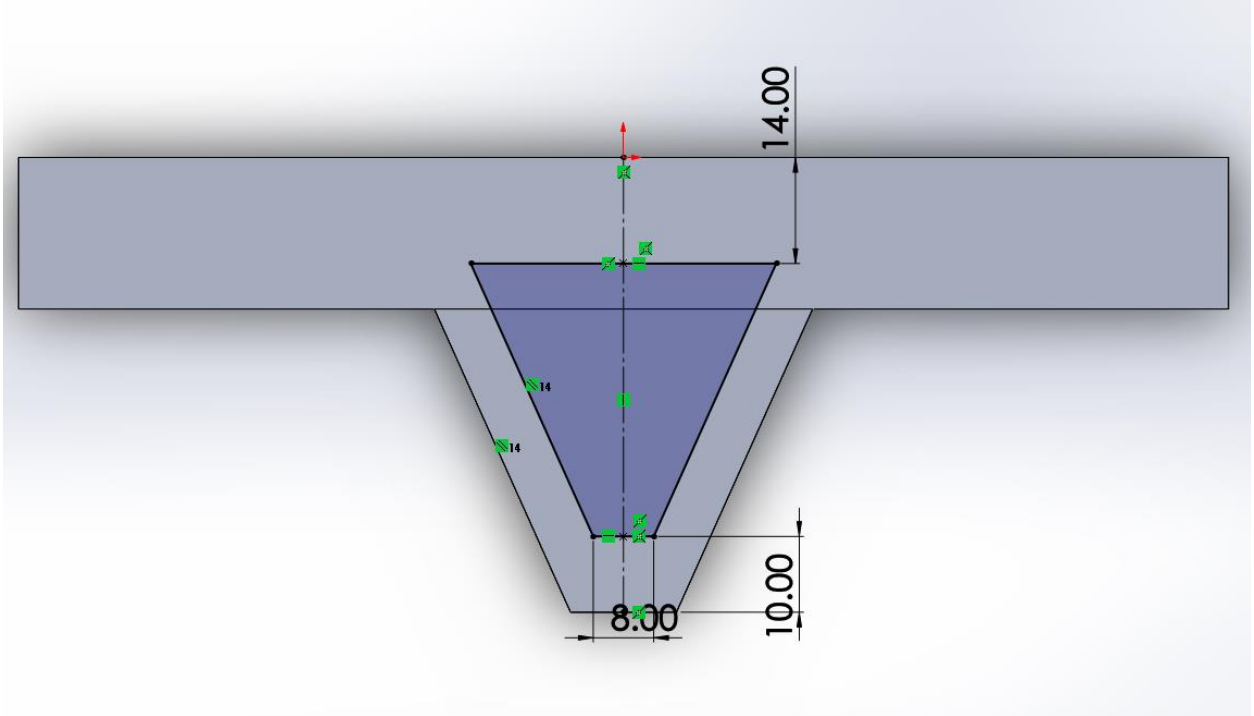
1. **Boss - Shape**: Create sketch on top plane. Extrude 0.4 cm.



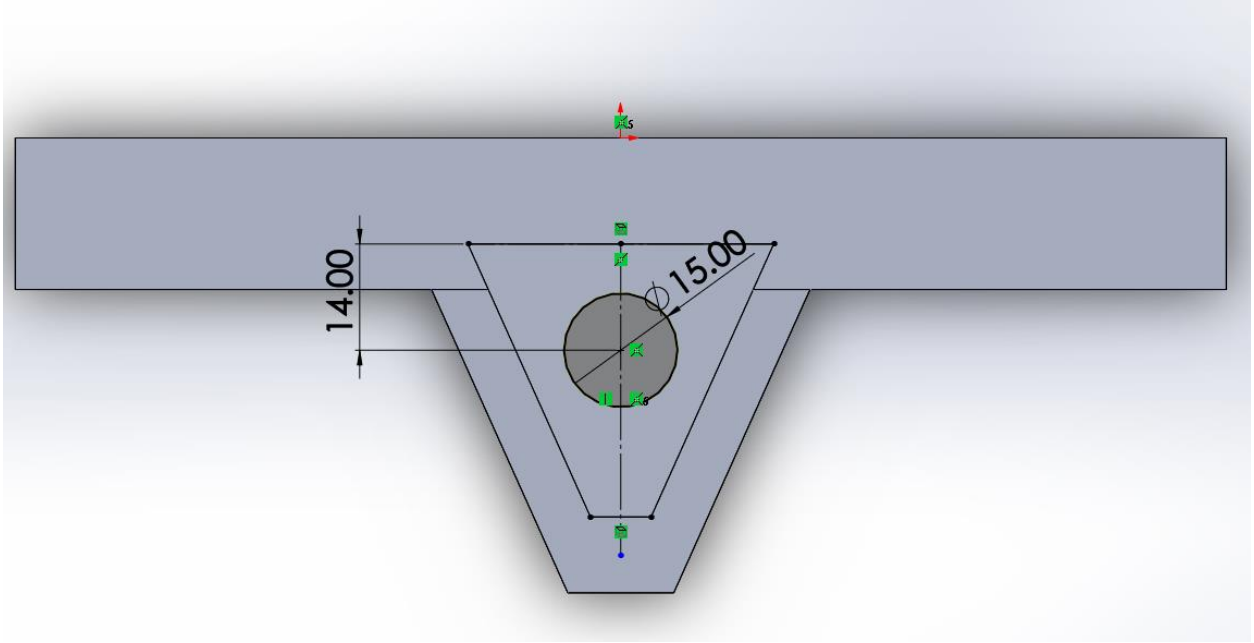
2. **Cut – Angled Front**: Create sketch on right plane. Through-all extrude cut



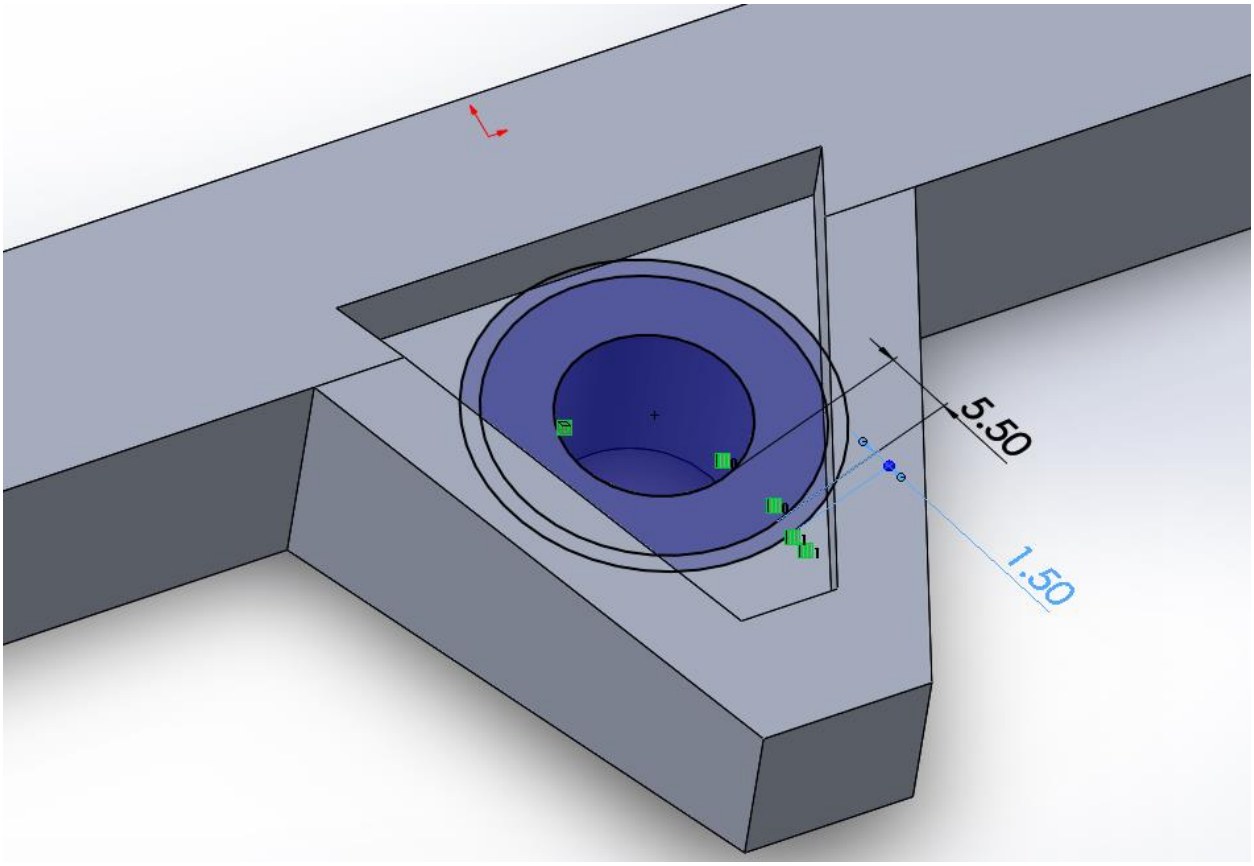
3. **Cut - Divot**: Create sketch, extrude cut 6.00mm



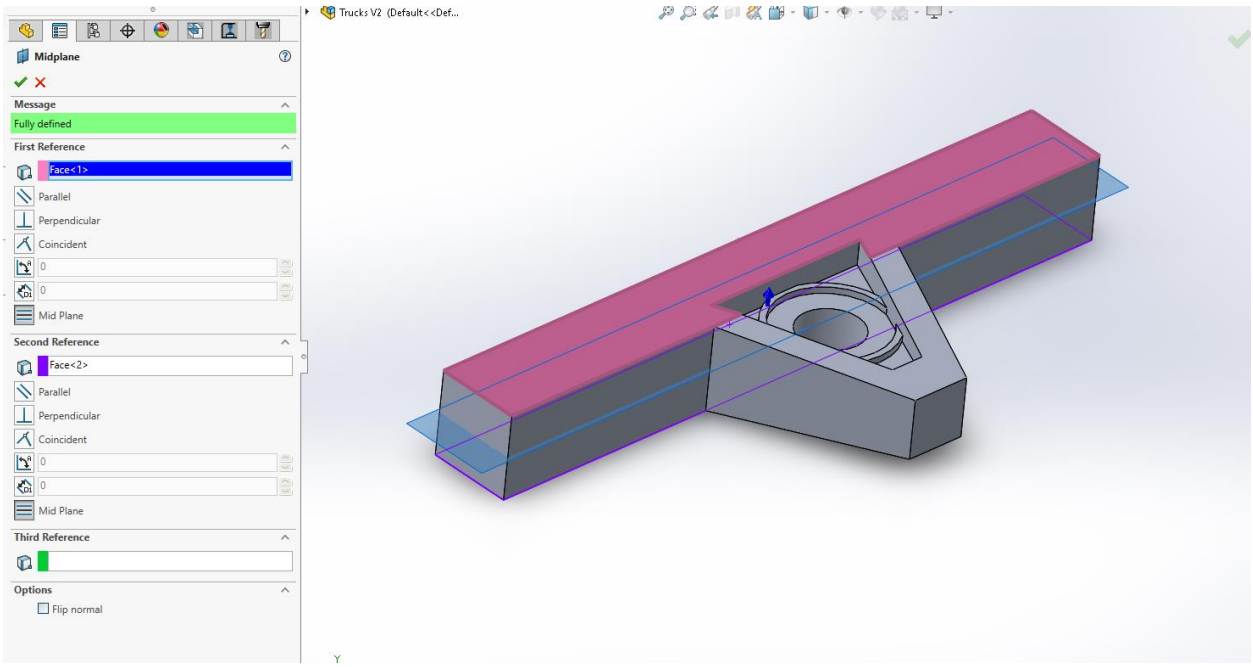
4. **Cut – Shaft Hole:** Create sketch on Cut – Divot and extrude cut through-all



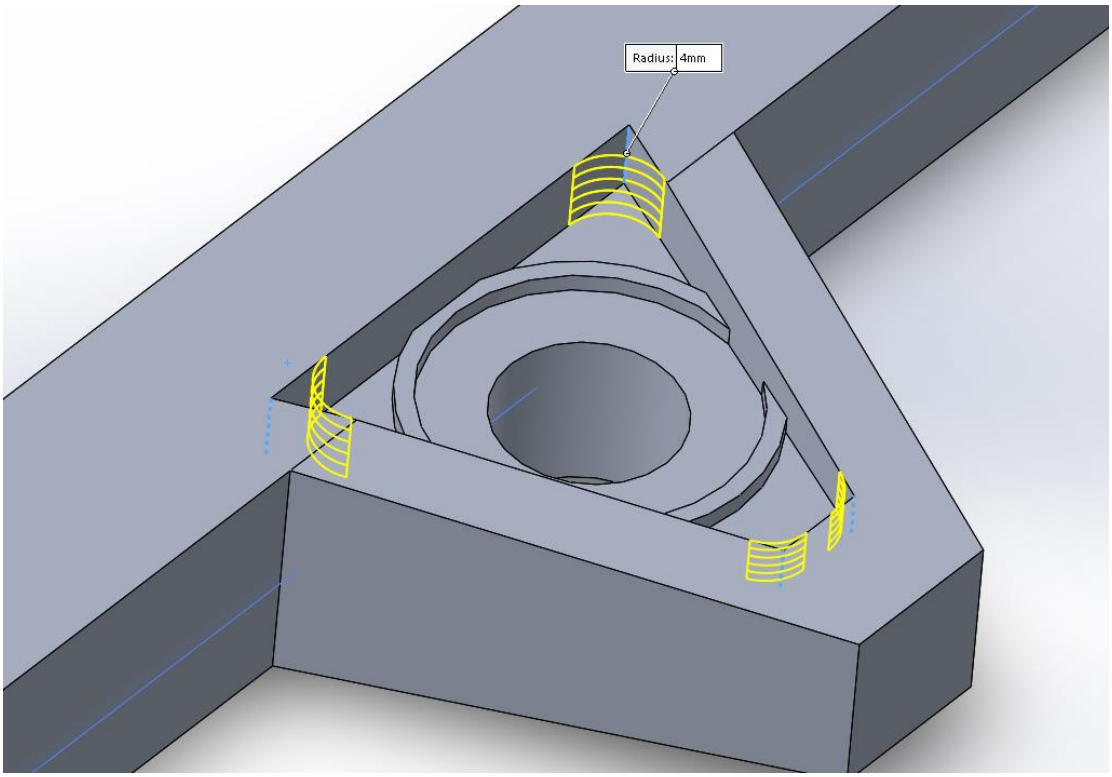
5. **Boss – Bushing Walls**: Create a circle with a diameter of 5.50mm, concentric to shaft hole, and offset circle by 1.50mm. Extrude by 1.50mm.



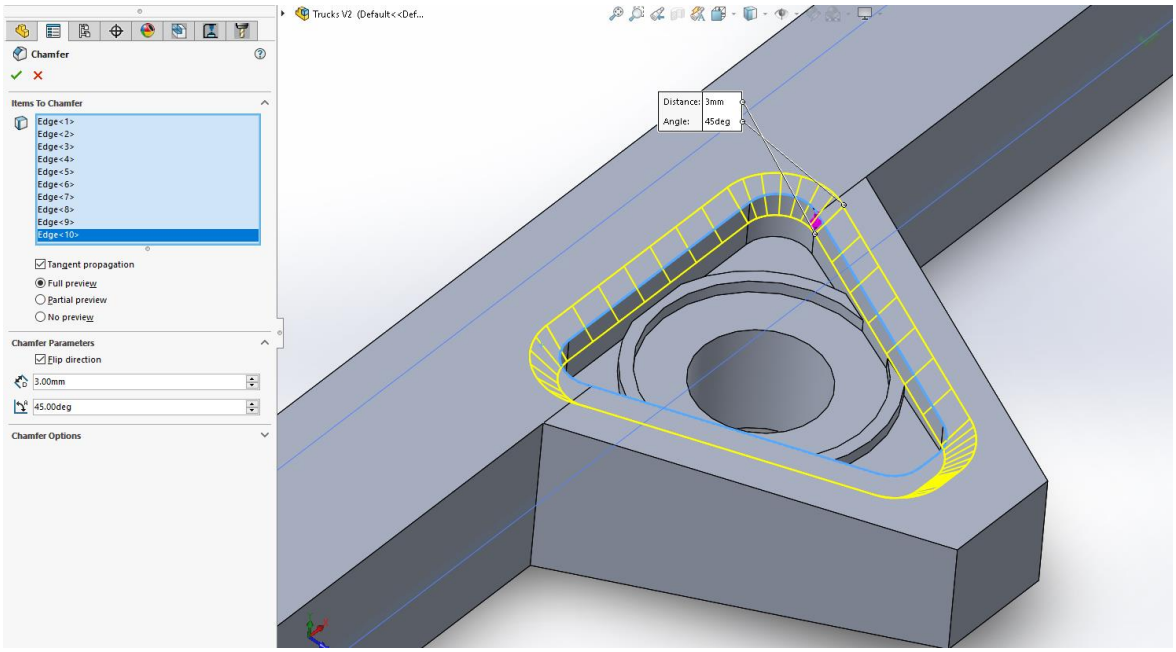
6. **Mid-Plane**: Create a midplane between the top and bottom surfaces.



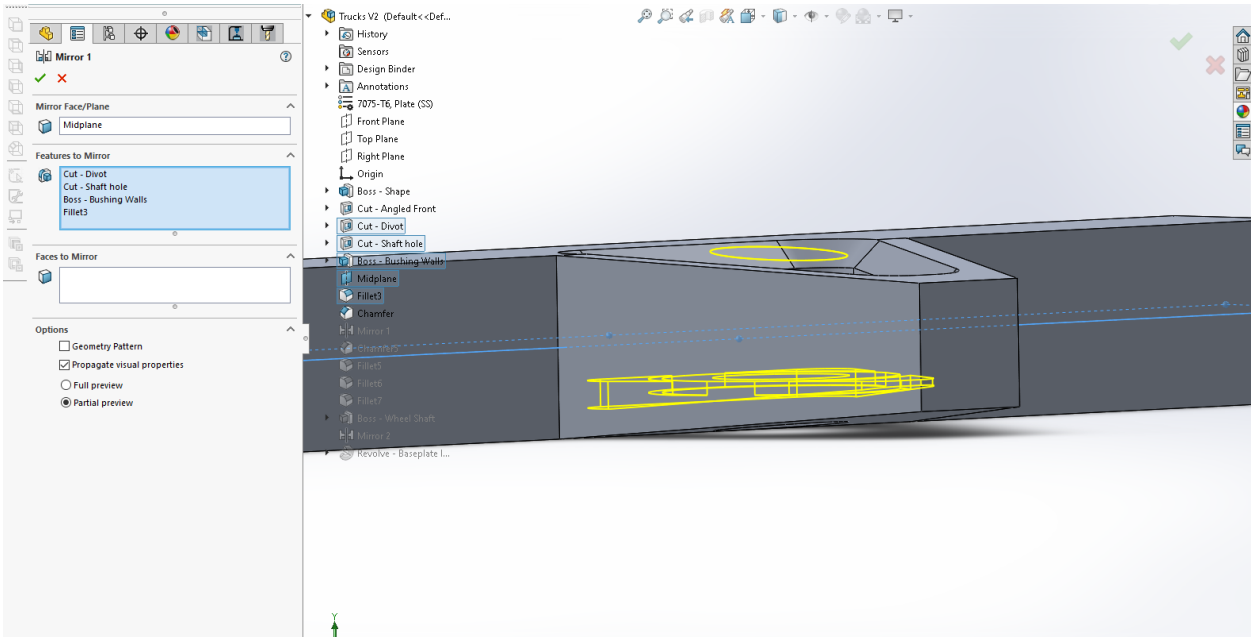
7. **Fillet 1**: Select these edges and fillet them, enter 4.00mm



