Functionality and design requirements:

The wings generate most of the lift to hold the plane in the air. There are various forces acting on a wing helping the aircraft to have a lift and move forward with the help of the engine. To generate lift, the airplane must be pushed through the air, which is done with the help of an engine. The air resists the motion in the form of aerodynamic drag and this drag is determined by the force acting over the span of area of the wing. Modern airliners use winglets on the tips of the wings to reduce drag.

In general, an airfoil that helps to lift a heavier-than-aircraft are designed in such a way to make the whole body aerodynamic and helping the aircraft to pierce through air to have a flight.

An airfoil is defined by various analysis, and there are midspan airfoil like b747c-il which is used in Boeing 747 aircraft. Each airfoil section has specific Reynolds number and Mach number defined at specific angle of attack. So, in Boeing 747, we implement B747c-il and where it depends on the wing length along with the coefficient of lift and coefficient of drag.

In terms of usage, High-speed aircraft usually employ low-drag, low-lift airfoils that are thin and streamlined. Slow aircraft that carry heavy loads use thicker airfoils with high drag and high lift.

The engine of an aircraft is very similar to turbine engine, where the body converges to give an output, which is the push to have the aircraft move forward. The engine has various types depending on the need, and there are various fan blades used according to the need in the power to be generated for the aircraft. The blade airfoils are defined as per the need at which an aircraft must pursuit.

The fan/blade of the engine requires airfoil design, where we can use NACA profile or the custom design profile to get the required output.

Whereas the wing design is considered depending on the angle of attach and it uses Bxxxx-il profiles where the angle of attach defines the life coefficient and drag coefficient.

Overall, the wing and engine works together to provide the lift/flight to the body as a whole helping us to transit.

The project deals with understanding what happens over the span of the wing and engine when on transit. The wing uses the defined airfoil b747c-il and the blades are defined as per the need

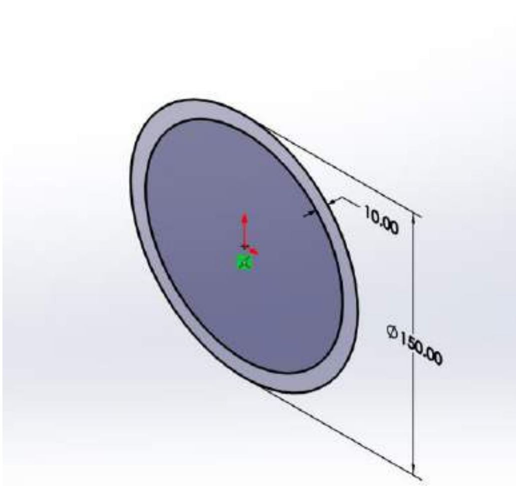
Outer Engine fan

Final Model

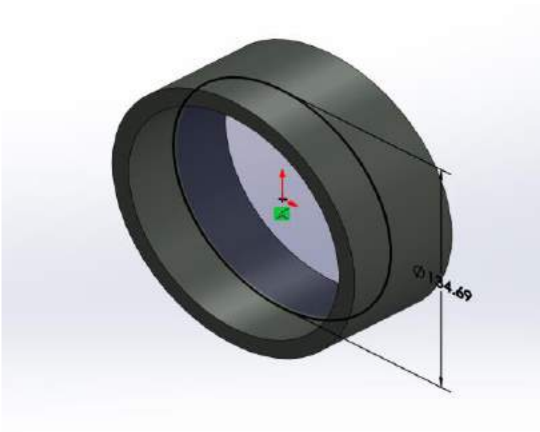
Used features:

- Boss Extrude
- Revolve feature
- Reference plan
- Guided loft feature

Step 1: Create a circular rim using sketch and extrude feature

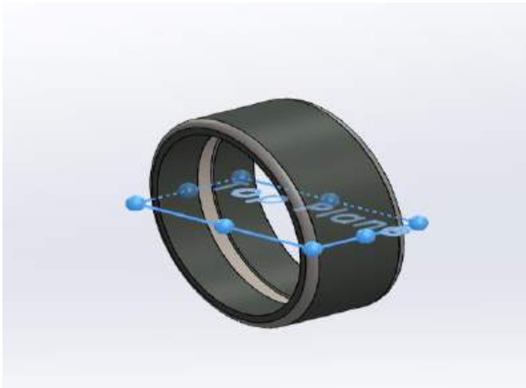


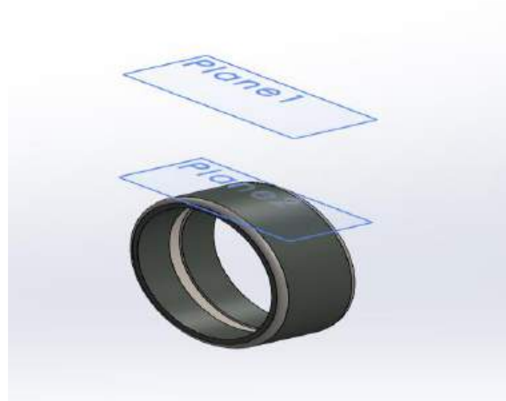
Step 2: Create an inner slot, to fix the rim to the shaft in later stage, using the mid plane and extrude cute feature.



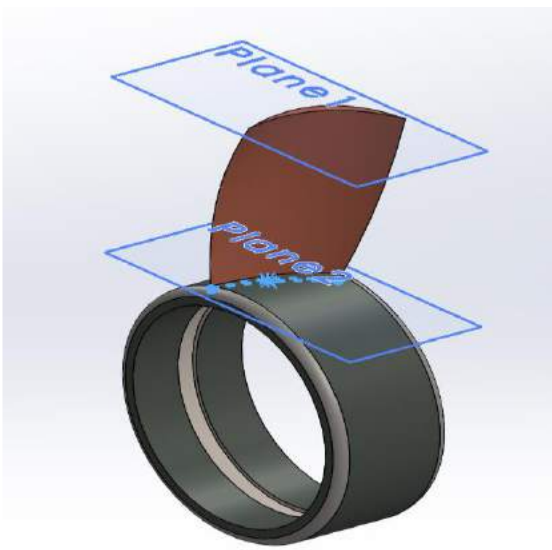
Step 3: Fillet the edges, to have the feature aerodynamic, using fillet feature with the required radius.

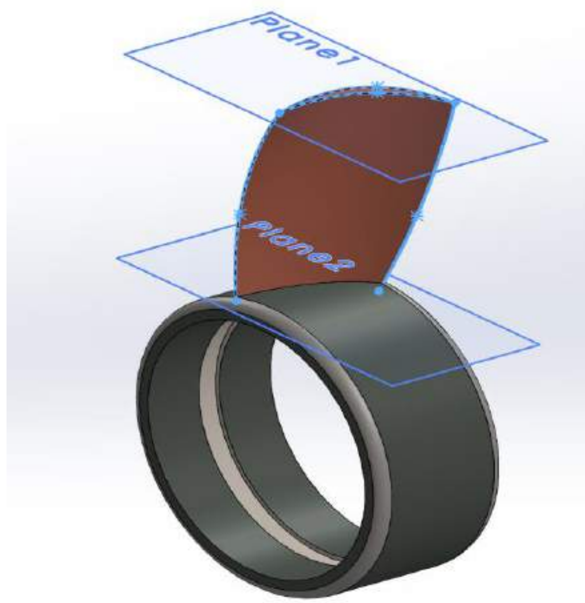
Step 4: Create a reference plan parallel to the geometric plan, using reference feature



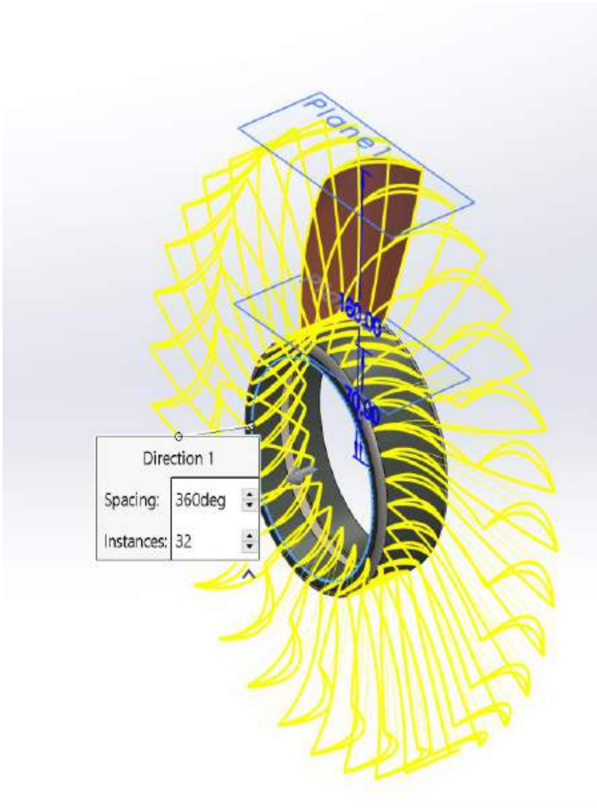


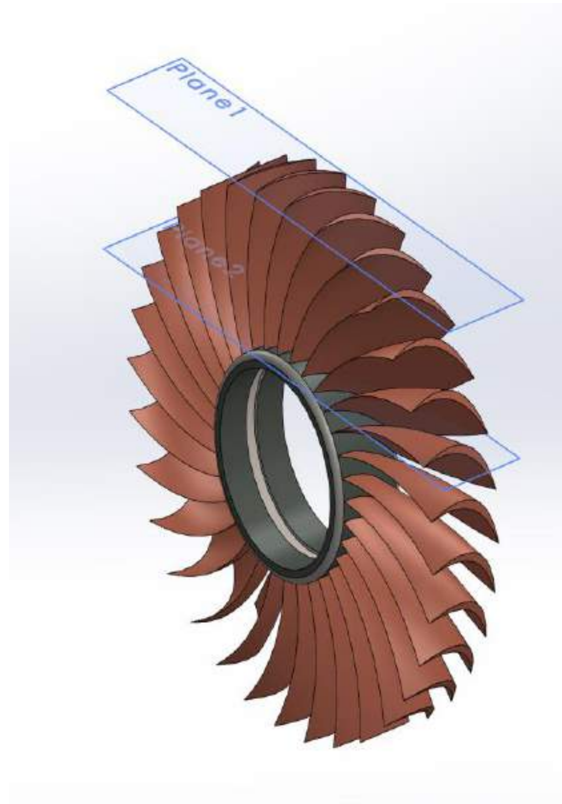
Step 5: Create the blade of the fan using the plan as reference and using the airfoil shape as needed and use loft feature and guided curve to get the shape needed





Step 6: Using circular pattern option, create the blades over the profile of the rim to get the complete fan for the engine.



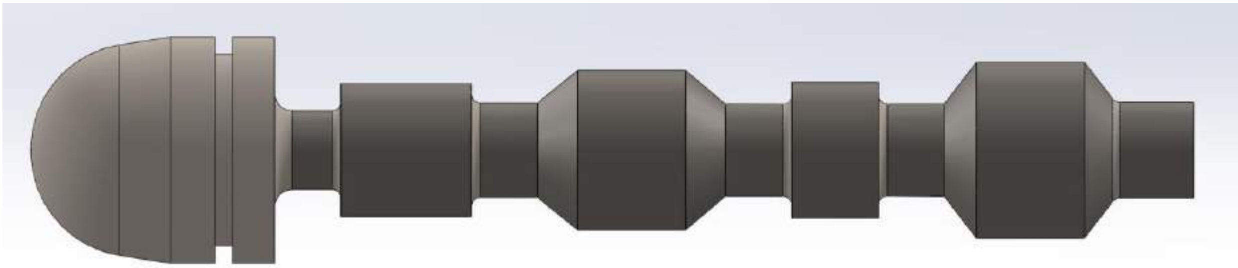


Engine Shaft

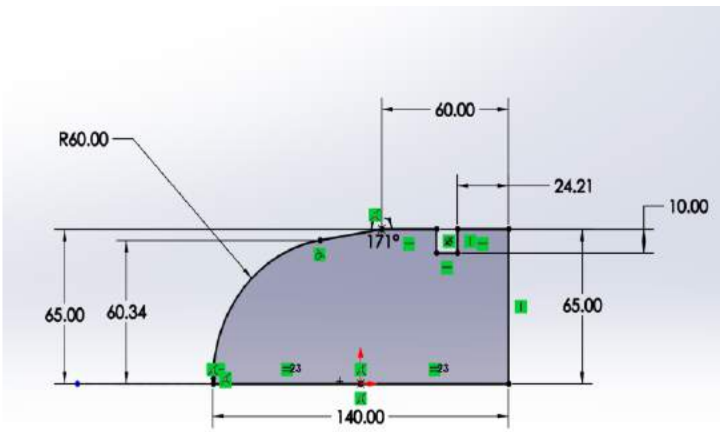
Final Part

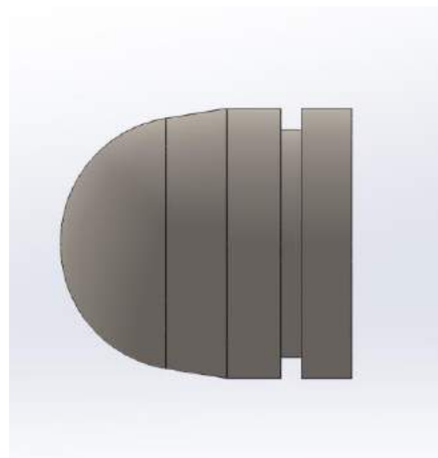
Used features:

- Boss Extrude
- Revolve feature
- Temporary axes revolve
- Extrude cut feature

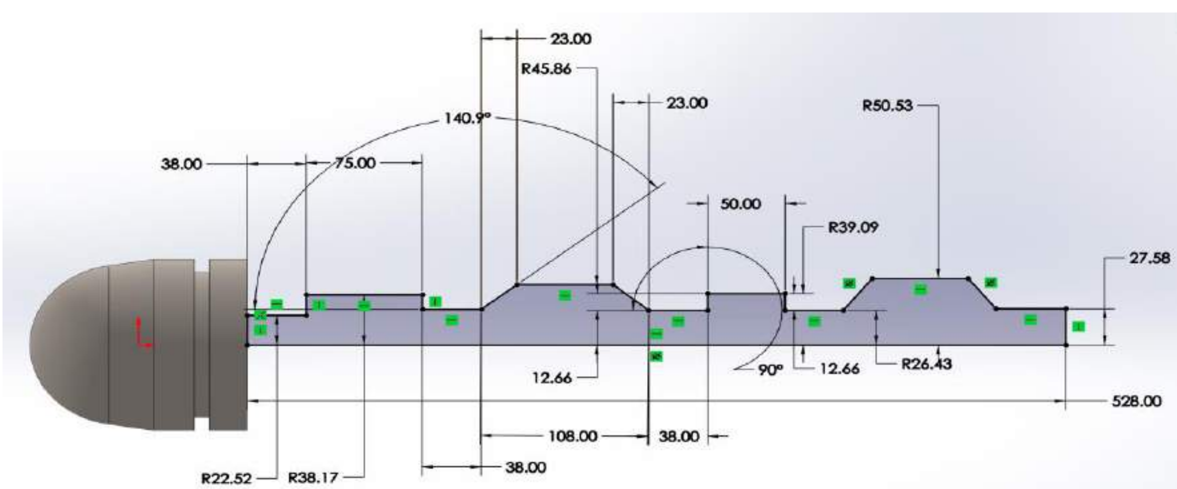


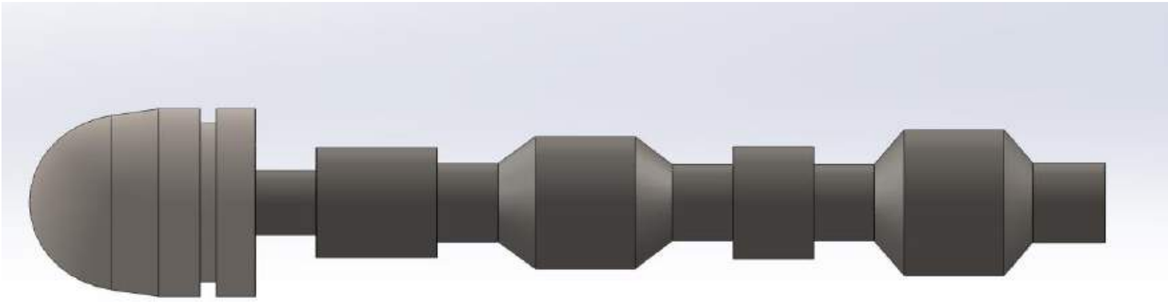
Step 1: Create the sketch below to have the shaft head, using the revolve feature, we create the head for the shaft to be place along.



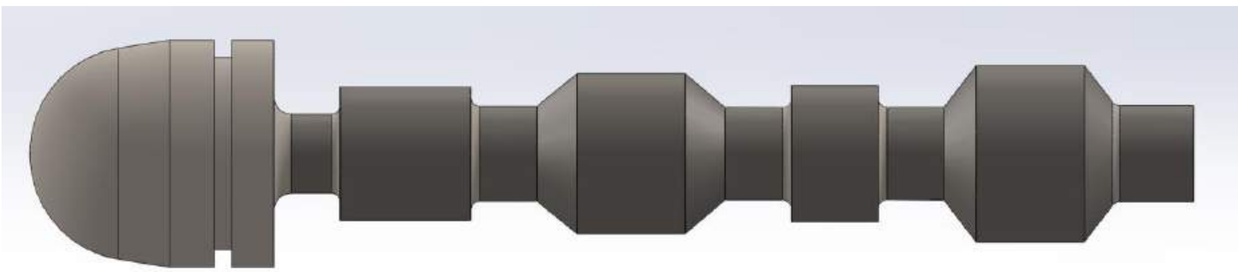


Step 2: Create the sketch below and use revolve feature to have the length of the shaft defined where the engine blades are placed to generate power along with other components of engine.



