JOSEPH F. WARE ENGINEERING LAB

Newsletter *2025-26*

ENGINEERING
VIRGINIA TECH

Welcome to our 2025-26 Newsletter!

Our latest edition of Virginia Tech's *Ware Lab Newsletter* has updates on activities for the academic year along with news about team participation in competitions throughout North America. As lab manager, I am excited to tell you about competition results in multiple world class events. Again this year, Ware Lab teams performed incredibly well at sponsored events as they traveled to places like San Luis Obispo, California; Ames, Iowa; and Tucson, Arizona to face off with the best engineering programs in the country.

A new feature of our newsletter this year includes *lab outreach*, *stats*, and *team project posters*. Ware Lab teams reached out to over 2100 people in 2025 in the form of lab tours and on-site visits. Lab stats provide a snapshot of team membership illustrating our range of student's backgrounds. Team posters provide an in-depth view of Ware Lab team progress in the design of autonomous systems, high strength materials, and EV and gas vehicle power-trains.

If you have any questions about Ware Lab please contact me at spangler@vt.edu. Tours of the facility can be arranged for families, school groups, and industry partners. More information about Ware Lab can be found on our web site:
https://eng.vt.edu/academics/warelab.html

Dewey Spangler, PE
Ware Lab Manager- Virginia Tech College of Engineering

BOLT VI during assembly prior to vehicle dyno testing.

Concrete Canoe's final prototype display at ASCE Nationals in California.

DBF's Hokie Autonomous Transport in flight with X-1 drone attached below.

On the Front Cover: Virginia Tech's 2025 Human Powered Sub tests XLIENN prior to traveling to the Navel Submarine Testing facility in Maryland, VA. The team earned 2nd place internationally out of 19 schools with their craft sustaining a 4.2 knots underwater speed during the ISR18 event, one of the fastest recorded!

New *Mustang* Dyno!

Testing BOLT VI on the Mustang chassis dyno.

Baja SAE on the chassis dyno. Notice the exhaust control in the left photo (orange pipe at back of vehicle).

Thanks to a collaboration between the College of Engineering and Mechanical Engineering, Ware Lab vehicle teams have access to two state-of-the-art Mustang dynos. A dyno (short for dynaometer) measures output power and top speed under controlled conditions. The engine dyno makes measurements directly from the engine and the chassis dyno measures output for the entire vehicle.

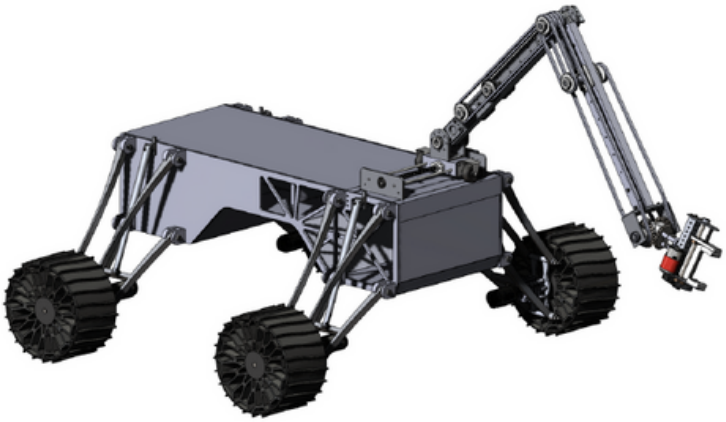
Housed at an off campus testing facility, the chassis dyno is capable of recording speeds in excess of 170 mph and power exceeding 200 hp. *BOLT*, *Formula SAE*, *HEVT* and *Baja SAE* use the equipment to determine rpm performance profiles, allowing for real-time parametric studies to determine optimal vehicle performance.

In the past teams had to travel to third-party vendors to access dyno equipment, costing time and money. **The Mustang dynos are 15 minutes away, making this a real game changer for our performance teams and guaranteeing success at upcoming competitions!**

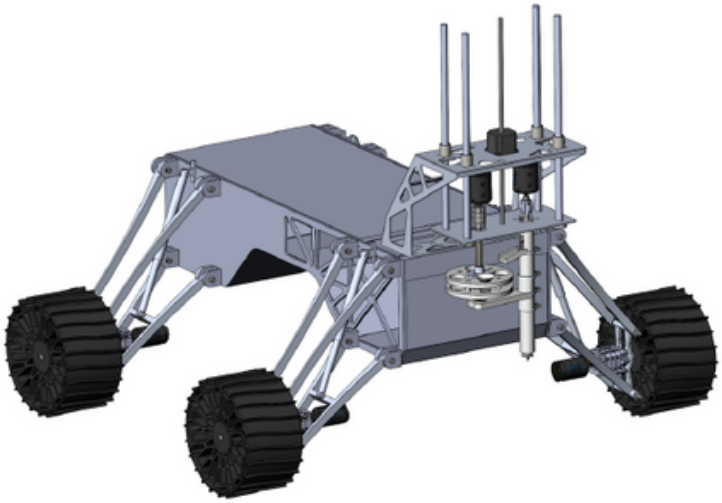
Thanks to Dr. Bob West (ME), Dr. Rick Clark (FSAE, BOLT) and Mr. Jared Bryson (Baja SAE) for their leadership in acquiring this new technology and in managing the equipment's lab space!