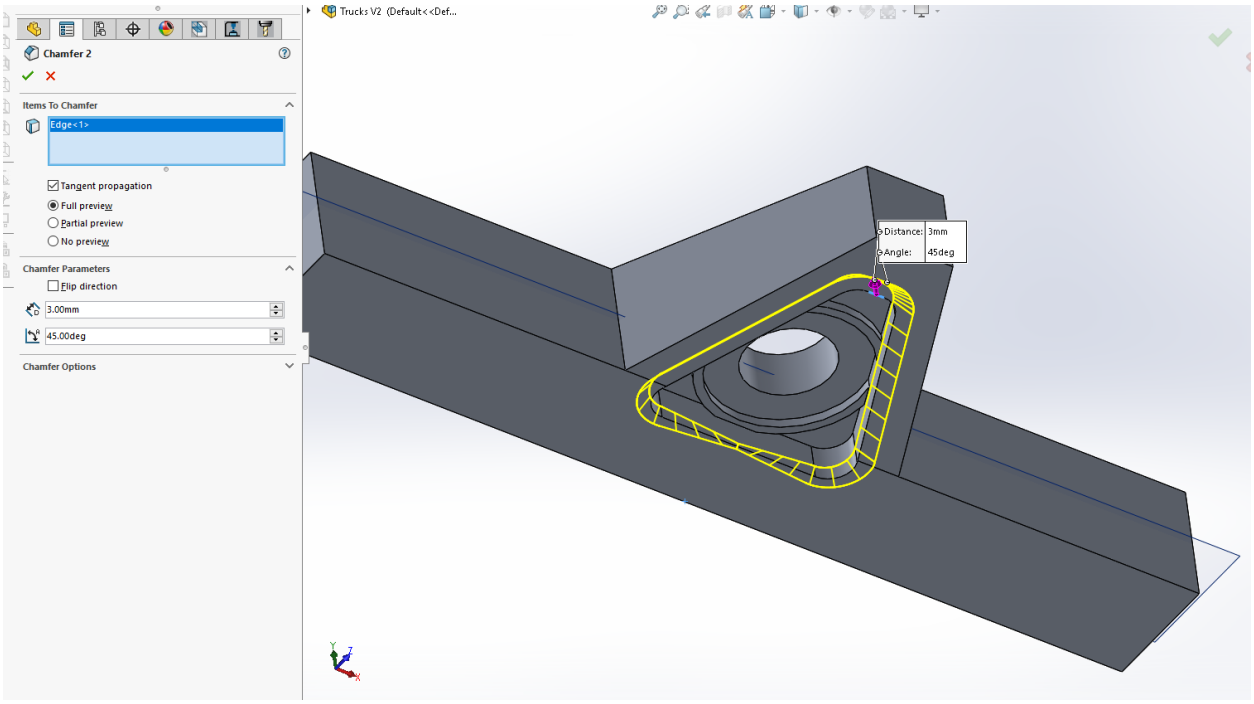
8. **Chamfer**: Select the surrounding edges of the divot and chamfer. Enter 3.00m @ 45 degrees



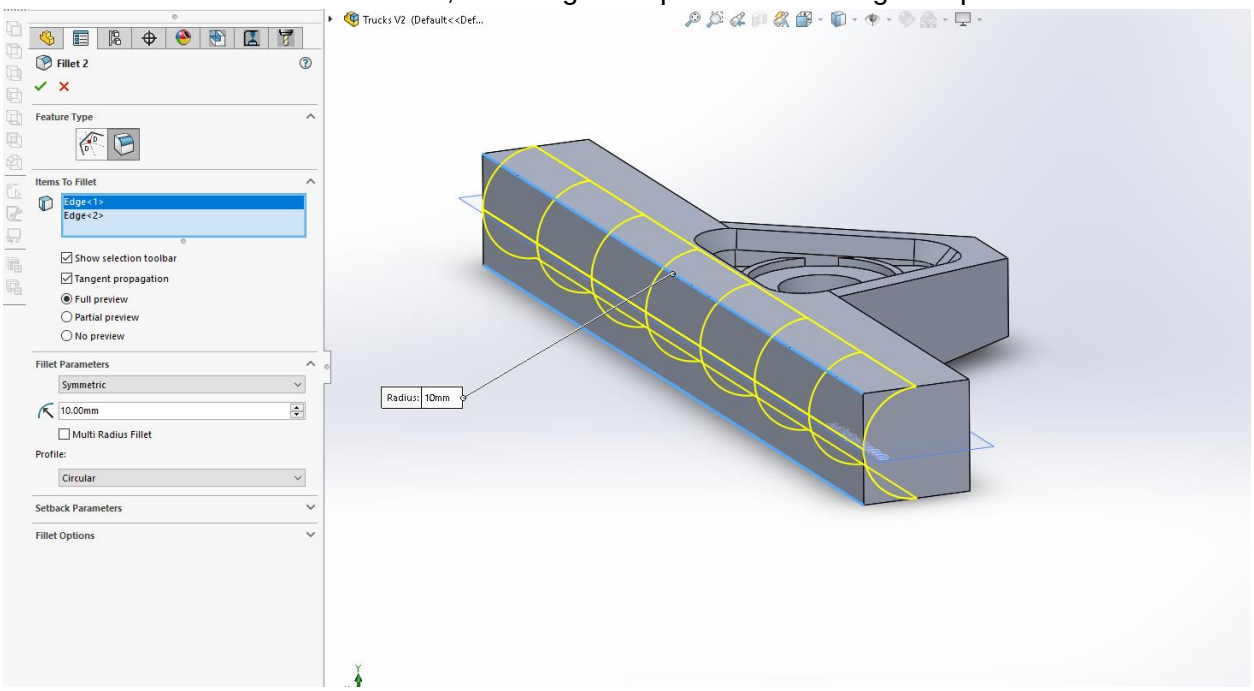
9. **Mirror 1:** Mirror the Divot, shaft Hole, Bushing Walls, and Fillet features across the midplane.



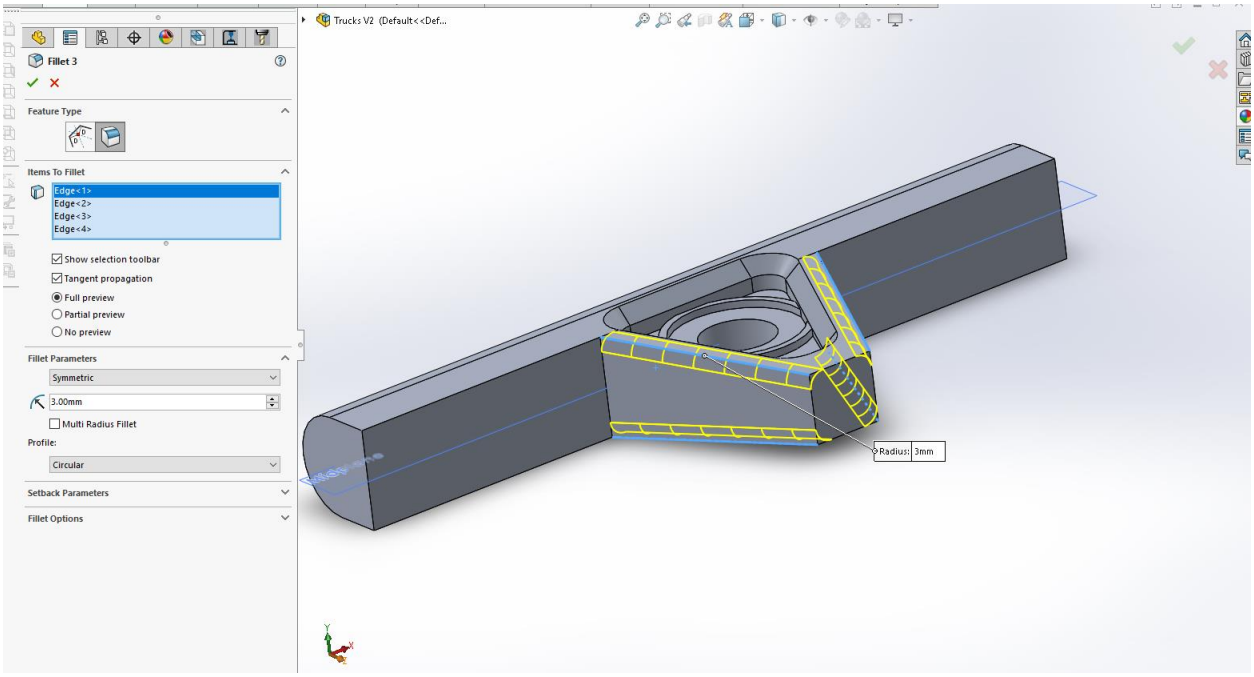
10. **Chamfer 2:** Perform a similar chamfer on the opposite mirrored edge.



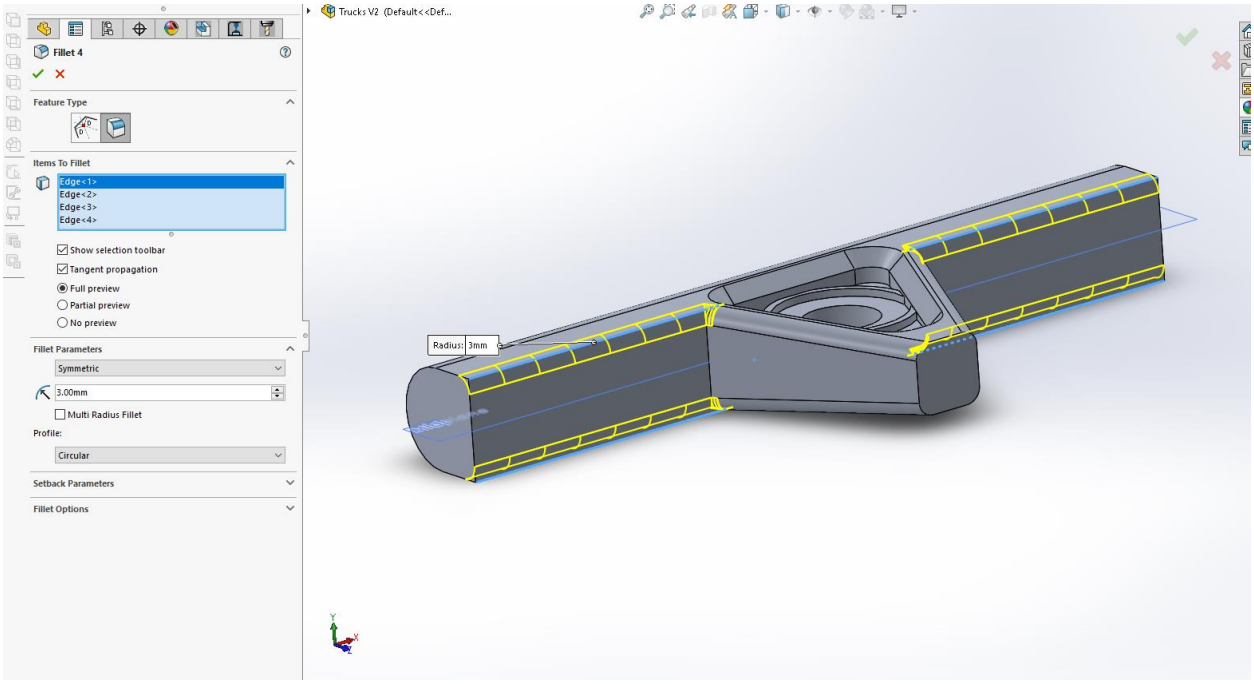
11. Fillet 2: Create a fillet on the back, selecting the top and bottom edges. Input 10.00mm.



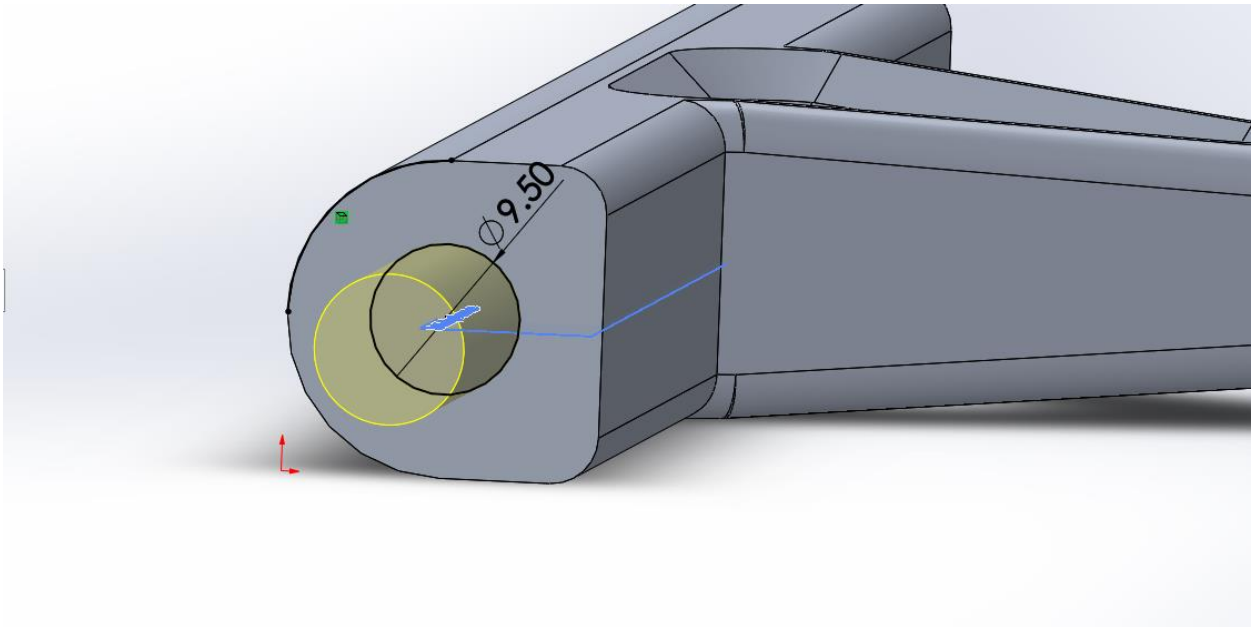
12. Fillet 3: Perform a fillet on the front nose of the trucks. Enter 3.00mm



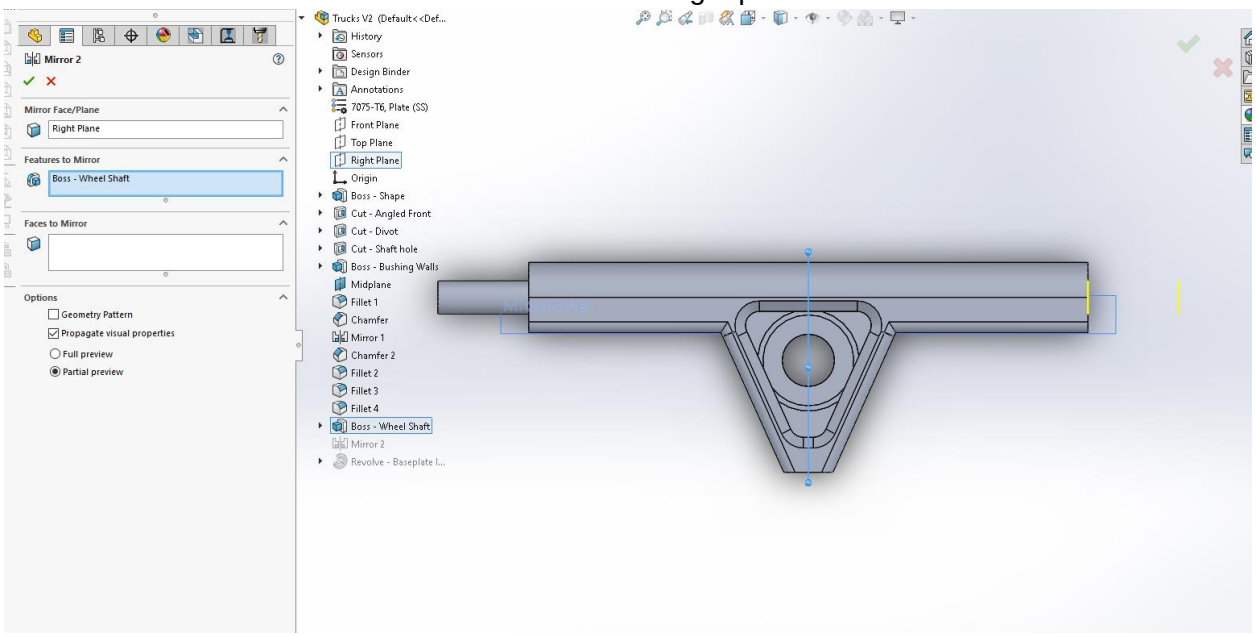
13. Fillet 4: Perform a fillet on the front edges. Enter 3.00mm



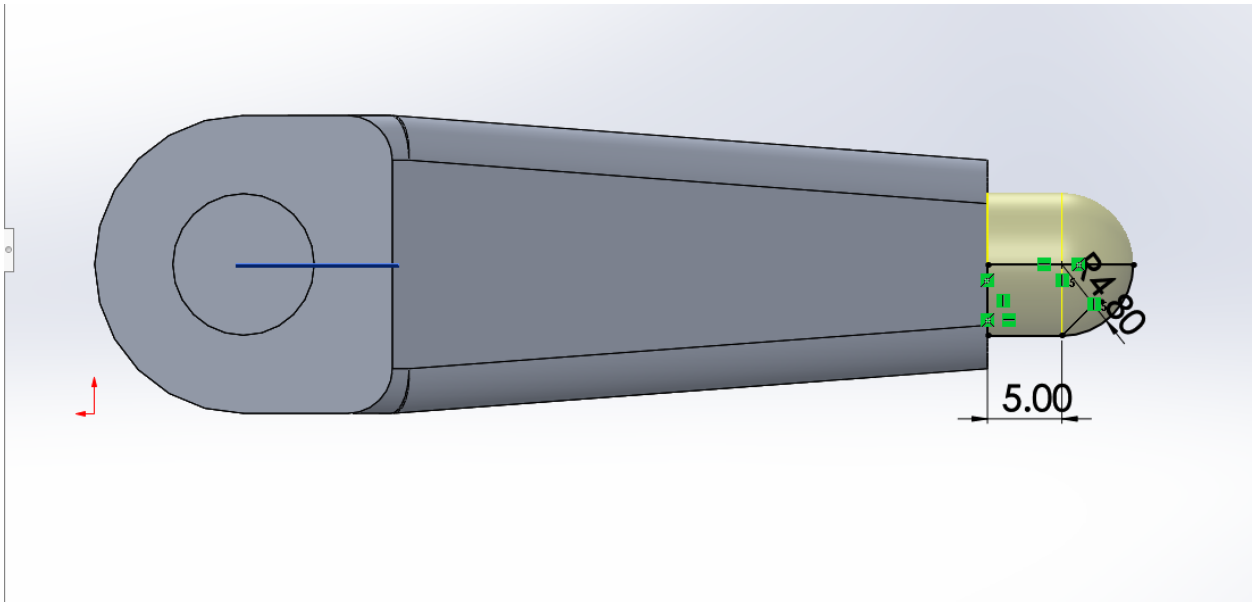
14. Boss – Wheel Shaft: Create sketch, concentric to the fillet, and extrude 9.50mm



15. Mirror 2: Mirror Boss – Wheel Shaft across the right plane



16. Revolve – Baseplate Insert: Create sketch below and perform a revolve



Design Binder

Design Journal

File Name: **Longboard Assembly.SLDASM**

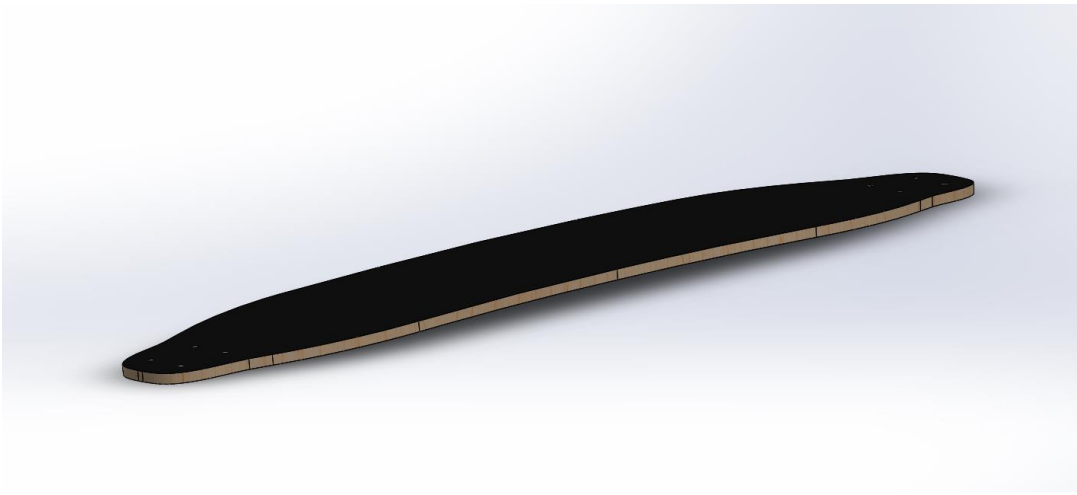
Description: **Longboard**

Material: **Poplar Wood, ABS, Polyurethane, 7075-T6 Plate (SS), Cast Carbon Steel**

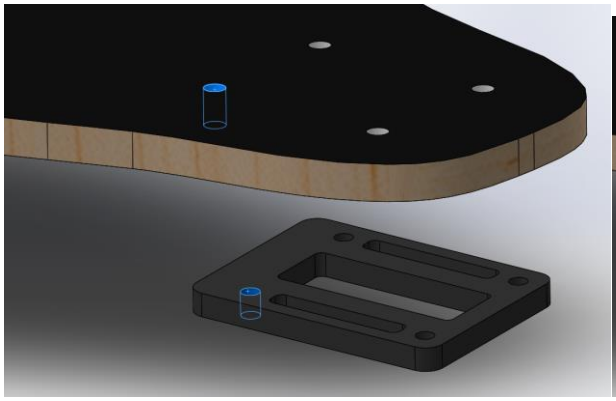
This longboard uses poplar wood for the deck to provide rigidity and flexibility when riding. The riser is made from ABS for a strong and simple part. Polyurethane is used in the bushings and wheels to provide a little bit of compression and cushioning. 7075-T6 Plate (SS) Aluminum Alloy is used in the trucks and baseplate for an extremely sturdy and rigid material for an important component of the assembly. The screw and nuts are made out of cast carbon steel. This product simply works by stepping on the board and allowing one self to roll smoothly forward while leaning one's weight to curve left or right.

