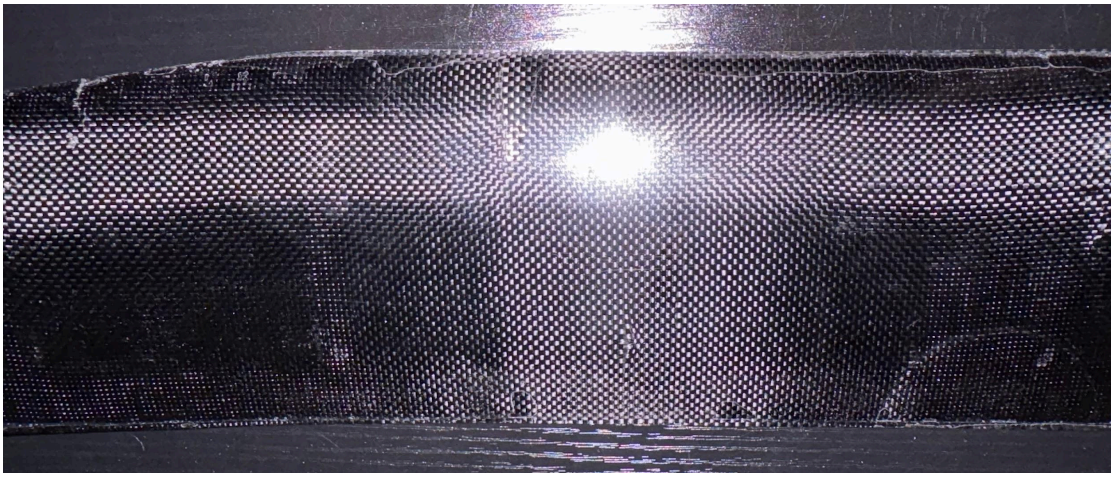
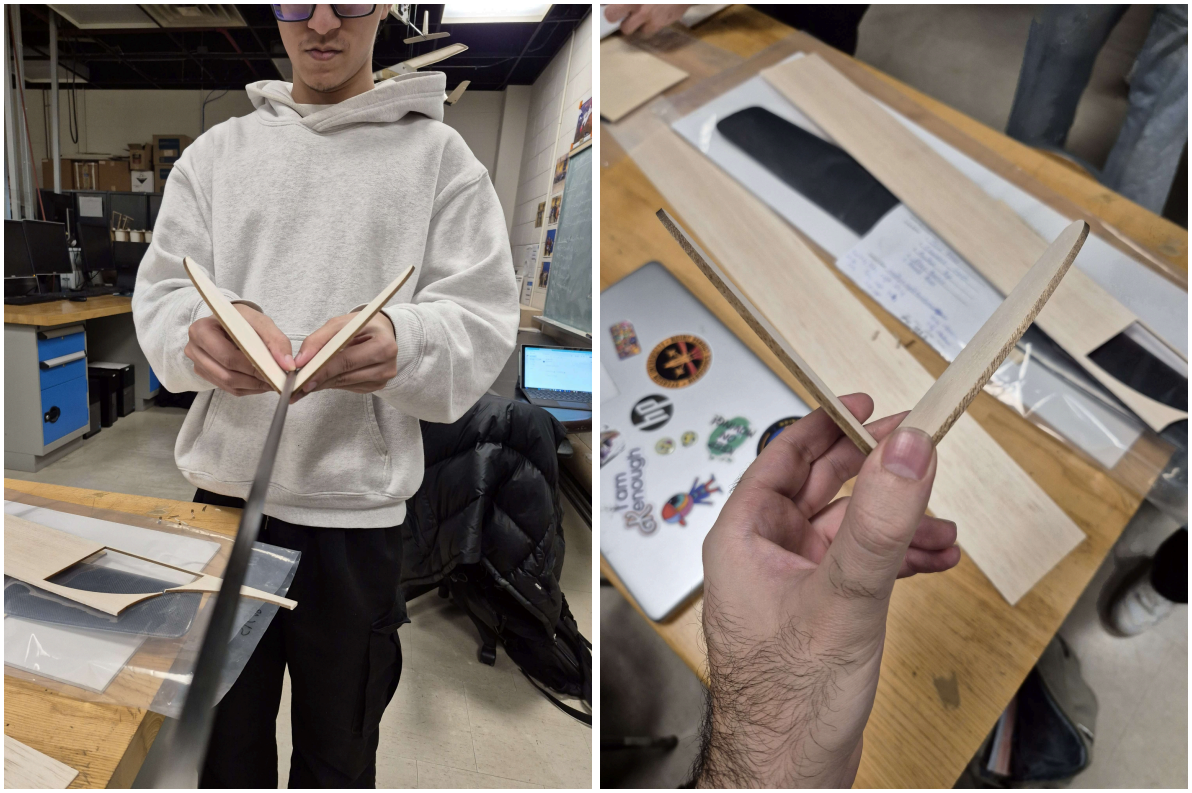
Figure 5.5: Imperfections along the leading and trailing edge (LE oriented up)



Fins

The second component that was manufactured for the glider was the fins and the bracket to hold them. The bracket was designed by a team member on Onshape, and 3D printed by a classmate to save lab time. The fins were designed on Onshape as well, and then cut out using the CNC machine on 1/8th inch thick balsa wood. A carbon fibre rod was given, the length of this rod was not trimmed, and the fin bracket slid on the end and friction fit onto the rod. The bracket was designed to allow for friction fitting of the fins, however before final assembly the fins were superglued into the bracket to ensure they don't misalign or fall out. The first manufacturing problem occurred at this step; one of the fins went in perfectly aligned with the bracket and the instant cure glue stuck it in place, while the other fin went in slightly unaligned. This fin was stuck on and was around 1-2 cm behind the other fin. This was unacceptable and the fin had to be removed from the bracket. This was a very tedious process as balsa wood is very fragile and left behind a lot of small pieces stuck to the bracket. These pieces had to be individually picked out of the bracket before another 2 copies of the fins were cut on the CNC machine. The second attempt of aligning the fins was successful, which concludes this stage of the manufacturing process.