Ware Lab Team Updates:

Astrobotics



ANUBIS with arm attached.



ANUBIS with sampler attached.

Astrobotics at VT continues to design, manufacture, and program viable semi-autonomous space-bound robots. During the past year the team's robot REAPER performed at the University of Central Florida (14th out of 35 teams) and at Iowa State (11th out of 15 teams). Both events involved construction of a soil berm , which future missions to the Moon and Mars will use as rocket launch/landing areas. The berm provides protection from flying debris to surrounding equipment and habitats.

This year, the team is assembling ANUBIS with a different purpose from REAPER. **ANUBIS features a robotic arm with a 5 kg payload capacity, and operational switches for interfacing with existing machinery.**

A new *science* sub-team has been created to analyze materials collected during each mission. The sub-team designed an onboard, remotely operated laboratory that performs chemical analysis for reagents found in the soil.

The team's progress is a testament to their commitment in advancing new technologies for future robotic space exploration.

www.vtastrobotics.com
vtastrobotics@gmail.com

AutoBoat

Autoboats's EV craft THESEUS during autonomy testing at Clator Lake, Virginia.

The team's sailing craft LUMPY undergoes autonomy testing.

Yamaha's *WaveRunner* jet sky.

AutoBoat (formerly *SailBOT*) focuses on EV motorboats and wind powered sailboats, both using autonomous steering. The team participates in two competitions: the *Promoting Electric Propulsion* (PEP) event, which tests a motorboat's ability to navigate through a course quickly and the *SailBOT* competition which tests a sail boat's autonomous abilities in precision navigation, computer localization, and station keeping.

Currently, Virginia Tech's AutoBoat is focusing on improvements in autonomous navigation, power output, and in the development of autonomous systems for the team's newest venture: an EV jet ski!

The team is creating open-source hardware and software platforms that are modular and extendible. Building off past successes, goals include better responsive control, computer simulation, navigation, and battery health-monitoring.

AutoBoat plans to integrate autonomous technology into a 1995 Yamaha WaveRunner III GP jetski. A full gas to EV power-train conversion is also a goal for this exciting new venture.

https://eng.vt.edu/academics/student-teams/sailbot.html

https://www.sailbot.aoe.vt.edu/

AutoBoat

Baja SAE

VT Baja traveled to three SAE events in 2025 including Baja South Carolina, where they finish 14th out of over 100 competitors. This competition marked the final outing for the 2025 car, SPUTTER, delivering strong performances across multiple events. Highlights include a 7th place finish in *Hill Climb*, 8th in *Design*, and 3rd in the *Cost Event*, demonstrating strides made in both static and dynamic competition categories. Solid results in *Endurance* (17th), *Suspension & Traction* (15th), and *Acceleration* (19th) deserve mention.

VT Baja SAE's SPUTTER during the grueling endurance event.

Overall, **the team achieved a final season standing of 8th place across all three SAE competitions.** With 2025 now complete, the team is focusing on designing a new vehicle (to be named later this semester), incorporating lessons learned from last year.

Virginia Tech's winning Baja SAE with advisor Jared Bryson.

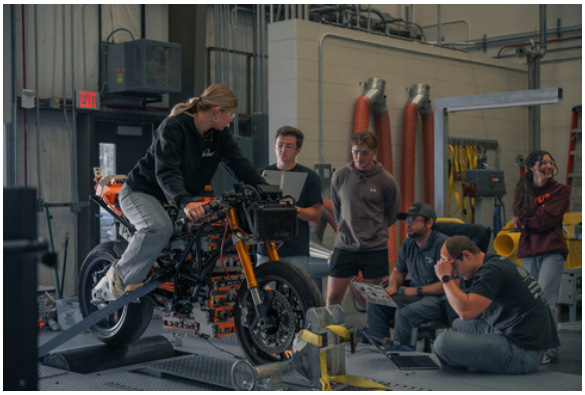
Manufacturing improvements for a custom build continuously variable transmission (CVT) is underway, with extensive use of finite element analysis (FEA) and track testing. A switchable rear-wheel to 4-wheel traction is being used this year as well. The team plans to do extensive vehicle testing at their local off-campus dirt track prior to competition. **VT Baja is very excited to compete in 2026, marking our 40th season of continuous racing excellence!**

www.vtbaja.com

BOLT

Battery Operated Land Transport (BOLT) had a busy 2025 with the manufacturing its next generation superbike, BOLT VI. For the second time in the team's history the bike featured a student-built 4130 chromium-molybdenum (*chromoly*) steel frame, custom battery management system (BMS), flexible wire harnesses, and a new power distribution unit (PDU). Compared to BOLT V, these updates provide the new bike with a more compact profile, improved vehicle handling and turning angle, and reduced assembly time.