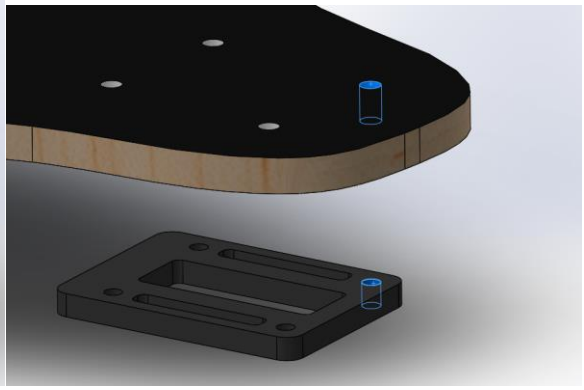
Assembly Instructions

1. **Insert Component**: Insert the deck into the assembly

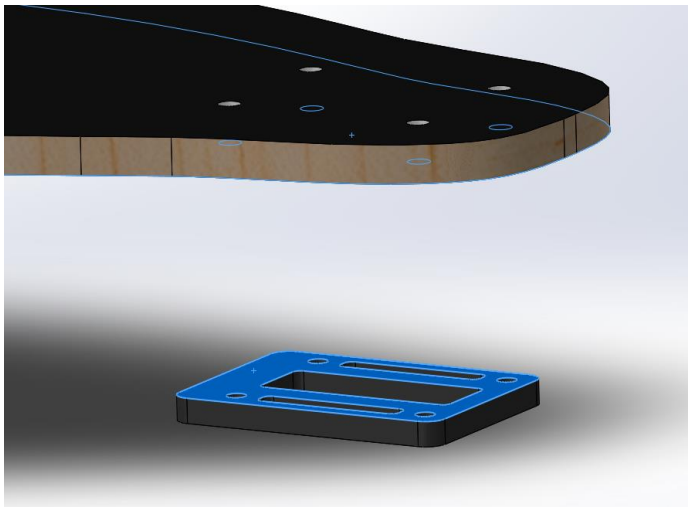


2. **Concentric mates**: Create concentric mates between the following faces of the **deck** and **riser**

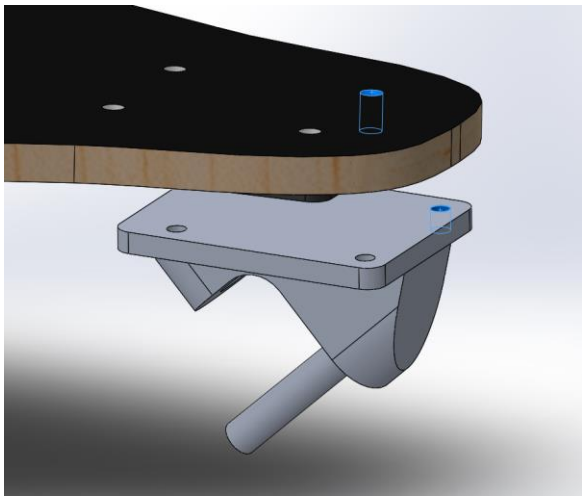


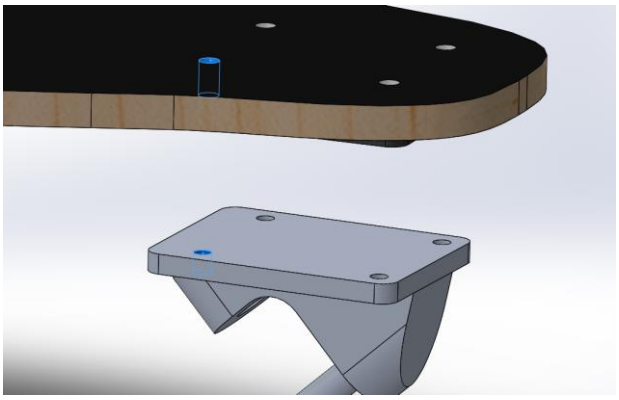


3. **Tangent Mate**: Create tangent mate between faces on the **deck** and **riser**

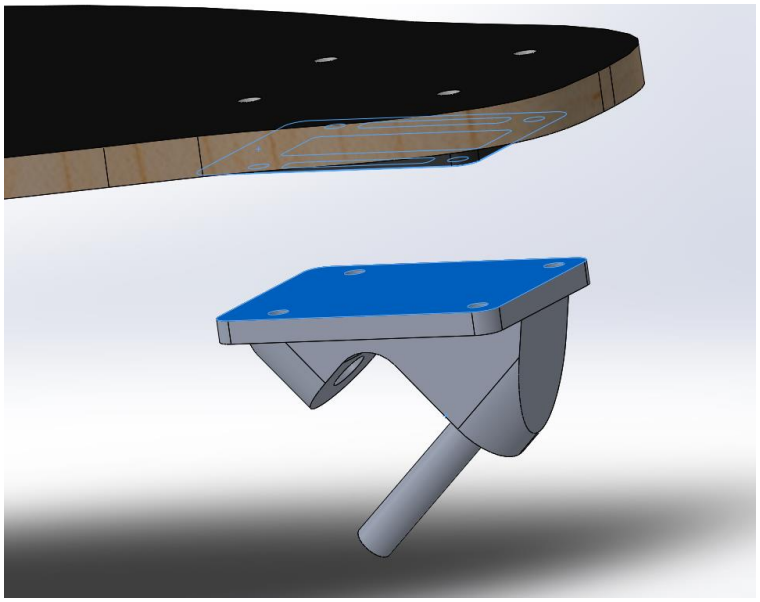


4. **Concentric mates**: Create concentric mates between the following faces of the **deck** and **baseplate**

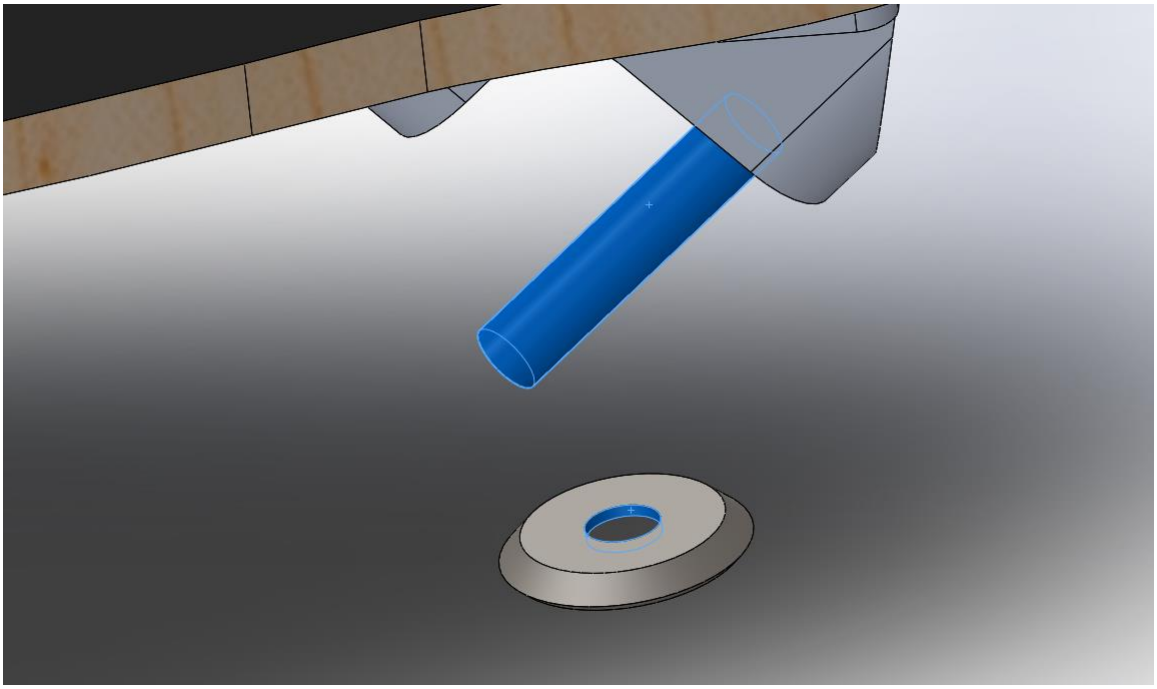




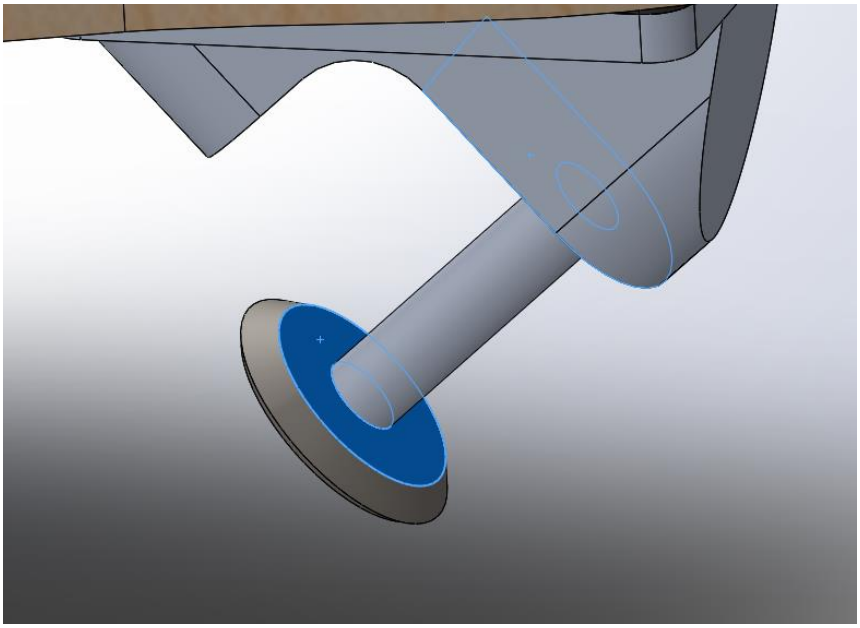
5. **Coincident mate**: Create coicident mate between following faces of the **riser** and **baseplate**



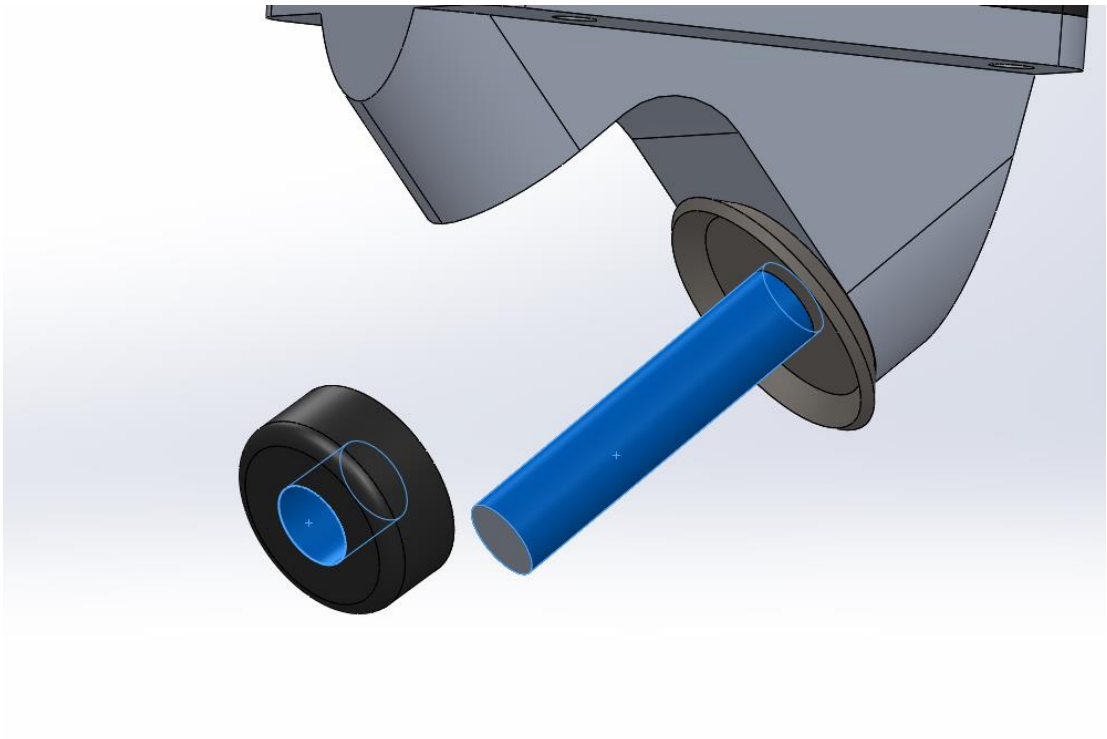
6. **Concentric mate**: Create concentric mate between the following faces of the **bushing cap** and the **baseplate.**



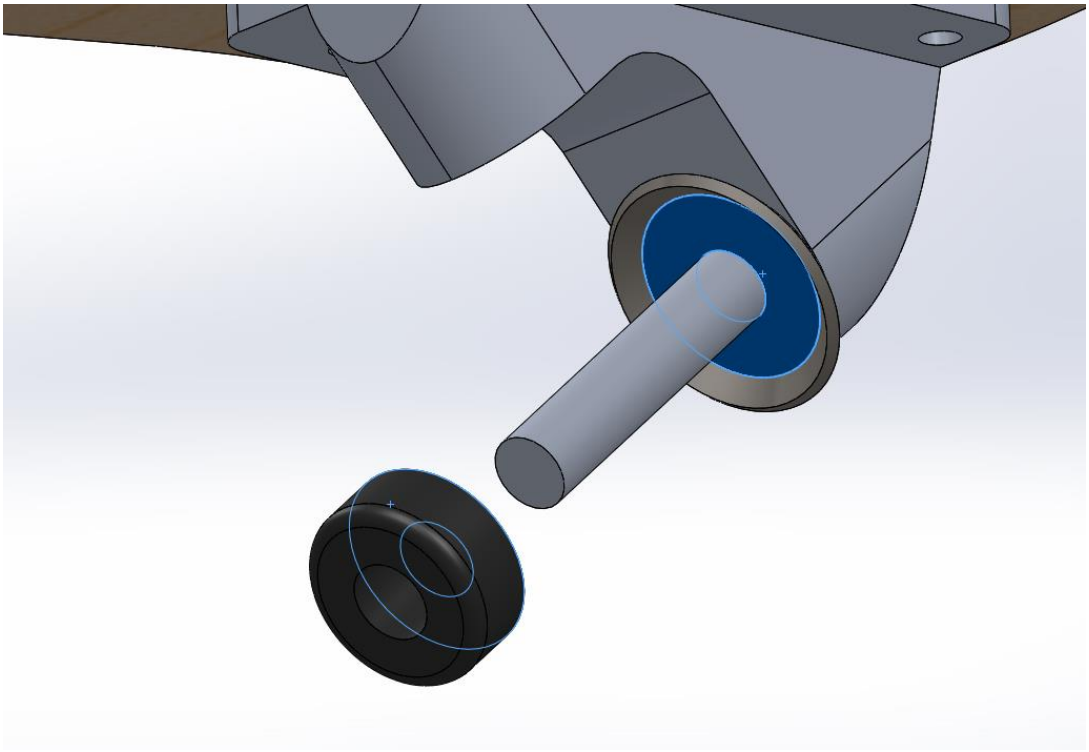
7. **Coincident mate**: Create coincident mate between the following faces of the **bushing cap** and the **baseplate.**



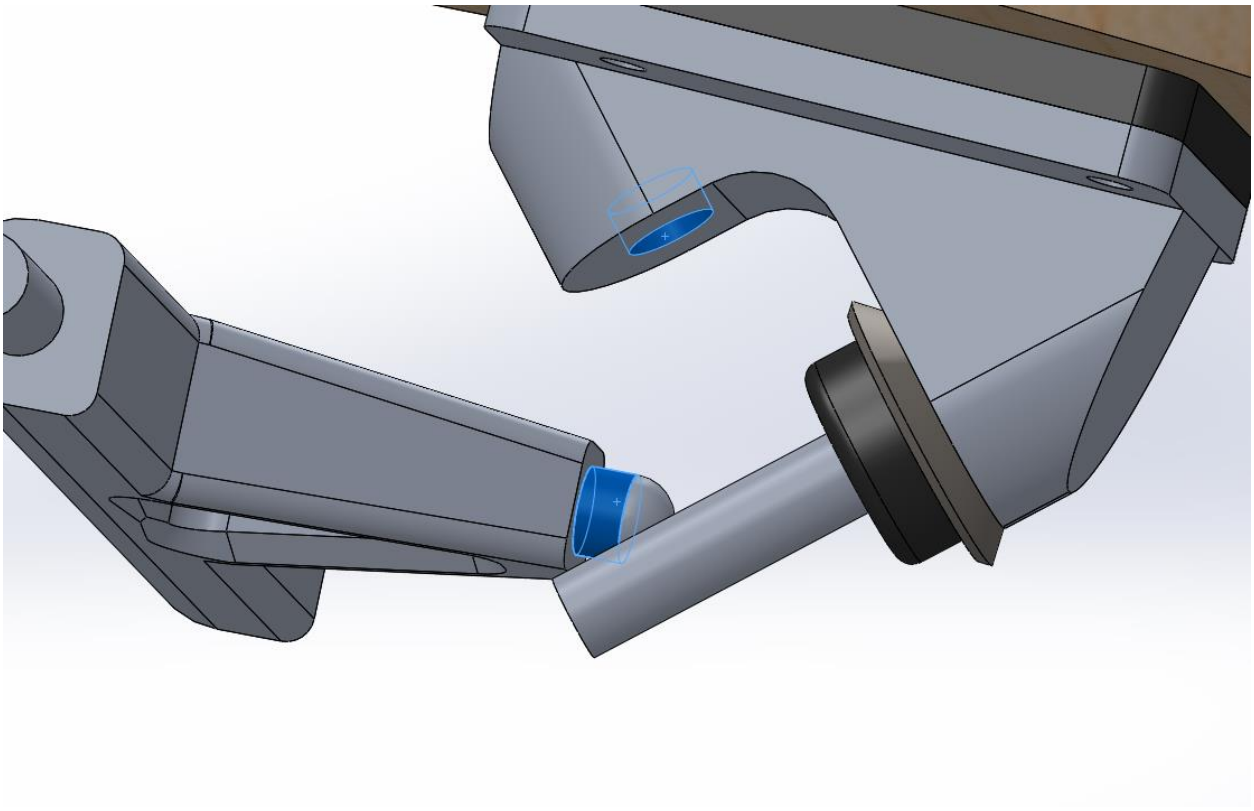
8. **Concentric mate**: Create concentric mate between the following faces on the **bushing cap** and **baseplate**



