

FSAE BATTERY COOLING

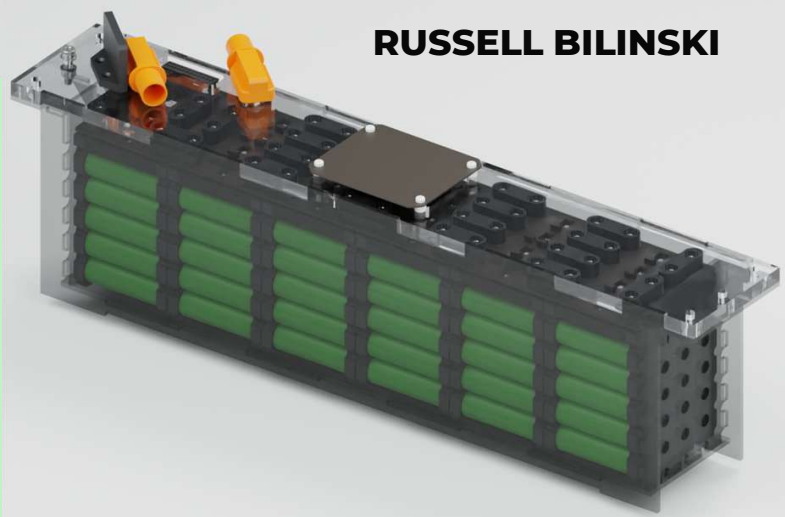
RUSSELL BILINSKI

My Role

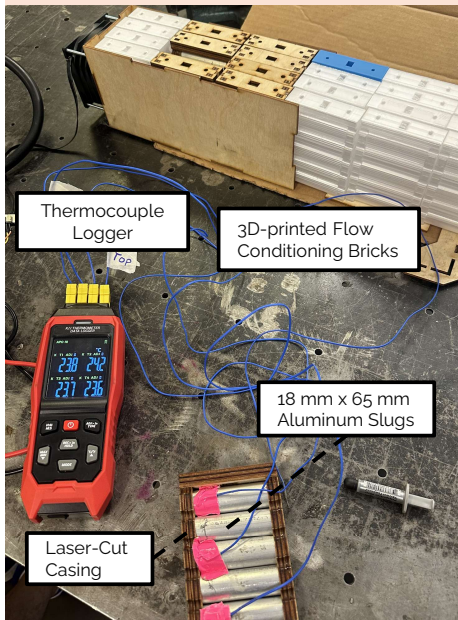
I developed thermal estimates, test setups, and instrumentation to select battery-cooling fans and define the cooling system's LV current requirements for our FSAE car.

Why was this important?

Overheating could prevent us from finishing endurance, and derating battery power would cost us lap time and competition points.



"Mock Brick" Testing

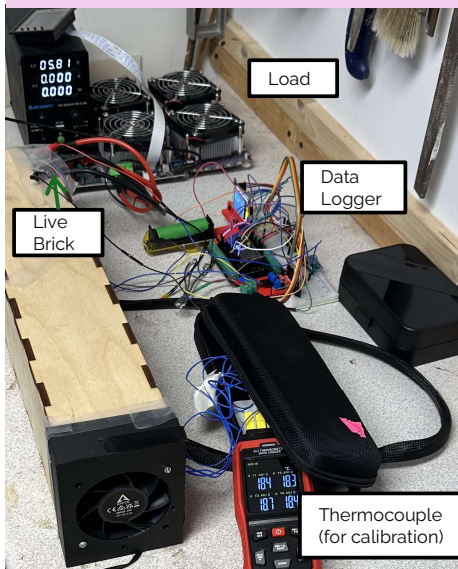


My initial test used a variety of fans to cool down heat-soaked, thermally similar aluminum slugs and casings.

The goal of these (scrappy) tests was to get rapid results before other systems started to finalize.

- *Mock 18650 Slug: ~41 J/K
- *18650 Li-ion Cell: ~43 J/K
- *Geometry is close to identical

Live Brick Testing



I then conducted a more representative test by discharging and measuring cooldown of live ENEPAQ cells under endurance loading while reading their in-built thermistors.

*Casing and internal flow conditioning mimic the airflow impedance of the real module. Custom DAQ also tracked ambient temperature and cell voltages.

