ACP & FEA OF THE CASE

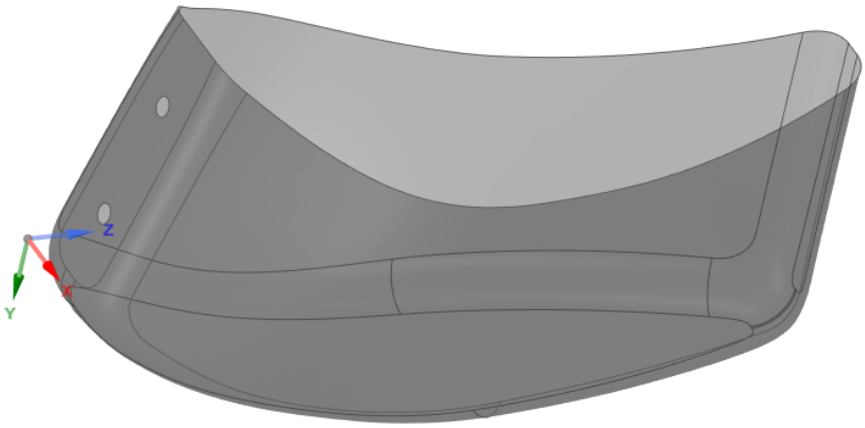
The week's objective: Finite Element Analysis on the Lower-case part.

The FEA of the case using ANSYS ACP tool simulates the part as a complete composite structure considering the fiber type, matrix type, fiber orientation, and fiber directions.

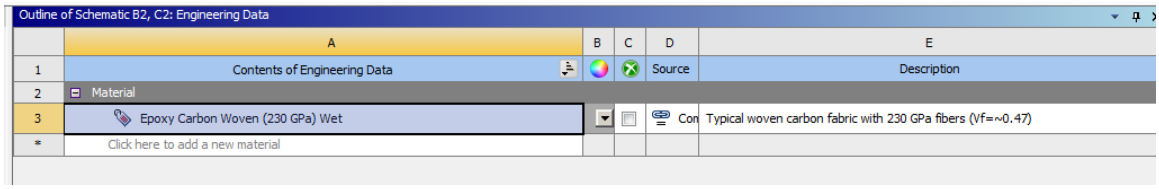
The tool enables to change the thickness of the part by adding or removing layers of fiber.

ACP:

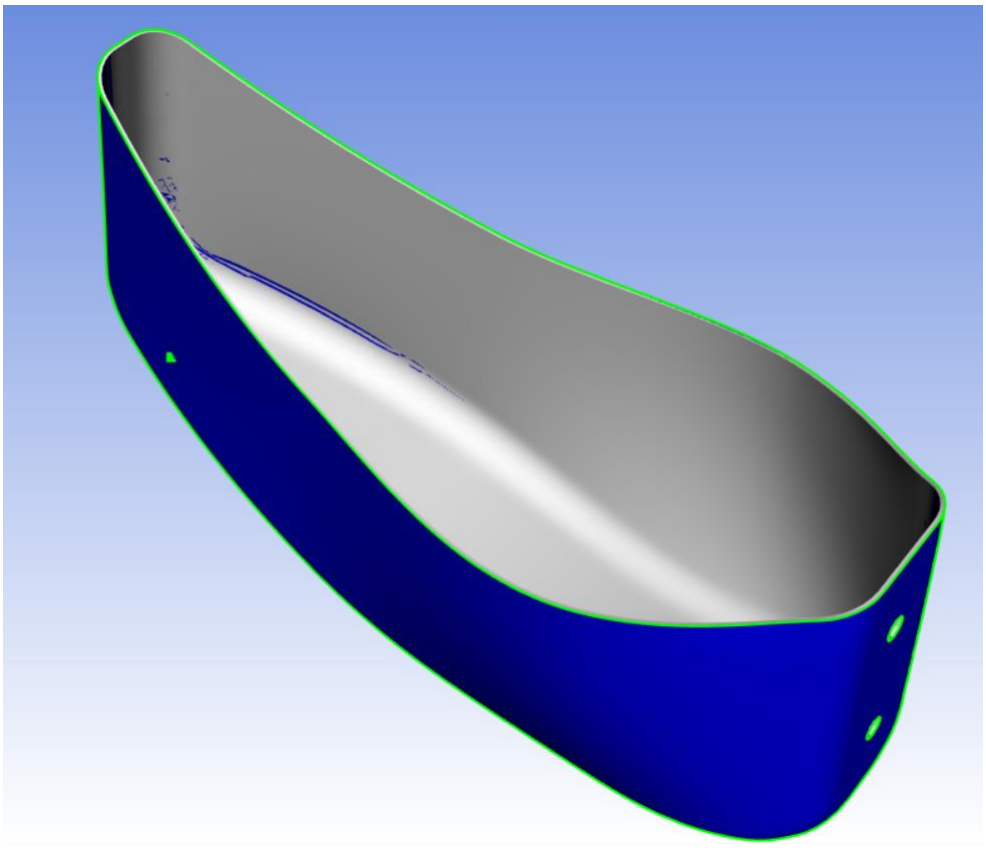
1- Start by modifying the geometry to keep only the surface of the case.



