Aerospace Engineering Senior Capstone

6’ Wingspan flying business jet
‘*FOD Vacuum’*

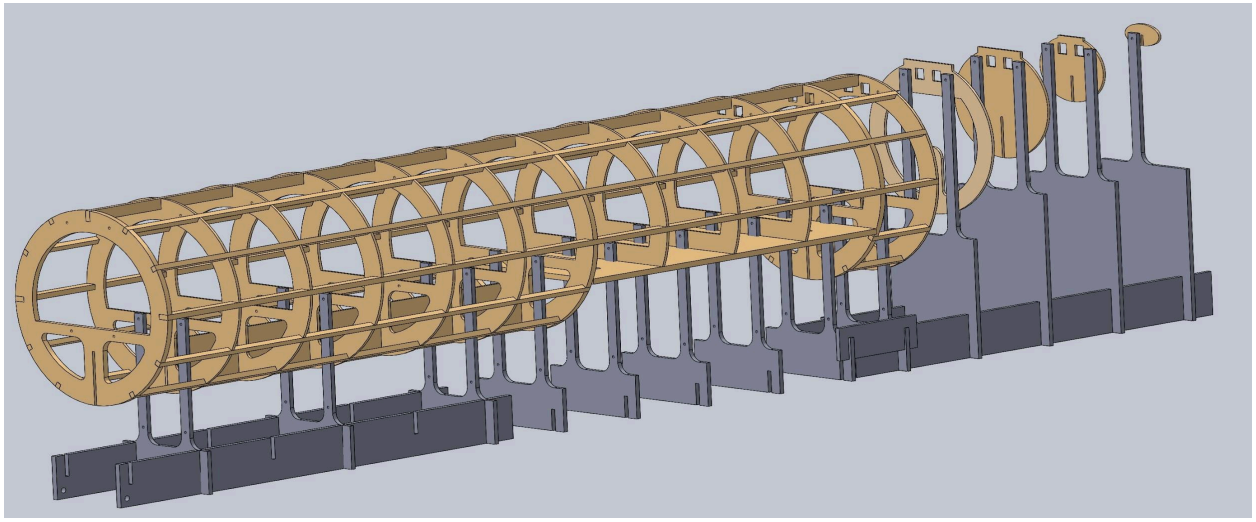
This project was designed and built, from an idea to a finished flying product, in 9 weeks. Completed by a team of 3, led by me.

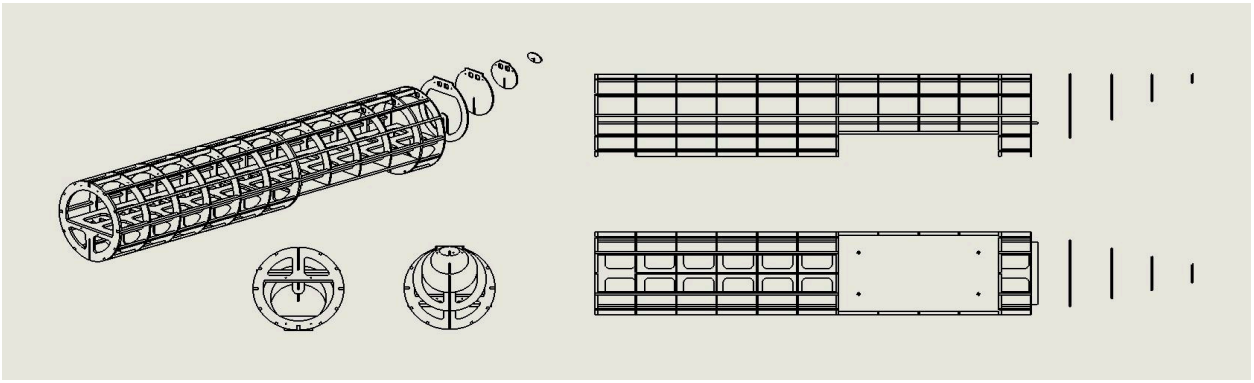
Project parameters: Design and build a business jet. Construction out of wood materials (balsa/bass/plywood), 3d prints allowed, carbon fiber/fiberglass disallowed. Given 3 weeks to design, with a critical design review presentation every week, design freeze at the 4th week, once design approved, start the build.