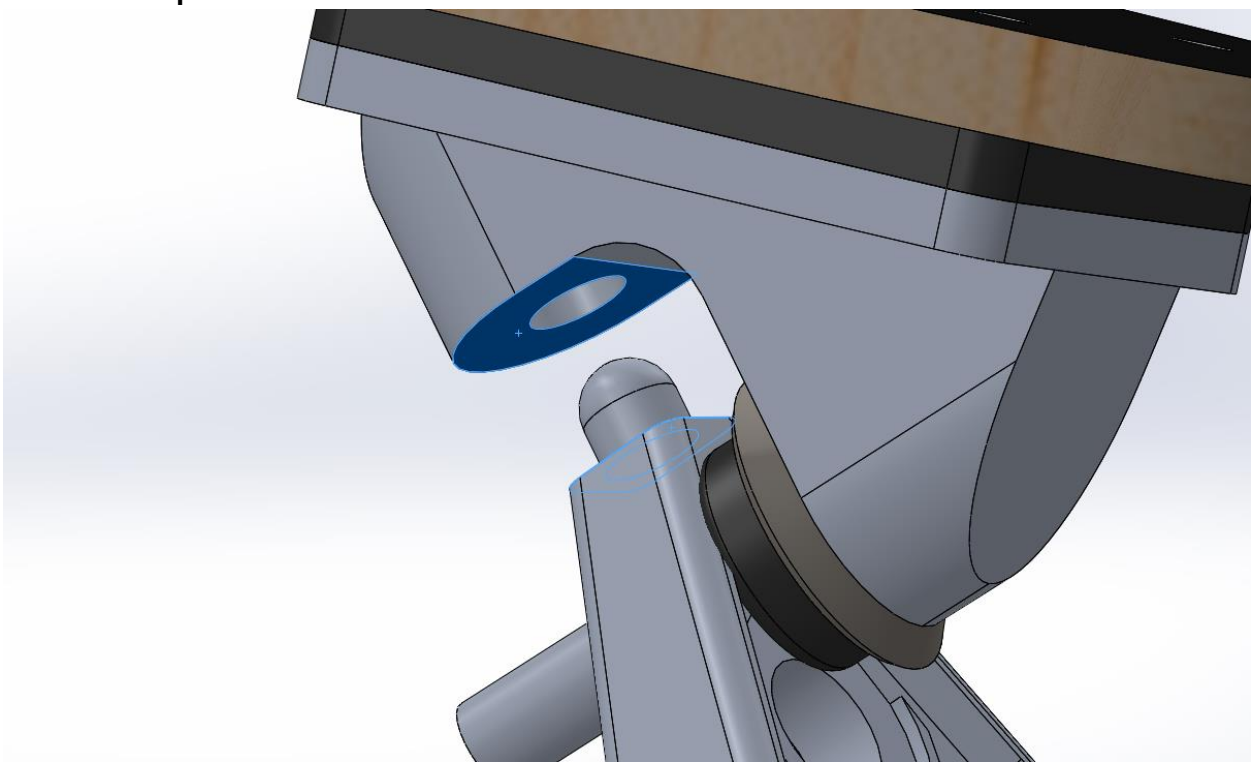
9. **Coincident mate**: Create coincident mate between the following faces on the **bushing cap** and **bushing**



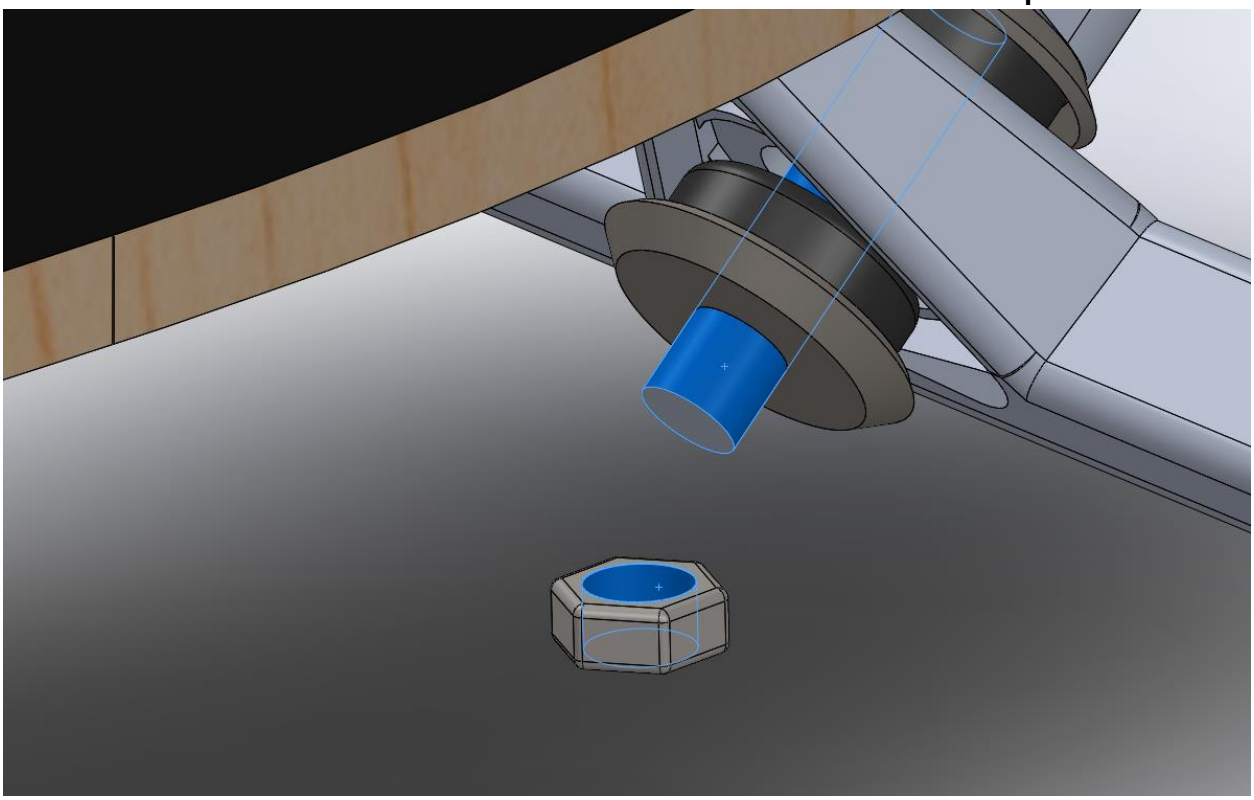
10. **Concentric mate**: Create concentric mate between the revolve on the **trucks** and the revolve on the **baseplate**



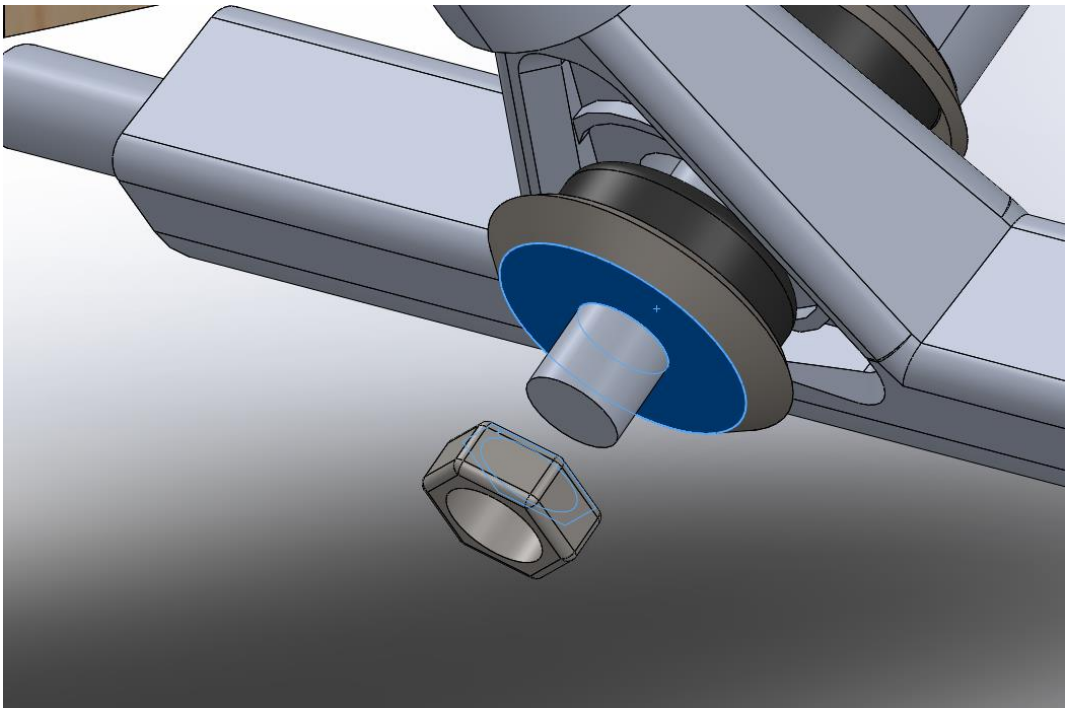
11. **Coincident mate**: Create coincident mate between the following faces on the **trucks** and the **baseplate**



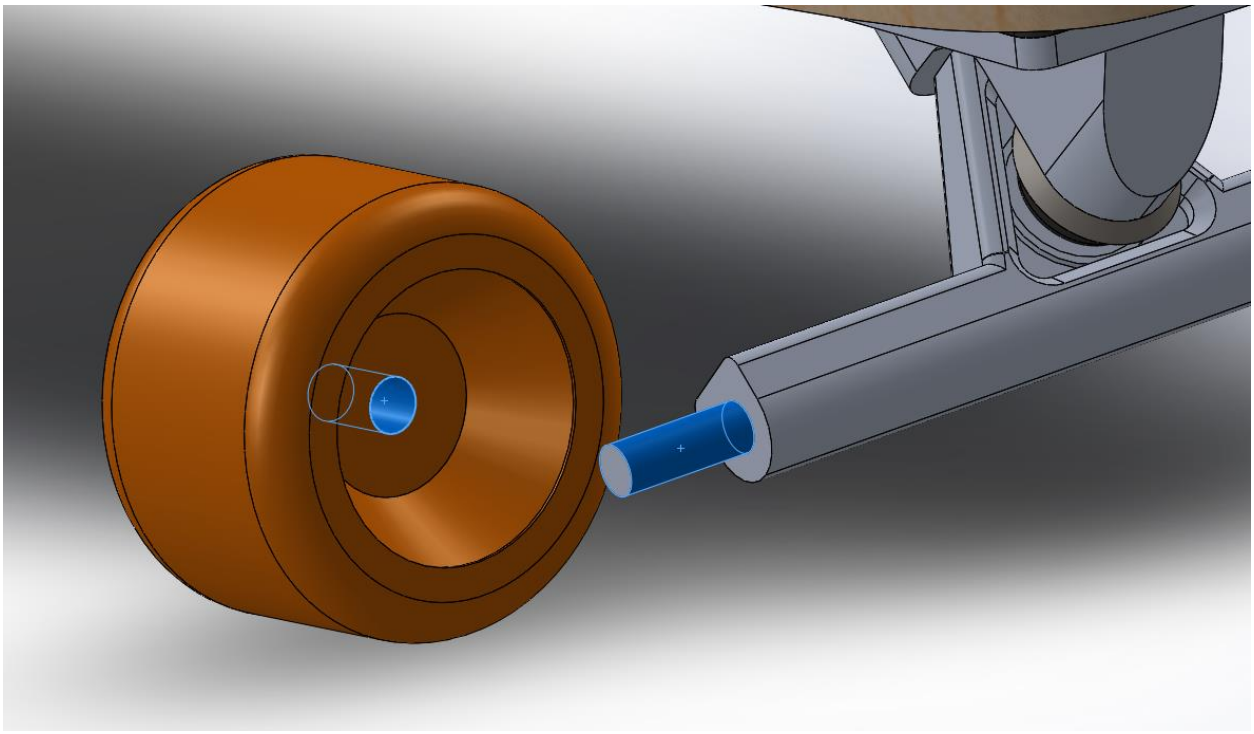
12. **Concentric mate**: Create concentric mate between the **Hex Nut** and the **Baseplate**



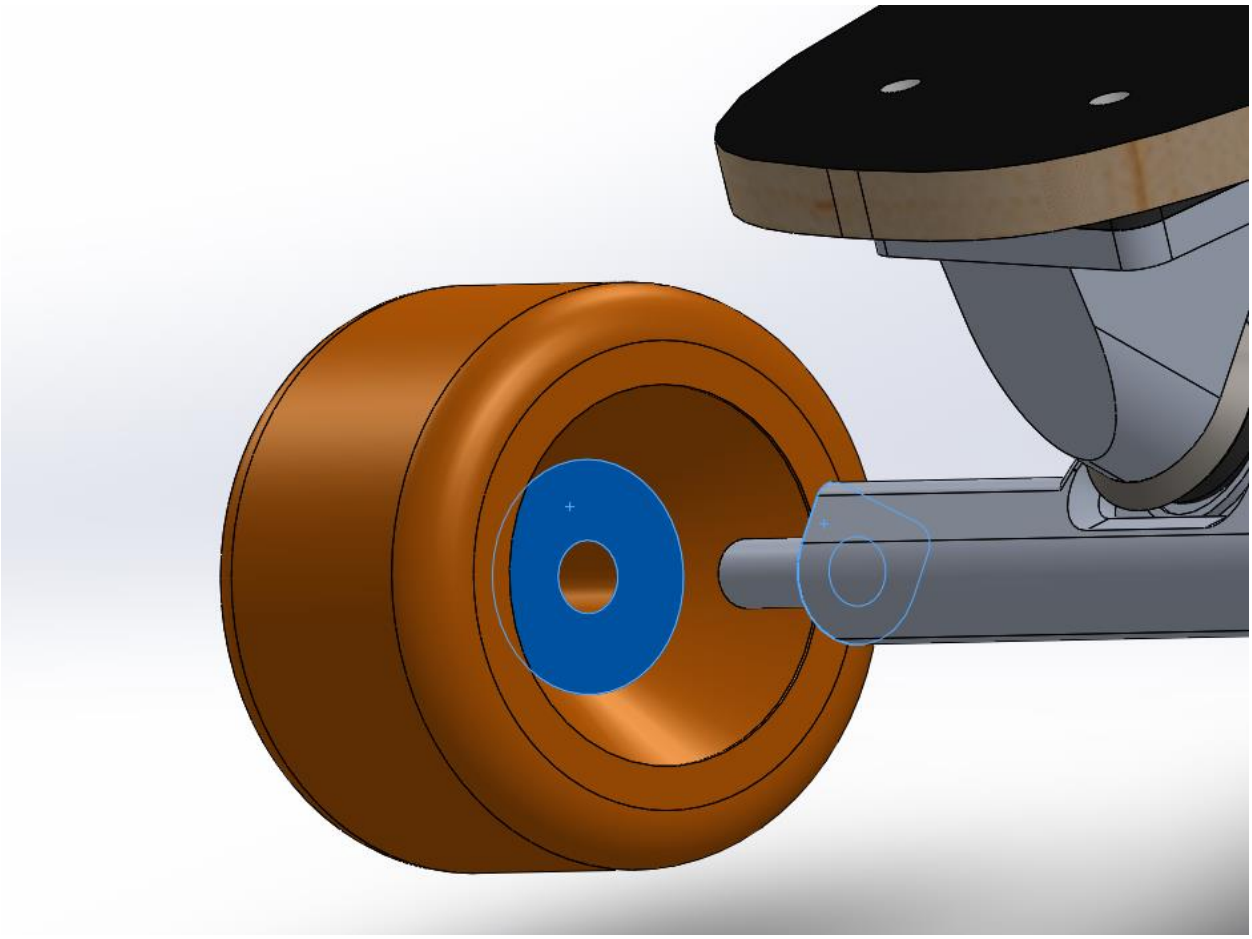
13. **Coincident mate**: Create coincident mate between following faces on the **Hex Nut** and **bushing cap**



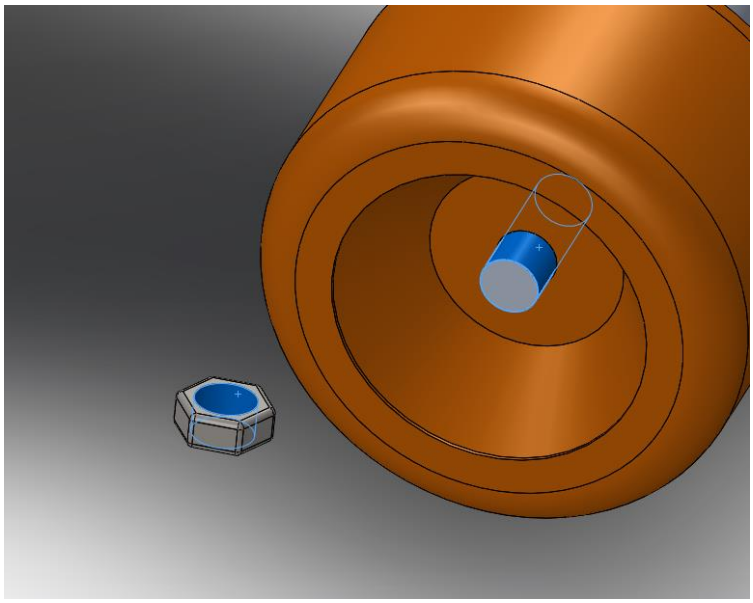
14. **Concentric mate**: Create concentric mate between the **wheel** and **trucks**



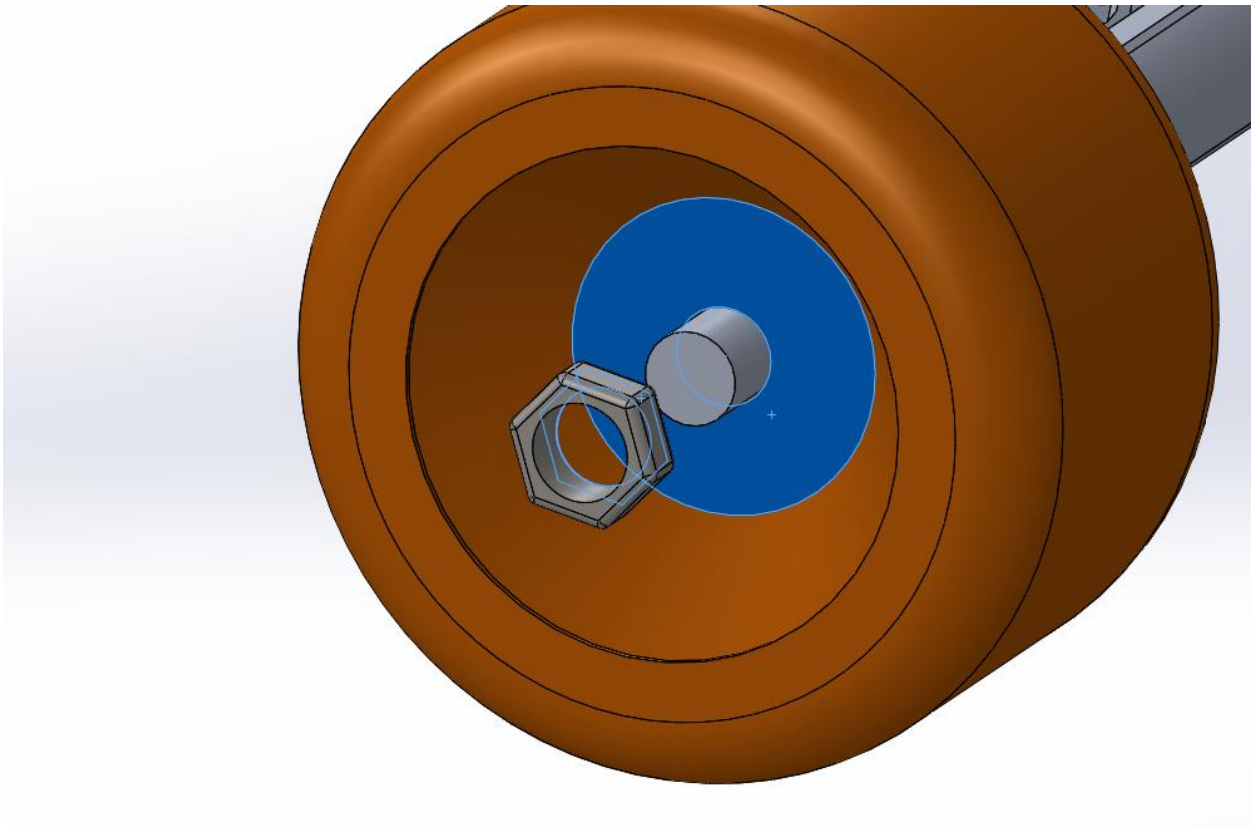
15. **Coincident mate**: Create coincident mate between the following faces on the **wheel** and **trucks**