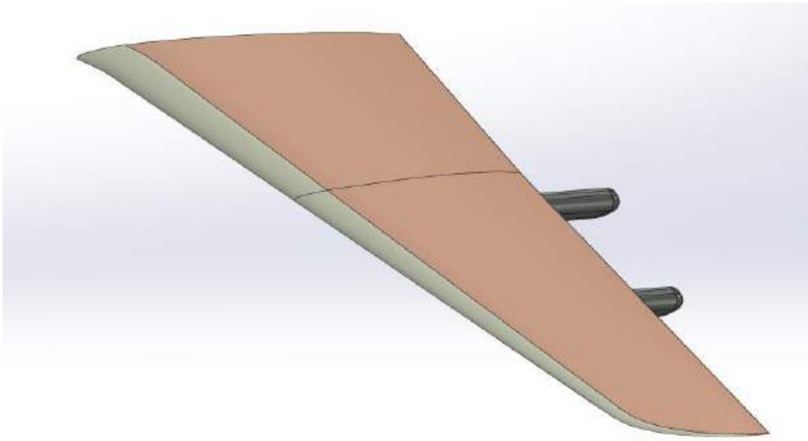


Step 3: Fillet the edges to have the smooth part



Wing

- Guided loft
- Fillet
- Boss extrude



Step 1: The shape is made using the multiple curves joining together so create the below sketch in top plane for one half of the wing profile

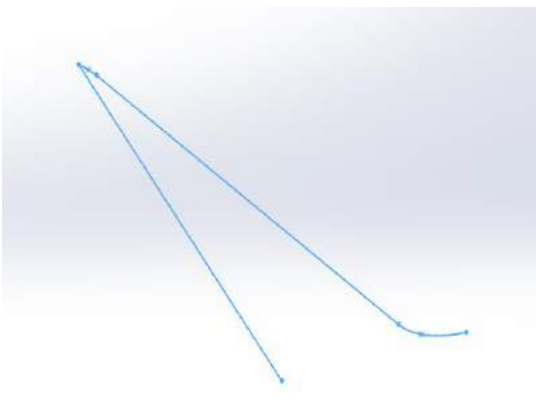


Fig 1

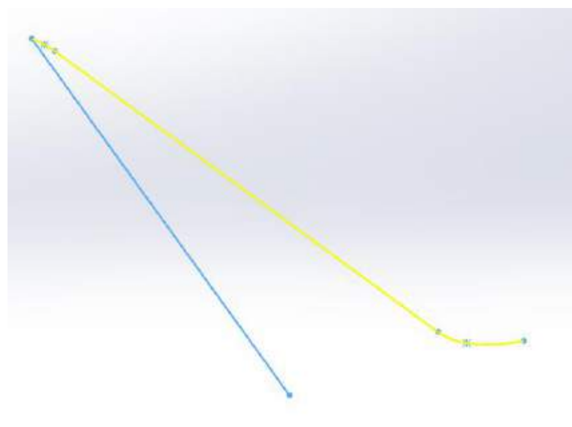
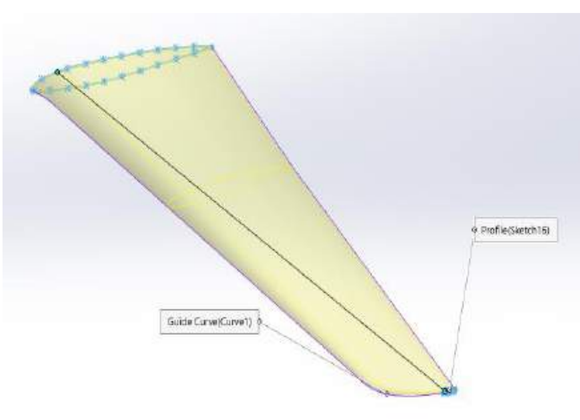
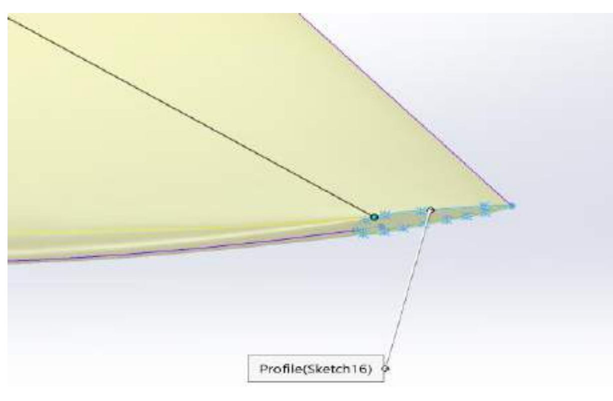


Fig 2

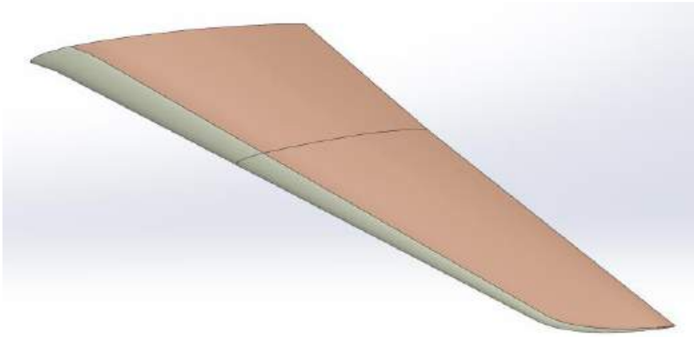
The figure 2 shows the projected curve combining the figure 1 curves for the profile of the wing

Step 2: Create the airfoil profile one end of the projected curve and the in the other end as shown below to get the span of the wing, then using loft feature and guide curve, create the wing.

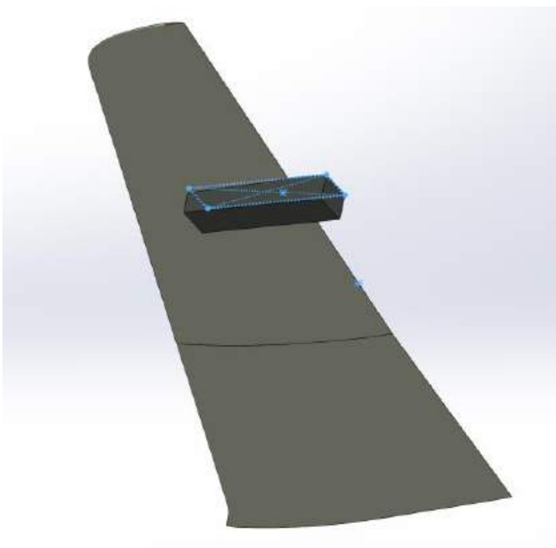


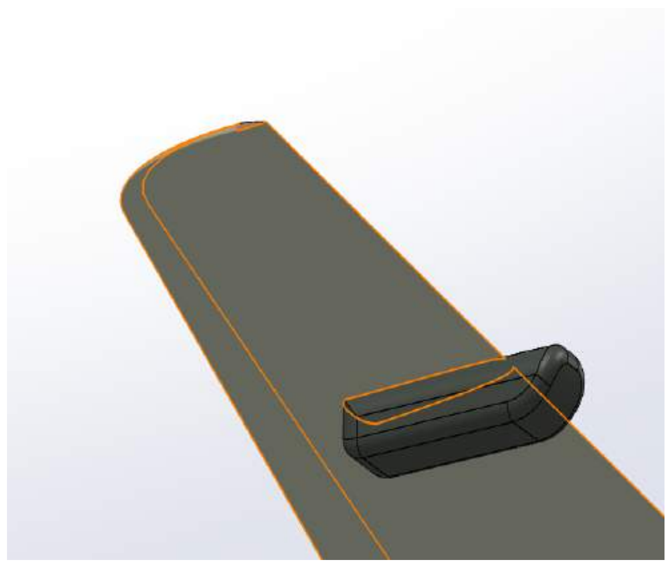


Step 3: Create the loft and choose the required material and appearance for the wing

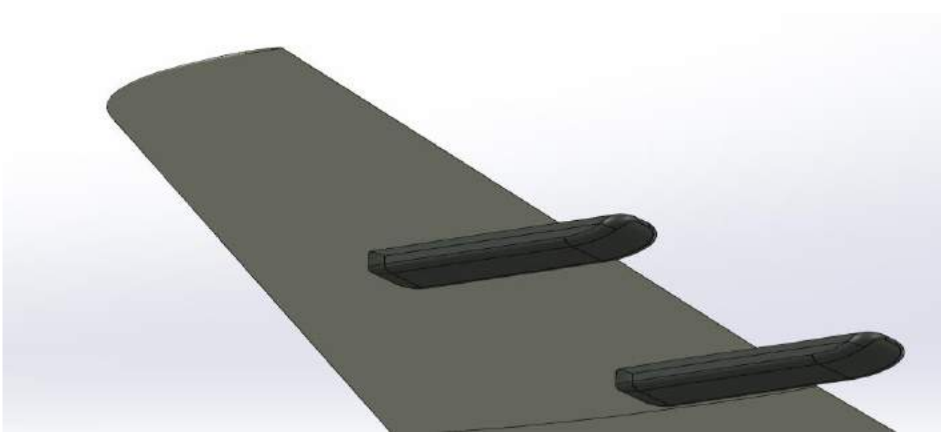


Step 4: create a track fairing, which is used to guide the wing vertically along the span, sketch the required size, which is directly proportional to the wingspan, then using extrude feature, extrude the sketch to the required height. After creating, fillet the edges to have the smooth curves for the system to be aerodynamic.

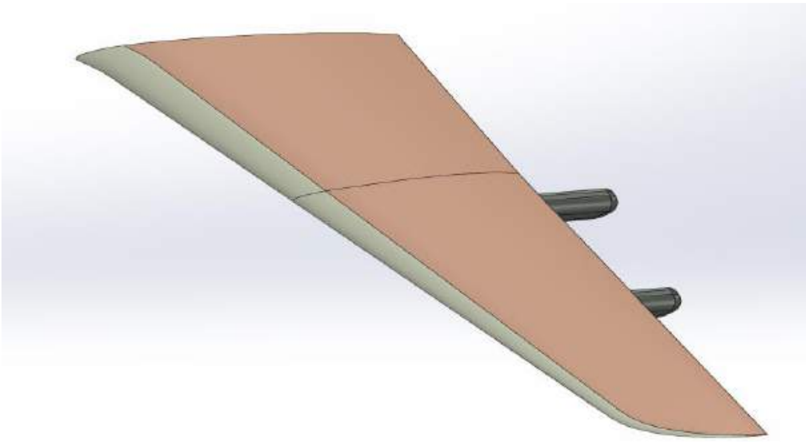




Step 5: Create another track fairing for the wing span (where the number of track fairing depends on the total wing span as the track fairings are the ones stabilizes the wing in the first place)



Step 6: Fillet the edges, so as to have a smooth curve to maintain aerodynamic nature to get the final model

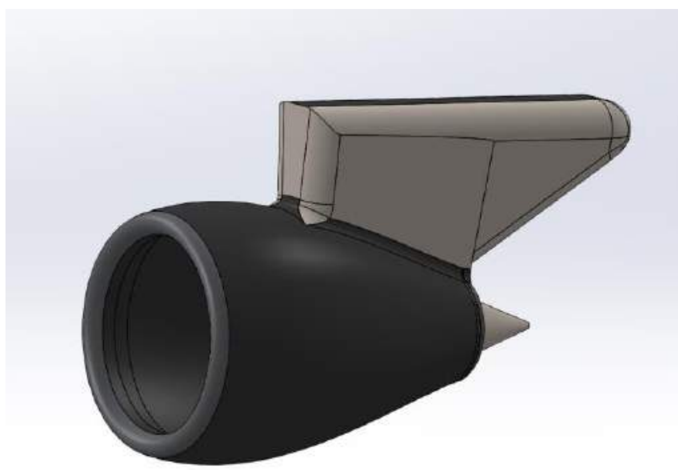


Engine Cover

Final Part

Used features:

- Boss Extrude
- Circular pattern feature
- Revolve feature
- Sweep feature
- Extrude cut feature
- Fillet feature



Step 1: Create the sketch as below to get the frame dimension of the engine cover, then use the revolve feature to revolve about an axis to get the complete cover

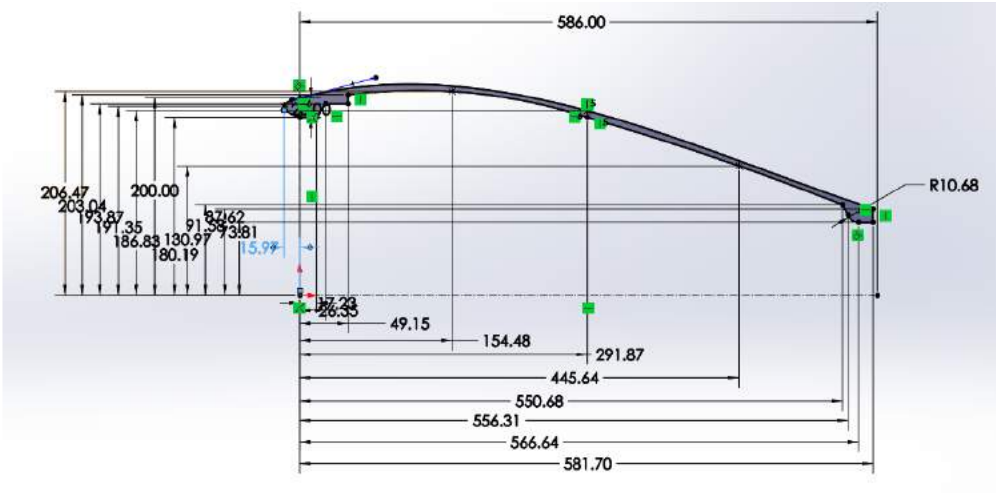
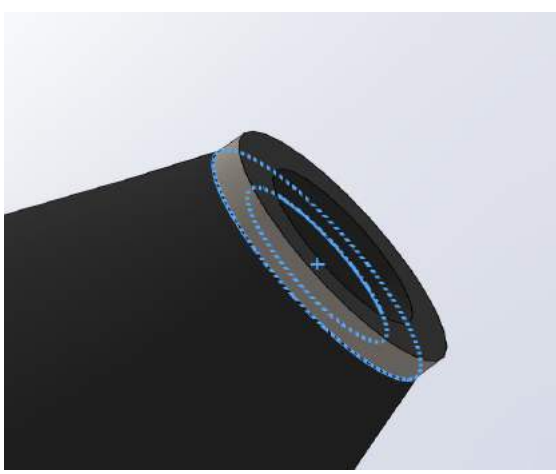


Figure 1

Figure 2

Step 2: Create sealing for the outlet of the cover as shown below using the extrude feature and then fillet the edges to have the smooth surface.



Step 3: Create the cover end for the engine cover frame, so that it defines the outlet of the exhaust, create the sketch as defined and using revolve feature, revolve around the axis and the using extrude cut, cut the exhaust holes with respect to a plan

Figure 1

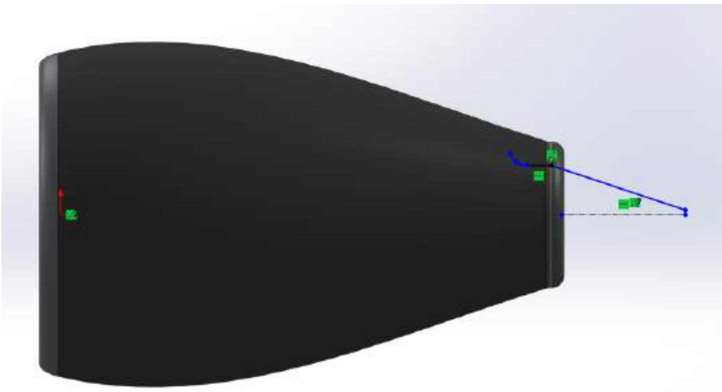


Figure 2

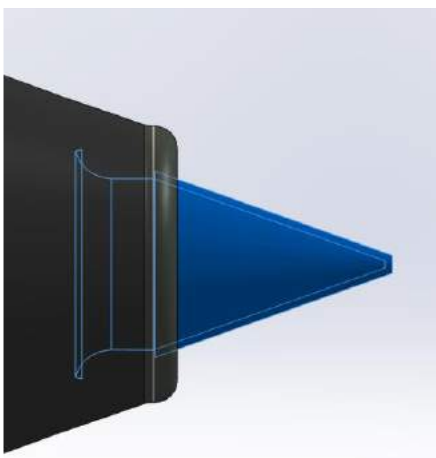


Figure 3

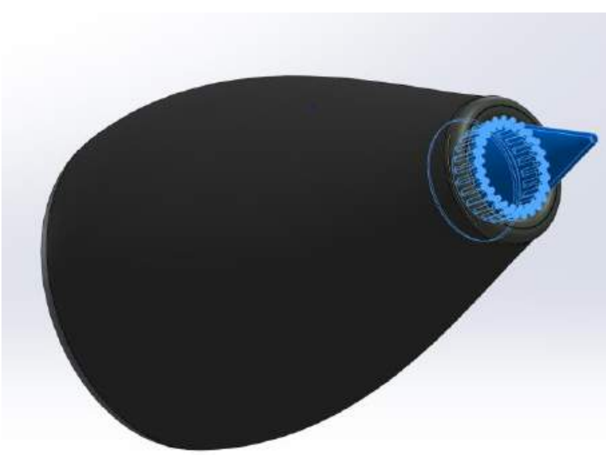


Figure 4

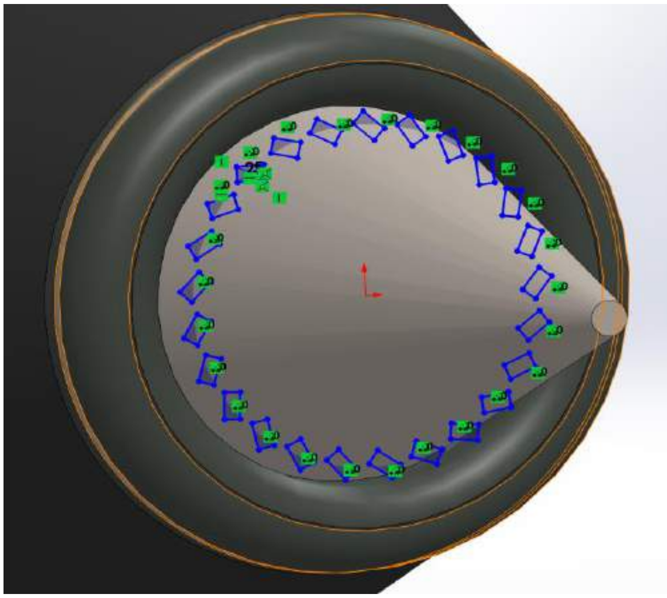
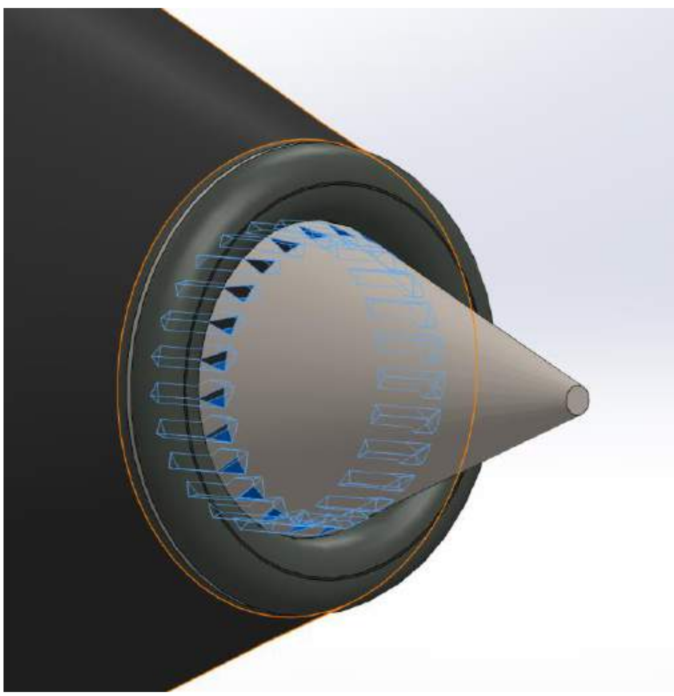
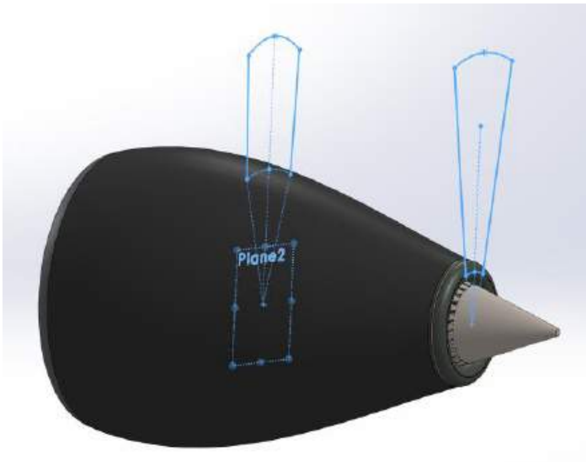
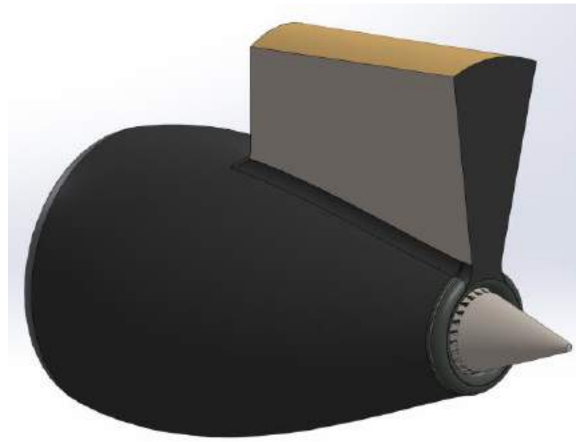


Figure 5

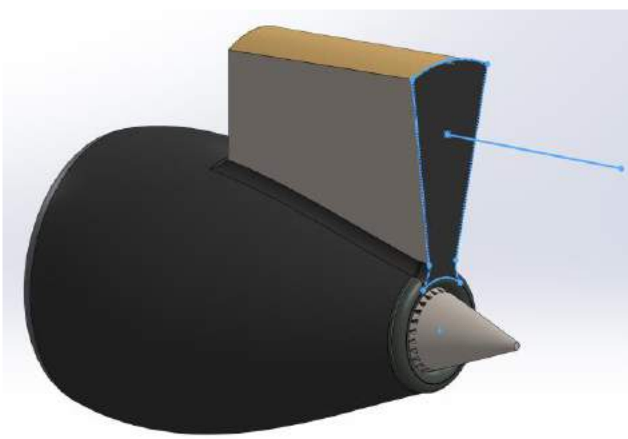


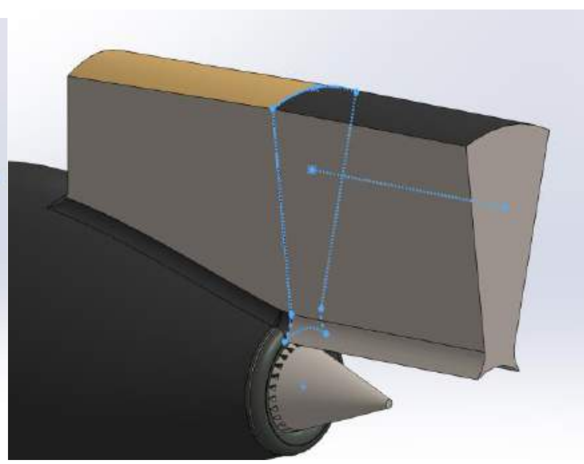
Step 4: Create a reference plan at a particular distance to create the structure that holds the engine to the wingspan, this is created using the loft feature where the profile is created, and the guide curve is used to get the entire structure and then fillet the edges to get the smooth curve.