The team planned to enter BOLT VI in the *American Historic Racing Motorcycle Association* (AHRMA) fall 2025 race series. Unfortunately, the EV portion of this event was cancelled due to safety concerns. Although this setback was disappointing, the team is undeterred and is connecting with other universities across the United States and Canada to organize a race day in the spring of 2026. This requires establishing rules, safety protocols, and sponsorship support for the event, no easy task. BOLT is using the spare time to make improvements to BOLT VI, including finishing fairing design and performing extensive power-train testing. **VT BOLT is making good use of a *Mustang* chassis dyno to enhance the bike's performance and reach speeds of 170 mph and power output of 200 hp!**



Left - Virginia Tech's BOLT performing acceleration and power testing using a Mustang vehicle dyno.
Right - The team street testing BOLT VI on the VT campus with advisor Rick Clark at the helm.

BOLT is also continuing the development of its first EV dirt bike, with a completion date of 2027. This project introduces new challenges including effective waterproofing, off-road capabilities (think: high impact forces), and quick battery swap-outs during pit stops. Design for key components such as bike frame, suspension swing-arm, battery packs, and control units have been finalized, with fabrication scheduled for spring 2026.

www.vtbolt.com/

Concrete Canoe

VT CCT at ASCE Nationals in San Luis Obispo, California.

Women's slalom paddling race during the nationals event.

2025 was a landmark year for Virginia Tech's Concrete Canoe. The team participated in the ASCE Regional Symposium hosted by West Virginia University of Technology in Beckley, WV. The team earned first place in all competition categories, securing a 1st place finish over nine other regional teams.

Following their success, the team advanced to the ASCE National Concrete Canoe competition in San Luis Obispo, California. Competing against 19 teams from across the U.S, the VT team showcased their vessel, DESPERADO, in four categories: *technical proposal (4th place)*, *oral presentation (3rd place)*, *paddling races (2nd place)*, and *final prototype (1st place)* resulting in a very impressive 2nd place finish overall. **This achievement represents the best performance in the history of the Virginia Tech Concrete Canoe program!**

Much of the team's success can be attributed to a strong focus on paddling practice, mix and reinforcement design, and manufacturing. Through the accurate application of wet concrete to the canoe's mold on *place day* and using techniques to minimize waste, a uniform craft thickness resulted. The VT team achieved the lightest canoe at the national event coming in at just 114 pounds. A reduction in hull thickness from 1/2 to 3/8 inches played a pivotal role in achieving weight reduction.

Looking ahead, the team plans to enhance canoe stability by lowering *rocker profile* (the upward curvature of the hull along it full length) and increasing *freeboard* (the distance from the waterline to the top edge of the canoe). Efforts are underway to develop a compelling theme to promote the canoe's design. Virginia Tech's Concrete Canoe continues to recruit passionate members and looks forward to another great year of innovation, teamwork, and competitive success.

https://asce.cee.vt.edu/concrete-canoe-team/

Design Build Fly

In April of 2025, DBF competed in the American Institute of Aeronautics and Astronautics (AIAA) competition at the Tucson International Modelplex in Tucson, AZ. The team's airplane, *Hokie Autonomous Transport* participated in military based challenges based on the development of an aircraft capable of carrying heavyweight fuel tanks and an X-1 test vehicle. Hokie Autonomous Transport could fly with 18 lbs fuel tanks, resulting in a total airplane weight of 26 lbs. In addition, the plane flew with an X-1 test vehicle that deployed in flight, autonomously guiding to a rendezvous location for extra bonus points. VT DBF was one of only a few teams to land in the bonus box! Part of the competition involved the installation of a removable fuel tank pylon system and the X-1 test vehicle, both took only 14 seconds to complete during the ground mission phase.

VT's team scored 13th in combined *report and proposal*, placed 7th overall out of 96 international finalist teams, and received the *Stan Powell Memorial Award* for most valuable lessons learned at competition. **This marks the 5th top 10 finish in a row for the team, making VT DBF the 5th most successful team in AIAA competition history!**

https://gobblerconnect.vt.edu/organization/dbf

VT DBF 2025 Team in Tucson, AZ with advisor Rakesh Kapania.

Hokie Autonomous Transport in flight with *X-1.* Total combined weight is only 26 lbs!

DBF's chief engineer, systems lead, and project manager with the *Stan Powell Memorial Award.*

Formula SAE

VT Formula SAE (FSAE) designs and races a scaled formula-style car over a two-year design cycle. The team performs extensive in-house manufacturing of metal and carbon fiber vehicle components, adding to the overall experience.