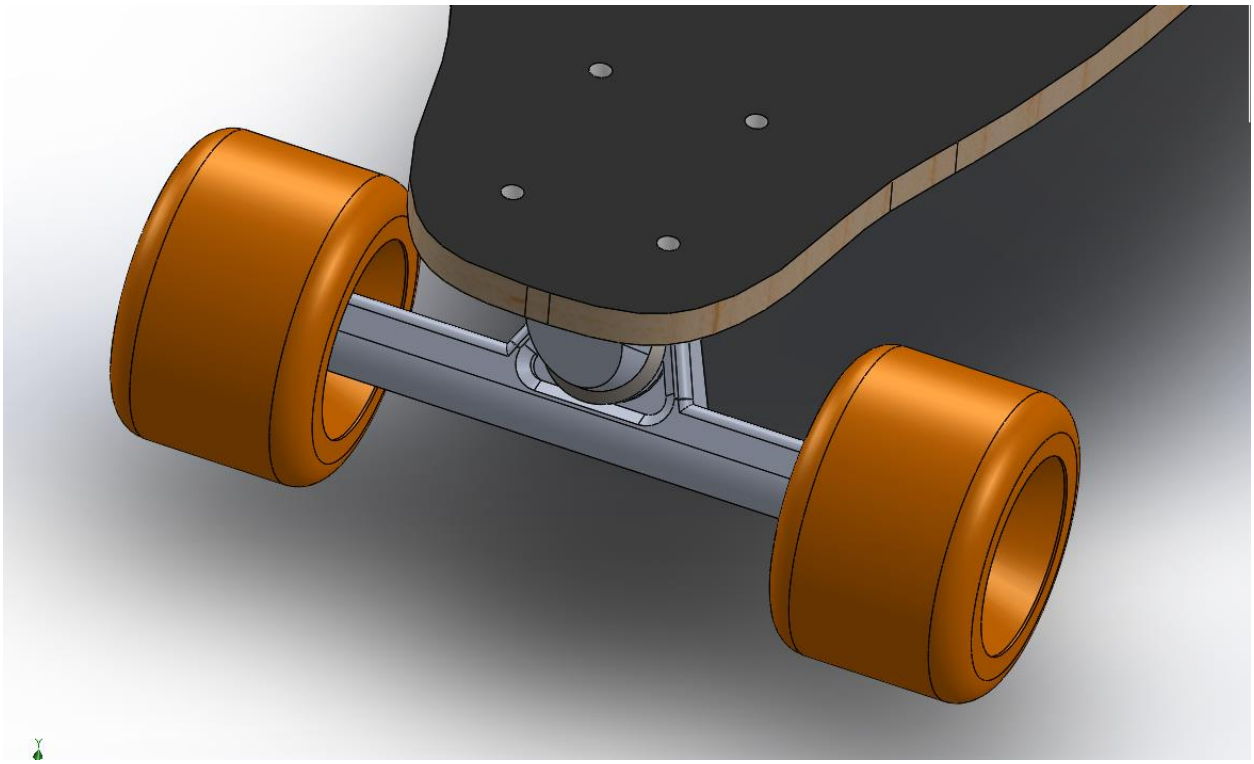
16. **Concentric mate**: Create concentric mate between the **Hex Nut** and **Trucks**



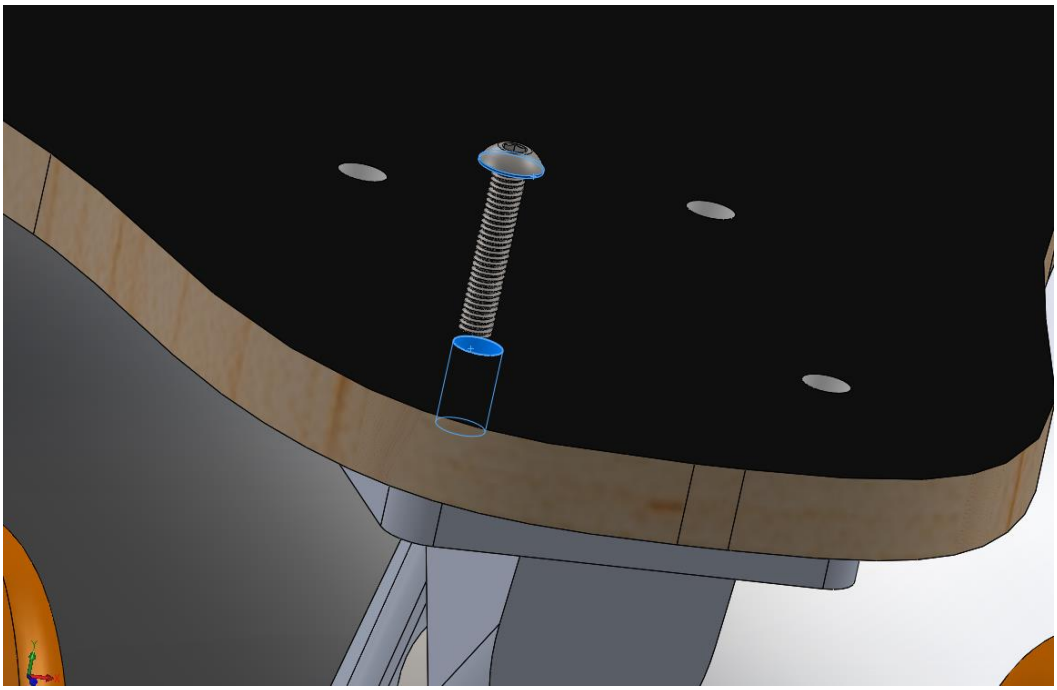
17. **Coincident mate**: Create coincident mate between the following faces on the **wheel** and **hex nut**



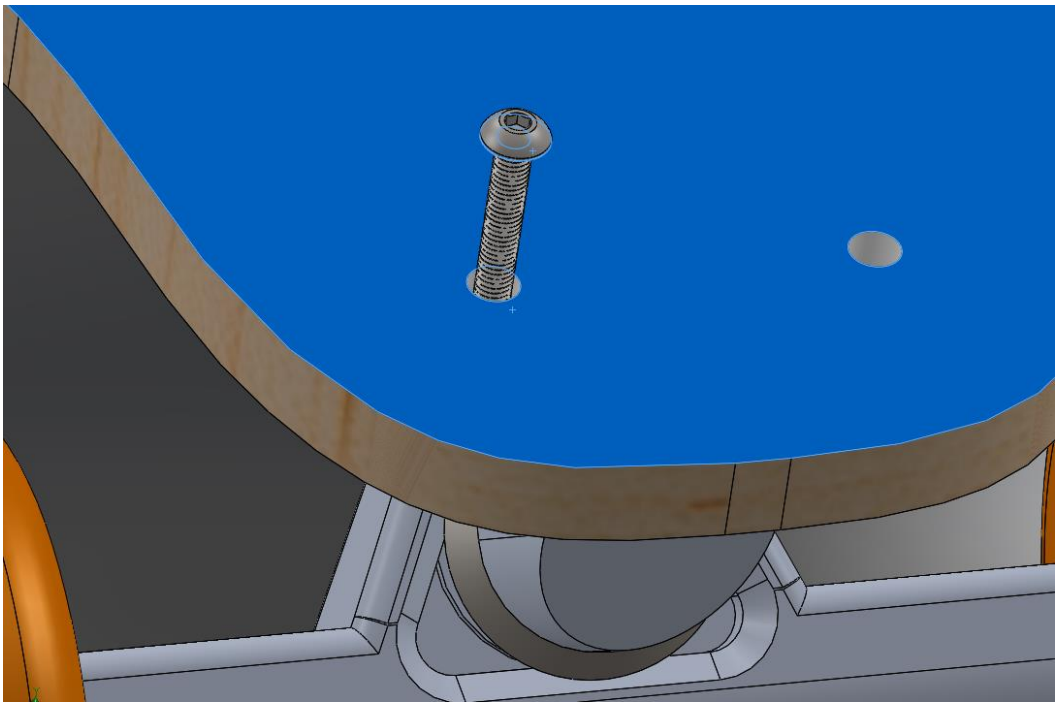
18. Repeat: Repeat the steps to mate the wheel on the other side of the truck.



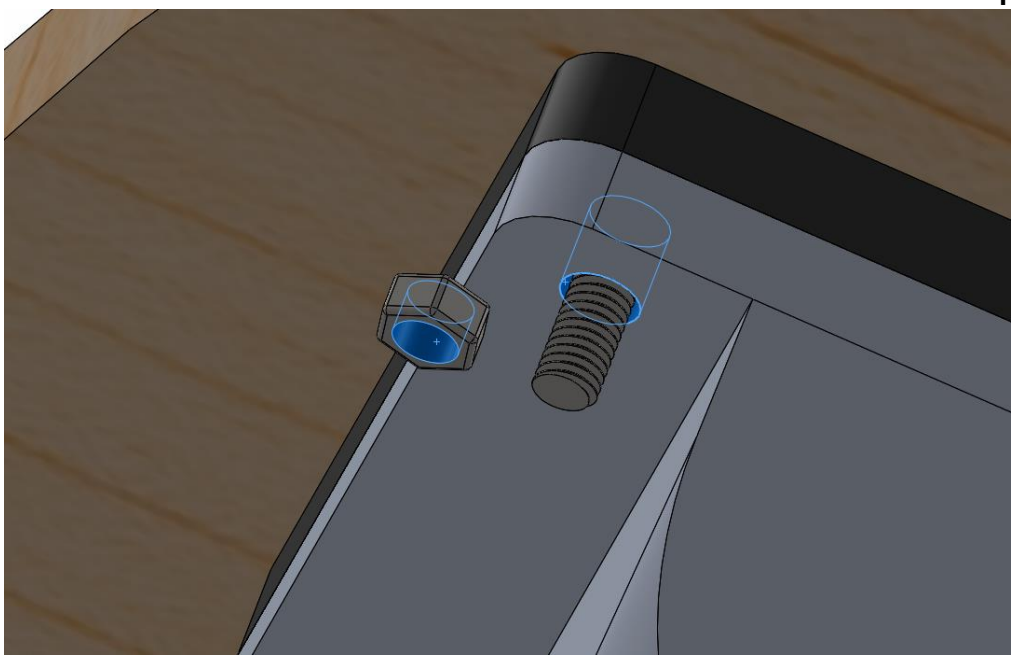
19. **Concentric mate**: Create a concentric mate between the **Screw** and the **Deck**



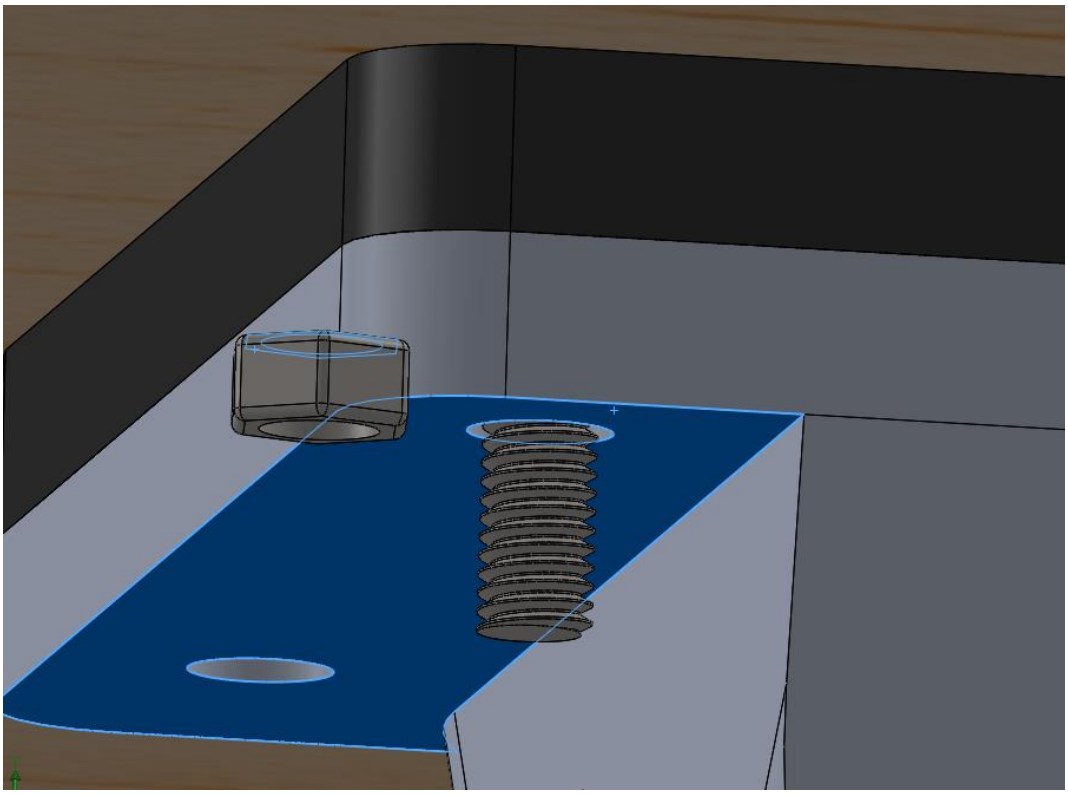
20. **Tangent Mate:** Create a tangent mate on the following faces between the **screw** and the **deck**



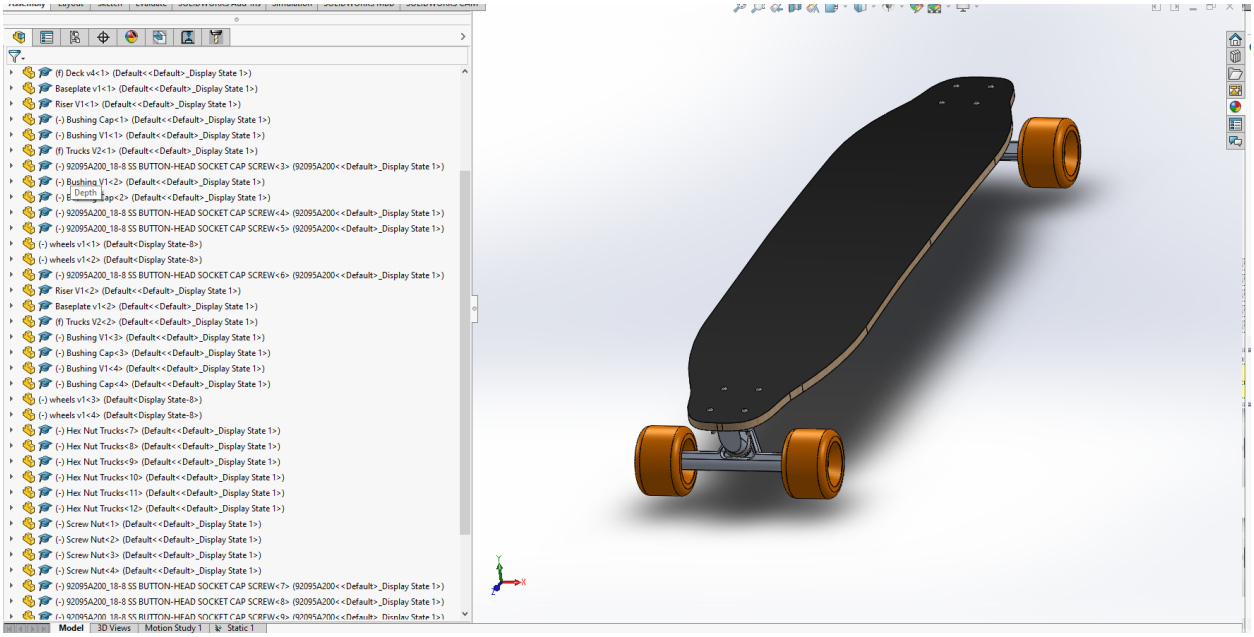
21. Concentric Mate: Create a concentric mate between the **screw nut** and **baseplate**



22. Coincident Mate: Create a coincident mate between the **screw but** and **baseplate**



23. Repeat: Repeat steps 2-22 on the other end of the longboard.

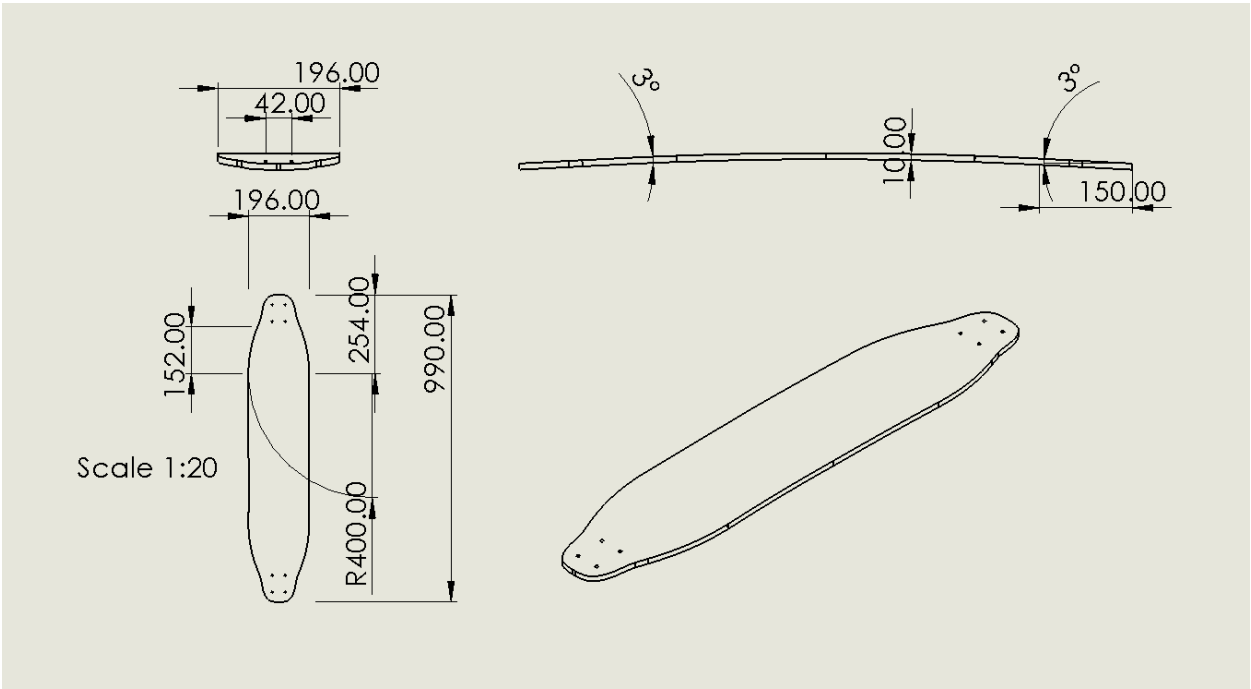


24. Lights: Display Manager Icon → View Scenes, Lights, Camera Icon → Right click lights to add light

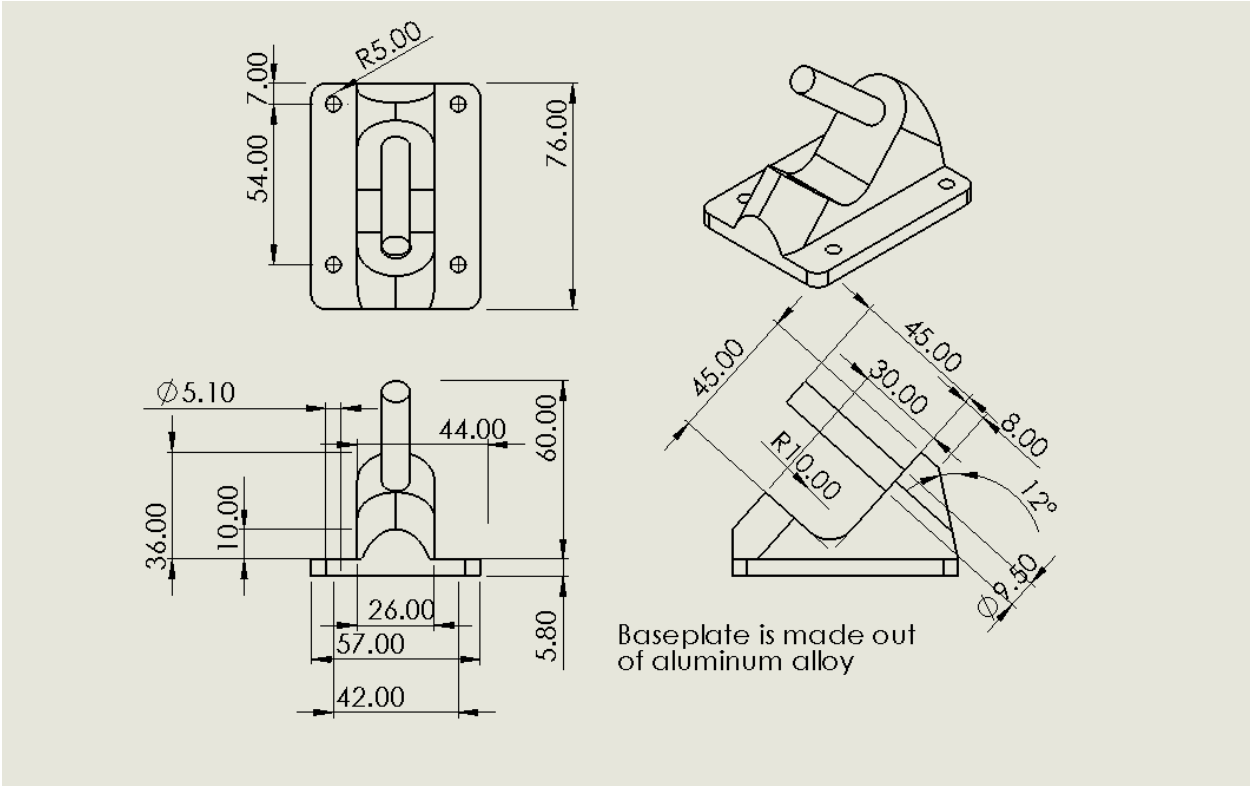
25. Scenes: Scenes, Lights, Camera Icon → Right click Scenes to edit scene.