An interesting constraint of note to this project was that every assembly (fuselage, tail sections, wings) needed to be built inside a jig. From the start, we designed our assemblies for manufacturing (DFM), understanding they had to be manufactured in a jig. Having done this multiple times as a hobby with and without a jig, it takes a significantly larger investment and more time, but the result is far superior in alignment, consistency, and ease of assembly to build with one.

CAD designs - SolidWorks

1.1 Fuselage

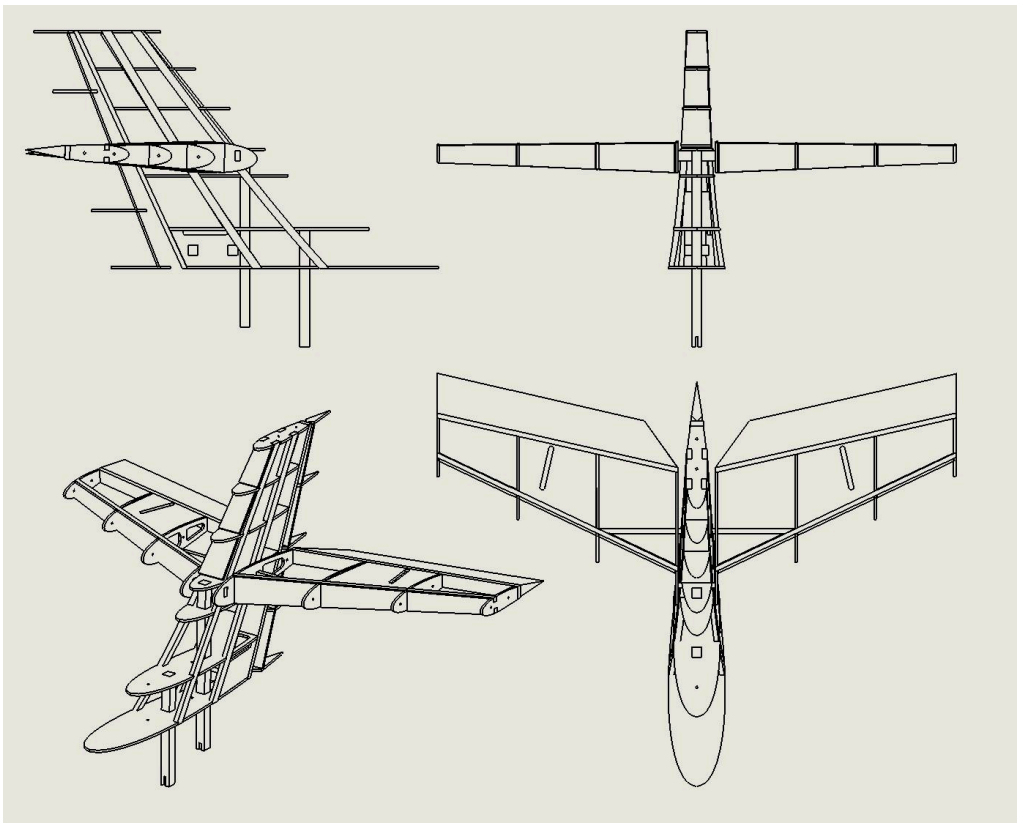


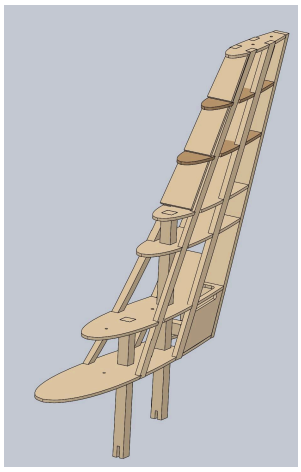


The fuselage bulkheads were designed with holes for alignment and fastening the jig, shown in grey. The gap under the fuselage near the rear was for the wingbox, the method used for having a rigid wing structure that could be removed for transportation.

