Bucket Seat overview

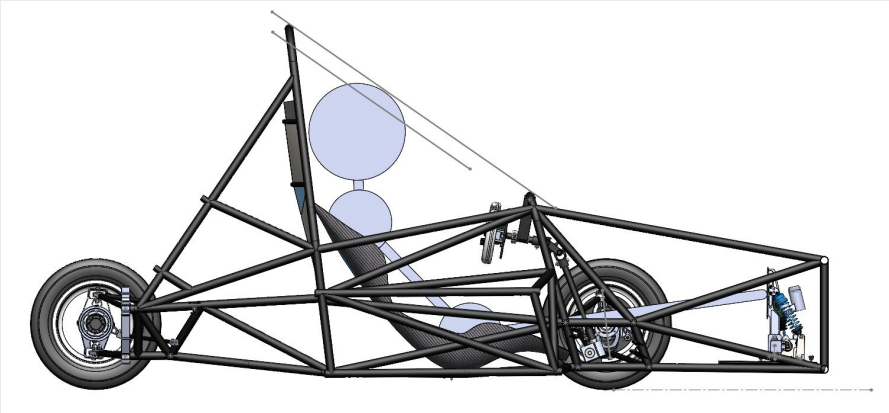
The initial seat design lacked sufficient head clearance and caused discomfort during extended use. To address these issues and comply with competition regulations, I redesigned the seat emphasizing ergonomics, lateral stability, and manufacturability.

Design Requirements:
- Head clearance ≥ 3"
- Improve lumbar support
- Fiberglass layer optimization for a 175 lb driver

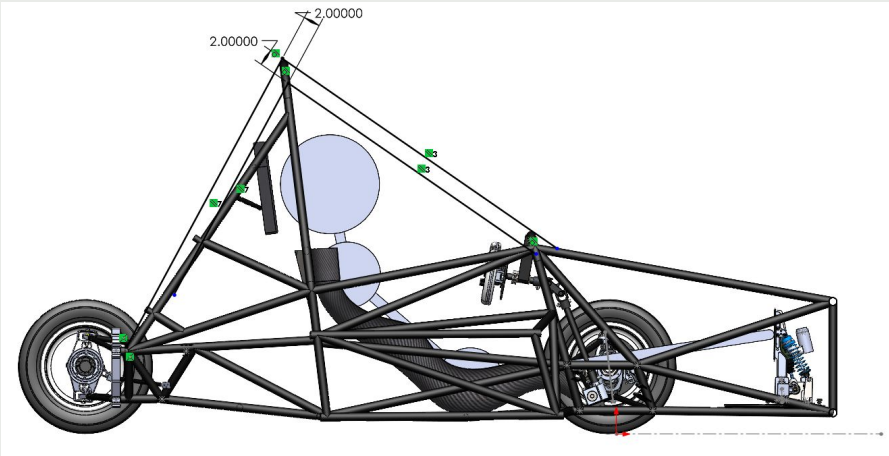
Sequence Optimization:
- 0°/90° cross-ply vs. ±45° angle-ply for compressive loads
- Number of layers for each sequence

Tools Used:
- SolidWorks – CAD modeling
- ANSYS – Static Structural Analysis

Approach:
- Assume 175 lb distributed axial load at 4 mounting points
- Simulate cross-ply (0°/90°) and angle-ply (±45°) layups
- Evaluate Safety Factor (SF) for each sequence



[1] 1st revision



[2] Second revision

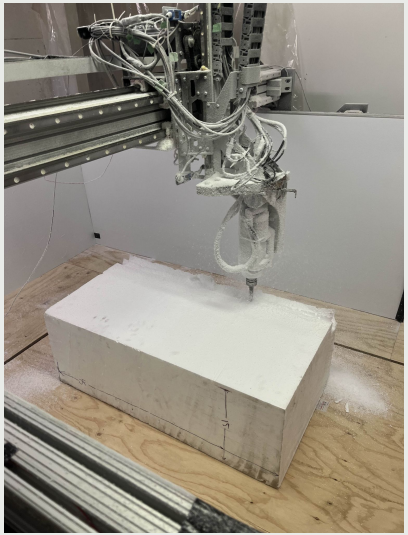
UVic Hybrid - Developing Seat Mold

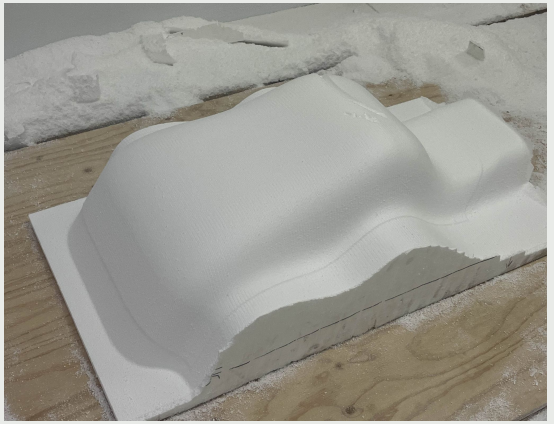
Techniques involved:
- 3D CNC machining
- Hot wire cutting
- Surface sanding
- Negative Geometry - for smooth surface finish

Material used:
- EPS foam (cost effective and machinable)
- Drywall filler + Epoxy
- 300-400 grit sandpaper

Lead time (total: 16+ hours)
- CNC machine time: 8 hours
- Mold prep (fill and sealant): 2 hours
- Drying: 6+ hours

Filler + Sanding may be required to ensure surface is smooth and uniform





UVic Hybrid - Composite Seat Layer Optimization (FEA)

Objective:

- Determine the number of 10 oz fiberglass (0.014”) layers required to achieve a safety factor (SF) ≥ 2.0 under compressive axial loading conditions.