Engineering Drawings

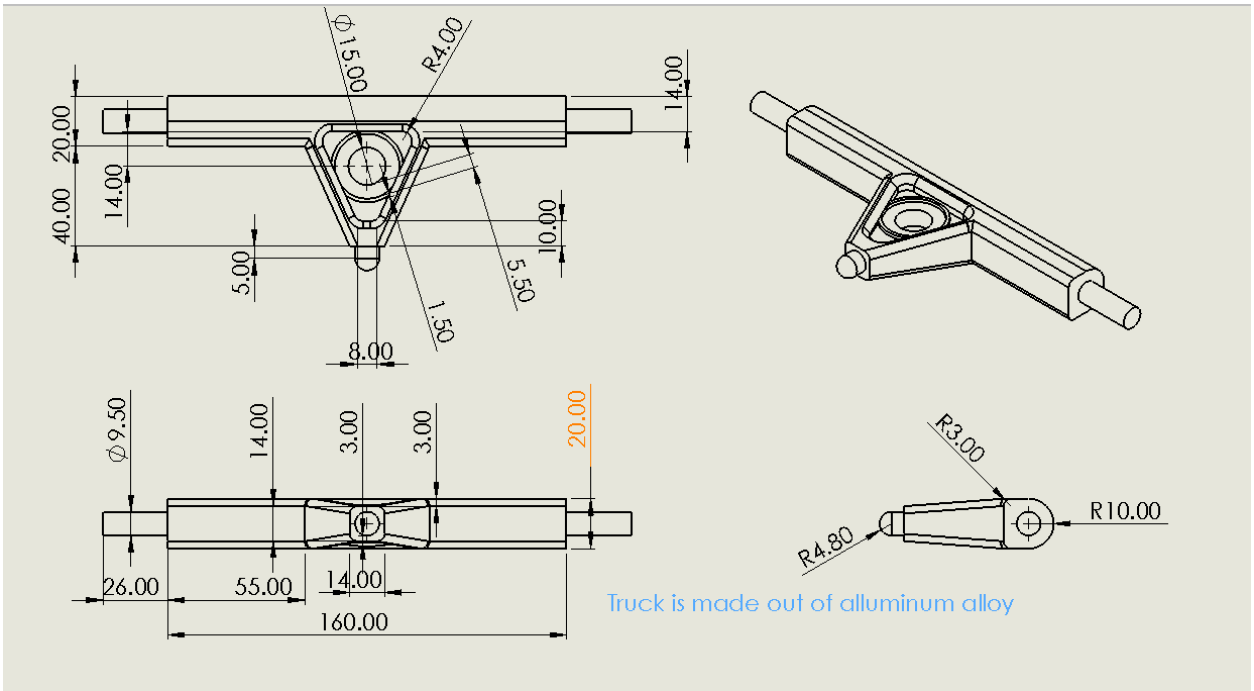
Deck Drawing



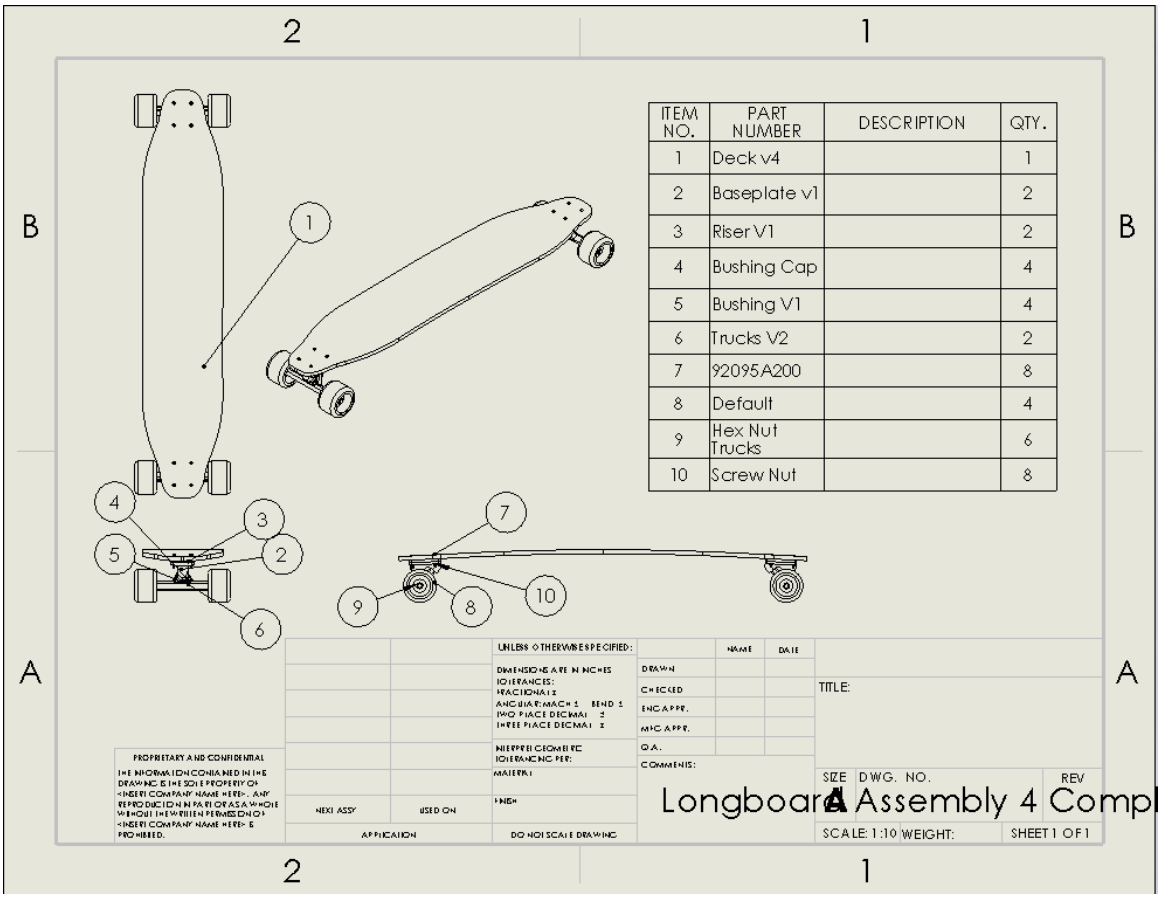
Baseplate Drawing



Trucks Drawing



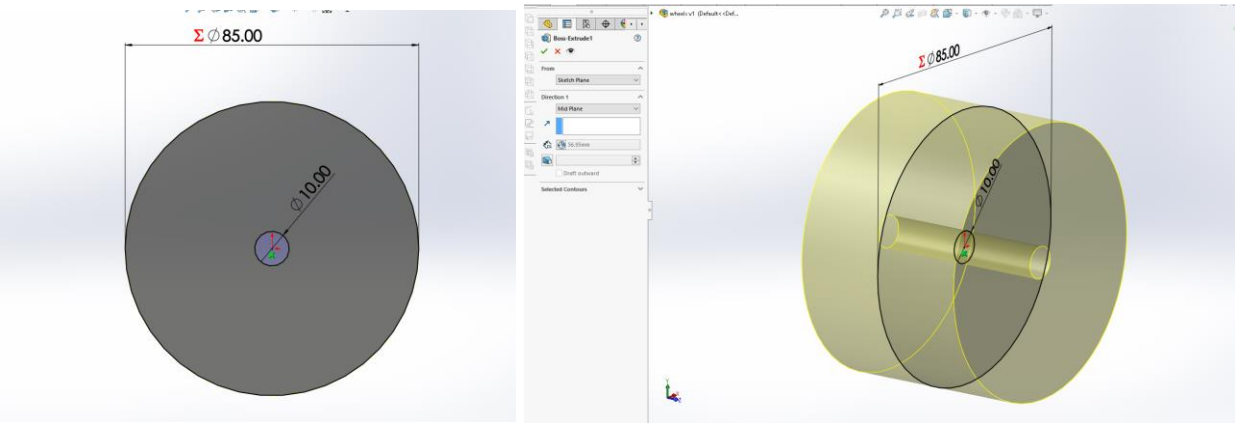
Assembly Drawing



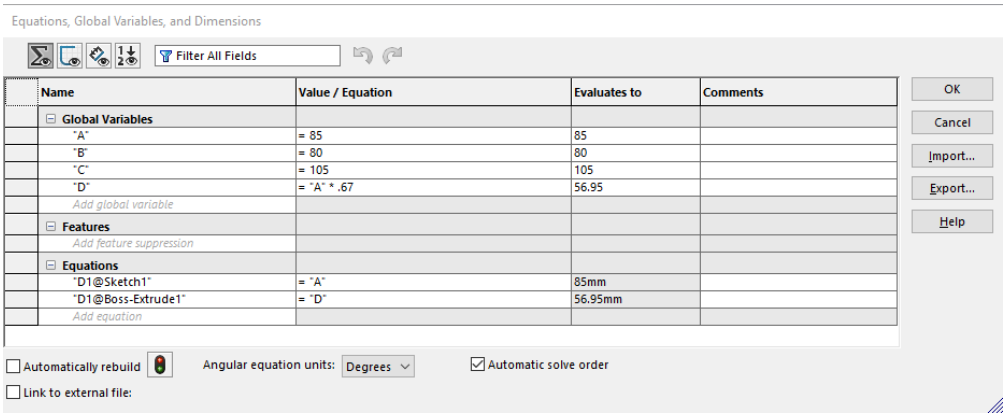
Design Intent & Part Configuration Analysis

Equation

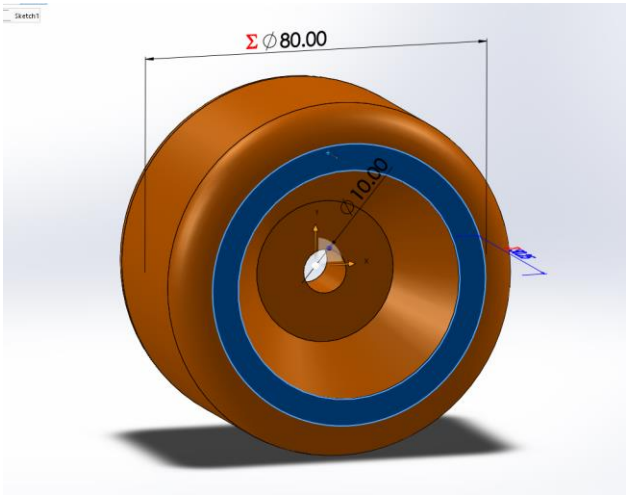
An equation was added to **Wheel**, relating the following dimensions:



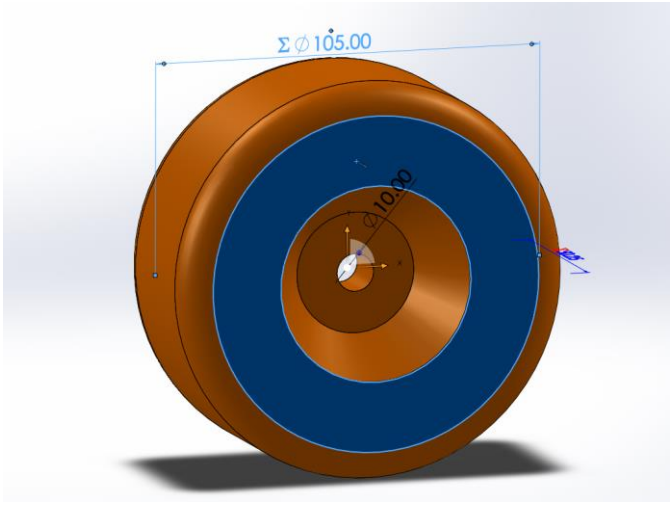
Equation table:



B = 80mm



C = 105mm

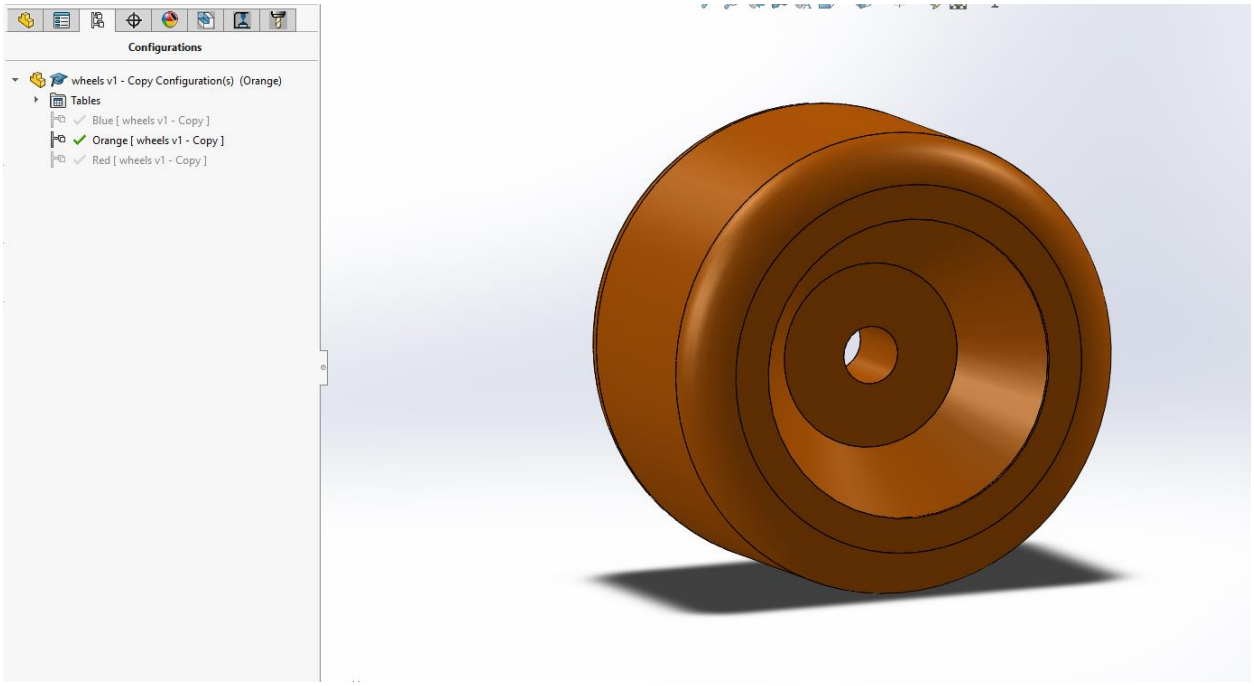


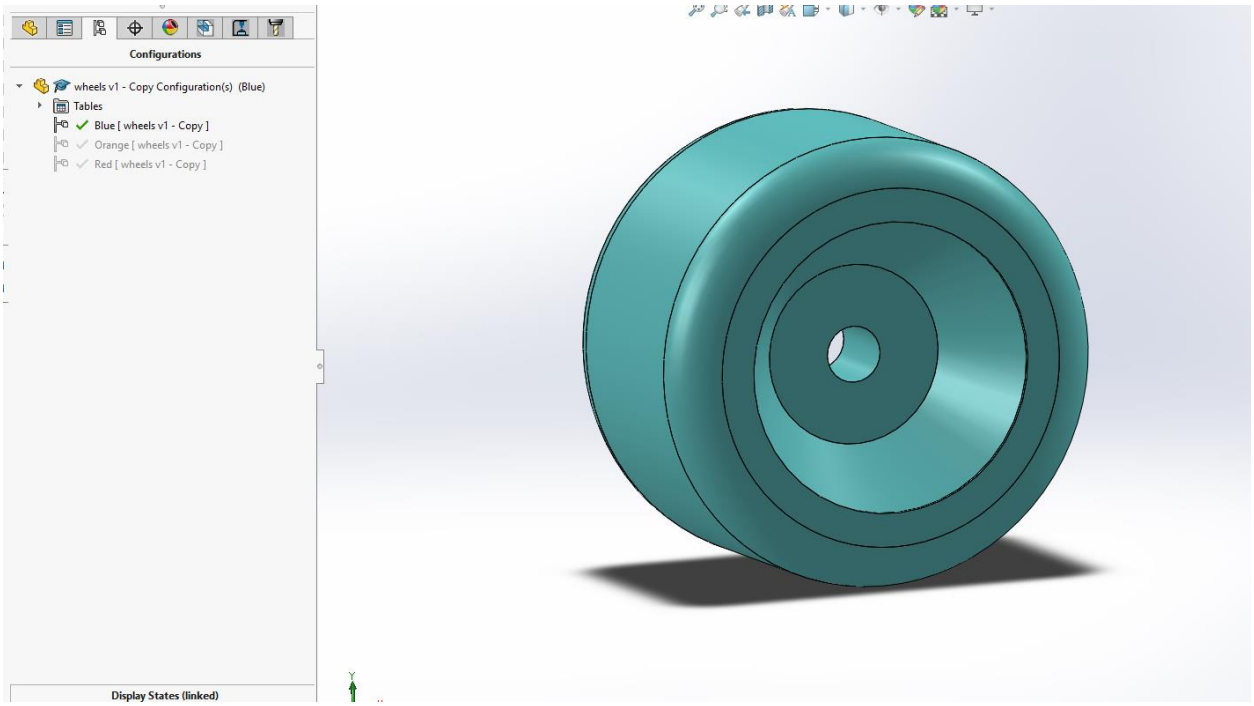
Configuration

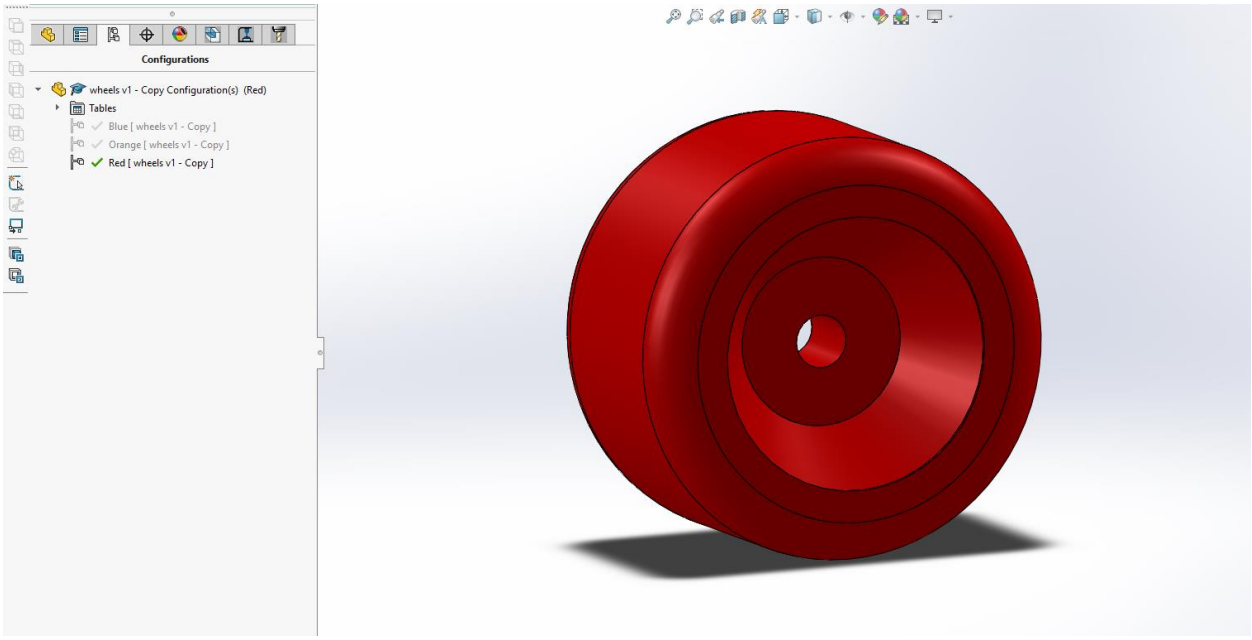
2 configurations were added to the **Wheel**, the original being a colored orange, one colored blue, one colored red