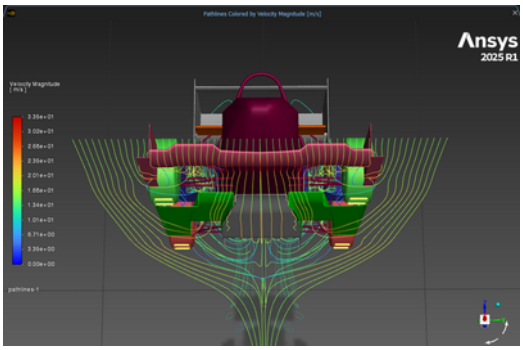
In 2025, FSAE achieved a strong 15th overall finish in a competitive field of over 120 teams at Michigan SAE (gas powered category). Focusing on static events, Virginia Tech finished 11th in *design* and 18th in *business presentation*, 38 places higher than in 2024. In dynamic events, the car finished 20th in *acceleration* and 16th in *skidpad*, both significant improvements over last year. VTM achieved its most impressive milestone by finishing the *endurance* event for the first time in more than five years. Only about one-third of participating competitors achieve this feat at Michigan SAE!

This year, the team continues to test its two-cylinder *Aprilia-powered* drive train, completing over 160 road test miles. Vehicle testing, integral in creating a competition-ready car, allows for fine-tuning, driver training, and on-track fault mitigation.

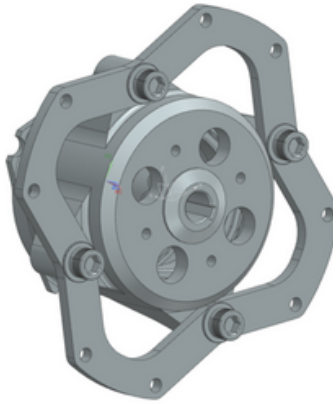
2026 is a development year for the Formula EV team. **For the first time, they are integrating a new approach by using four DTI in-hub electric motors (one attached at each wheel) allowing for independent full-torque vectoring.** With this new technology VT FSAE hopes to achieve a top ten finish at the Michigan EV event.

Moving forward, VTM is in full manufacturing and testing mode of its combustion and EV competition cars and is excited to be a part of upcoming SAE events.

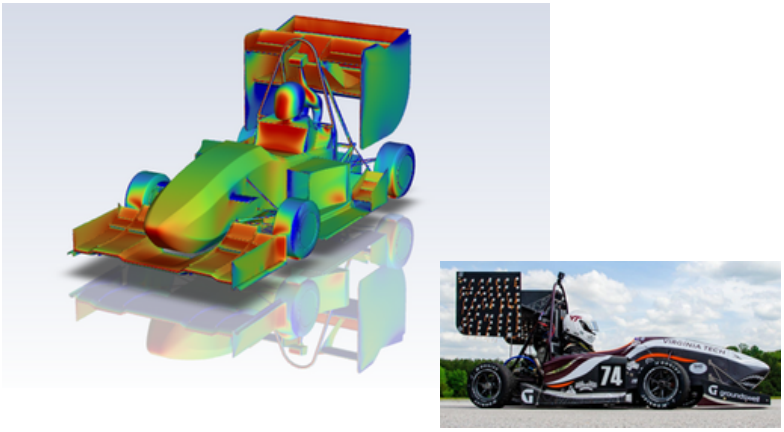
https://eng.vt.edu/academics/ student-teams/formula-sae.html



Ansys computational fluid dynamics (CFD) simulation of air flow over front of the VTM competition vehicle.



DTI in-hub EV motors, a new innovation in 2026.



Left: Vehicle CFD results (higher air flow shown in bright orange). Right: gas vehicle during track testing.

HEVT

Hybrid Electric Vehicle Team (HEVT) is on the go, road testing their new custom LYRIQ BEV around the local Blacksburg and Christiansburg areas. Currently in the final year of a 4-year event, HEVT competes in the EcoCAR EV Challenge. 16 participating universities were given a new Cadillac Lyriq in 2023 and were tasked with redesigning the electric power train, propulsion system, and autonomous programming to meet higher energy efficiency goals. HEVT is set to have a great conclusion to this competition series in 2026 and is excited to get the Lyriq production-ready through intensive road testing and system calibration.

2025 HEVT at Roanoke STEAM Day.

HEVT during testing at VTTI.

The *Systems Design and Integration* sub-team is finalizing vehicle integration and conducting thermal testing that will benefit the vehicle's overall performance. The *Connected and Automated Vehicles* sub-team is testing the adaptive cruise control, automated intersection navigation, and lane centering control. The *Propulsion, Controls, and Modeling* sub-team is calibrating the LYRIQ for consumer appeal, including acceleration (0-60mph in 7.8 seconds), durability, and efficiency. Our goal is to have a viable production vehicle that is comparable to the best available on today's automobile market.