2- Choose material to be Woven Carbon fiber mixed with Epoxy.



3- Start building the layers:



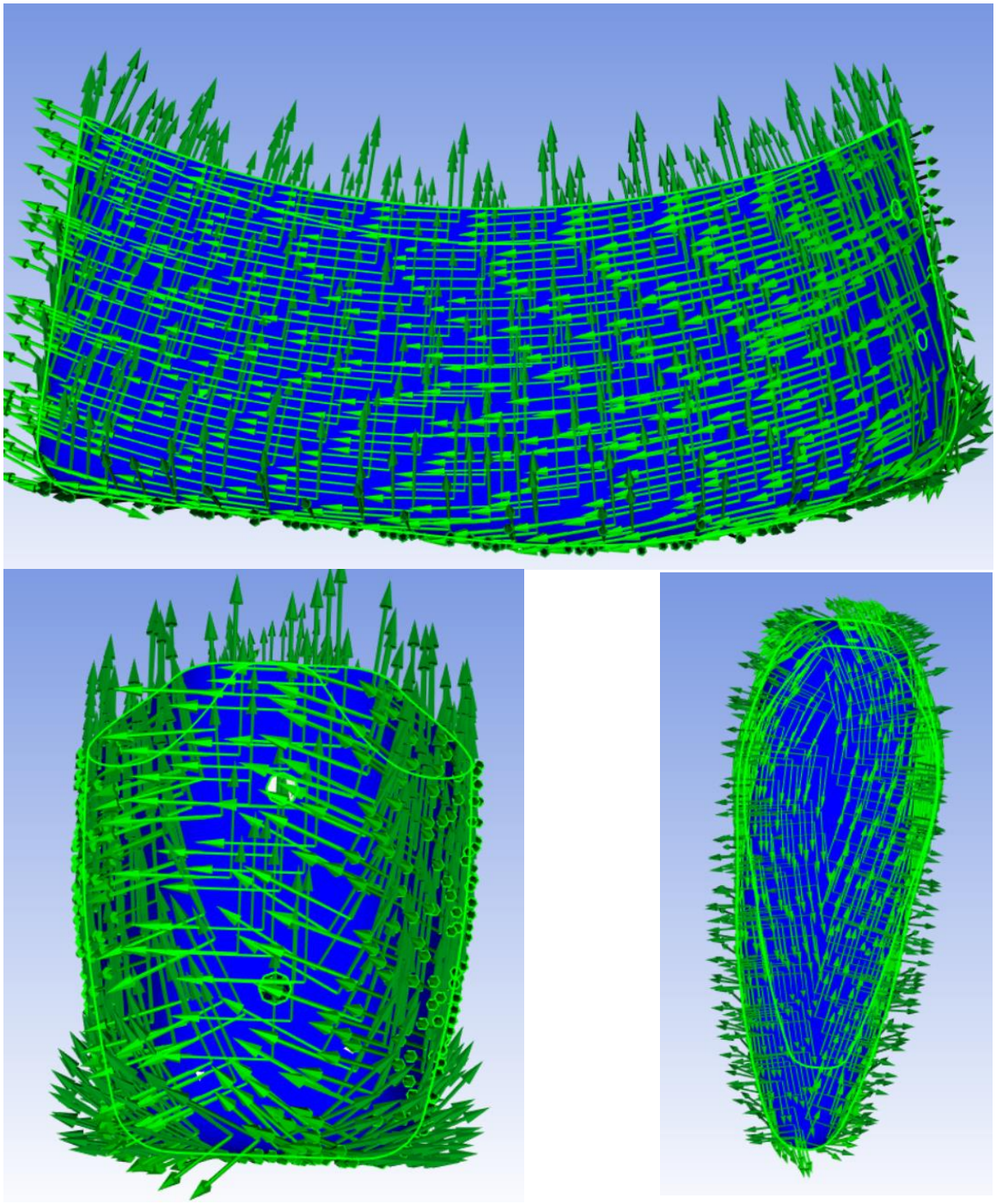
Fiber Orientation:

The used carbon fiber is (Woven) which means no specified orientation is needed.

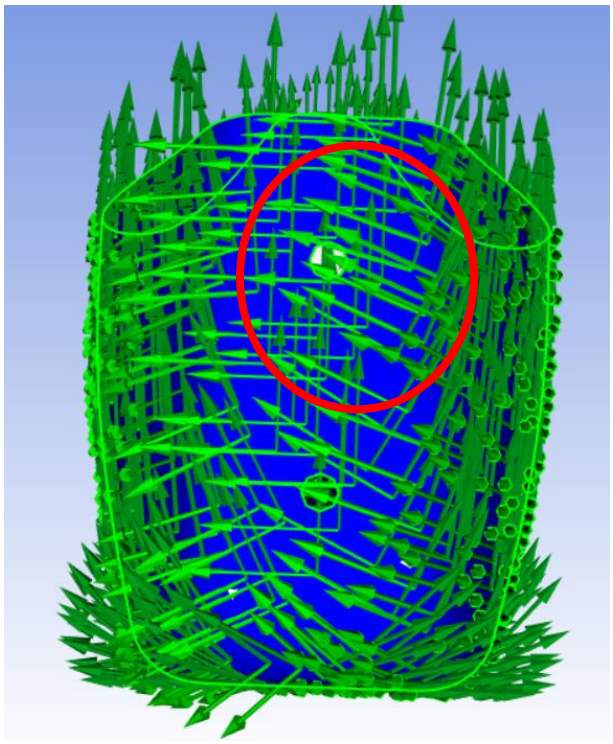
If Unidirectional carbon fiber is used, the best orientation is **(0,90).**

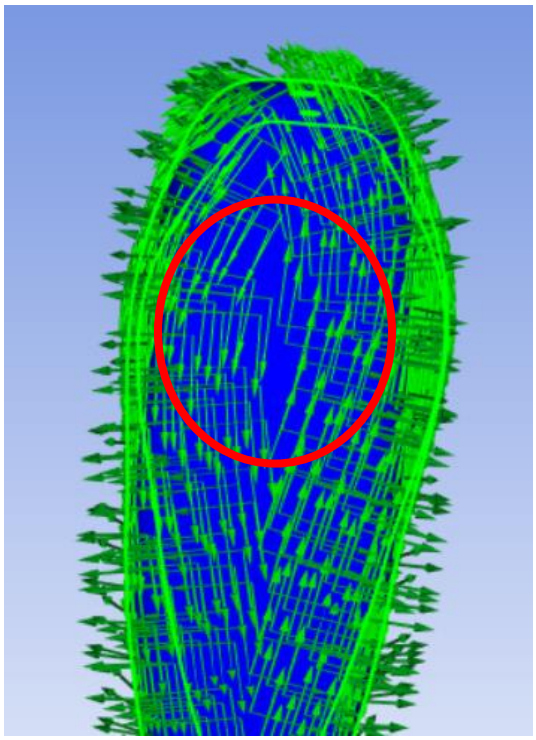
Fiber Direction:

The fiber direction is showed in the following pictures:



These non-horizontal or non-vertical fibers should be horizontal as much as possible during the manufacturing process.





Number of Layers:

Number of layers is determined according to the output thickness from the static test.