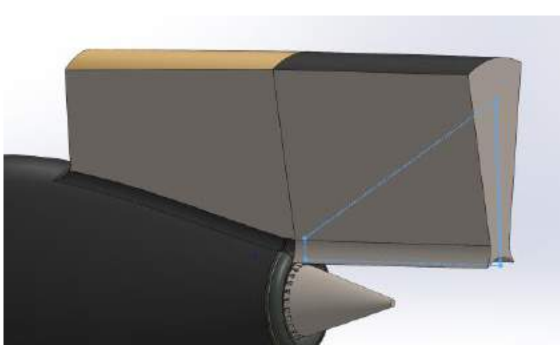


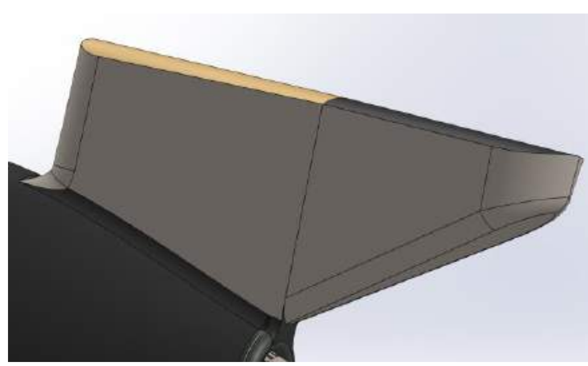
Step 5: Create the extended feature of the holding structure of the engine to get the center of mass of the whole right on the holding structure. This is done using sweep feature, with profile of the end of the loft feature and this is created by using convert entity option and then defining the length up to which the feature is defined



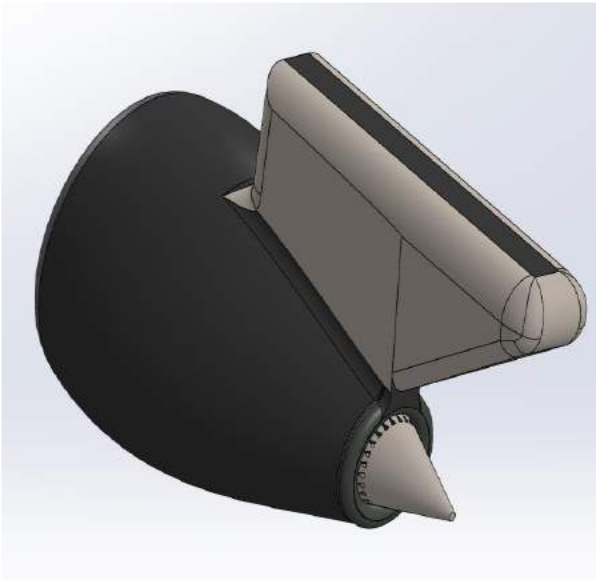


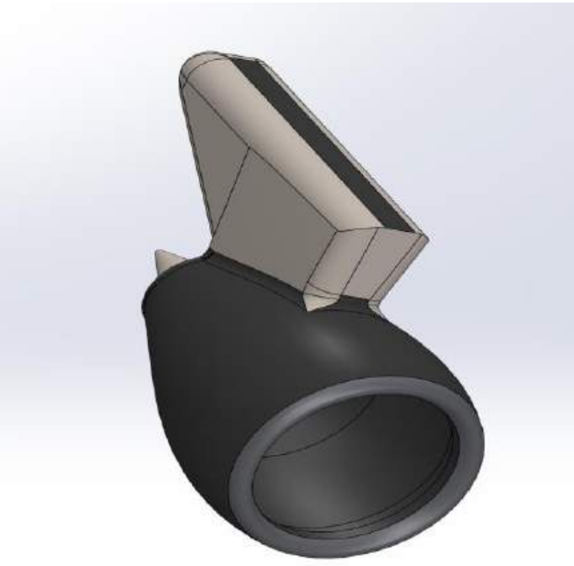
Step 6: Now, cut the extra material available in the sweep extrude, so that we get the aerodynamic feature for the aircraft and then fillet the edges to get the perfect design





Step 7: Fillet all the edges, apply the required materials and define the configuration needed for the part

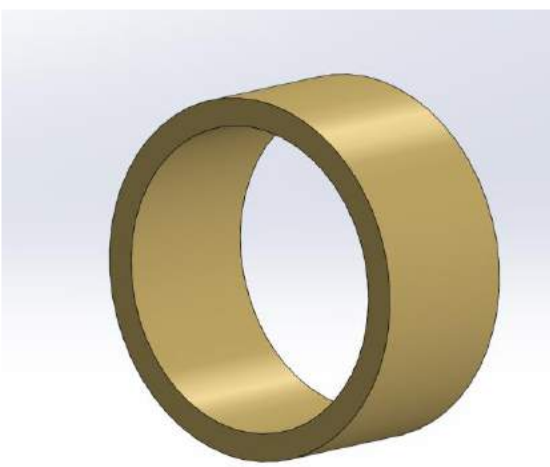




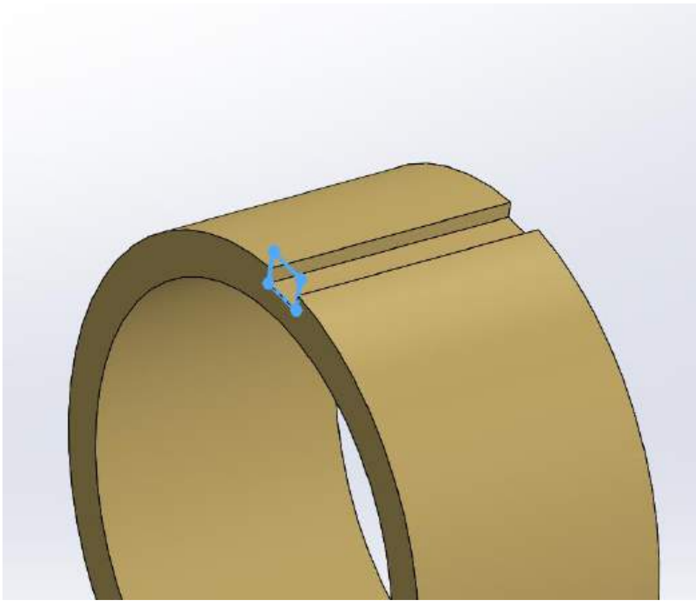
Compressor

This is just a model of compressor, assuming the feature does the same function as the real compressor in the engine, as said in Page 2, compressor is the one of the main components in the engine which helps to put in power for the lift.

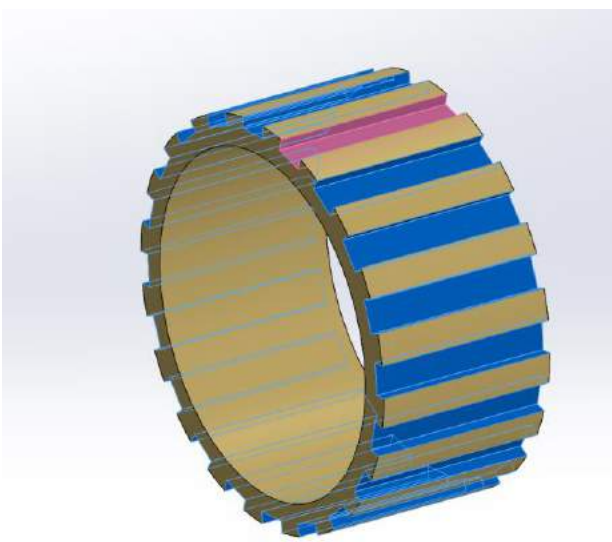
Step 1: Create the circular sketch that symbolizes the compressor

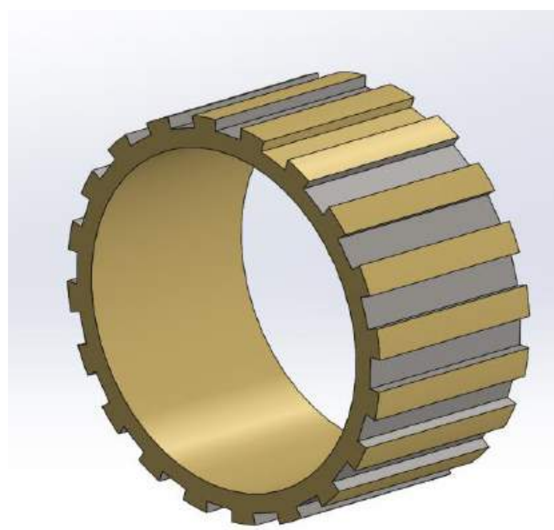


Step 2: Cut the slots in the circular section of the compressor, using the sketch and extrude cut feature



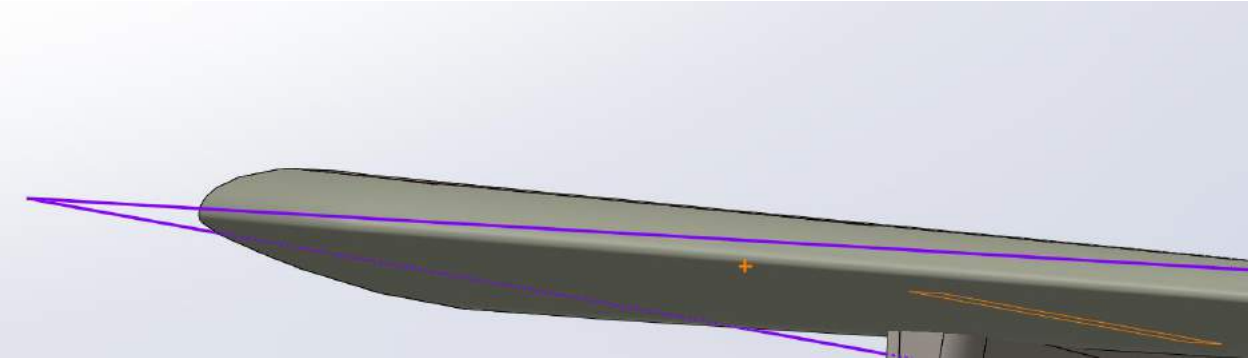
Step 3: Using the circular pattern feature, cut the slot over the profile in order to get the

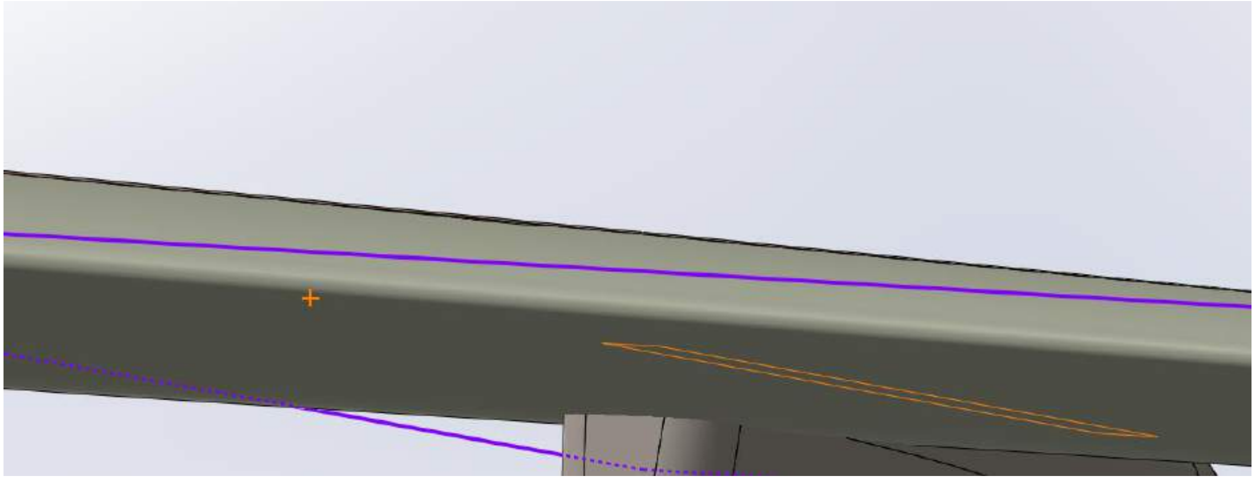




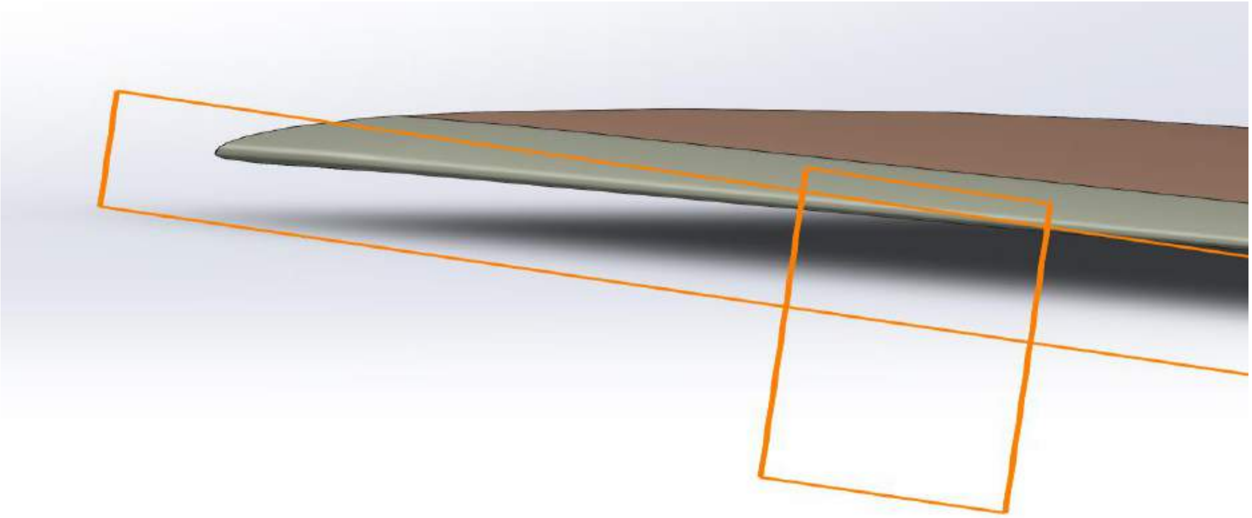
Assembly of the wing and engine

Step 1: Select the Top plan of the geometric system and top plan of the wing and use coincident mate to join

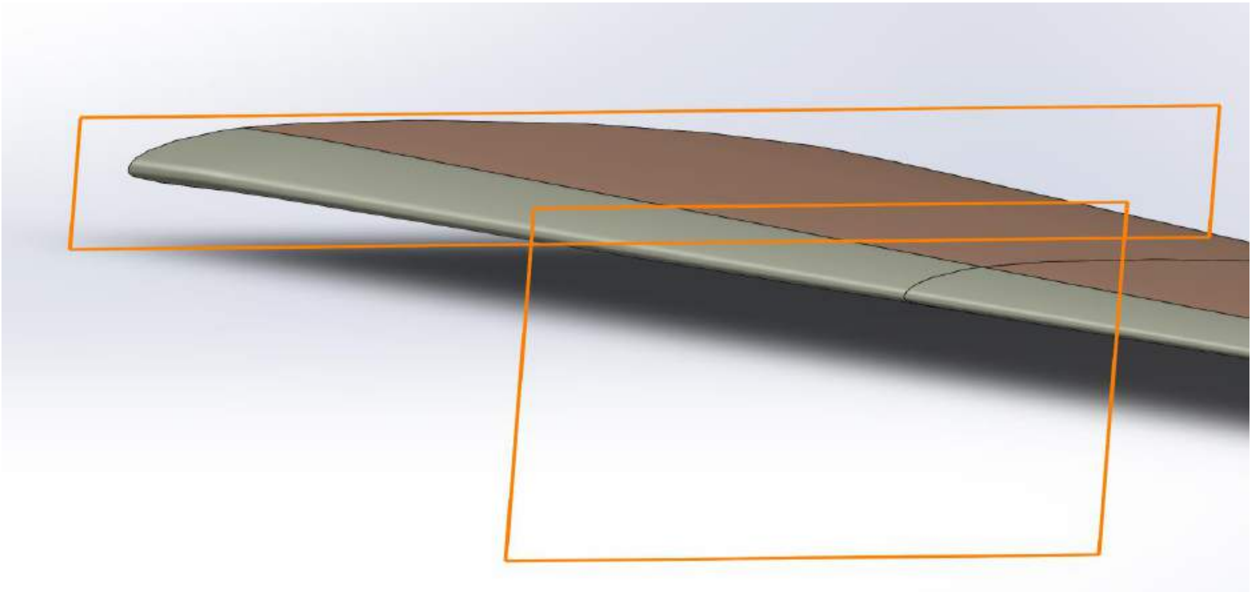




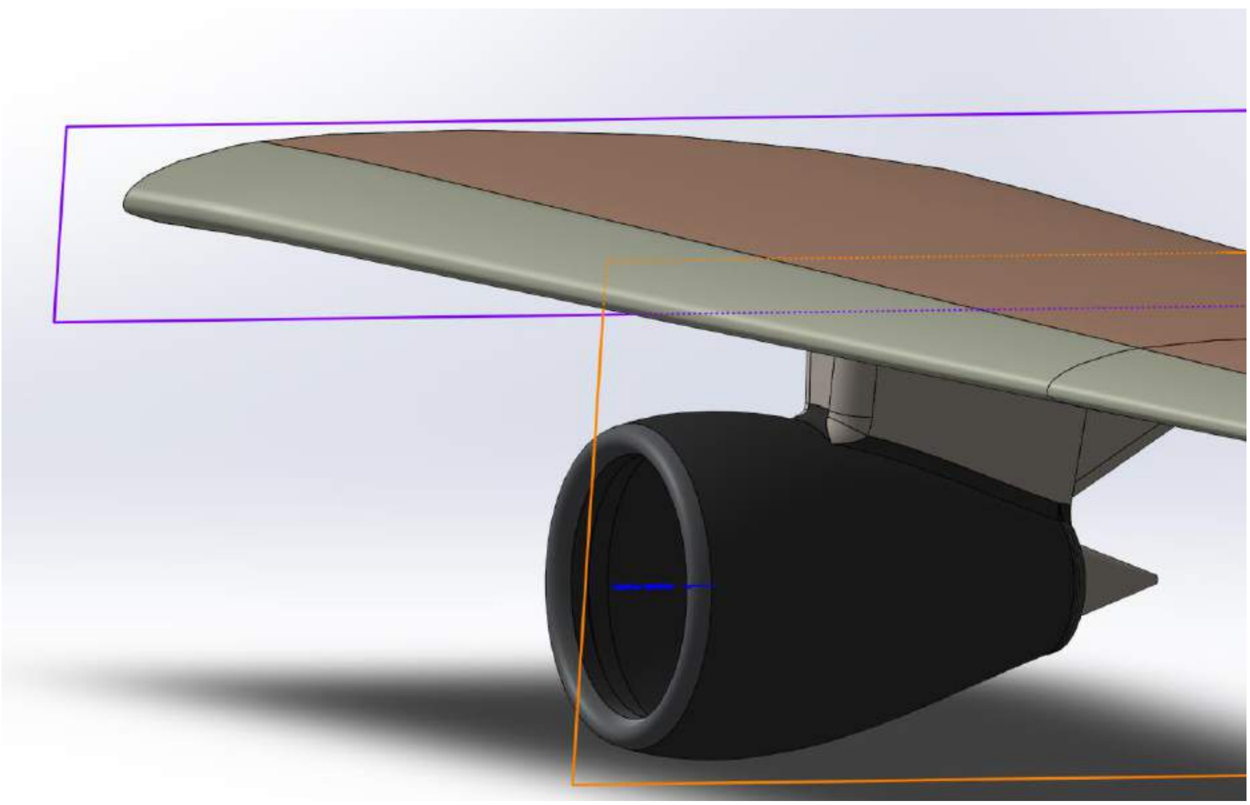
Step 2: Using Front plan of the system and front plan of wing, use distance mate to place it at a distance.