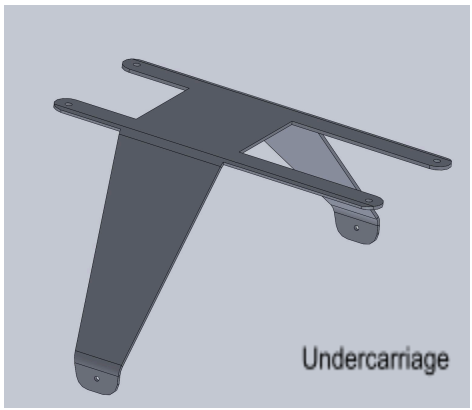
1.2 Cruciform Empennage

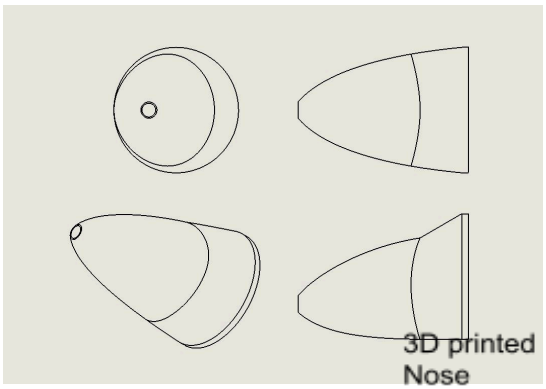
Our design choice of the cross style tail was due to our first design decision to go with above wing pylon-attached engines. The thrust stream from our electric ducted fans would flow directly into the horizontal tail if we had a conventional tail, causing unnecessarily sensitive controls and a large loss of thrust efficiency. The T-tail empennage is very common for smaller jets with turbines above the wing, however we decided to go with cruciform, deciding that a T-tail was unnecessarily structurally demanding and risky with our material constraints, a cruciform beat T-tail minimizing risk for both structure and dynamics.



