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.

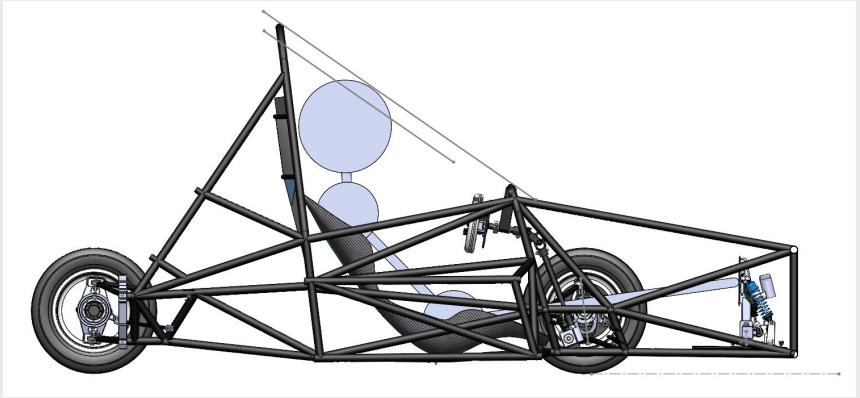
Design Objectives:
- Head clearance ≥ 3"
- Improve lumbar support
- Fiberglass layer optimization for a 175 lb driver (Driver's average)

Sequence Optimization:
- 0°/90° cross-ply vs. ±45° angle-ply for compressive loads

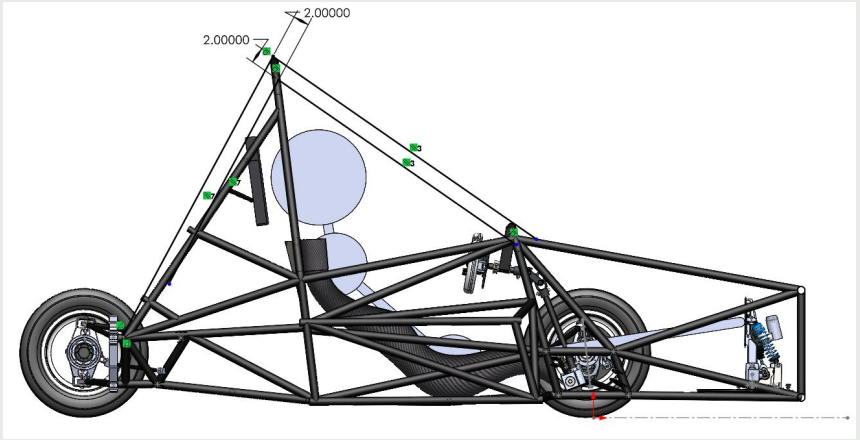
Tools Used:
- SolidWorks – CAD modeling
- ANSYS – Static Structural Analysis
- ANSYS - Pre ACP (composite) layer optimization

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

Result:
- FEA concluded a SF ≥ 2 for cross-ply and Symmetric Laminate (0°/0°)
- Wet layup optimization yielded 17% material reduction from previous design



[2] First Seat Design



[3] Second Seat Design

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.

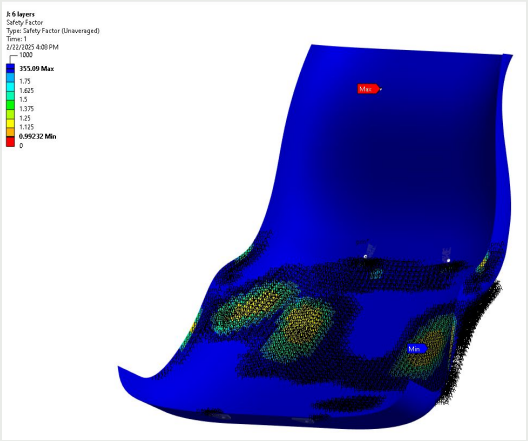
Fiberglass properties:

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°	10	2.5
±45°	10	1.25
0°/0°	10	2.1

	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



[5] -45/45 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

[6] 0/90 sequence

UVic Hybrid - Developing Seat Mold

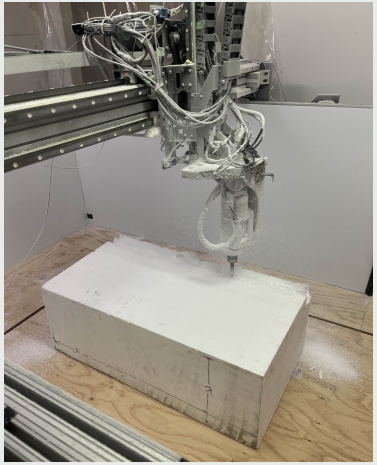
Techniques involved:
- 3D CNC machining
- Hot wire cutting
- Surface sanding
- Negative Geometry - for smooth surface finish

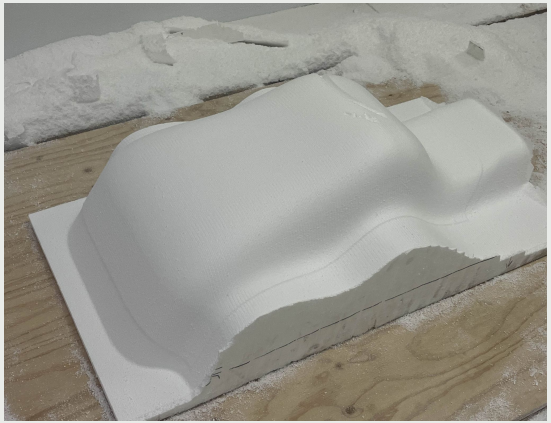
Material used:
- EPS foam (cost effective and machinable)
- Drywall filler + Epoxy
- 300-400 grit sandpaper
- Lamination rollers

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

Drywall filler + 300 grit sandpaper was used to fill gaps and to create a smooth surface finish.

Ready for epoxy and wet layup!





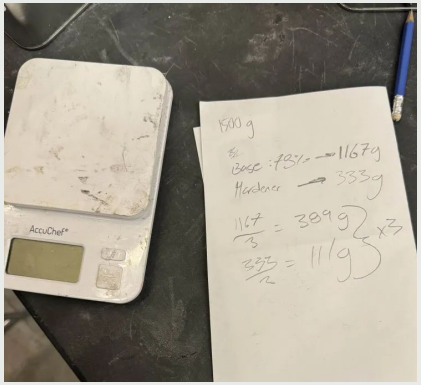
[4] Mould Development of Seat

UVic Hybrid - Fiberglass layup

Wet Layup Process for test seat:

- 2 layers - 6 oz fiberglass 0°/0° sequence
- 4 layers - 10 oz fiberglass 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. - Drywall filler effective but requires long drying times for larger cracks. Harder to sand	- Pre-wetting fiberglass layers to preventing delamination and voids during curing. - Utilize lamination rollers to distribute uniform pressure to saturate resin into fibers - Wax paper for ease of part removal (prevents destroying mold)



[7] Test Seat development

UVic Hybrid - Finalizing Composite Seat Structure

Final SEAT materials:
- **2 layers** - 6 oz fiberglass (Style 3733)
- **8 layers** - 10 oz fiberglass (Style 7500)

Key Learnings:
- Style 3733 was unsuitable for complex curves, leading to delamination — additional Style 7500 was added.
- Negative mold geometry yielded a high-quality surface finish.
- Back surface retained rough peel ply texture.
- 2 layers of Style 3733 reduced the number of Style 7500 by 17% from previous seat

[8] R.Turner, Seat Model, 2024

[9] Final result of 0/0 wet layup sequence for seat