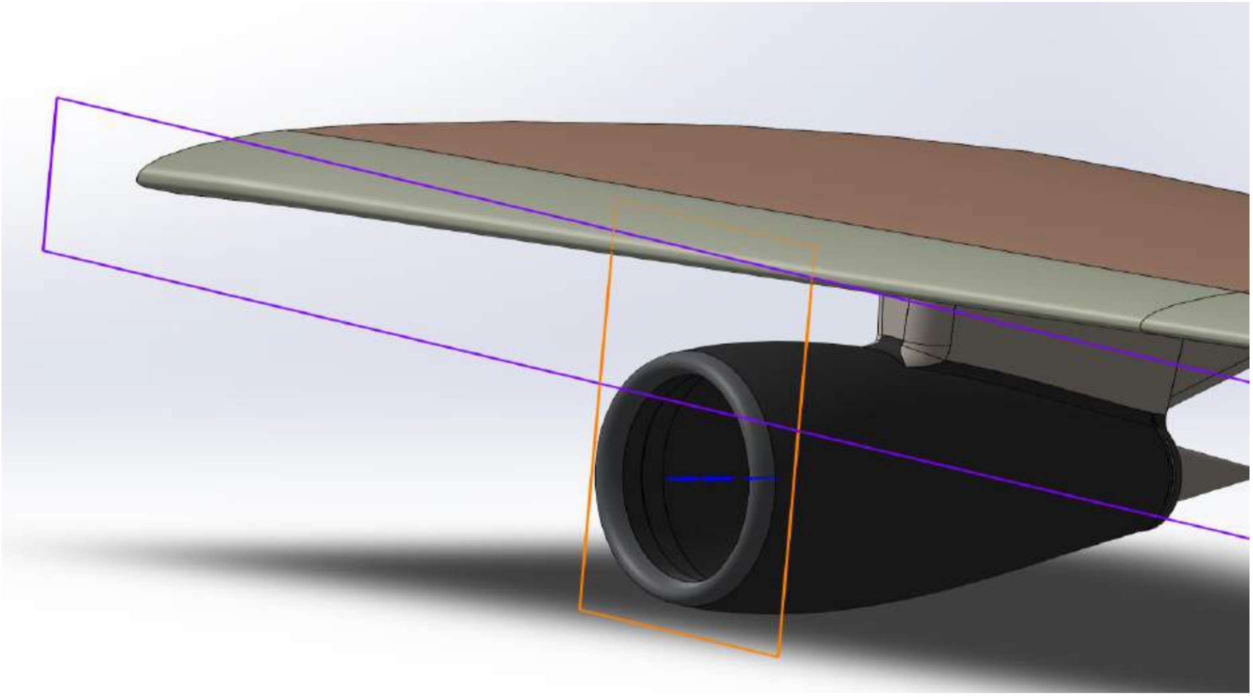
Step 3: Now to fix the part without any rotation, select the right plan of the system and right plan of the wing and using distance mate to fix the wing



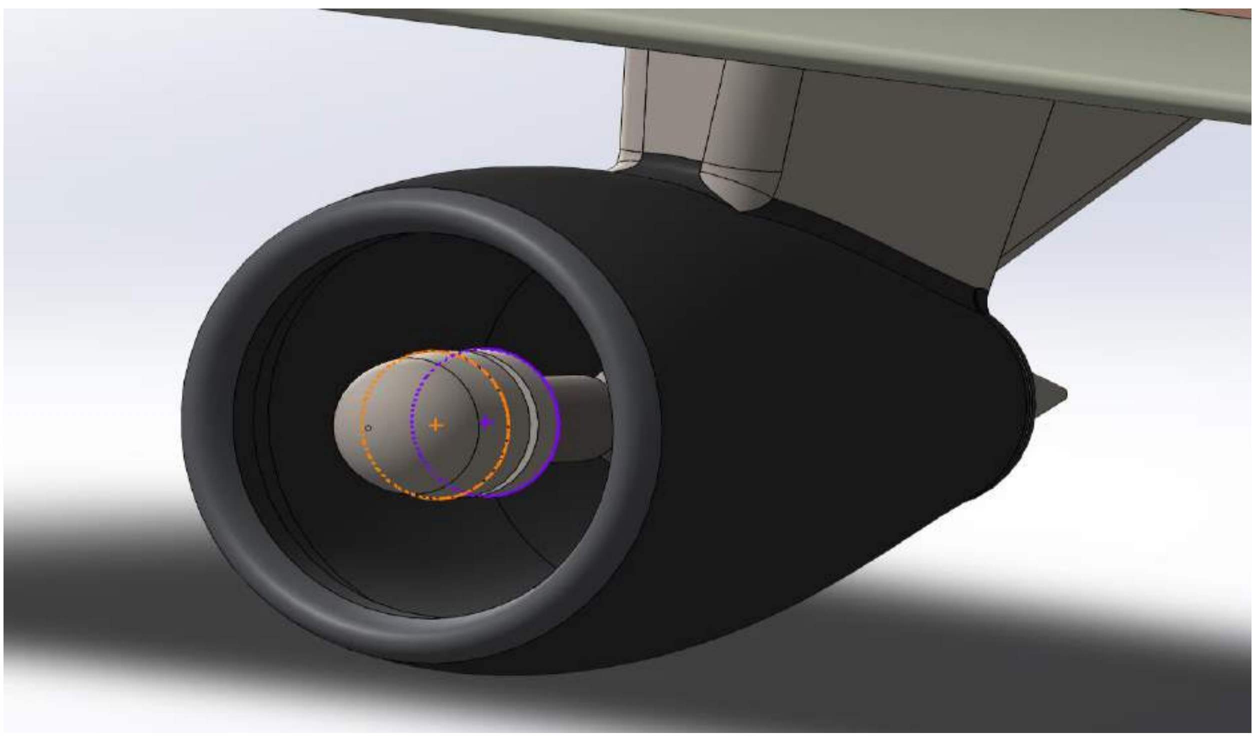
Step 4: Now to emplace the cover of the engine, using the right plan of the cover, do a coincident mate to the right plane of the wing



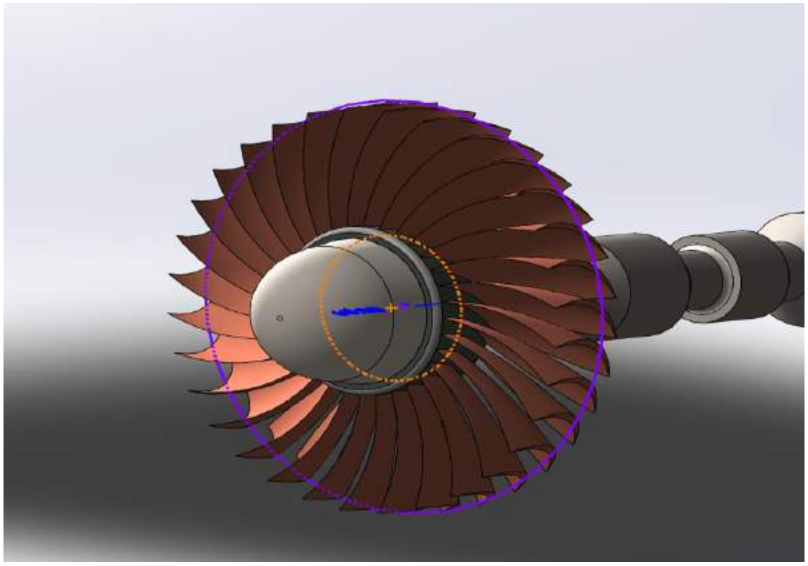
Step 5: Similarly, do a coincident mate for the other planes to the planes of the wing to fix the geometry from rotating



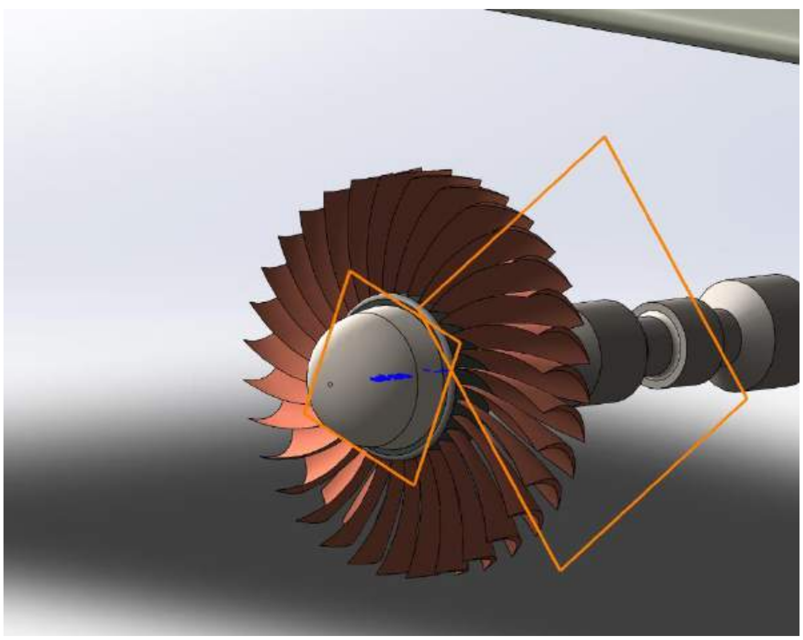
Step 6: Now place the engine shaft inside the engine cover, so we use a profile center mate



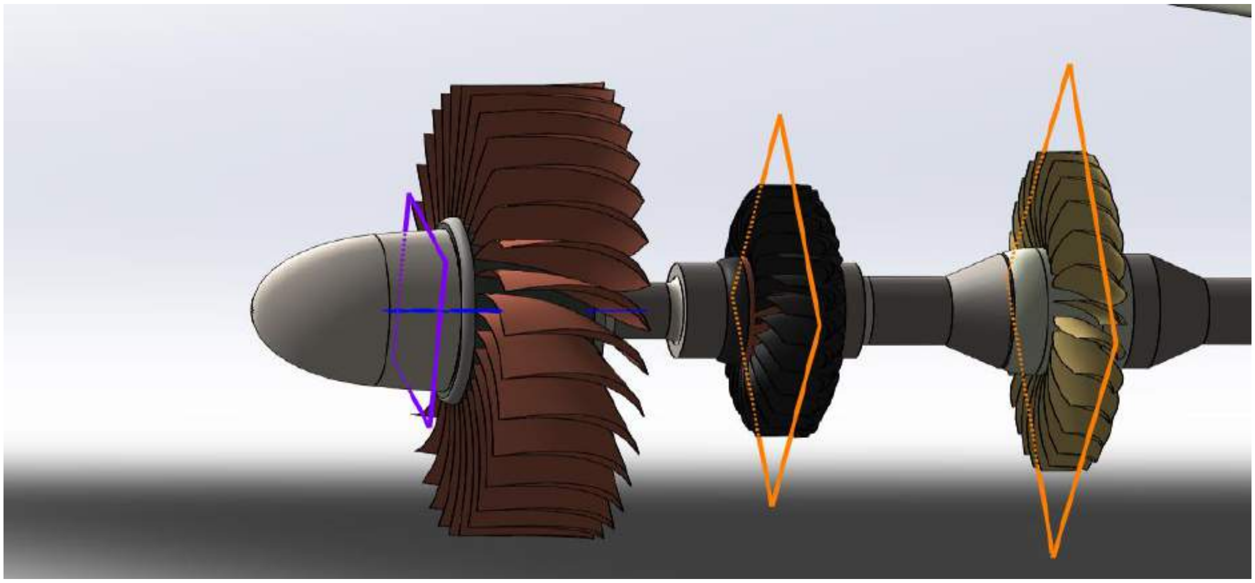
Step 7: Now to place the first out blade to the engine shaft, use concentric mate to the engine shaft and outer ring of the fan.



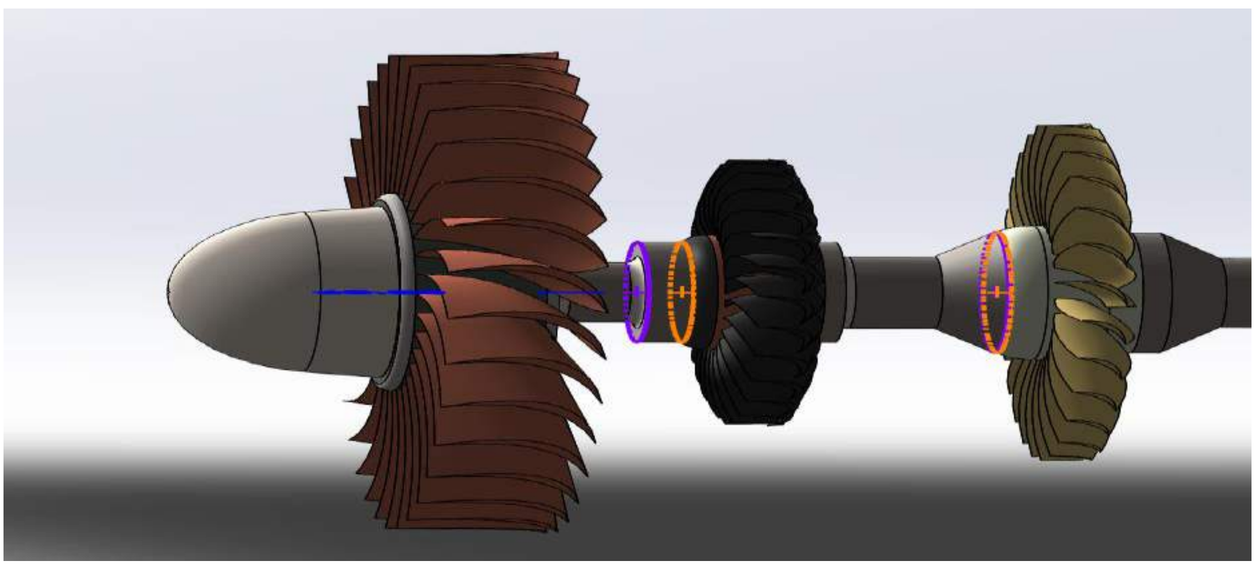
Step 8: Now to place the position of the blade on the shaft, use the front plane of the engine shaft and fan/blade and use coincident mate to place it in the position



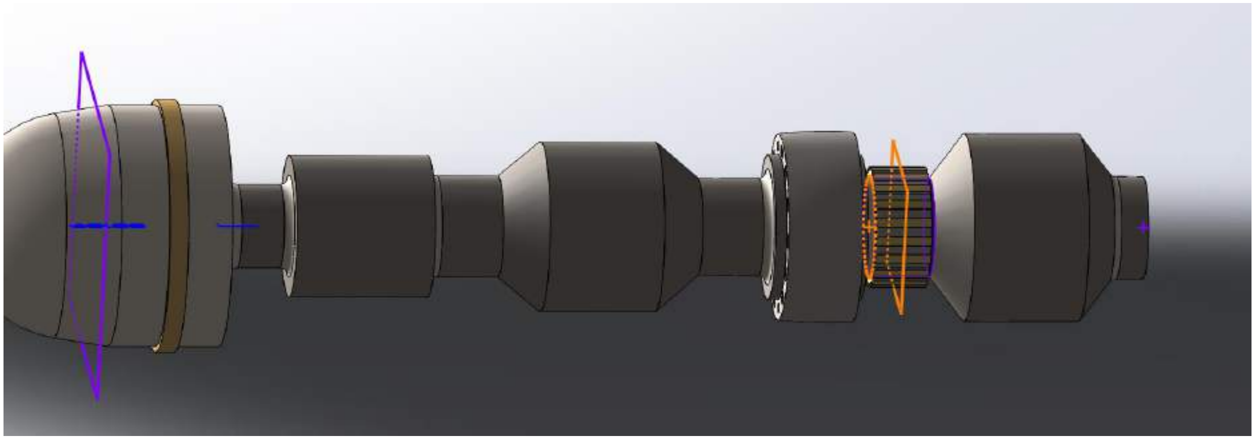
Step 9: Similarly, to emplace the inner blade in position, follow the above same procedure but vary the distance from the common plan i.e., the front plane of the engine shaft and place the blades in position



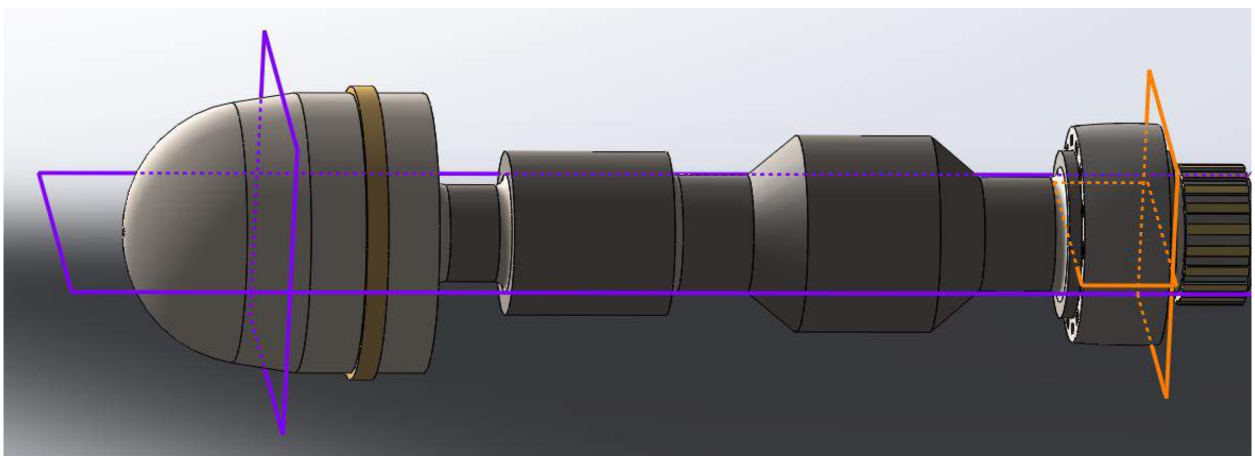
Step 10: using concentric mate, keep the blades in position



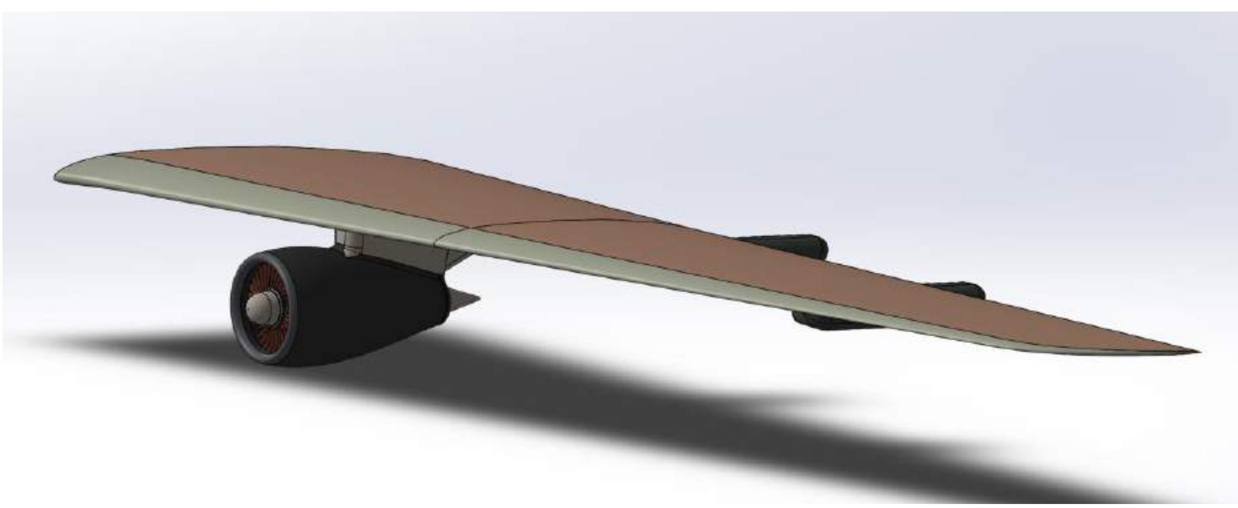
Step 11: Now, using concentric mate and coincident mate with the temporary axis of the shaft and the compressor, place the compressor in position



Step 12: To keep the turbine burner, using coincident mate and distant mate with respect to the plane of the part and shaft.