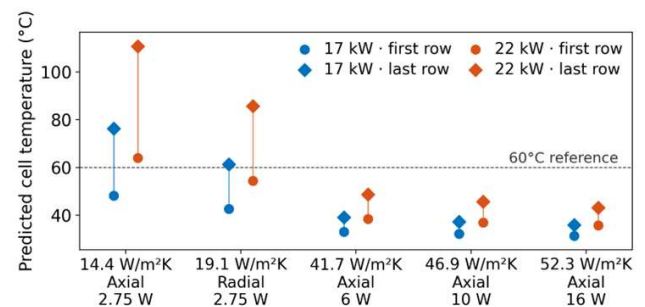
Why not CFD? CFD needed understanding and inputs I didn't have, risking convincing but incorrect results. Even with that, I expected physical testing to give more accurate cooling estimates while helping me learn heat-transfer fundamentals.

Estimated power from lap-time simulation and used a 1-Resistor Cell model to estimate heat generation.

$$\text{Isolated for } h \quad m c_p \frac{dT}{dt} = -hA(T - T_{\text{ambient}})$$

Applied additional safety factors and accounted for progressive airflow heating.

Predicted steady-state cell temperatures
RMS trim-cap range: 17 kW (lower)–22 kW (upper)



Conclusion

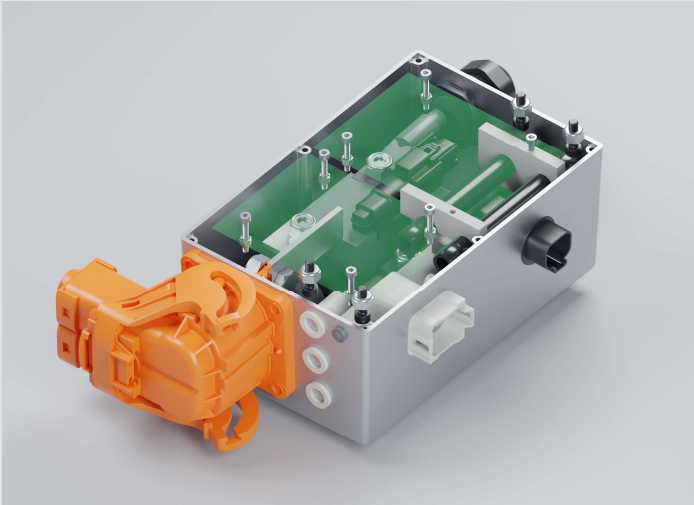
This test enabled high confidence that our fan sizing and current budget would survive a full FSAE endurance. This also allowed us to correlate cooling effectiveness to operating power.

Further Validation & Learnings

The airflow through our segments is a relatively high-impedance system. The radial (blower-style) fans showed higher cooling to power draw efficiency. The final selection upsized our blower fan to 60 x 23mm (~5W draw). Final validation rests on TMS & UV26 being fit to drive (est Oct. 2026).

HIGH-VOLTAGE JUNCTION BOX

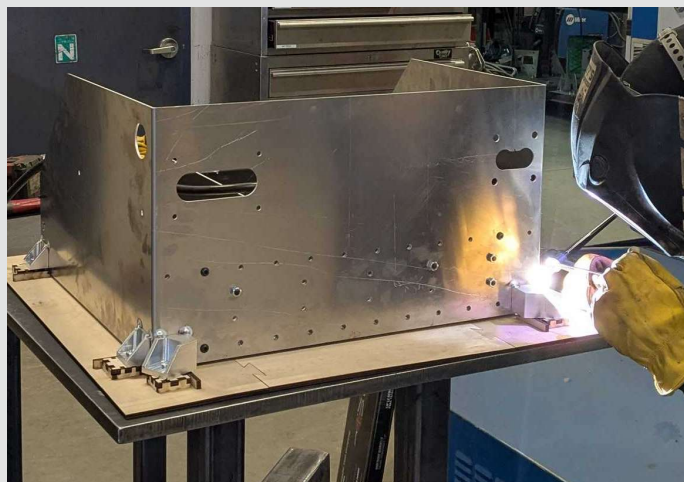
Took responsibility for the mechanical design as my first major team project, developing an initial circuit sketch into drawings ready for machining. The completed design later served as a reference for the 2026 junction box.



*Design completed, but UV24 was cancelled before manufacturing.

BATTERY HOUSING WELDING JIG

Designed and built a parametric laser-cut jig to accurately position battery housing mounts during welding.



SEGMENT STRUCTURAL CALCULATIONS

Worked through the structural requirements and consulted a competition design judge about upcoming changes, incorporating those into my calculation tool to enable our casing design through the two-year development cycle.