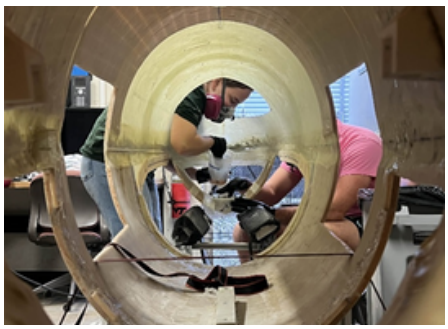
The *Equity in Mobility* sub-team is working with Warm Hearth Village in Christiansburg, VA to develop a prototype seat for the elderly community. Our *communications* sub-team is promoting HEVT's progress to sponsors and the Tech community, as shown on our LinkedIn, Facebook, and Instagram pages. To learn more about VT HEVT contact us at hevt@vt.edu!

https://gobblerconnect.vt.edu/organization/hevt

Week 1 of competition in May 2025.

16 EcoCAR competition teams at GM's Desert Proving Grounds.

Human Powered Sub



HPS team members constructing EXLIENNI's hull.

Testing, testing, and more testing at a local YMCA.

VT HPS spotting team and craft on the launch pad at ISR 18 in Maryland.

HPS Competition Team at ISR 18 with a **2nd place overall win out of 17 teams!**

VT HPS took 2nd overall out of 17 teams at the 18th *International Submarine Races* (ISR18) in 2025: earning 3rd in *Underwater Speed* (4.2 knots, fastest VT sub in 20 years). They also won the *Smooth Operator* award for excellent diver underwater performance.

With these big wins, Virginia Tech's Human Powered Sub team is constructing a new sub for 2026-27. This craft will race in ISR 19 in summer 2027, at the US Navel testing facility in Bethesda, Maryland. In addition, HPS is retrofitting EXLIENNI (last year's sub), to race in the *European International Submarine Races* (eISR) in summer 2026 in Gosport, United Kingdom. Participation in this event is a first for Virginia Tech! The team is happy to announce that HPS is now integrated with *interdisciplinary capstone design*, allowing students from multiple majors to earn academic credit as team members.

The sub is constructed with a fiberglass hull, along with machined and 3D- printed parts. The team plans to incorporate autonomous steering controls and an improved circular drive-train. This drive-train, similar to that of a bike, results in smooth non-reciprocating motion during piloting. With these improvements, the sub's human occupant will concentrate less on steering and more on powering the craft, resulting in high underwater speeds.

HPS will continue to test EXLIENNI in 2026 to improve sub component integration, strength compliance, and performance in preparation for eISR and ISR19. HPS is excited to represent Virginia Tech at these upcoming events.

https://www.hps.aoe.vt.edu/

HUMAN POWERED SUBMARINE
AT VIRGINIA TECH®

Steel Bridge

2025 SBT team during construction practice at AISC Regionals in West Virginia.

Virginia Tech's 2025 Steel Bridge Team.

Completed 20 foot span bridge.

Steel Bridge had a truly remarkable year in 2025 with great performances at the AISC Regionals in Morgantown, West Virginia and at the national event in Ames, Iowa. **At nationals the team earned 3rd place out of over 40 teams, making this the best year in the history for the Virginia Tech Steel Bridge program!**

During the 2025 fall semester, VT SBT focused on AISC competition rules (which change every year) and how bridge design would conform to the new guidelines. The team conducted weekly brainstorming meetings, inviting alum team members with bridge design experience. At the meetings bridge layout, connection type, and high strength material use were discussed.

Bridge fabrication will occur in the spring semester with the use of solid metal slip connections, reducing bridge construction time. The team will also use a high quality chromoly steel, improving bridge strength. Project funds have been applied to the purchase new Milwaukee drills (used during modular bridge construction), allowing for decreases in construction time to under 10 minutes. Load testing, a must, will also occur in the spring to determine the bridge's ability to carry 2500 lbs.

With a first place win at the 2025 regionals and an all time best performance at nationals, Virginia Tech's Steel Bridge Team is now a top tier North American program.

https://asce.cee.vt.edu/steel-bridge-team/

VTSBT

Ware Lab Outreach

In addition to attending competitions, Ware Lab teams perform outreach in the form of lab tours and on-site visits. Over 1100 visitors from K12, home schools, industry, and academia toured the facility to learn more about our programs. All ten Ware Lab teams traveled to Roanoke VA in October, 2025 to participate in STEAM Day (STEM + the arts) where 990 visitors spoke with team members in a relaxed, welcoming environment. In total over 2100 folks learned about our great teams in 2025!

Tour Group or Outreach Event	Number of Participants
STEAM Day 2025 - on site in Roanoke Va.	996
4H Groups	40
ABET Appraisers	2
Admitted Students	17
Alumni Families	16
CEED Summer Camp - BLAST	20
CEED Summer Camp - Imagination	54
CEED Summer Camp - C-Tech^2	32
CEED Summer Camp - Pathways	57
Environmental Health and Safety Staff Tour	2
Elementary School Students	207
Hendrick Motorsports Representatives	5
High School Students	141
Holston High School Science Group	40
Josh Johnson with Ingersoll Rand	4
LabCORE Conference	20
Lucid Motors CEO	3
Middle School Students	235
Prospective Students and Families	110
SAE Club	4
SuperDARN Conference Participants	20
UPWARDS@VT	20
VT Office of Admissions New College Counselors	16
WEE VT	64
Total	**2125**

Lab Stats

All Ware Lab students must complete a survey each year in order to gain access to the on-campus facility. Survey results for this academic year are shown below.