Fiberglass properties:

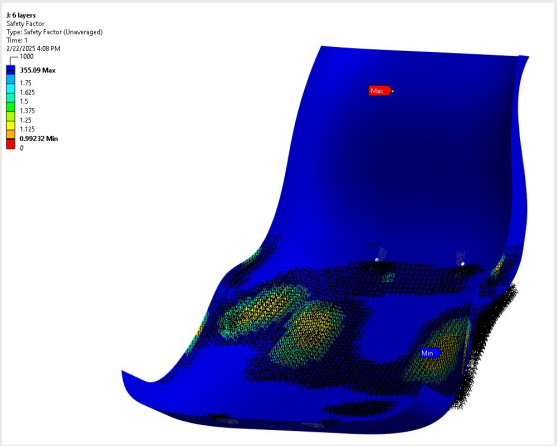
Fiberglass plain weave	Thickness
6 oz (Style 3733)	(0.008 - 0.010)”
10 oz (Style 7500)	(0.012 - 0.016)”

Result:

Sequence	# Layers	SF Achieved
0°/90°	6	2.5
±45°	6	1.25
0°/0°	6	2.1

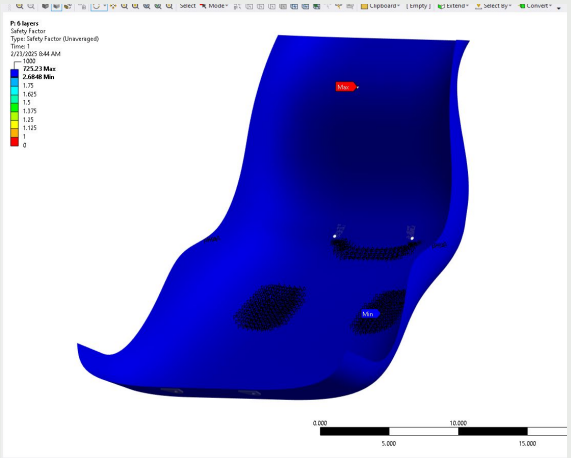
-45/45 sequence

	Fabric	Angle
1	Fiberglass Wet Layup	-45.0
2	Fiberglass Wet Layup	45.0
3	Fiberglass Wet Layup	-45.0
4	Fiberglass Wet Layup	45.0
5	Fiberglass Wet Layup	-45.0
6	Fiberglass Wet Layup	45.0
7	Fiberglass Wet Layup	-45.0
8	Fiberglass Wet Layup	45.0
9	Fiberglass Wet Layup	-45.0
10	Fiberglass Wet Layup	45.0



0/90 sequence

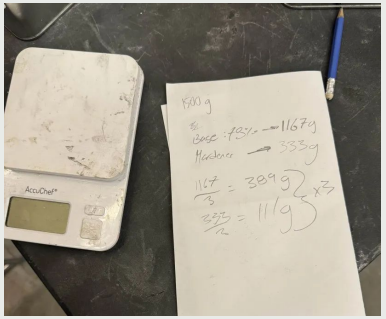
	Fabric	Angle
1	Fiberglass Wet Layup 10oz	0.0
2	Fiberglass Wet Layup 10oz	0.0
3	Fiberglass Wet Layup 6oz	0.0
4	Fiberglass Wet Layup 6oz	0.0
5	Fiberglass Wet Layup 10oz	90.0
6	Fiberglass Wet Layup 10oz	0.0
7	Fiberglass Wet Layup 10oz	90.0
8	Fiberglass Wet Layup 10oz	0.0
9	Fiberglass Wet Layup 10oz	90.0
10	Fiberglass Wet Layup 10oz	0.0



UVic Hybrid - Fiberglass layup

Wet Layup Process:

- Applied 2 layers of 6 oz + 2 layers of 10 oz fiberglass using a 0°/0° sequence
- Resin-to-hardener ratio: 1167 g epoxy : 337 g hardener
- Red dye added to ensure uniform mixing



Challenges:	Improvements
Insufficient resin saturation caused delamination during curing and damaged the mold.	To prevent delamination and voids during curing, I revised the layup process to include pre-wetting of each fiberglass layer, improving resin distribution and final part quality.

UVic Hybrid - Finalizing Composite Seat Structure

Materials Used:
- 2 layers of 6 oz fiberglass (Style 3733)
- 8 layers of 10 oz fiberglass (Style 7500)

Key Learnings:
- Style 3733 was unsuitable for complex curves, leading to delamination — replaced with thicker Style 7500.
- Negative mold geometry yielded a high-quality surface finish.
- Back surface retained rough peel ply texture (see [2]).

[1]

[2]

[3]