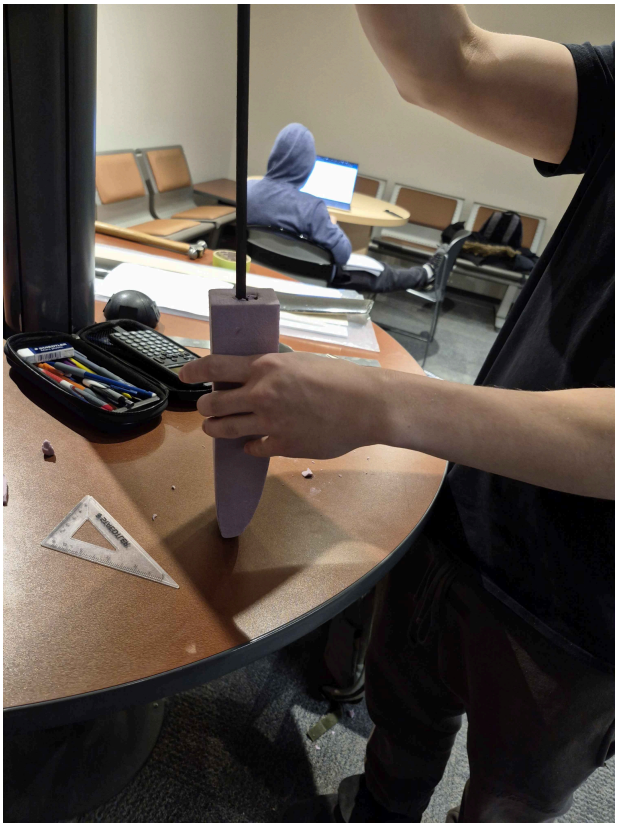
Figures 5.6 & 5.7: Fin cutout and orientation with respect to carbon fibre rod

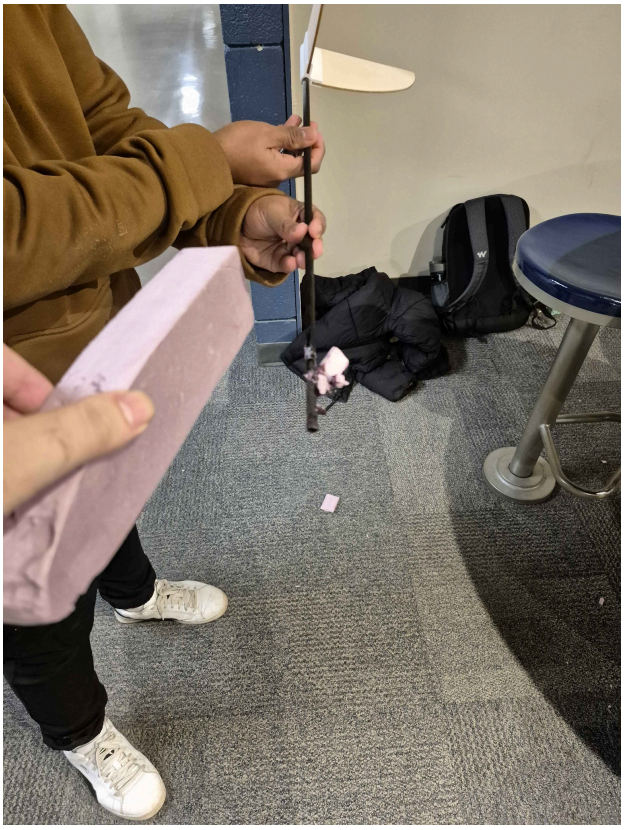


Fuselage

The final component of the glider that was manufactured was the fuselage. The initial idea was to produce the fuselage out of foam to save as much weight as possible, and use batteries to displace the centre of gravity to the desired position. A rough shape was outlined with a sharpie on a foam block based on a CAD design made by one of the group members. The shape was then cut out using a bandsaw, and sanded until all edges were smooth. The carbon rod was fit in through the use of force and torsion, digging 3-4 inches into the fuselage. In order to keep the carbon rod from spinning (and keep the fins perfectly straight) the carbon rod was secured to the fuselage using superglue. This superglue had acetone inside which reacted with the foam causing it to melt, which is the second issue faced during the manufacturing process.

Figures 5.8 & 5.9: During and after pouring superglue into foam fuselage





The timing for this mistake could not have been worse, the glider was due to fly in 4 days, out of which the lab was only open for 2 days. A design matrix was made to determine the most optimal manufacturing method, which led to an emergency redesign of the fuselage. The decision matrix pointed towards a foamboard ‘skin’, featuring a centre made of foam to ensure structural stability. The new design required the use of the CNC machine on the foamboard, and bandsaw to shape the foam to an appropriate shape. The carbon fibre rod was then glue-gunned to the foam, ensuring it doesn’t slide out or rotate. This left 2 parts for the final assembly, the foam with carbon rod and fins, and the foamboard ‘skin’.

Table 5.1: Decision making matrix pertaining to fuselage materials used

Selection Criteria	Weight (100%)	Foamboard	Skinned Foamboard	Foam	Skinned Foam	Foamboard and Foam

Lightweight	30%	4	3.5	4.5	4	3.5
Sturdiness	40%	2	3	2	3	4.5
Adjustability	10%	2	2	2	2	2
Manufacturing Time	20%	4	2	4	2	3.5
Total	100%	3	2.85	3.15	3	3.75