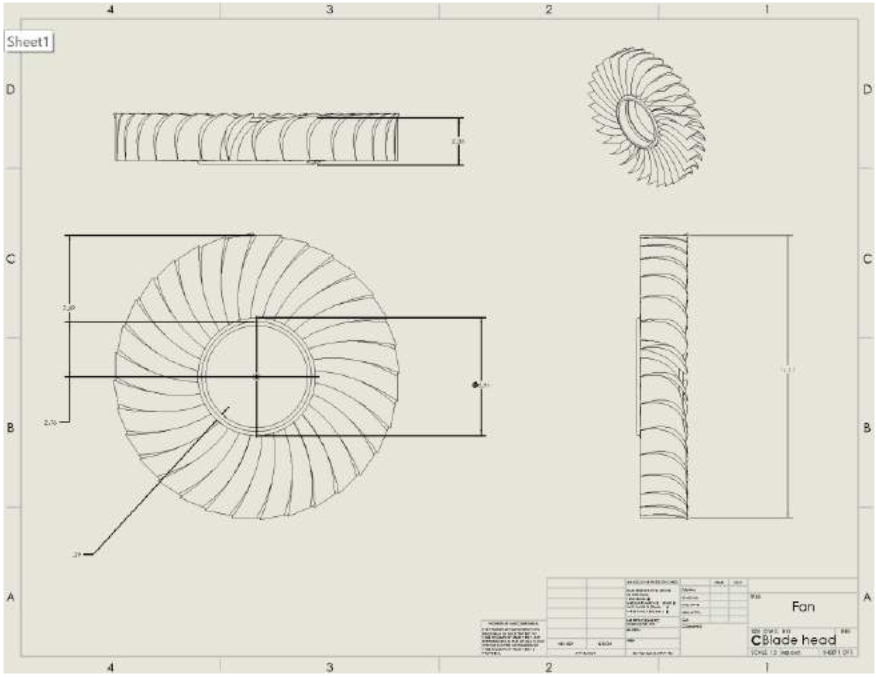


Step 13: After doing all above steps, click on rebuild feature and we get the required assembled part