How did you learn about Ware Lab?	Number Responding	Percentage
Word-of-Mouth	331	21.0%
Lab Tour	133	8.4%
CEED O'Show	187	11.8%
Gobblerfest	285	18.0%
Team Info Session	566	35.8%
Other	77	4.9%

Academic Major		
Aerospace and Ocean Engineering (AOE)	120	10.7%
Biomedical Engineering and Mechanics (BEAM)	5	0.4%
Business	10	0.9%
Civil and Environmental Engineering (CEE)	94	8.4%
Communications	3	0.3%
Computer Science (CS)	42	3.7%
Construction Engineering and Management (CEM)	5	0.4%
Electrical and Computer Engineering (ECE)	208	18.6%
Engineering Education (ENGE)	58	5.2%
Industrial Systems Engineering (ISE)	22	2.0%
Materials Science Engineering (MSE)	12	1.1%
Mechanical Engineering (ME)	479	42.7%
Mining and Minerals Engineering (MINE)	1	0.1%
Physics	3	0.3%
Other	59	5.3%

Academic Level		
Freshman	391	36.3%
Sophomore	334	31.0%
Junior	224	20.8%
Senior	113	10.5%
Grad Student	14	1.3%

Academic Credit		
Senior Design Credit	67	5.9%
Volunteer (no academic credit)	773	67.7%
Independent Study	97	8.5%
Undergraduate Research	48	4.2%
Other	156	13.7%

Ware Lab Team		
Astrobotics	107	9.6%
Baja SAE	248	22.2%
Battery Operated Land Transport (BOLT)	102	9.1%
Concrete Canoe (CCT)	11	1.0%
Design Build Fly (DBF)	103	9.2%
Formula SAE (FSAE)	242	21.7%
Human Powered Sub (HPS)	71	6.4%
Hybrid Electric Vehicle Team (HEVT)	74	6.6%
Autoboat	63	5.6%
Steel Bridge (SBT)	96	8.6%

Thank you!

Ware Lab would like to thank our corporate, university and private sponsors for their continued support of Virginia Tech's undergraduate teams. Thanks go to the *Bare*, *Donehower*, and *Jones* families, Virginia Tech's *College of Engineering* and the SEC (*Student Engineers' Council*), along with *Boeing*, *General Motors*, *Ingersoll Rand*, *Lockheed Martin*, and the *US Department of Energy*.

Additional Ware Lab team support is provided by...