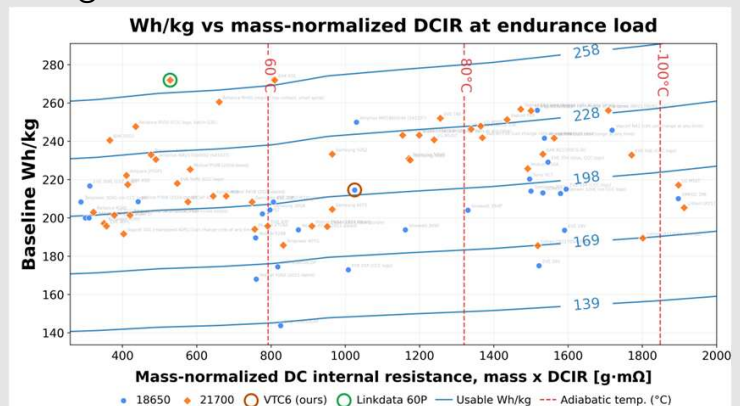


Other Engineering Tools

Lap-Time Simulation: Estimated duty cycles and component requirements for UV26 tractive-system components.

Kerf Compensation Macro: Automated a repetitive, error-prone laser-cutting export process in SolidWorks.

Cell and Pack Configurator: Combined cell-test data and FSAE-specific loads to compare and optimize cell and pack configurations for our next EV.

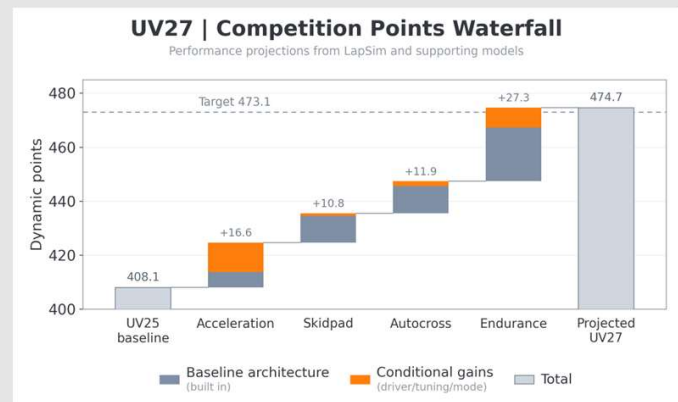
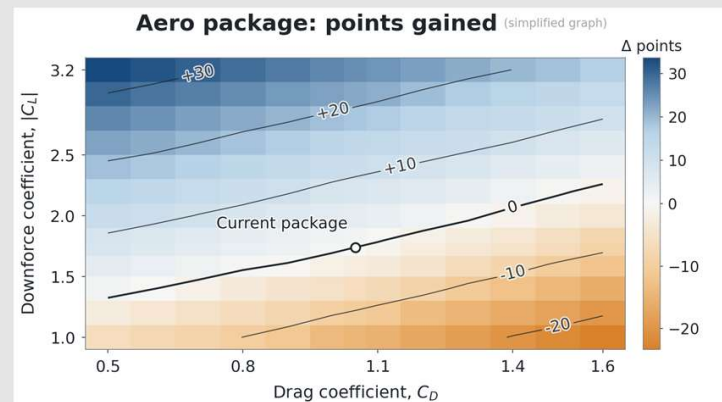


Performance Manager

As Performance Manager, I develop the vehicle-level analysis behind our subsystem targets and development priorities. I also connect competition objectives to vehicle characteristics, compare design alternatives, and work with subsystem leads to judge trade-offs for the complete car. My work involves vehicle performance modeling, reviews with subsystems, and developing actionable team and sub-team goals.

I maintain an expected competition points model and subsystem key metrics documents. My models let us compare effects such as mass, downforce, and other quantifiable parameters on a common performance basis. The key metrics documents also cover reliability, manufacturing, and other considerations that influence the design and execution of the race car even when they might not have a defensible points value.

For Aero, I worked with the leads to create initial targets and created competition point sensitivities for comparing packages using downforce, drag, and installed mass. Additionally, I modeled the performance uplift of a DRS system and quantified other projects with much higher ROI, prioritizing our resources and making sure our decisions were justifiable.



Vehicle Dynamics Lead

I re-established the Vehicle Dynamics sub-team after a two-year gap in dedicated leadership, organizing weekly meetings and technical sessions. Building on my earlier battery modeling, I developed lap-time and tire models and led the performance analysis behind gearing, battery sizing, and competition endurance energy strategy. This work built the vehicle-level understanding and modeling capabilities I now apply as Performance Manager.