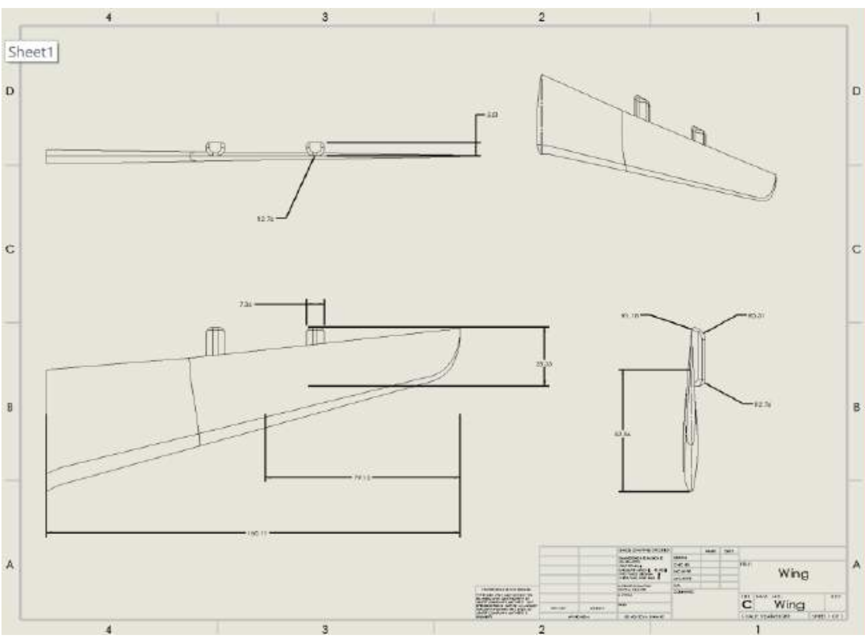


Drawing of the parts

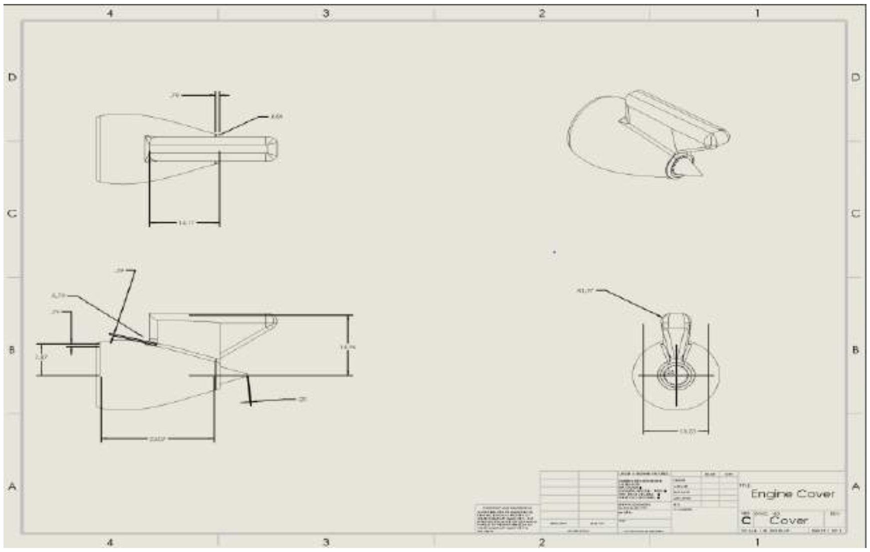
Blade Head



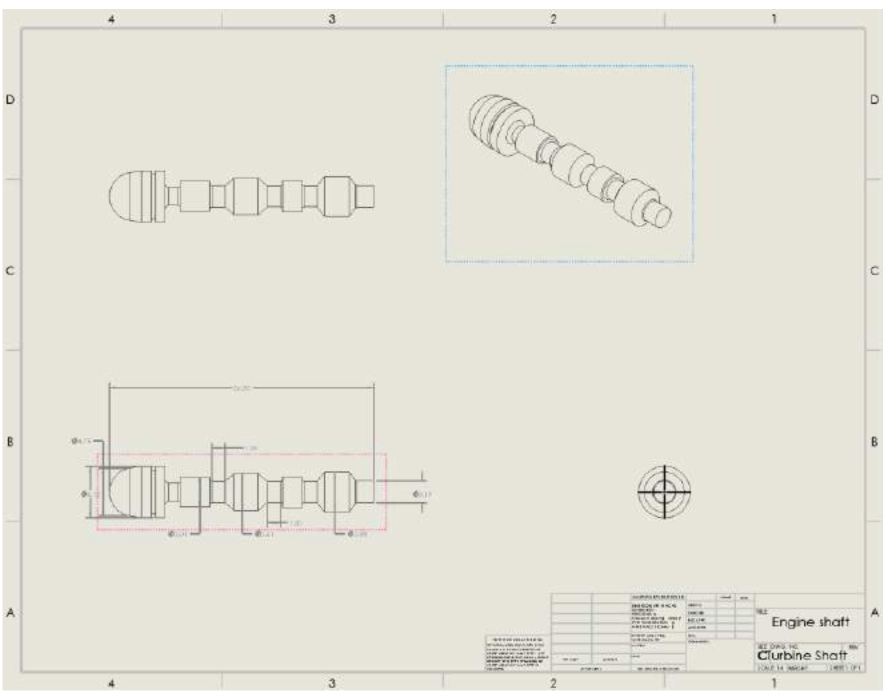
Wing



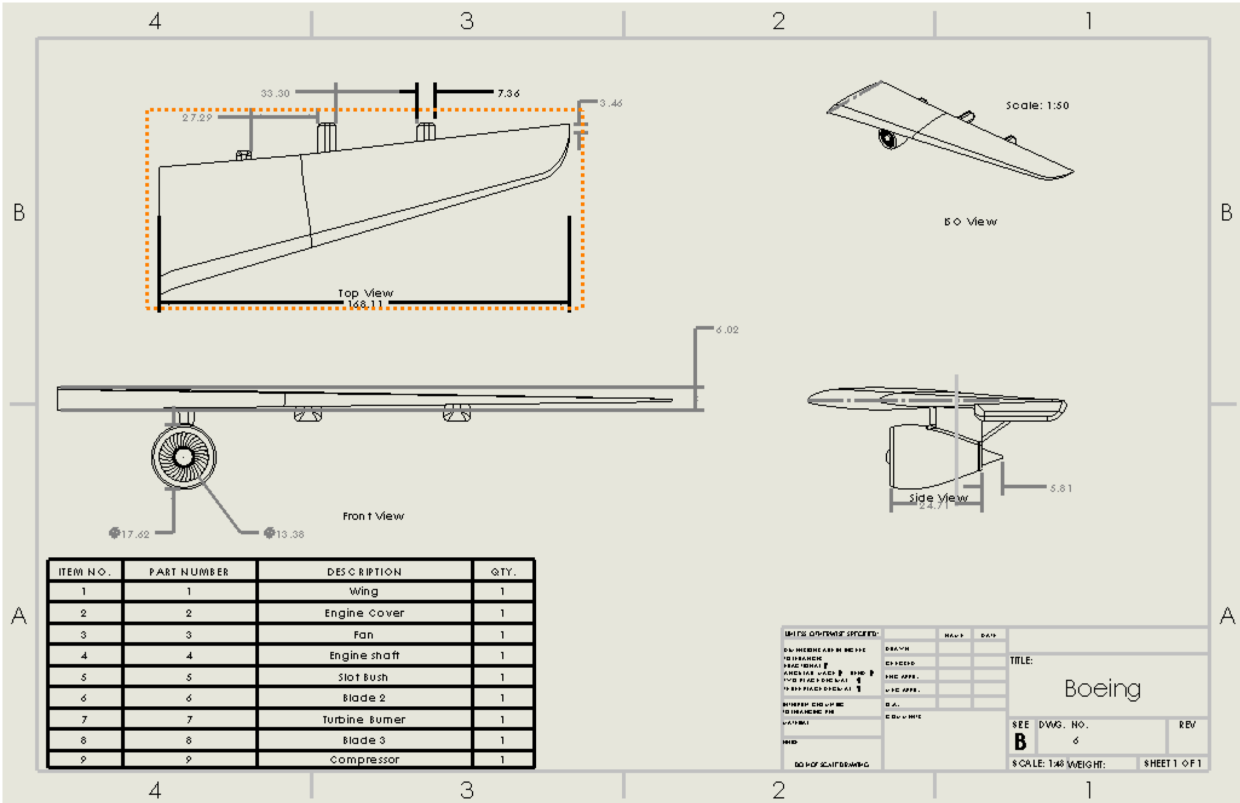
Engine Cover



Shaft

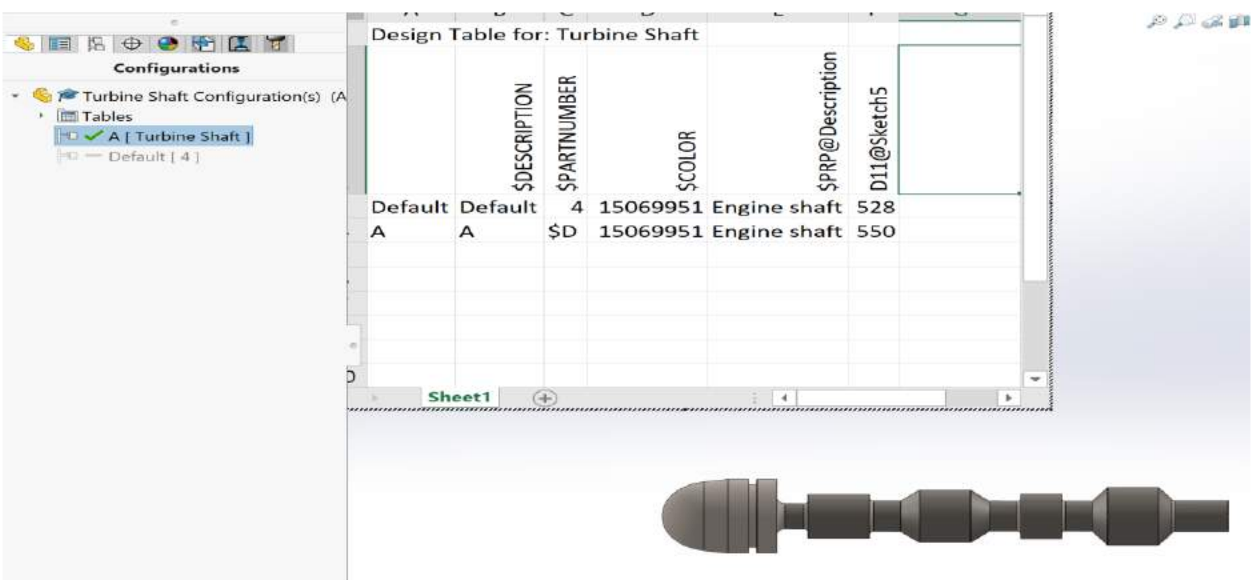


Assembly

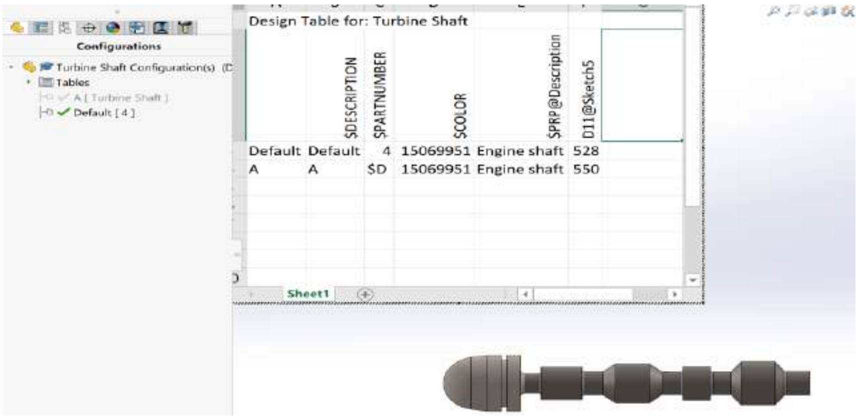


Design Table

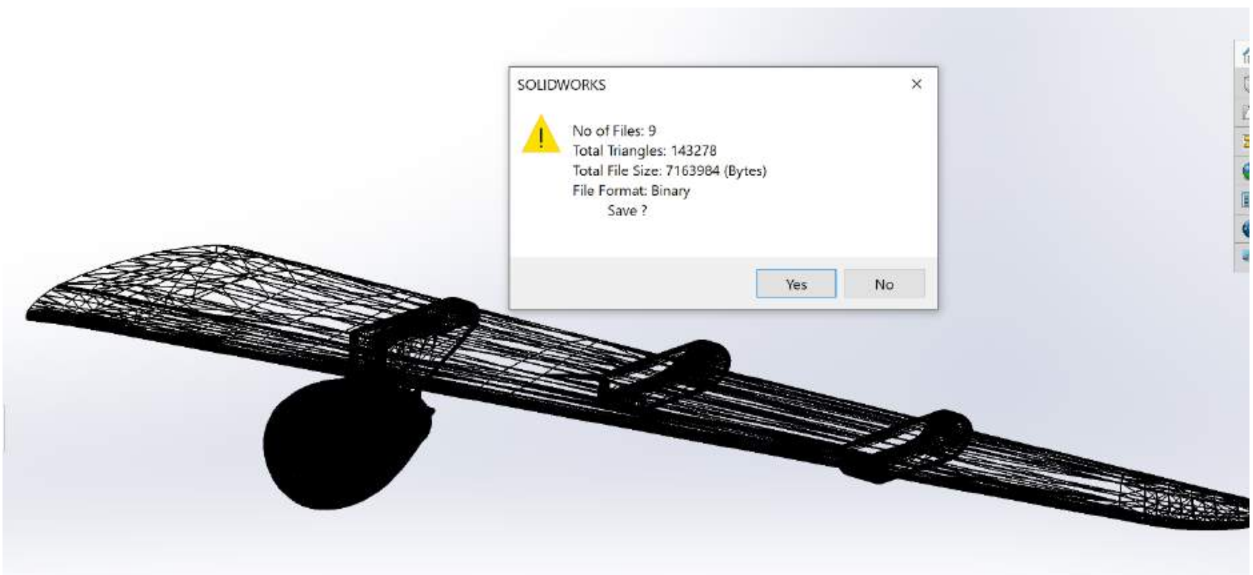
Configuration A



Configuration Default

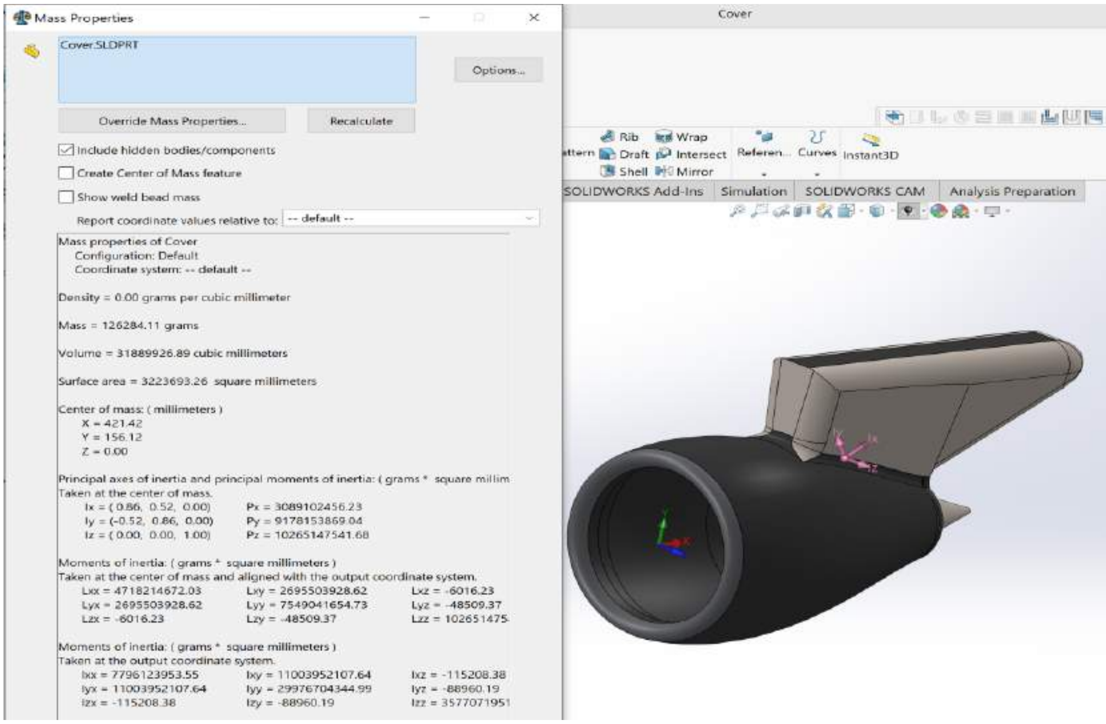


STL File

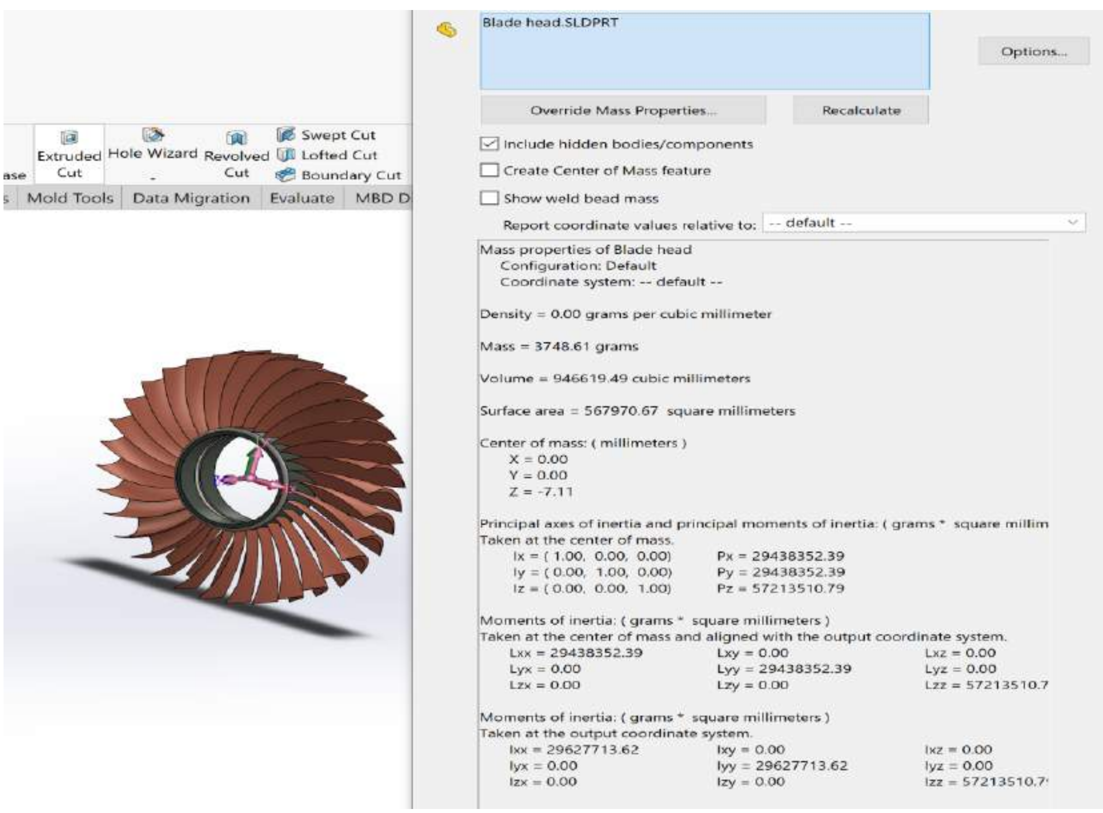


Mass Properties

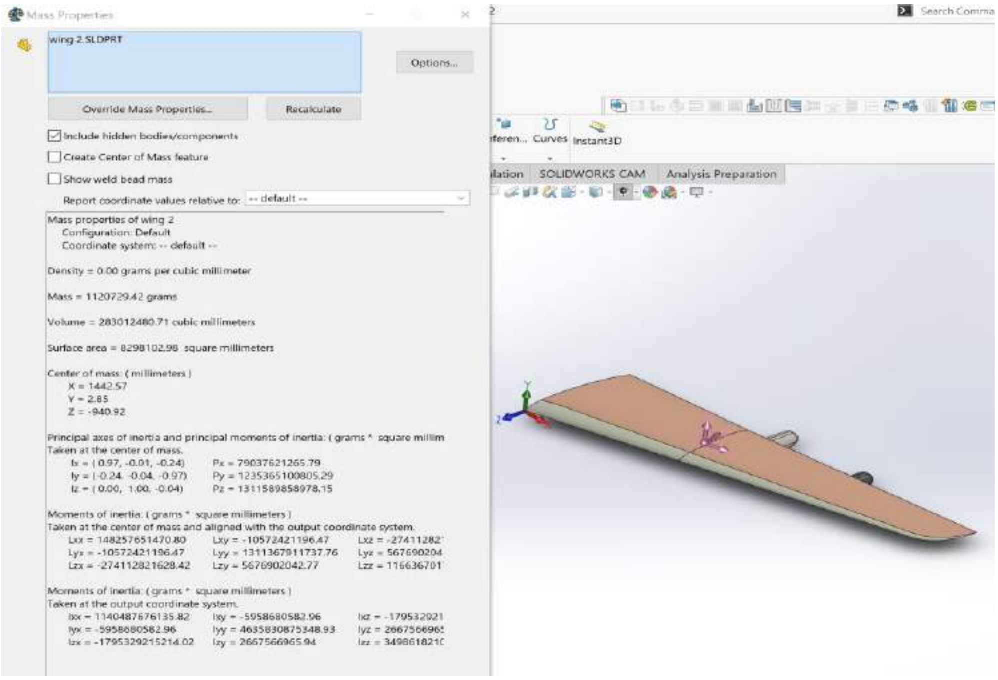
Engine Cover



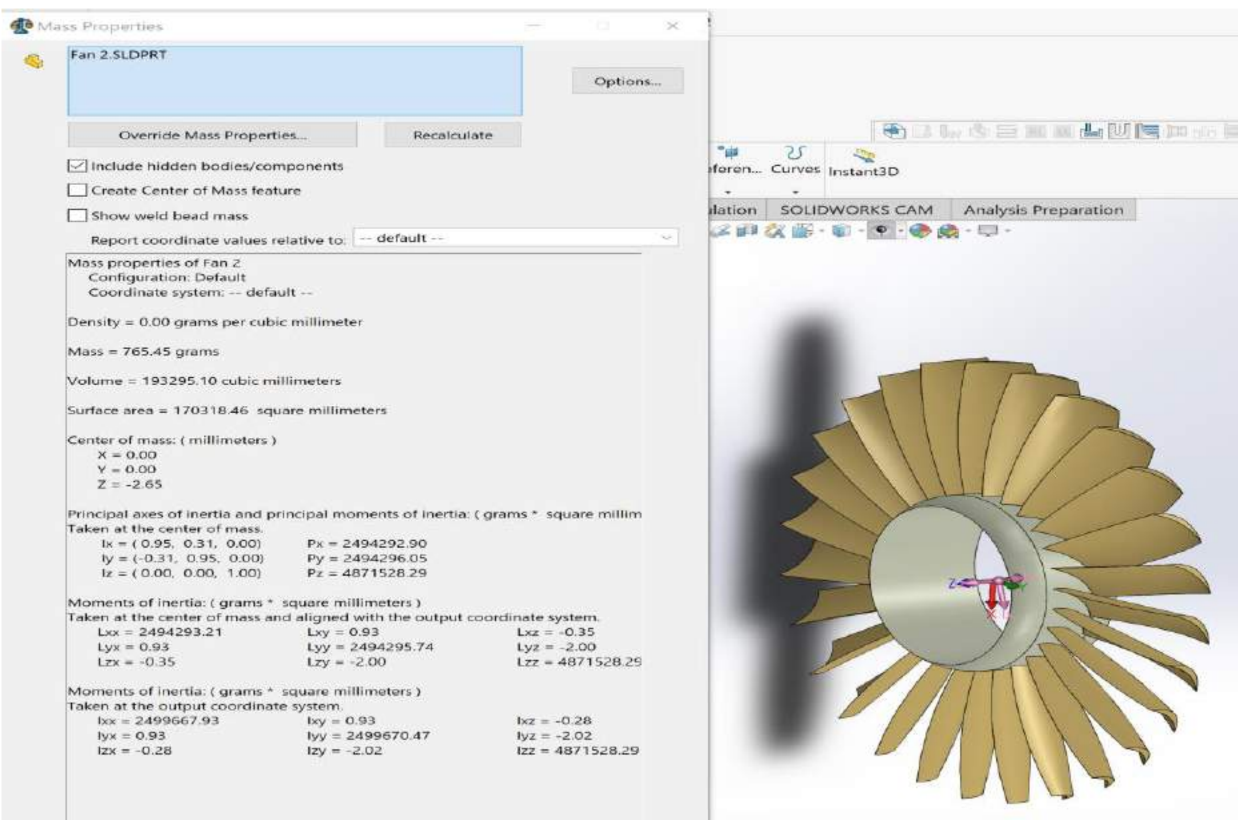
Outer blade



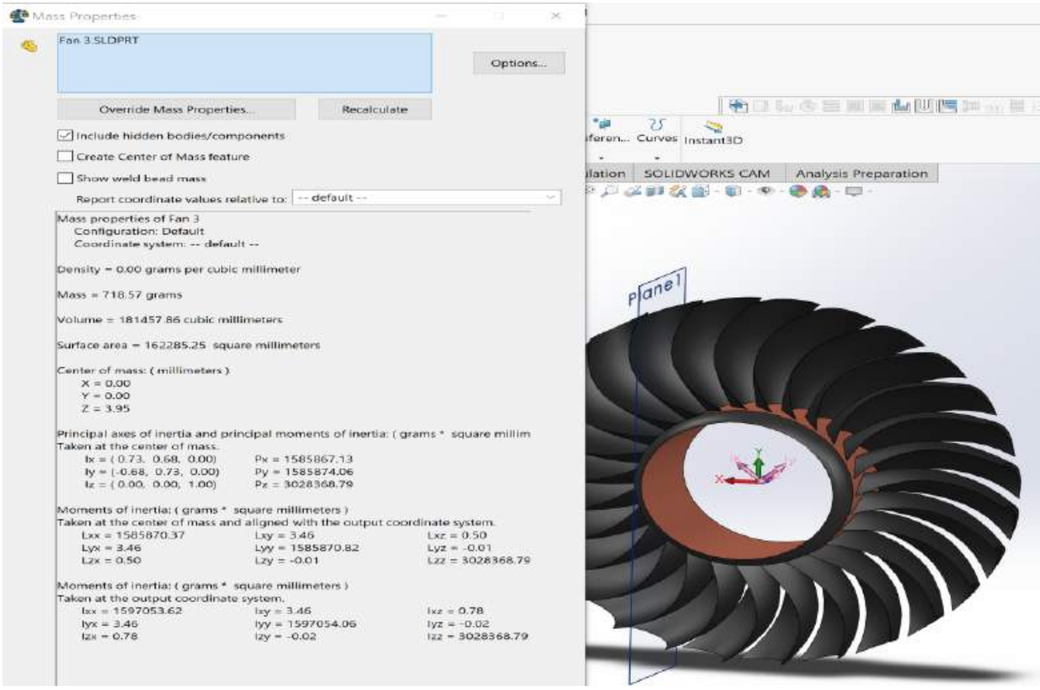
Wing


Mass Properties
wing 2.SLDPRT
Options...
Override Mass Properties...
Recalculate
Include hidden bodies/components
Create Center of Mass feature
Show weld bead mass
Report coordinate values relative to: -- default --
Mass properties of wing 2
Configuration: Default
Coordinate system: -- default --
Density = 0.00 grams per cubic millimeter
Mass = 1120729.42 grams
Volume = 283012480.71 cubic millimeters
Surface area = 8298102.98 square millimeters
Center of mass: (millimeters)
X = 1442.57
Y = 2.85
Z = -940.92
Principal axes of inertia and principal moments of inertia: (grams * square millim
Taken at the center of mass.
Ix = (0.97, -0.01, -0.24) Px = 79037621265.79
Iy = (-0.24, -0.04, -0.97) Py = 1235365100805.29
Iz = (0.00, 1.00, -0.04) Pz = 1311589858978.15
Moments of inertia: (grams * square millimeters)
Taken at the center of mass and aligned with the output coordinate system.
Lxx = 148257651470.80 Lxy = -10572421196.47 Lxz = -27411282
Lyx = -10572421196.47 Lyy = 1311367911737.76 Lyz = 567690204
Lzx = -274112821628.42 Lzy = 5676902042.77 Lzz = 116636701
Moments of inertia: (grams * square millimeters)
Taken at the output coordinate system.
Ixx = 1140487676135.82 Ixy = -5958680582.96 Ixz = -179532921
Iyx = -5958680582.96 Iyy = 4635830875348.93 Iyz = 266756696
Izx = -1795329215214.02 Izy = 2667566965.94 Izz = 349861821
Search Comma
Curves
Instant3D
SOLIDWORKS CAM
Analysis Preparation

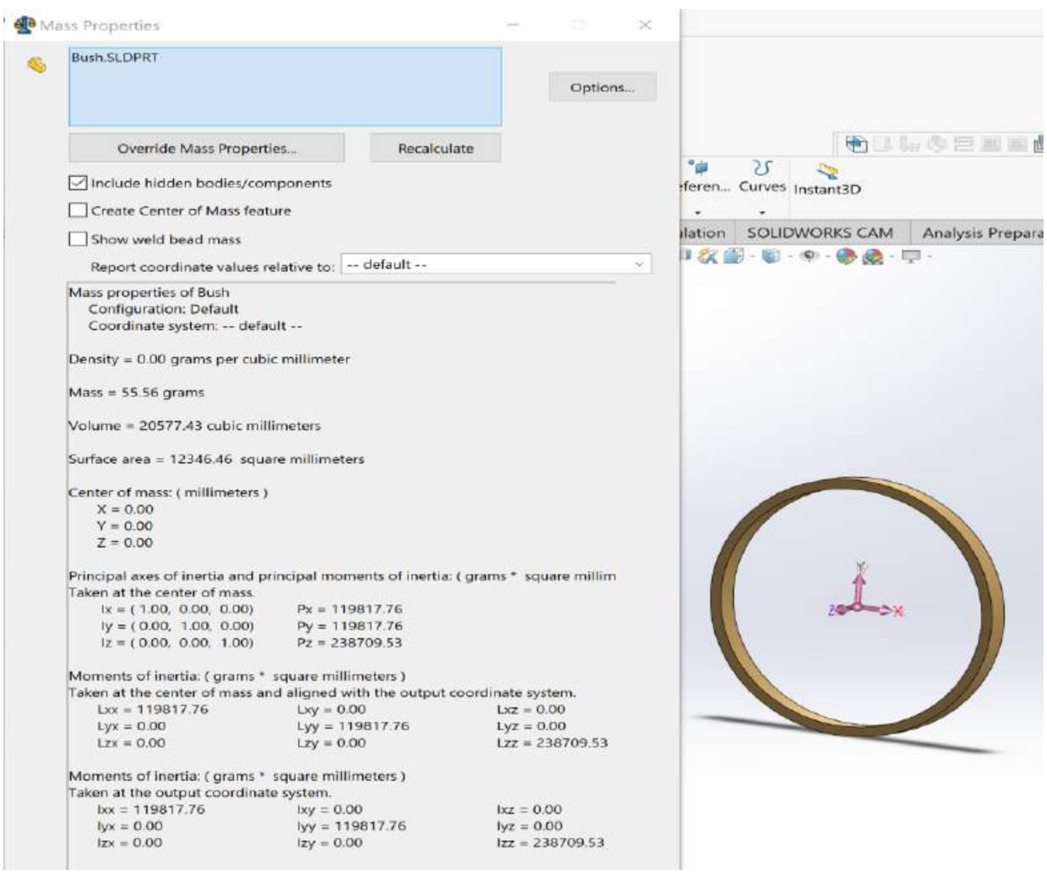
Fan 2


Mass Properties
Fan 2.SLDPRT
Options...
Override Mass Properties...
Recalculate
Include hidden bodies/components
Create Center of Mass feature
Show weld bead mass
Report coordinate values relative to: -- default --
Mass properties of Fan 2
Configuration: Default
Coordinate system: -- default --
Density = 0.00 grams per cubic millimeter
Mass = 765.45 grams
Volume = 193295.10 cubic millimeters
Surface area = 170318.46 square millimeters
Center of mass: (millimeters)
X = 0.00
Y = 0.00
Z = -2.65
Principal axes of inertia and principal moments of inertia: (grams * square millim
Taken at the center of mass.
Ix = (0.95, 0.31, 0.00) Px = 2494292.90
Iy = (-0.31, 0.95, 0.00) Py = 2494296.05
Iz = (0.00, 0.00, 1.00) Pz = 4871528.29
Moments of inertia: (grams * square millimeters)
Taken at the center of mass and aligned with the output coordinate system.
Lxx = 2494293.21 Lxy = 0.93 Lxz = -0.35
Lyx = 0.93 Lyy = 2494295.74 Lyz = -2.00
Lzx = -0.35 Lzy = -2.00 Lzz = 4871528.29
Moments of inertia: (grams * square millimeters)
Taken at the output coordinate system.
Ixx = 2499667.93 Ixy = 0.93 Ixz = -0.28
Iyx = 0.93 Iyy = 2499670.47 Iyz = -2.02
Izx = -0.28 Izy = -2.02 Izz = 4871528.29
Curves
Instant3D
SOLIDWORKS CAM
Analysis Preparation

Fan 3


Mass Properties
Fan 3.SLDPRT
Options...
Override Mass Properties...
Recalculate
Include hidden bodies/components
Create Center of Mass feature
Show weld bead mass
Report coordinate values relative to: -- default --
Mass properties of Fan 3
Configuration: Default
Coordinate system: -- default --
Density = 0.00 grams per cubic millimeter
Mass = 718.57 grams
Volume = 181457.86 cubic millimeters
Surface area = 162285.25 square millimeters
Center of mass: (millimeters)
X = 0.00
Y = 0.00
Z = 3.95
Principal axes of inertia and principal moments of inertia: (grams * square millim
Taken at the center of mass.
Ix = (0.73, 0.68, 0.00) Px = 1585867.13
Iy = (-0.68, 0.73, 0.00) Py = 1585874.06
Iz = (0.00, 0.00, 1.00) Pz = 3028368.79
Moments of inertia: (grams * square millimeters)
Taken at the center of mass and aligned with the output coordinate system.
Lxx = 1585870.37 Lxy = 3.46 Lxz = 0.50
Lyx = 3.46 Lyy = 1585870.82 Lyz = -0.01
Lzx = 0.50 Lzy = -0.01 Lzz = 3028368.79
Moments of inertia: (grams * square millimeters)
Taken at the output coordinate system.
Ixx = 1597053.62 Ixy = 3.46 Ixz = 0.78
Iyx = 3.46 Iyy = 1597054.06 Iyz = -0.02
Izx = 0.78 Izy = -0.02 Izz = 3028368.79
feren... Curves Instant3D
lation SOLIDWORKS CAM Analysis Preparation
Plane1