Design Table

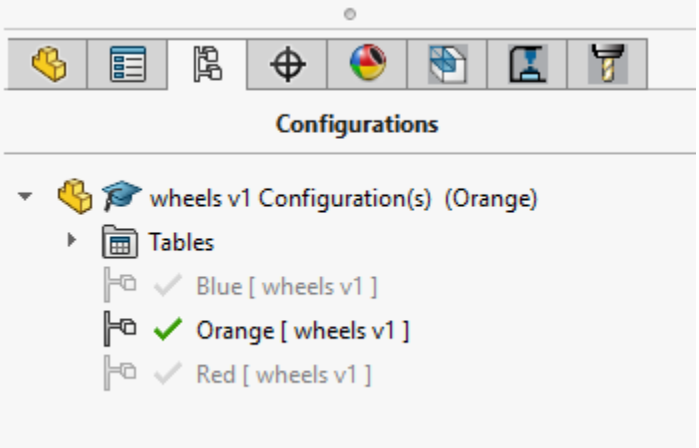
Design Table for: wheels v1				
	$DESCRIPTION	$COLOR	$VALUE@A@Equations	$VALUE@C@Equations
Default	Default	33535	=85	=10
105mm	105mm	33234	=105	=10
80mm	80mm	35347	=80	=10


Configurations
wheels v1 - Copy Configuration(s) (Orange)
Tables
Blue [wheels v1 - Copy]
Orange [wheels v1 - Copy]
Red [wheels v1 - Copy]


Configurations
wheels v1 - Copy Configuration(s) (Blue)
Tables
Blue [wheels v1 - Copy]
Orange [wheels v1 - Copy]
Red [wheels v1 - Copy]
Display States (linked)



Configuration Manager

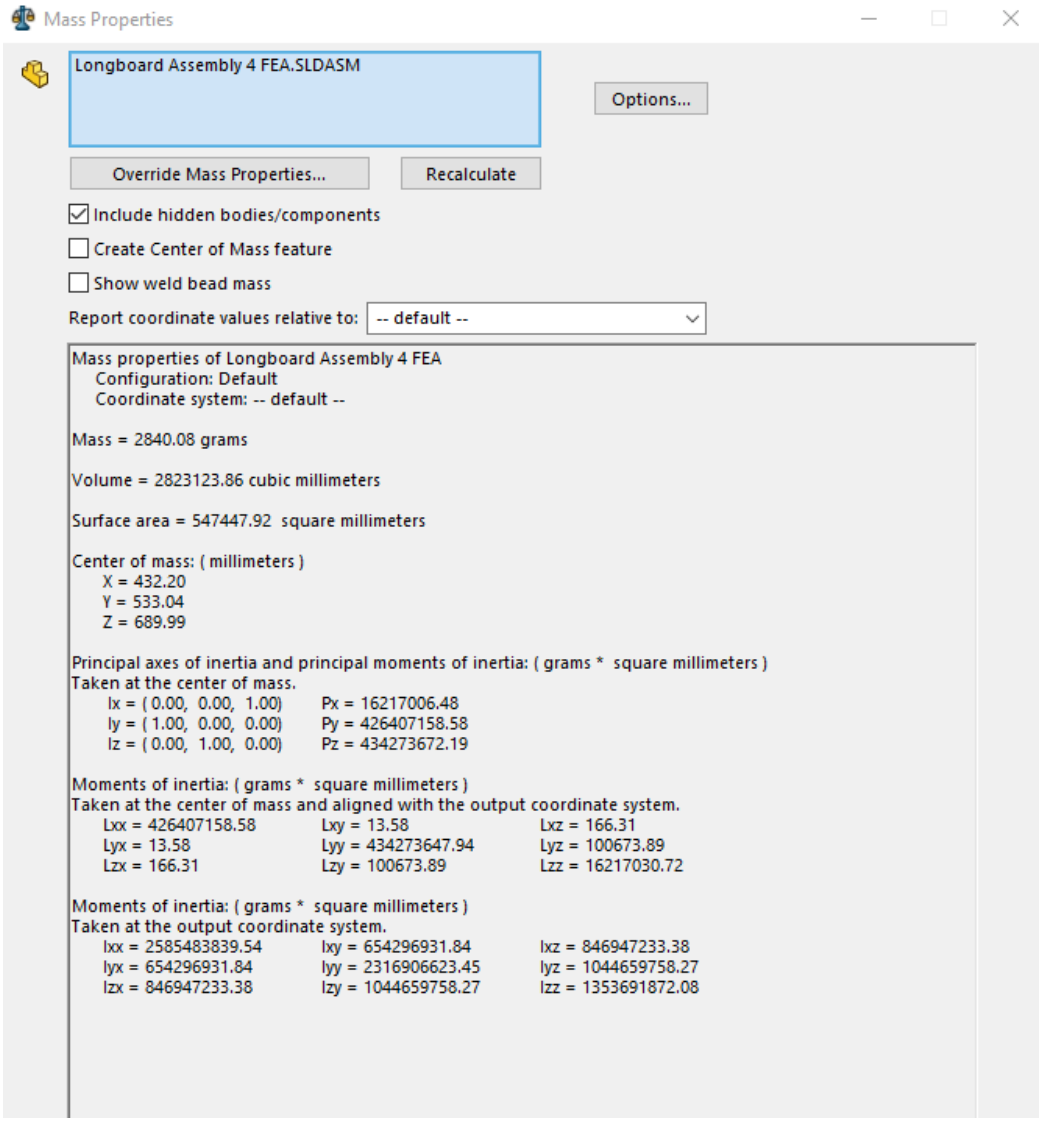


STL File

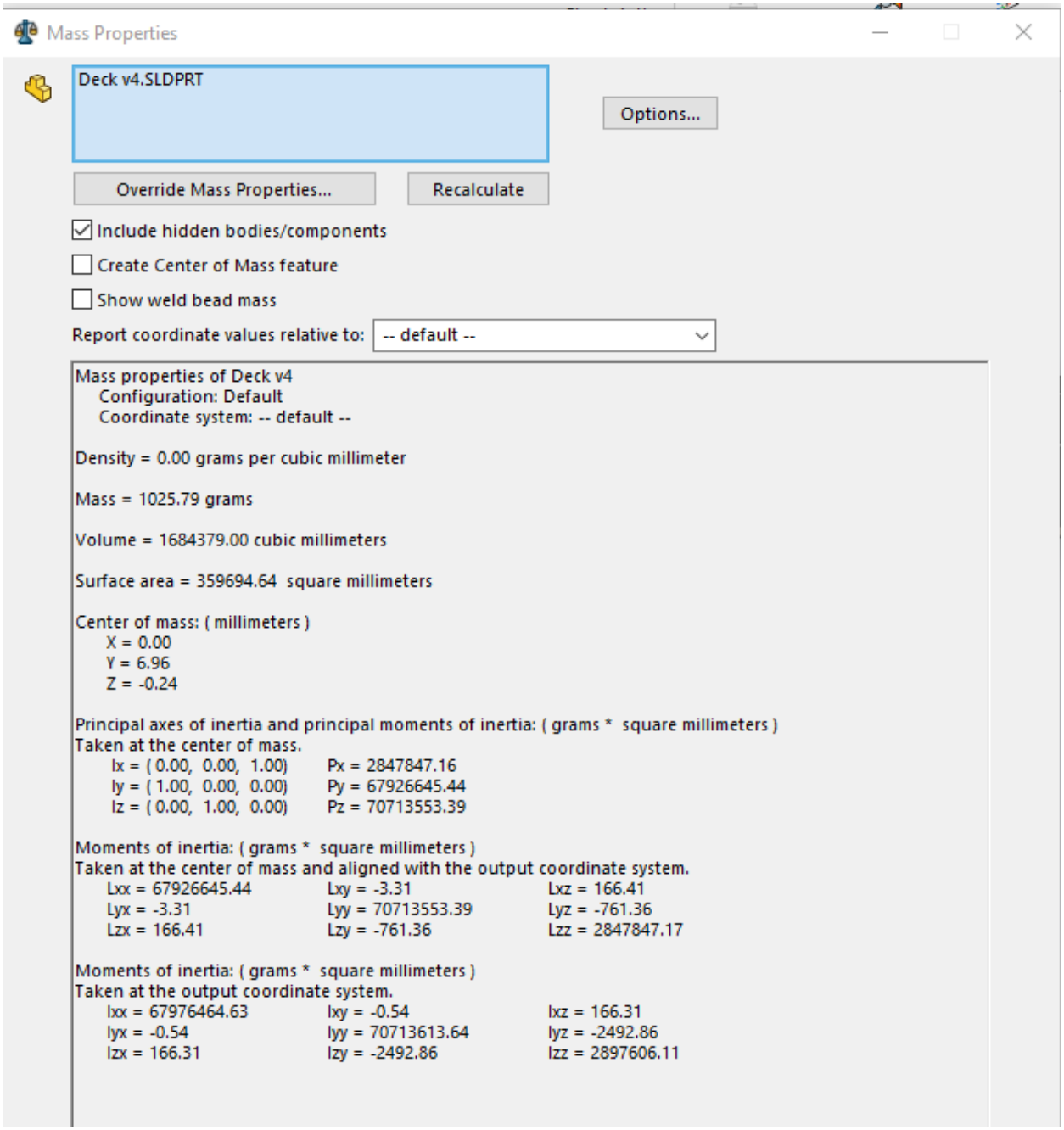

Longboard Assembly 4 FEA (Default<
Design Binder
Surface Bodies(10)
Solid Bodies(14)
Annotations
Material <not specified>
Front Plane
Top Plane
Right Plane
Origin
Surface-Imported1
Imported1
Imported2
Imported3
Imported4
Imported5
Imported6
Surface-Imported2
Imported7
Imported8
Imported9
Imported10
Imported11
Imported12
Imported13
Surface-Imported3
Surface-Imported4
Surface-Imported5
Surface-Imported6
Surface-Imported7
Surface-Imported8
Surface-Imported9
Imported14

Mass Properties

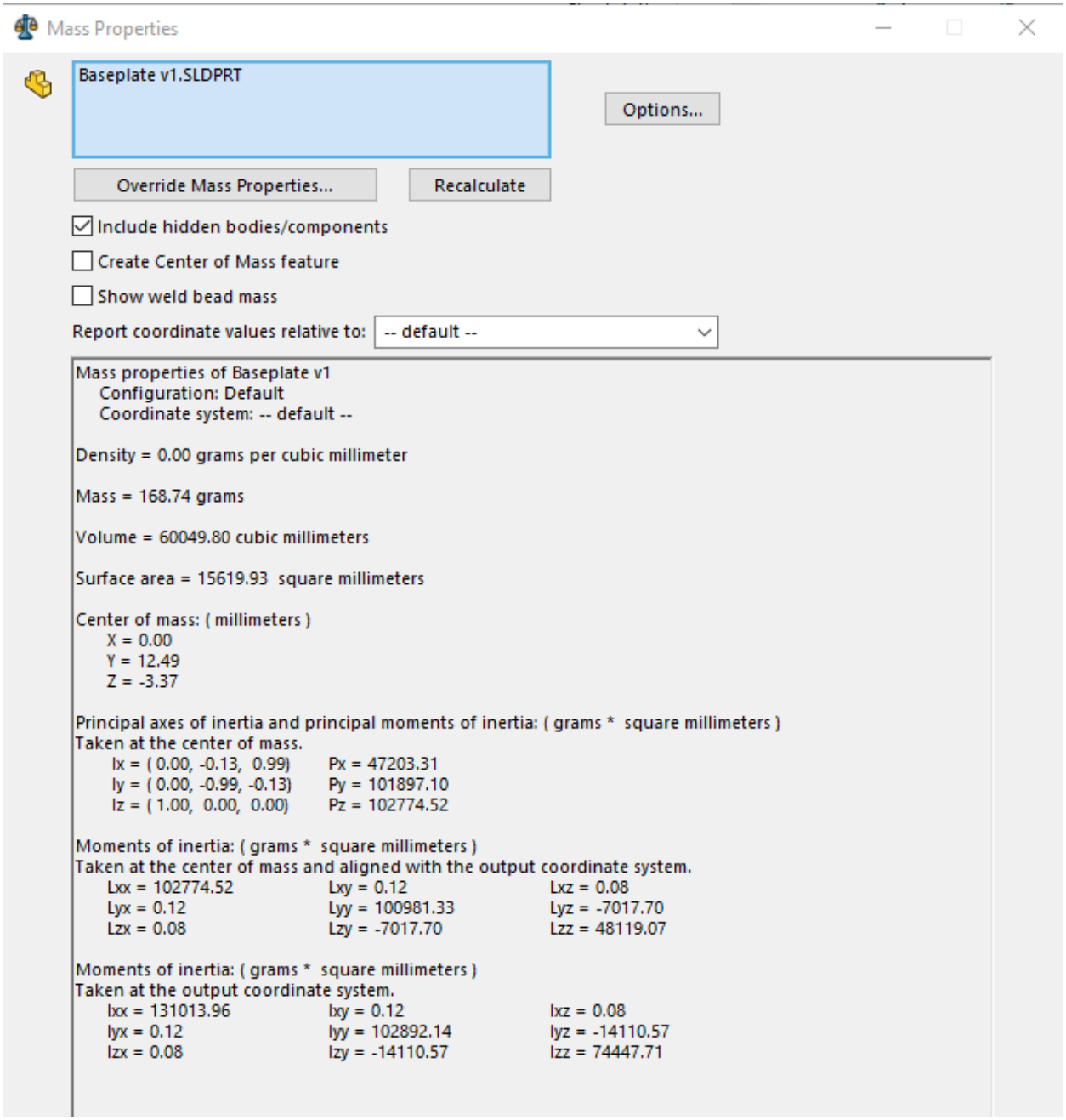
Assembly Mass Properties



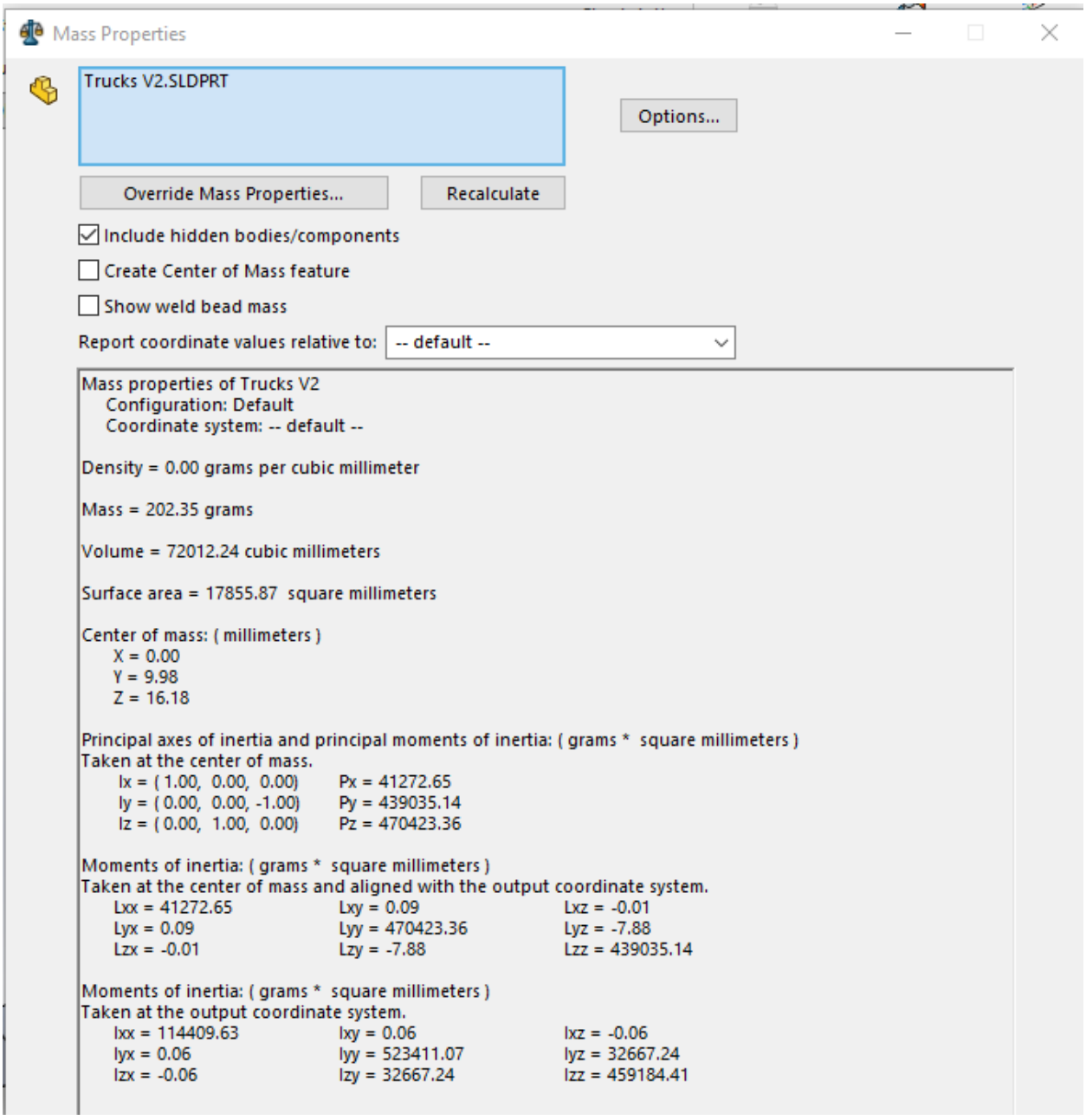
Deck Mass Properties



Baseplate Mass Properties



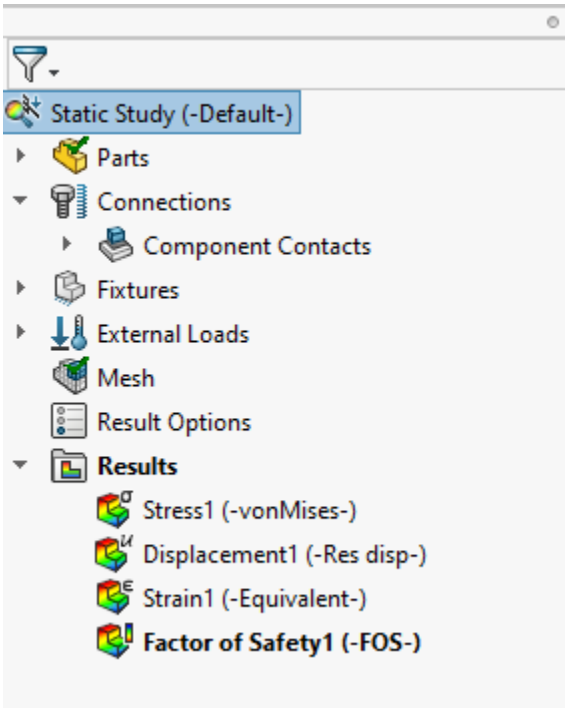
Trucks Mass Properties



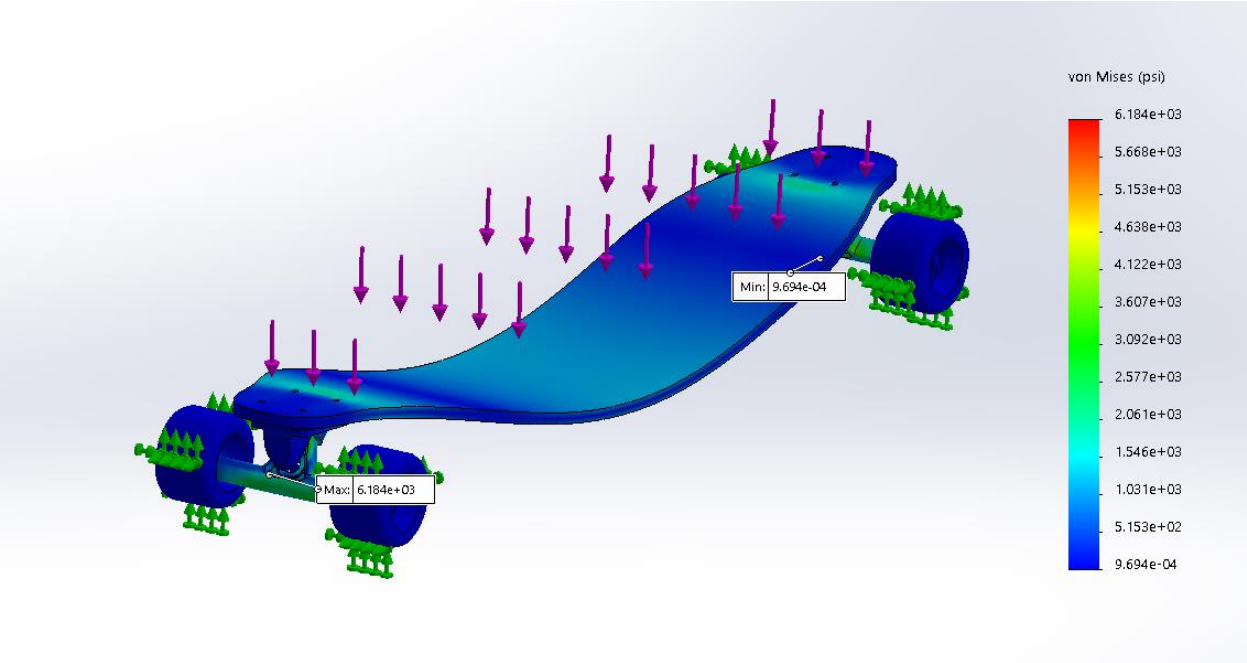
FEM/FEA

An FEM/FEA was performed on the longboard to analyze stress and displacement resulting from a compressive normal 160lb force on the wooden deck. This was analyzed with fixtures on the flat faces of the wheels.