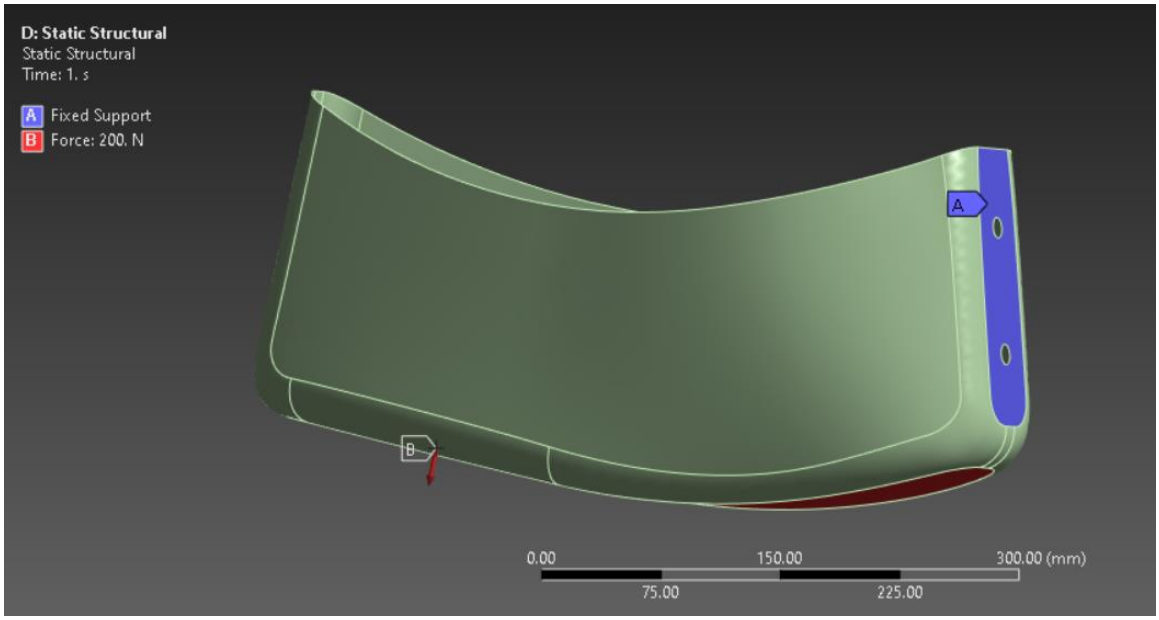
Static Test:

Two trials are made to get the most optimized thickness for the case.

First Trial: Thickness 2 mm

The test is made by fixing the right face of the case as a fixed support.

Applying a 200N force on the lower face of the case in the gravity direction.



Results:

This 2 mm thickness model shows about **6 mm of deformation** and a **minimum safety factor of 5.85**

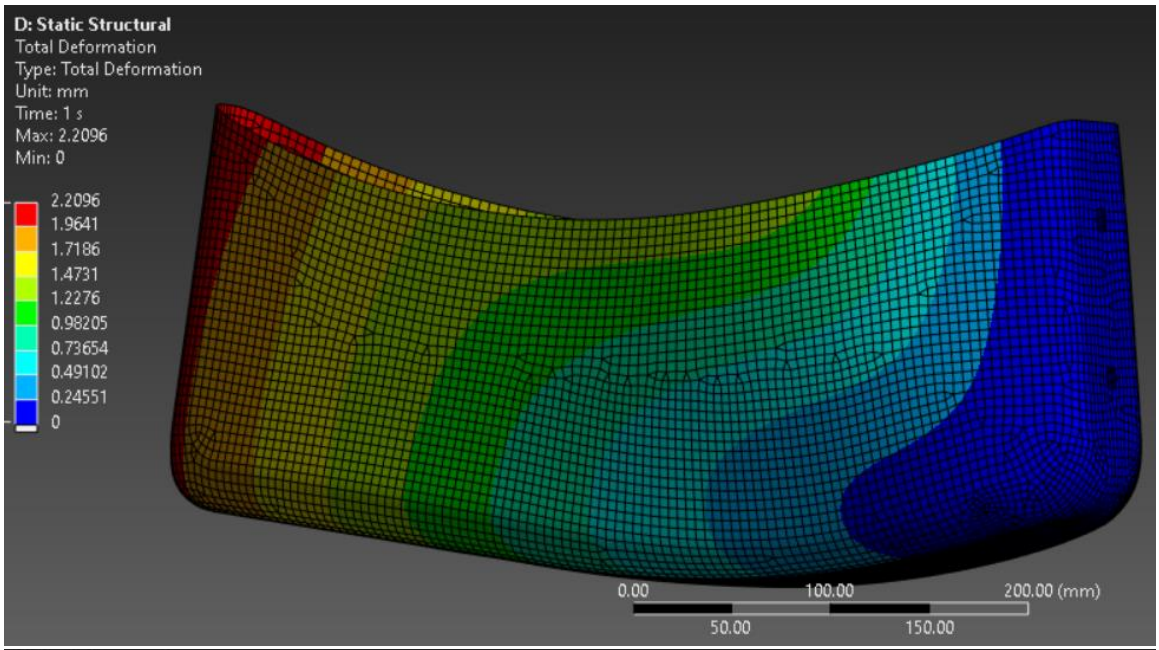
Comment: The safety factor is more than enough. But the deformation is quite large for the case application.