Ware Lab Adminstration

- ***Keith Thompson –*** Ware Lab Director and Associate Dean of Student Affairs

- ***Dewey Spangler –*** Ware Lab Manager

- ***Phillip Ratcliff –*** Ware Lab Assistant Manager

Ware Lab Faculty Advisors

Alex Brand (CEE) - *Concrete Canoe*

Rakesh Kapania (AOE) - Design Build Fly

Scott Huxtable (ME) - Hybrid Electric Vehicle Team

Stefano Brizzolara (AOE) - AutoBoat

Matt Eatherton (CEE) - Steel Bridge

Robert Stone (BEAM) - Human Powered Sub

Ware Lab Faculty Advisors

- ***Kevin Shinpaugh (AOE)*** **–** Astrobotics

- ***Jared Bryson (VTTI)*** **-** Baja SAE

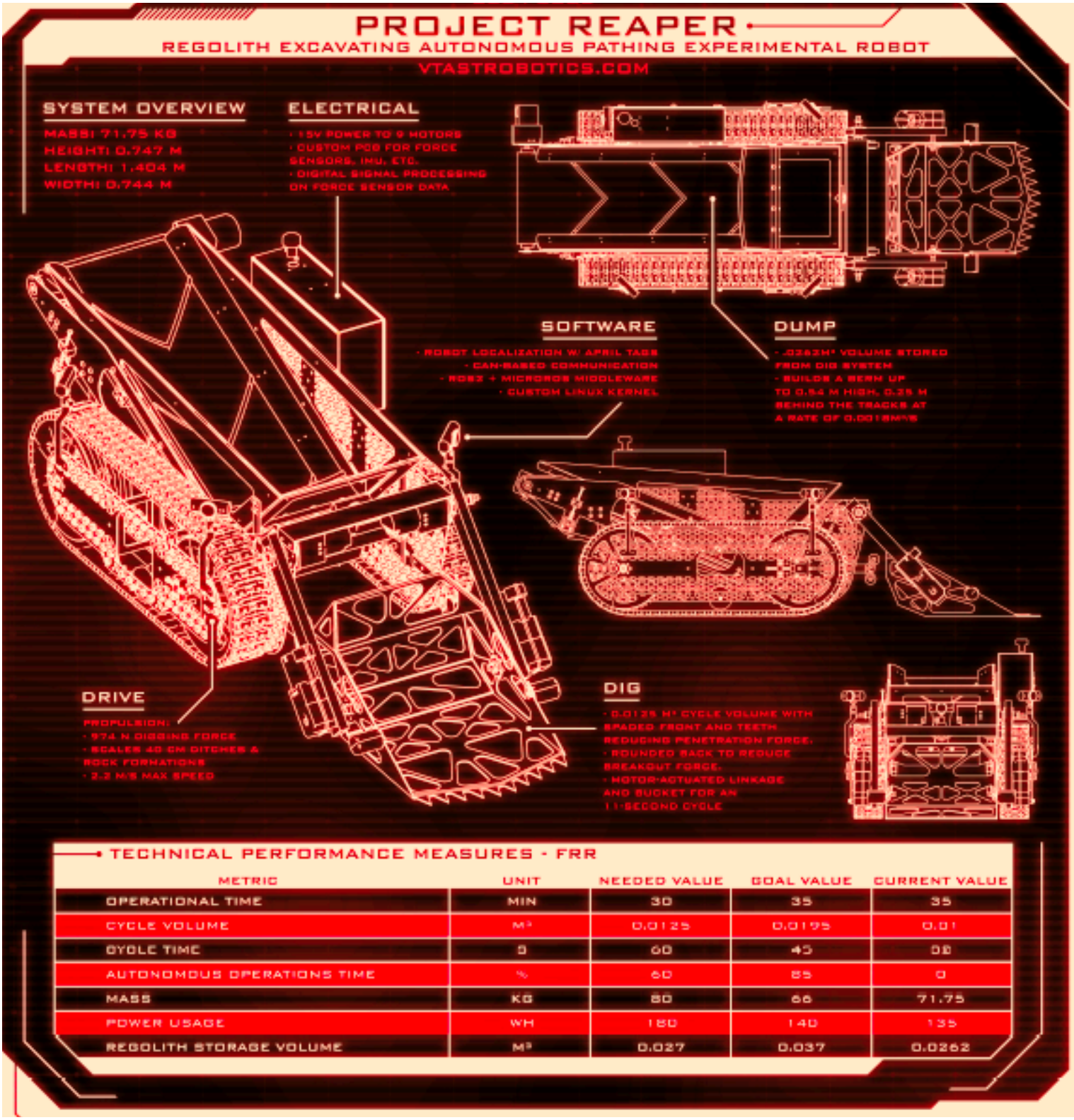
- ***Arthur Ball (ECE)*** **-** BOLT

- ***Richard Clark (ME, MSE)*** **-** BOLT and Formula SAE

- ***Bill Baumann (ECE)*** - Formula SAE - EV

Team Posters

Ware Lab teams submit posters each year for competition presentations and senior design course requirements. These are shown below for 2025-26.



AutoBoat At Virginia Tech

What is AutoBoat?

AutoBoat is an engineering and robotics based design team open to all academic years and skill levels, with the goal of designing and building autonomous sailboats and autonomous electric motorboats.

All majors and skill levels are welcome to help in every part of the process. All team members are volunteers, participating for the experience and the fun of it.

AutoBoat allows for real-world application of classroom learning along with the development of interpersonal skills, time and finance management, and public speaking.

Reach Out

autoboat@vt.edu
www.autoboat.aoe.vt.edu

Subteams

Electrical: Responsible for boat and shore hardware and communication, and implementation

Mechanical: Responsible for the design and manufacturing of drivetrains and components for each boat

Naval Architecture: Responsible for the overall design of the boat and construction structural elements

Propulsion/Sail: Responsible for sail design and fabrication

Software: Responsible for boat autonomy through control algorithms, machine learning, and communication with our groundstation

Public Relations: Responsible for sponsorships, social media, and outreach

Future Projects

We are currently working on a project where we are adding electric propulsion to a gas jetski and add autonomous features. The jetski will be driven at approximately 30kW and will have support for manual, remote, and autonomous control.

BAJA SAE AT VIRGINIA TECH

About the Team:

- Undergraduate engineering design team
- 50+ Students from 12+ majors in engineering and beyond
- All students welcome, no prior experience required
- Mechanical Engineering capstone opportunity
- Fleet of 4 vehicles maintained as test-platforms, driver and maintenance training
- Designing a data acquisition system for validation of engineering design
- Students manage all sponsor acquisitions and relations
- Team running continuously since 1986
- Engineering outreach for students across Virginia

About the Car:

- Competing across the USA against 90+ other Universities at each event
- Competition regulated 10 hp motor
- Top speed of 41 mph
- 15 inches of suspension travel per corner
- Full roll cage and 5 point harness system
- Designed and Manufactured fully in the Ware Lab at Virginia Tech in Blacksburg, VA
- Custom designed 4WD system with 2WD disconnect
- Driven by students in competition
- Can hit a 12 inch log at 15 mph