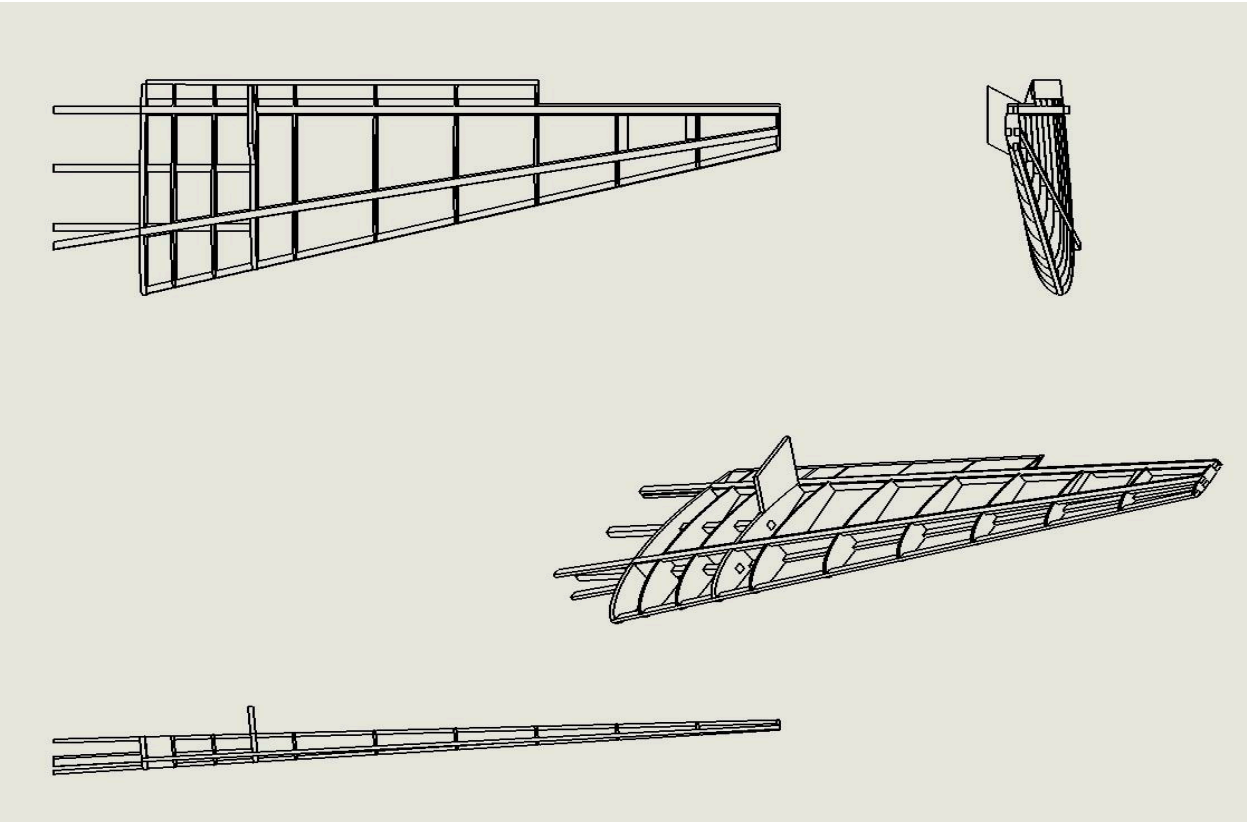


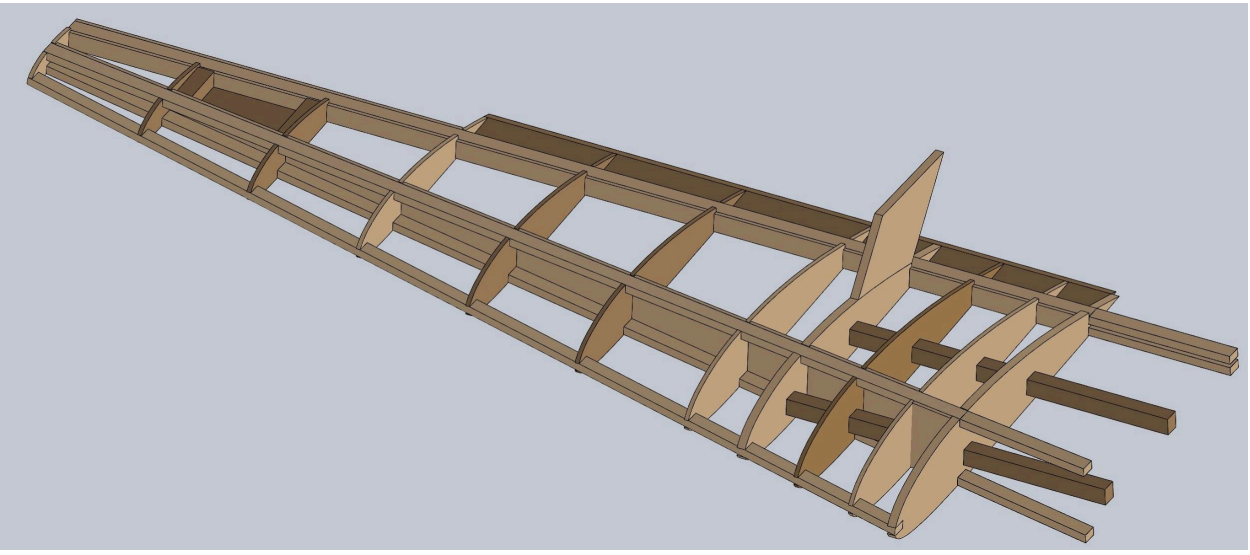
1.3 Fiddly bits





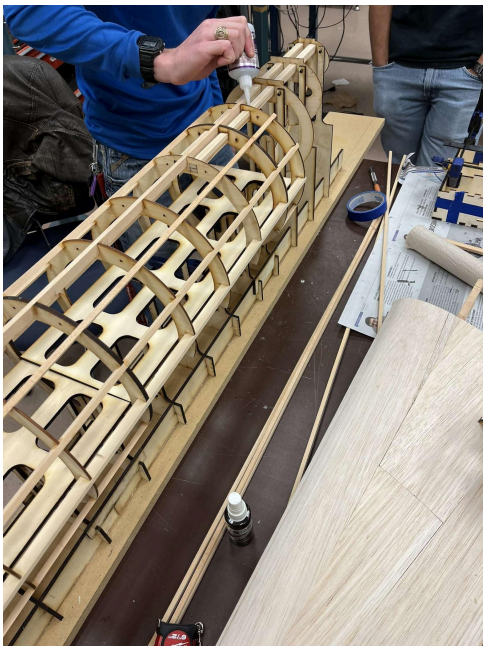
1.4 Wing



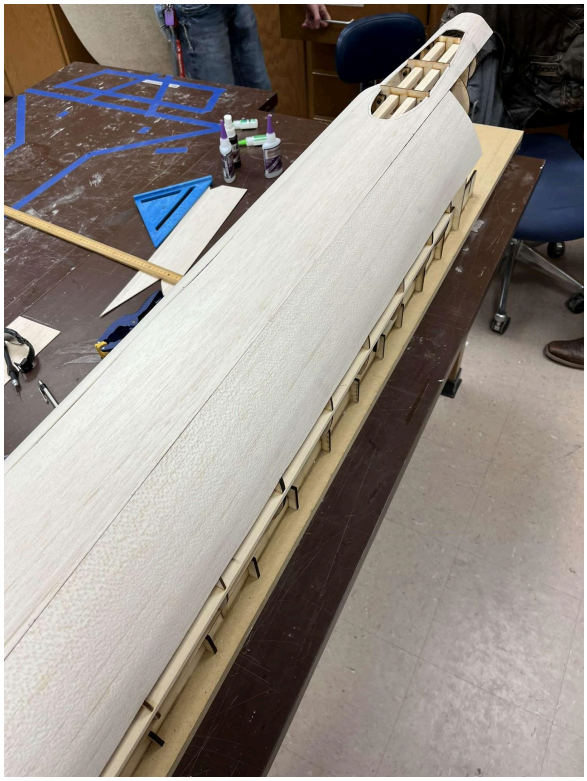


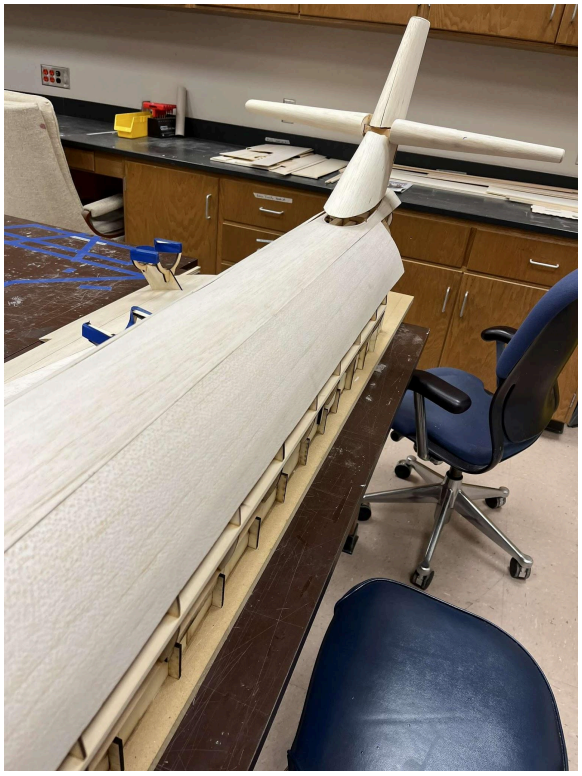
The wing was relatively simple with a slight leading edge sweep, 2 degree dihedral, and heavy bracing into the wingbox. The most unique feature is the integrated pylon rib for the electric ducted fan (EDF) mounting.