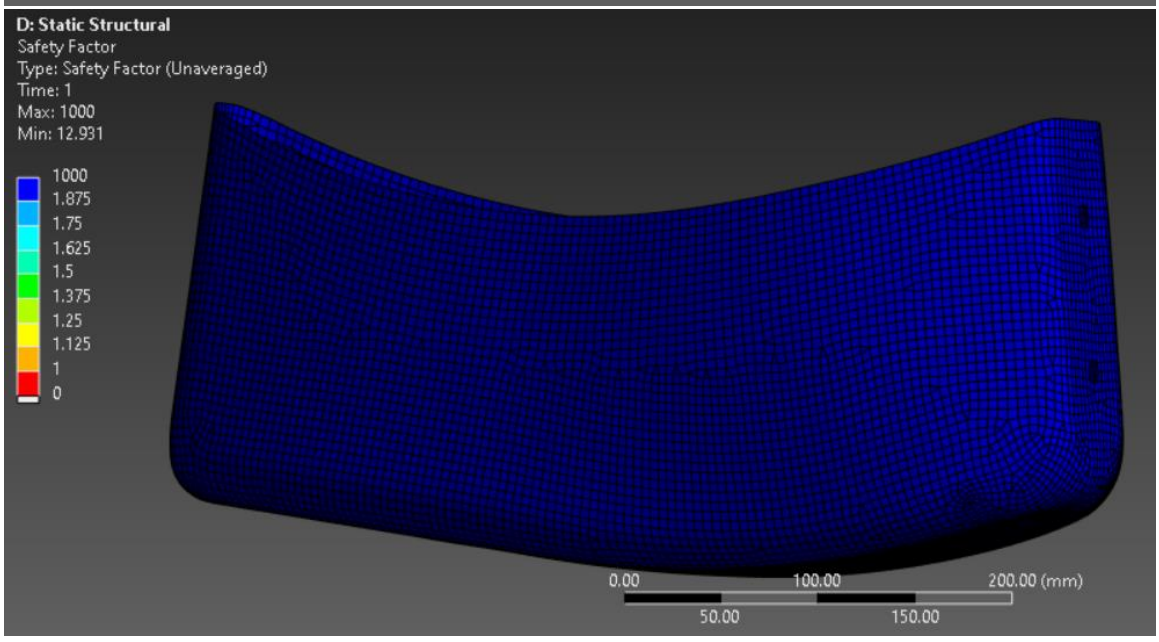
Second Trial: Thickness 3mm

With the same loading conditions, 3mm Thickness shows **Deformation of 2.3 mm and minimum safety factor of 12.9.**

Comment: The deformation here is acceptable and will be reduced by increasing the actual fixation area of the case.

The safety factor is more than enough.





Number of Layers:

From the static test, **the recommended case thickness is 3mm.**

By taking carbon fiber layer thickness equals to 0.2mm the **initial number of layers will be 15 layers.**

These 15 layers will be altered by making different prototypes until reaching **Fiber volume fraction of 60%** which means that Fiber weight is 60% from the overall product weight and 40% for the resin.

Summary of ACP & FEA Results:

Case Thickness	3 mm
Fiber number of layers	15 (initial)
Fiber Orientation	Woven or (0,90)
Volume Fiber Fraction	60%