Bush


Mass Properties
Bush.SLDPRT
Options...
Override Mass Properties...
Recalculate
Include hidden bodies/components
Create Center of Mass feature
Show weld bead mass
Report coordinate values relative to: -- default --
Mass properties of Bush
Configuration: Default
Coordinate system: -- default --
Density = 0.00 grams per cubic millimeter
Mass = 55.56 grams
Volume = 20577.43 cubic millimeters
Surface area = 12346.46 square millimeters
Center of mass: (millimeters)
X = 0.00
Y = 0.00
Z = 0.00
Principal axes of inertia and principal moments of inertia: (grams * square millim
Taken at the center of mass.
Ix = (1.00, 0.00, 0.00) Px = 119817.76
Iy = (0.00, 1.00, 0.00) Py = 119817.76
Iz = (0.00, 0.00, 1.00) Pz = 238709.53
Moments of inertia: (grams * square millimeters)
Taken at the center of mass and aligned with the output coordinate system.
Lxx = 119817.76 Lxy = 0.00 Lxz = 0.00
Lyx = 0.00 Lyy = 119817.76 Lyz = 0.00
Lzx = 0.00 Lzy = 0.00 Lzz = 238709.53
Moments of inertia: (grams * square millimeters)
Taken at the output coordinate system.
Ixx = 119817.76 Ixy = 0.00 Ixz = 0.00
Iyx = 0.00 Iyy = 119817.76 Iyz = 0.00
Izx = 0.00 Izy = 0.00 Izz = 238709.53
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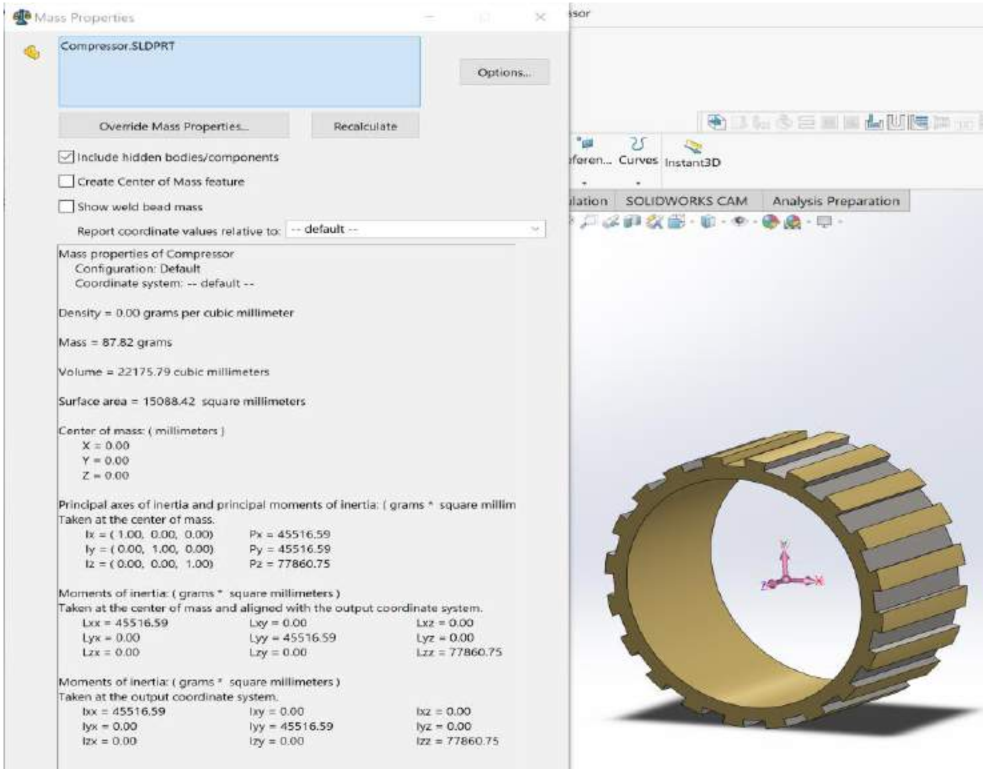
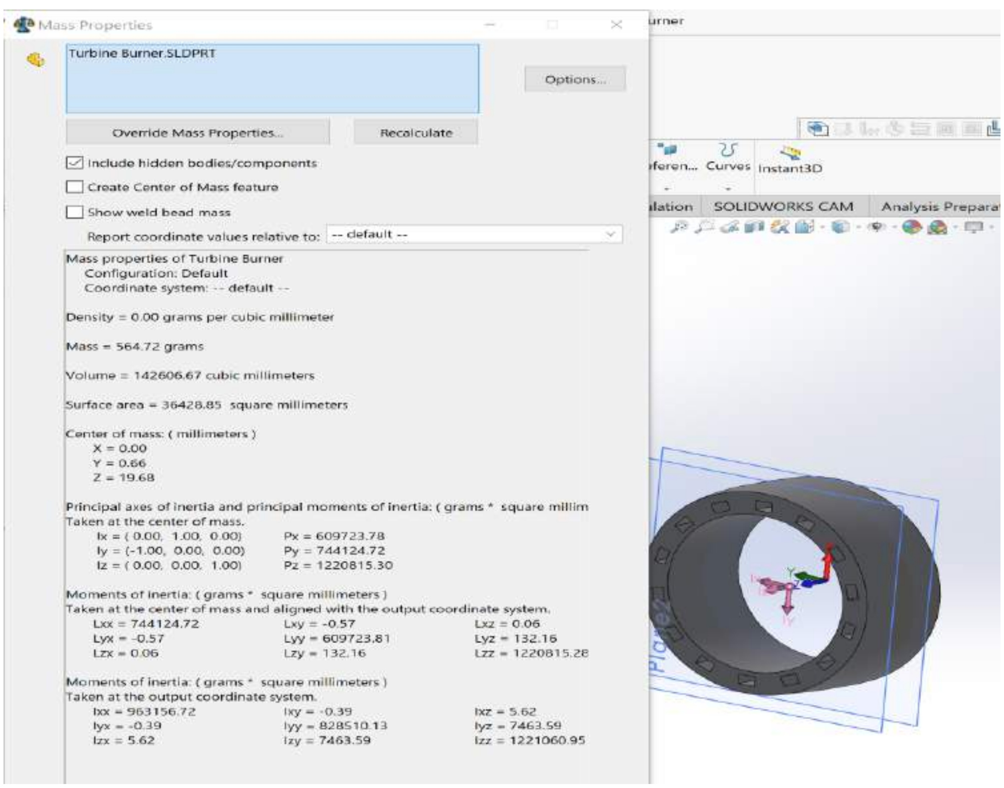
lation SOLIDWORKS CAM Analysis Prepara

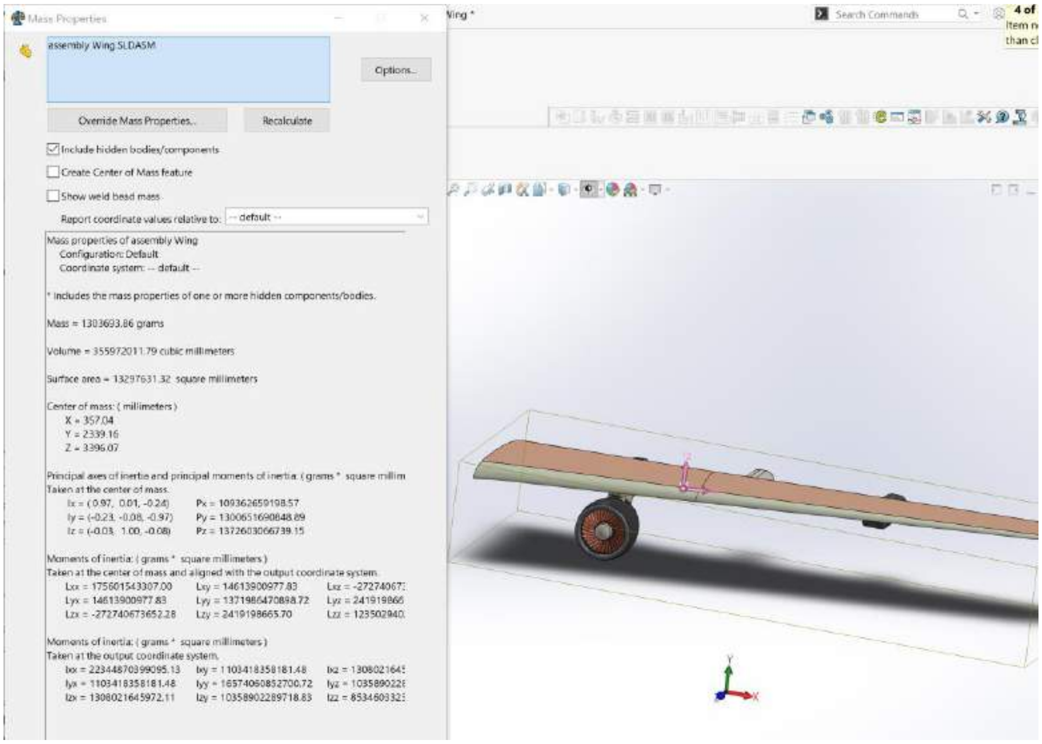
Compressor



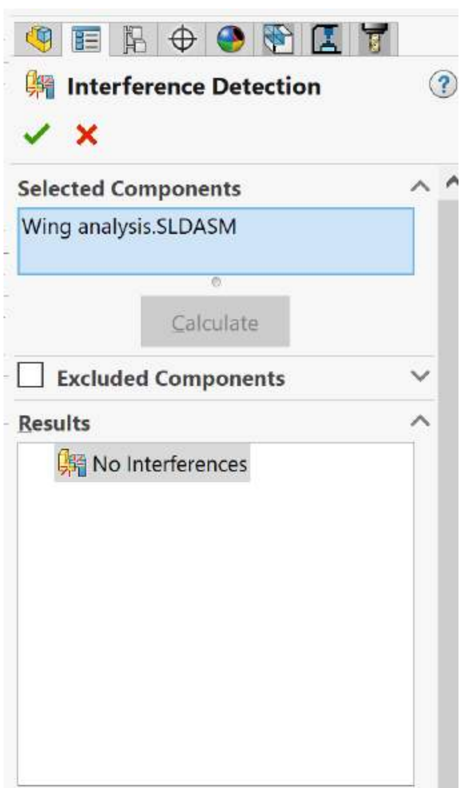
Turbine Burner



Assembly



Interference



Design Binder

Design Journal

File Name: **Wing analysis.SLDASM**

Description:

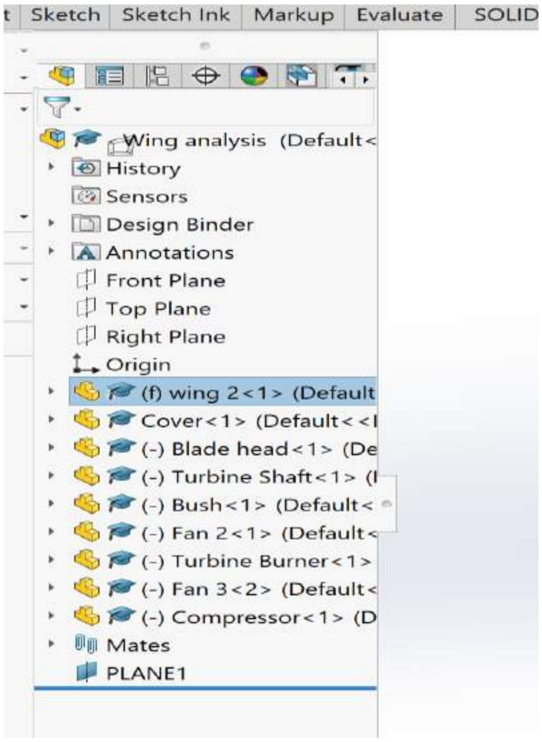
Material:

The wings generate most of the lift to hold the plane in the air. There are various forces acting on a wing helping the aircraft to have a lift and move forward with the help of the engine. To generate lift, the airplane must be pushed through the air, which is done with the help of an engine. The air resists the motion in the form of aerodynamic drag and this drag is determined by the force acting over the span of area of the wing. Modern airliners use winglets on the tips of the wings to reduce drag.
In general, an airfoil that helps to lift a heavier-than-aircraft are designed in such a way to make the whole body aerodynamic and helping the aircraft to pierce through air to have a flight.
An airfoil is defined by various analysis, and there are midspan airfoil like b747c-il which is used in Boeing 747 aircraft. Each airfoil section has specific Reynolds number and Mach number defined at specific angle of attack. So, in Boeing 747, we implement B747c-il and where it depends on the wing length along with the coefficient of lift and coefficient of drag.
In terms of usage, High-speed aircraft usually employ low-drag, low-lift airfoils that are thin and streamlined. Slow aircraft that carry heavy loads use thicker airfoils with high drag and high lift.
The engine of an aircraft is very similar to turbine engine, where the body converges to give an output, which is the push to have the aircraft move forward. The engine has various types depending on the need, and there are various fan blades used according to the need in the power to be generated for the aircraft. The blade airfoils are defined as per the need at which an aircraft must pursuit. The fan/blade of the engine requires airfoil design, where we can use NACA profile or the custom design profile to get the required output.
Whereas the wing design is considered depending on the angle of attach and it uses Bxxxx-il profiles where the angle of attach defines the life coefficient and drag coefficient.
Overall, the wing and engine works together to provide the lift/flight to the body as a whole helping us to transit.

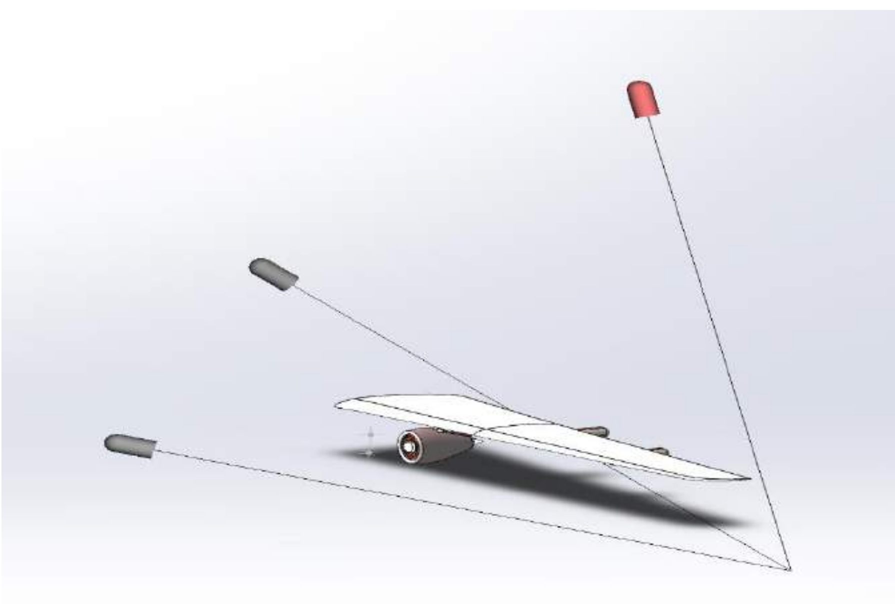
Design Table

	A	B	C	D	E	F	G	H
1	Design Table for: Turbine Shaft							
2	Default	D11@Sketch5	D1@Sketch3					
3	Config 1	50	="B"					
4	Config 1	65	="B"					
5								
6								
7								
8								
9								