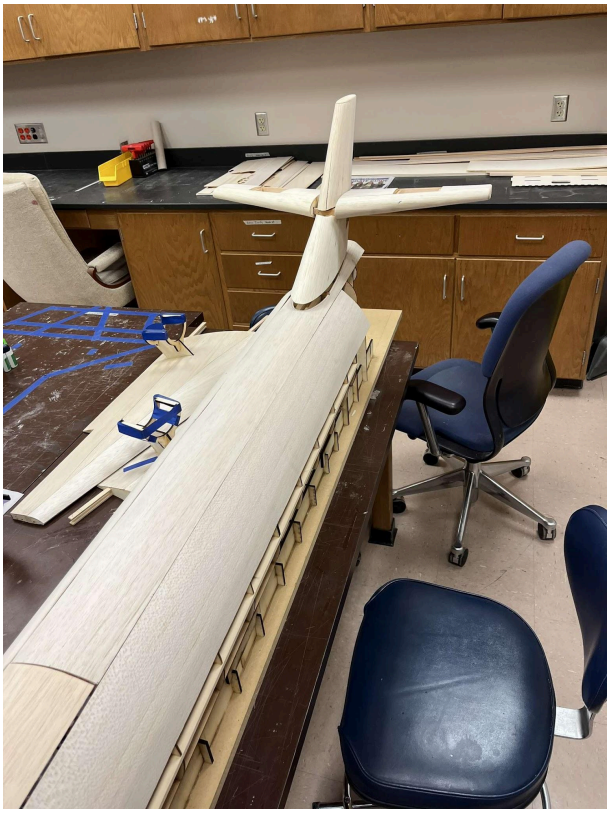
1.5 The Build

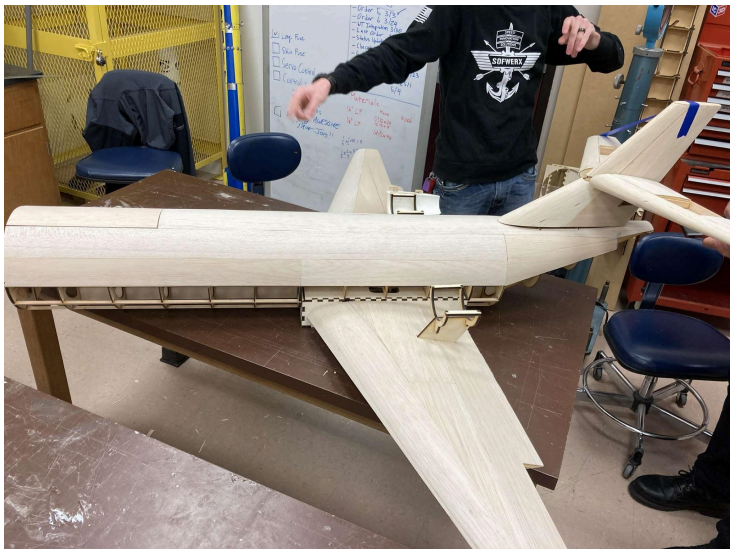



FLAMMABLE
Deadlines
Materials





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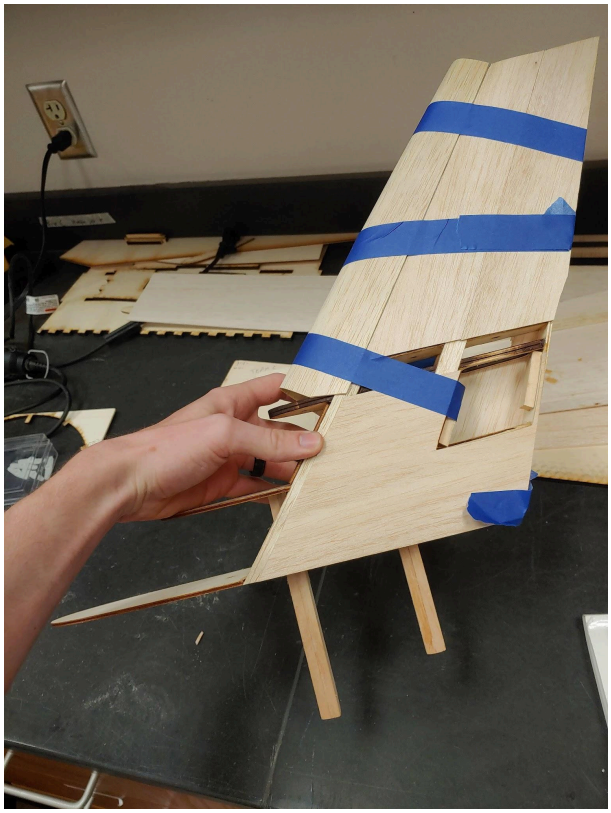

1.6 Flight day

There were 4 teams of seniors that designed and built their own version of a business jet. Our design was the only one that flew and did not crash. On the first flight (https://youtu.be/eo1whniWZGQ?si=O6B9NIlOqZEHIMnM) FOD Vacuum flew with stability, was easy for the pilot to take-off, control, and land. He was confident enough to fly it a second time (https://youtu.be/eo1whniWZGQ?si=CKLdxx9SCPtilFRs), we were the only team that got to fly twice, where he did some aerobatic tricks with it like a roll and a loop.

Our jet was later put on display for end of semester events for the University Aerospace Department.