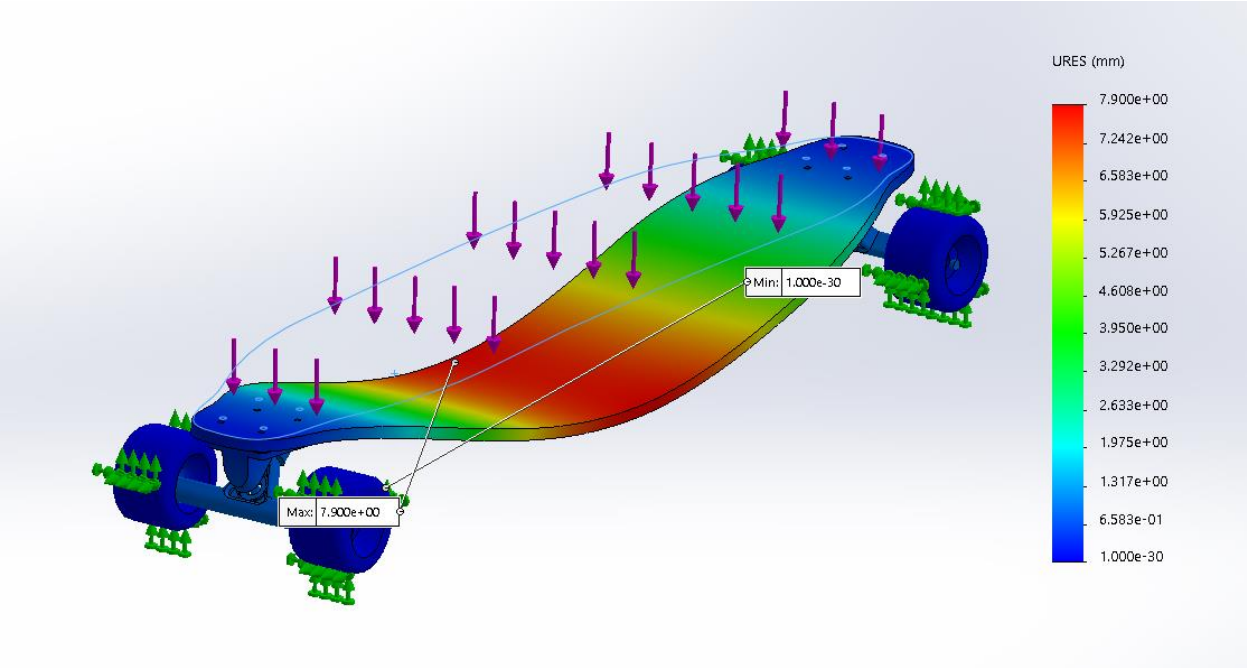
Simulation Tree



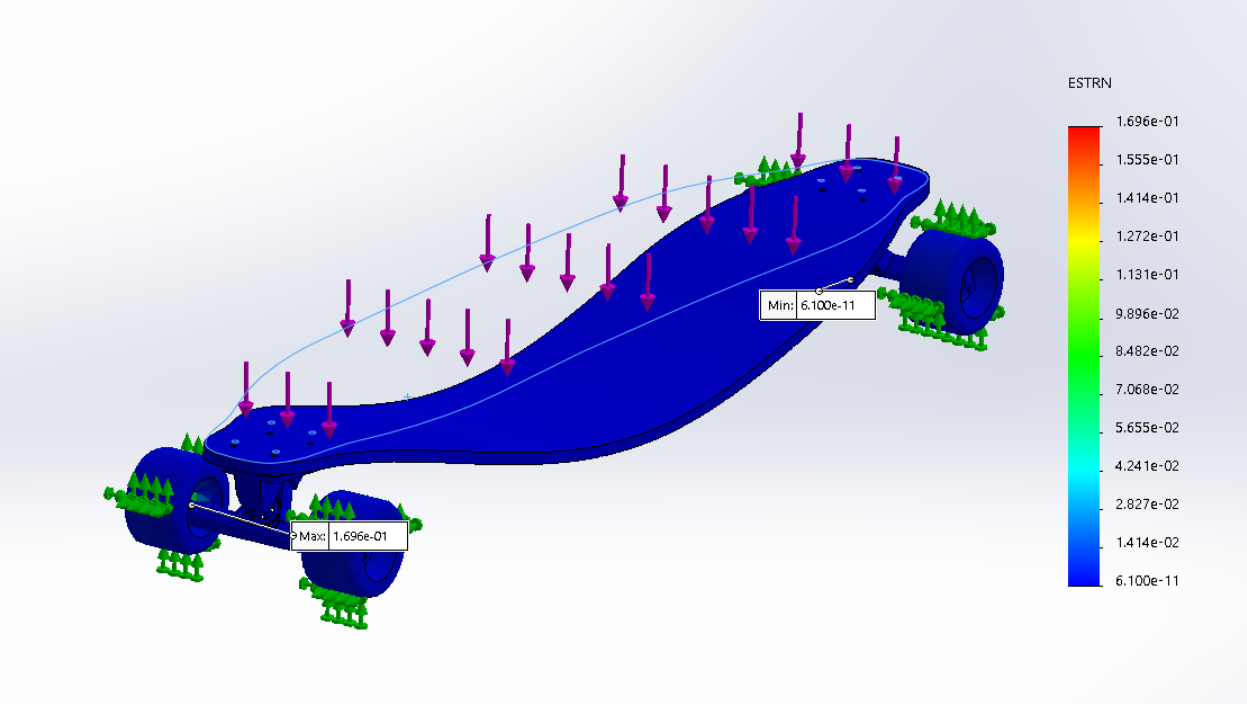
Stress Graph



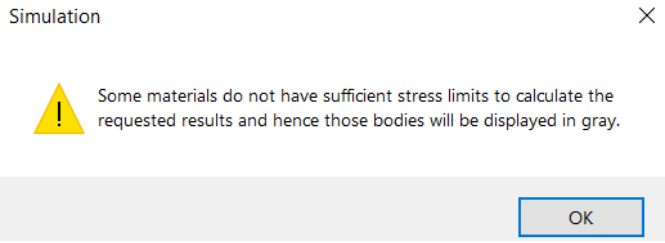
Displacement Graph

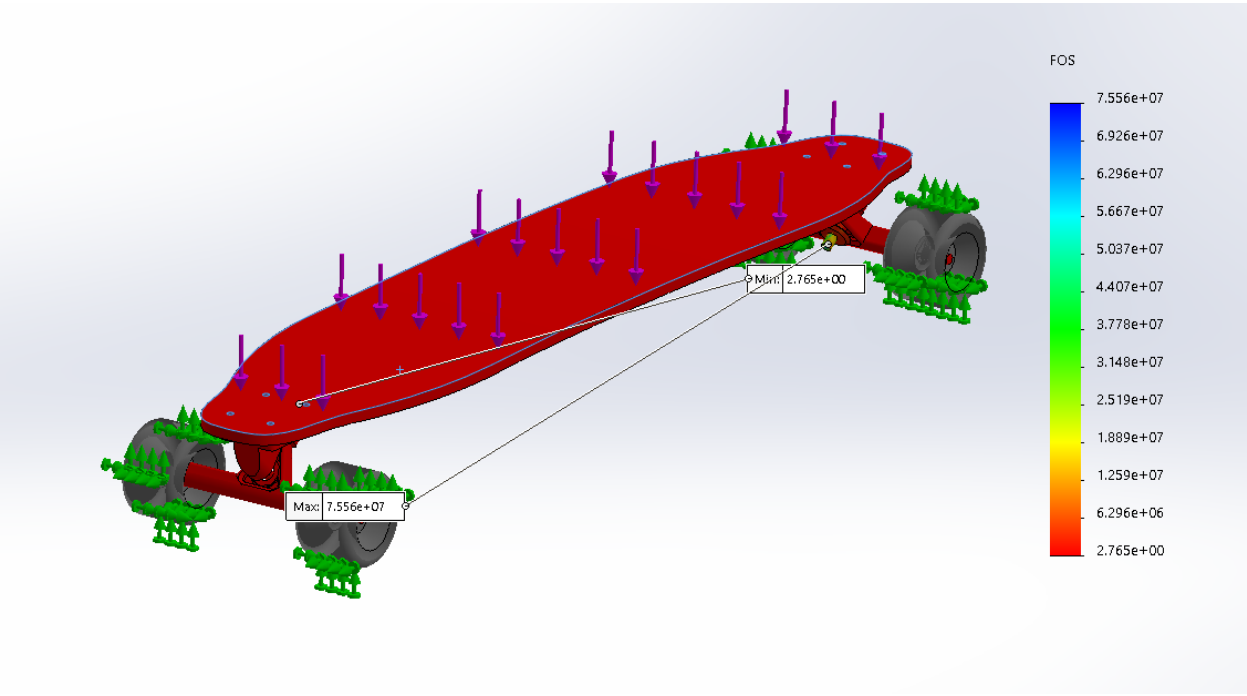


Strain graph



FOS Graph (due to materials not having enough stress limits, graph was displayed in gray)

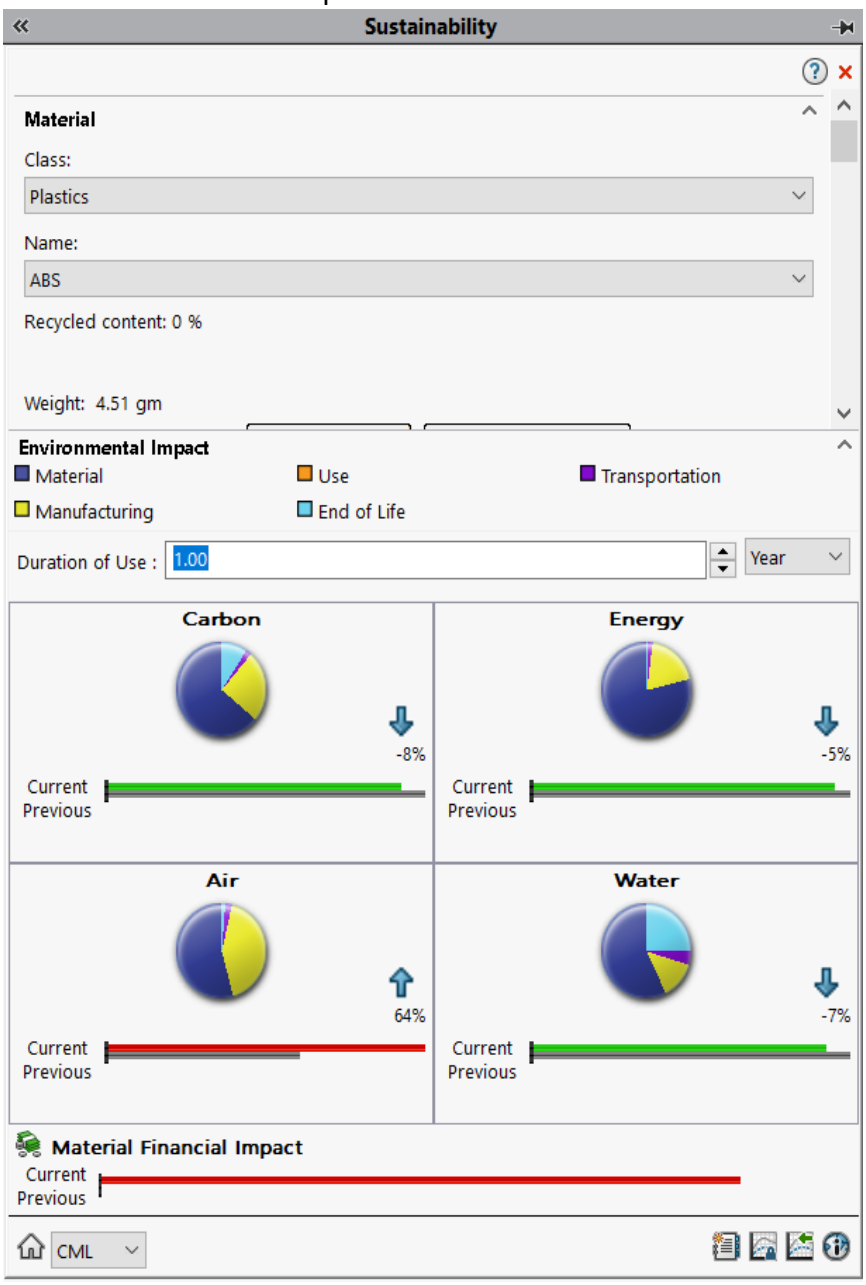




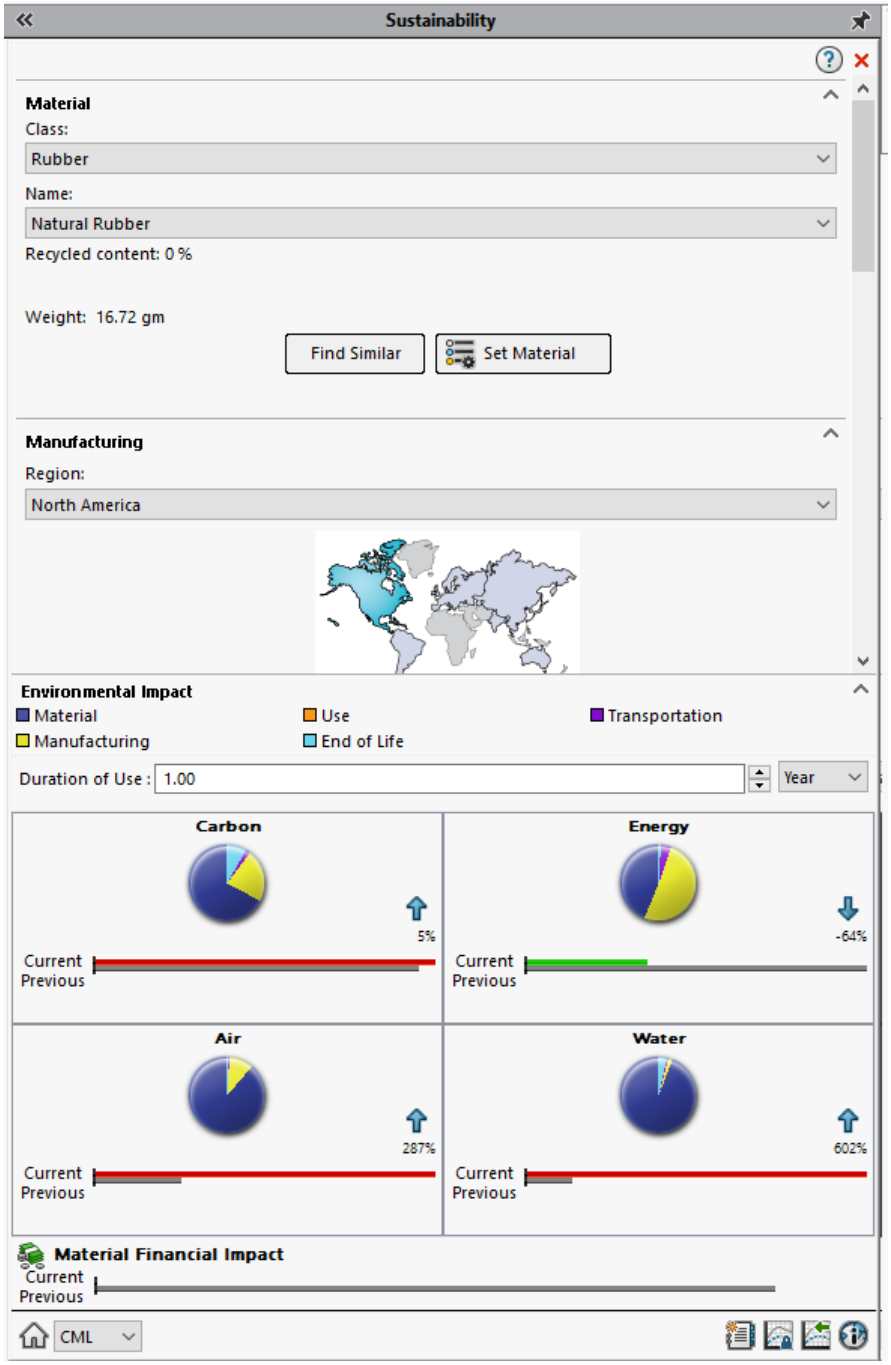
Sustainable Design

The **risers** were evaluated for sustainable design

Using ABS plastic the environmental impact is shown below:



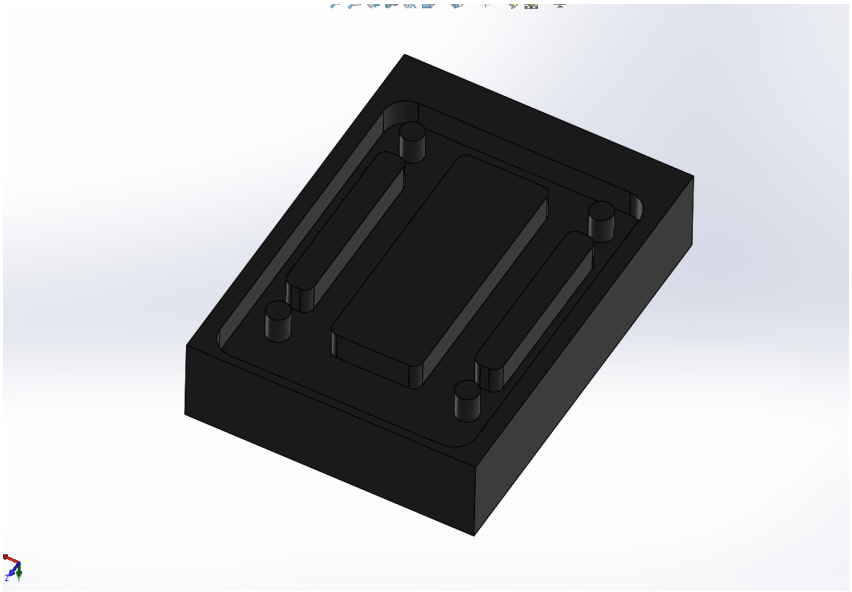
Using Rubber, the environmental impact is shown below:



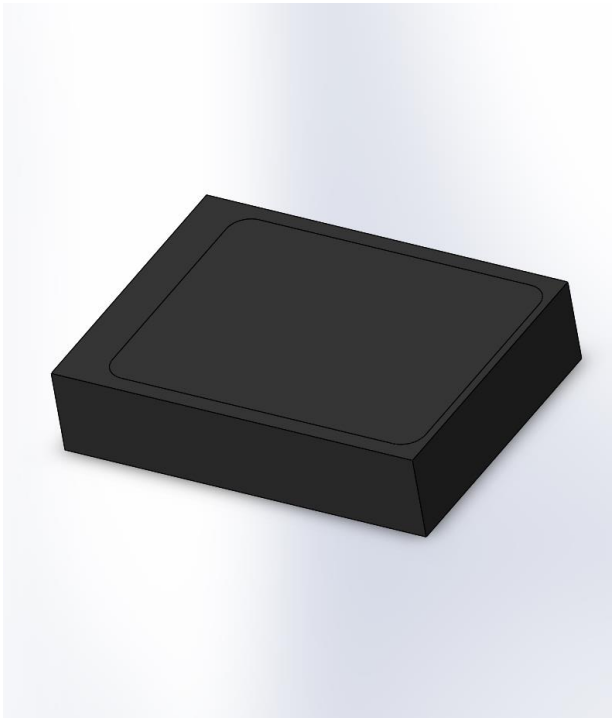
Part Manufacturing

Injection molding would be used to create the **risers**. Below are the mold pieces for the riser.

Cavity



Core



Cavity , Part, and Core