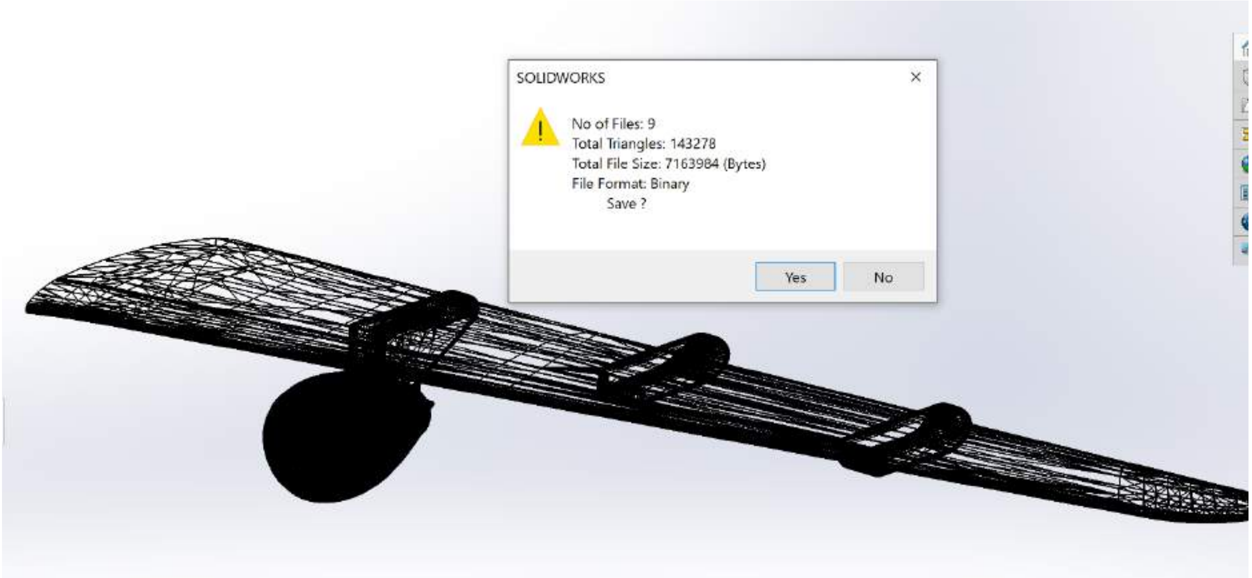
Assembly Tree



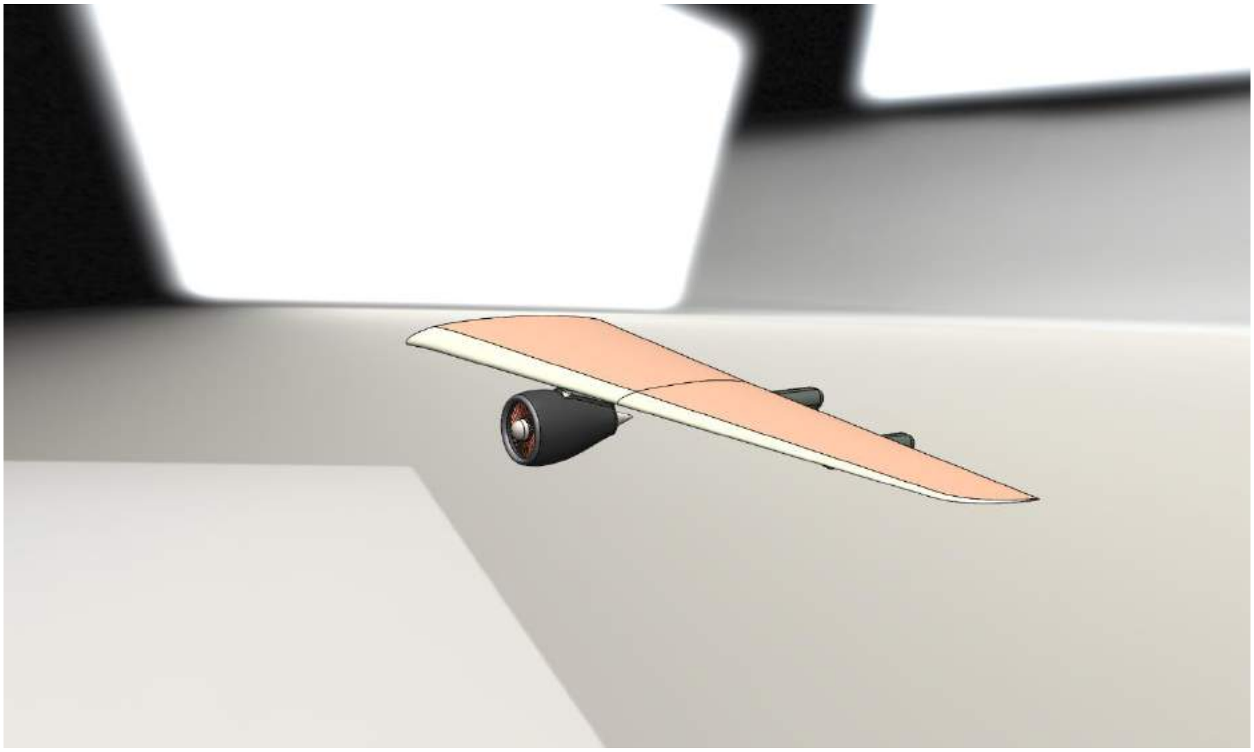
Lights



STL Files



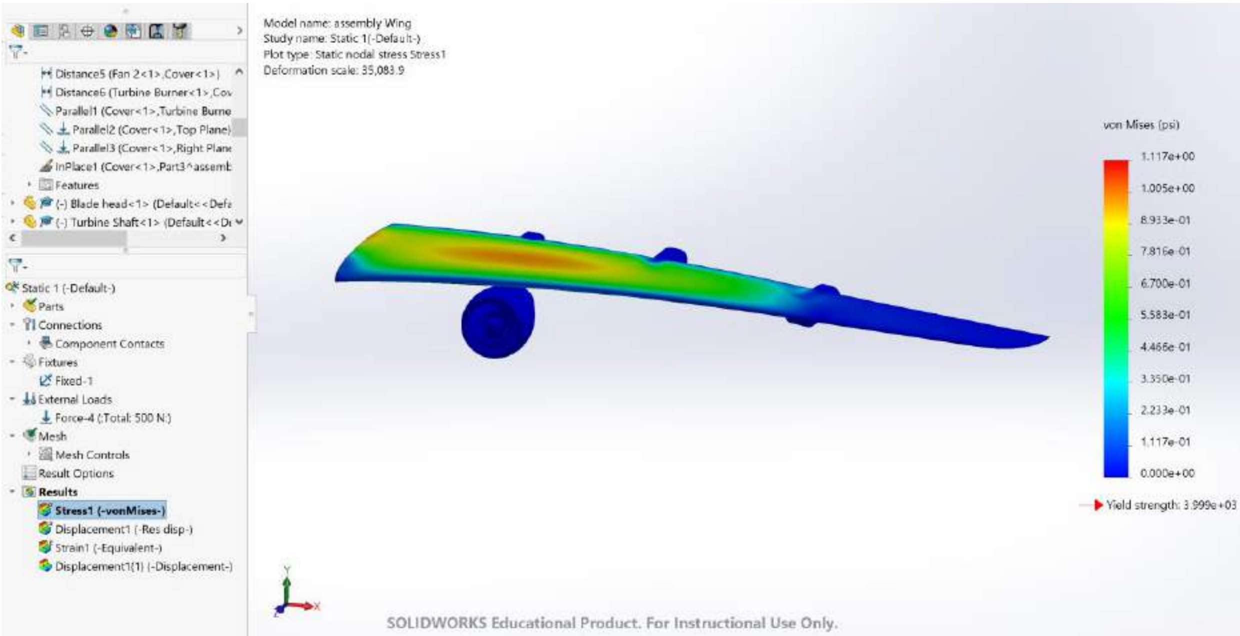
Background



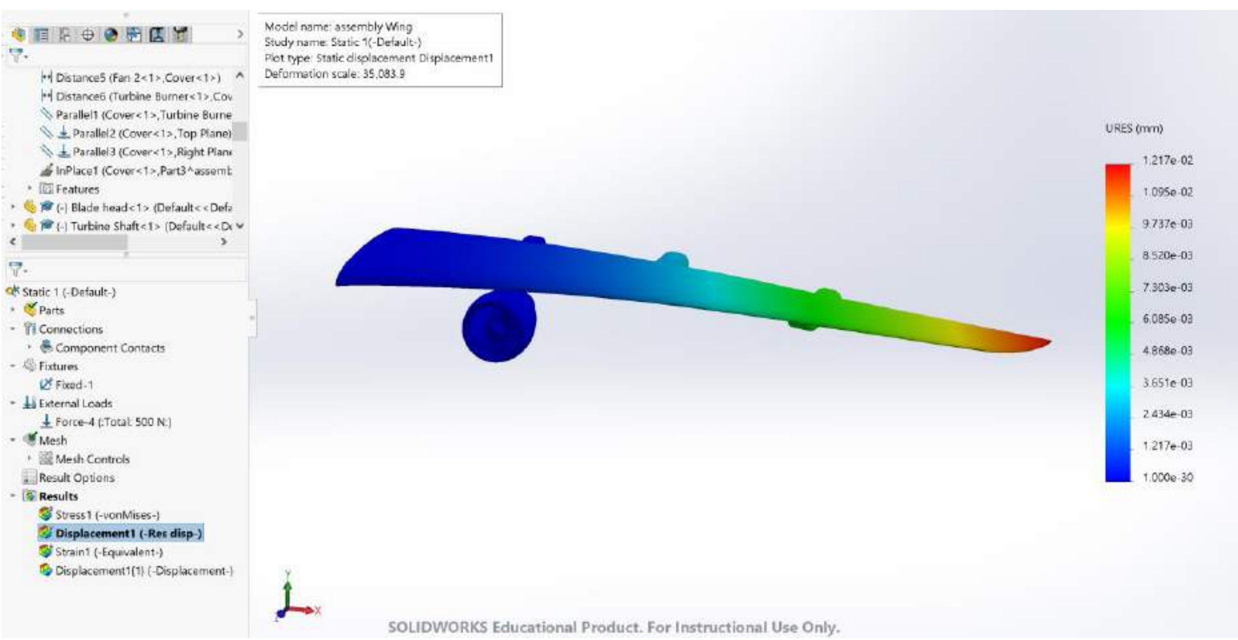
FEA

Force applied to the wing

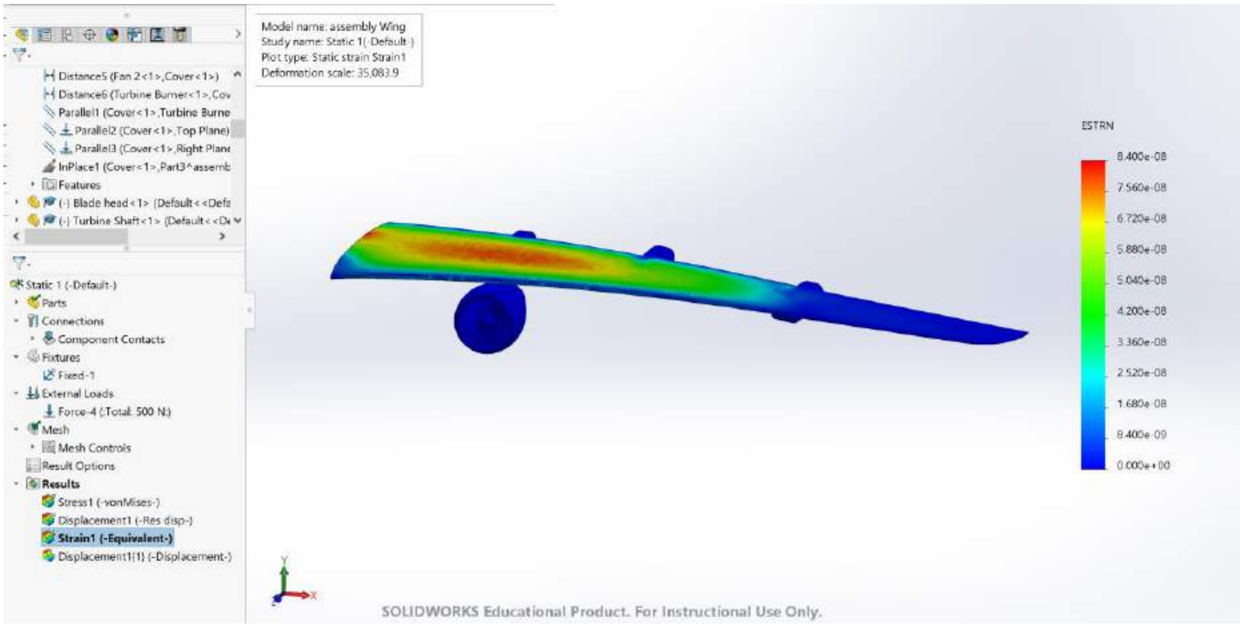
Stress (Von Mises)



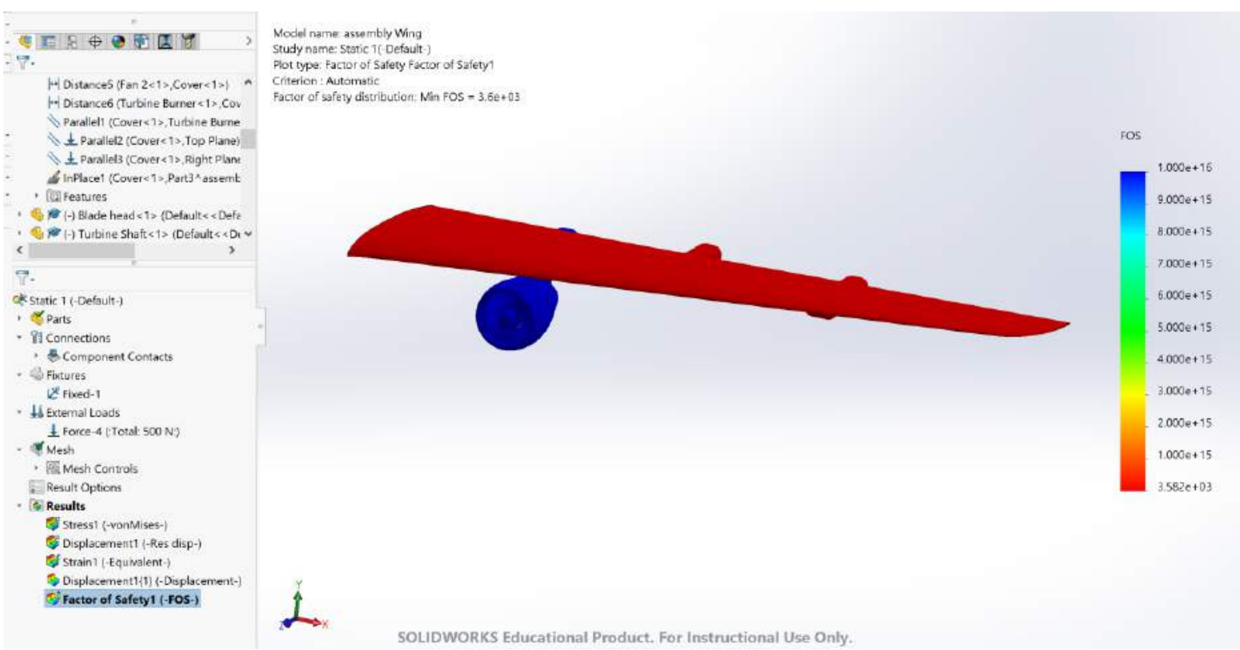
Displacement (Res Disp)



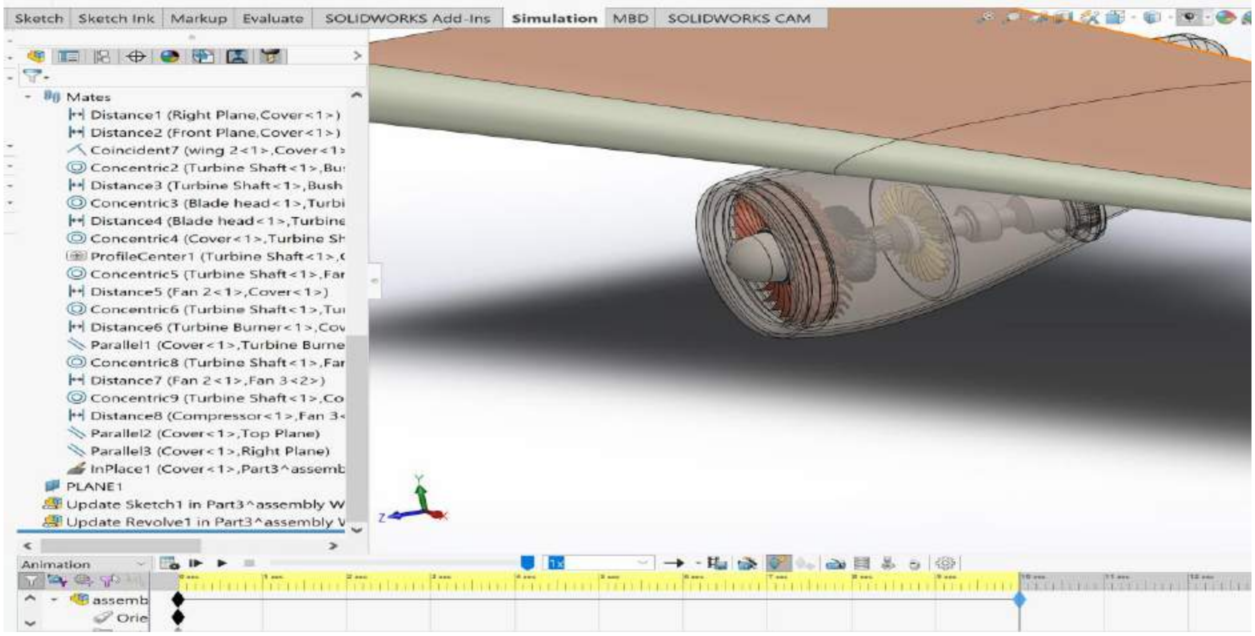
Strain (Equivalent)



Factor of safety (FOS)



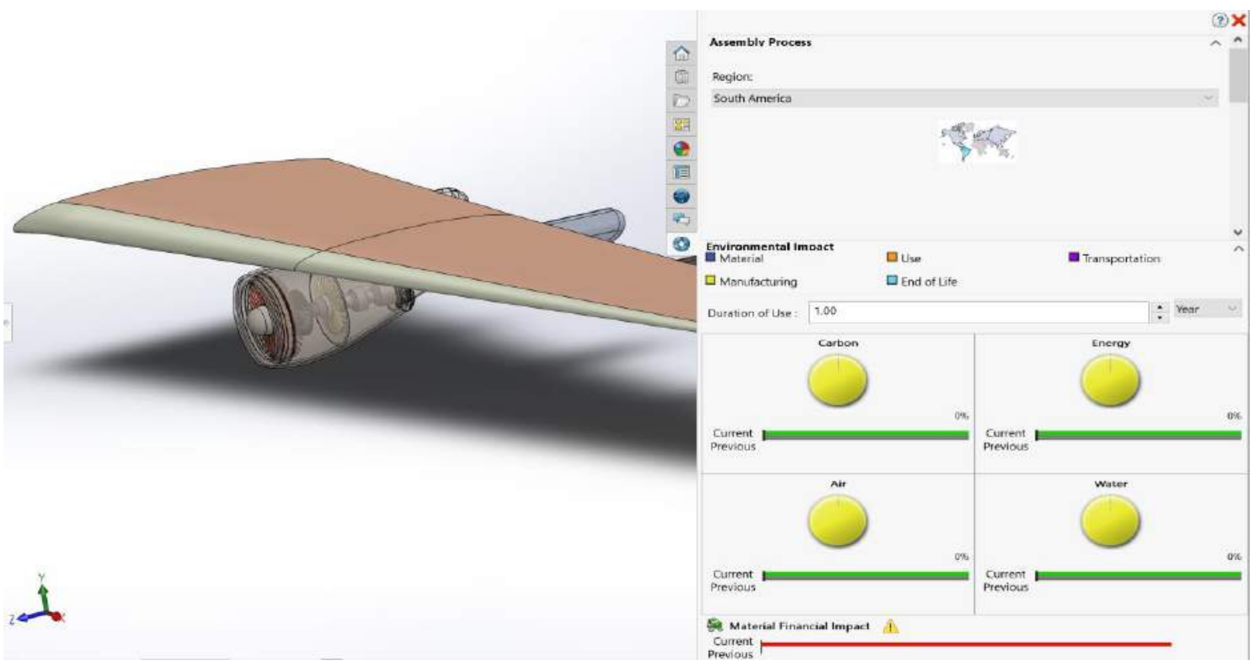
Motion Study



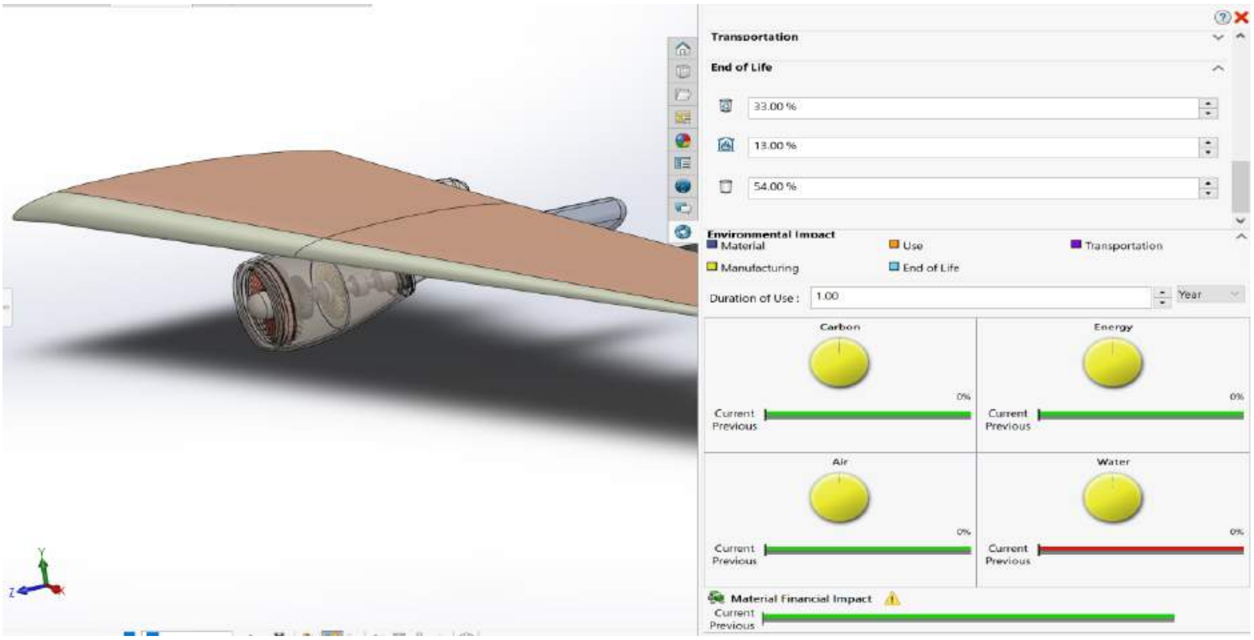
**Video attached as different file

Sustainability

Assembled in South America and used in North America



Assembled in Asia and used in North America



Assembled in Europe and used in North America