2025 Competition results:

Arizona 2025
- 8th place Overall
- 1st place Overall Dynamics
- 3rd place Pilot Pull
- 10th place Endurance

Maryland 2025:
- 13th place Overall
- 4th place Overall Dynamics
- 1st place Suspension & Traction
- 3rd place Hill Climb
- 8th place Manuverability

About our Competition:

- Split into Static and Dynamic Events
- Static Events include Cost Event, Business Presentation and Design Presentations
- Dynamic Events include Suspension & Traction, Maneuverability, Acceleration, Hill Climb, Sled Pull
- 4 hour Endurance race where all cars race wheel to wheel

BOLT Electric Motorcycle

2024-2025 Interdisciplinary Capstone

Competition:
AHRMA Formula Lightning Varsity Challenge

Key Sponsors:
Altium Designer, Roanoke Valley Harley Davidson., CSM, General Motors, Vector

Senior Design Members: Javid Alasti, Bradley Frye, Benjamin Kriebel, David LeBlanc, Wyatt Getz, William Hoff, Will Webster, Levi Heizer, Aniruddh Chauhan
Faculty Advisors: *Dr. R.L. Clark Jr., Dr. Arthur Ball* **Liaison:** *Thad Petty*

Introduction

BOLT designs, builds, and races electric motorcycles. The goal of this year's project is to develop the next-generation electric road racing motorcycle that will compete in the AHRMA Formula Lightning Division against other college teams.

This year, we focused on improving overall durability of the bike, optimization of subsystems, and reliability.

- Fully custom 4130 Chromoly steel frame
- Custom distributed Battery Management System (BMS)
- Refined battery pack structure
- Revised Power Distribution Unit (PDU)
- Custom nose, tank, tail, and side fairings
- Flexible PCB wire harnesses
- Improved wireless communications
- "Anything to CAN" hardware

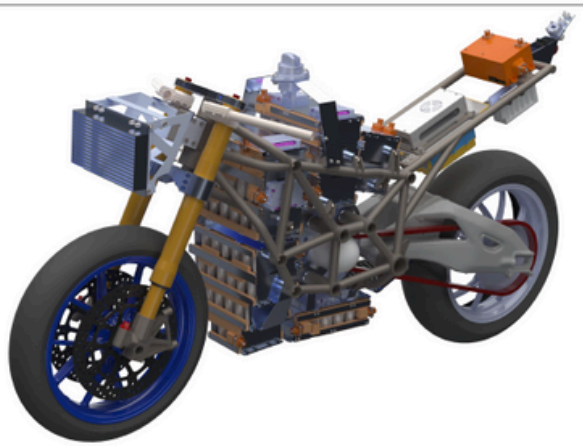
Customer Needs

Student Team Members	Rider and Competition
• Maximize mean time between failure • Reliable bike for future years use • Minimize assembly & disassembly time	• Reliable power transmission to rear wheel • Competitive Lean Angle • Power output on par with comparable gas bikes

Validation Results

The electrical and mechanical systems of the bike were validated during full power dynamometer testing.

	Target	Validated
Pack Voltage differential	+/- 0.25 V	+/- 0.005 V
Battery Pack Capacity	21Ah	22.5Ah
Battery pack current	300A	300A
Peak Torque Output	450 Nm	448 Nm
Peak Power Output	152 kW	117 kW
Top Speed	170 MPH	140 MPH
Battery Pack Temperature	<80°C	<35°C



Frame

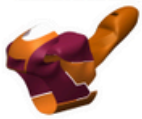
- Custom design for simple integration of battery packs
- Capable of supporting 60° lean angle
- Subframe designed for supporting motor controller
- Optimized with FEA

Pack Structures

- New pack structures designed for improved safety and ease of assembly
- Consistent design reduces build time
- Lightweight aluminum design

Fairings

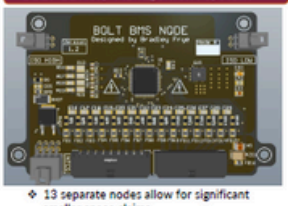
- Custom fairings to enclose electrical components and improve aerodynamic performance
- Balance of function and aesthetics
- Substructure transfers load from rider and drag into frame, increasing the useful life of the fairings



Future Considerations

- In-house frame DFM focus
- Cooling loop optimization
- BMS Master Improvements
- BMS balance speed increase
- Pack weight savings
- 3D-Printed Fairings

BOLT Battery Management System



- 13 separate nodes allow for significant smaller space claims
- Allows battery management to be fully controllable
- Low voltage design allows for greater safety and ease of use

PDU Revisions

- Low voltage power distribution board capable of up to 720W
- Custom forward enable circuit using solid state relays
- Custom firmware for status and power statistics

Wireless Comms.

- Increased range for effective track communication
- Improved range allows for consistent telemetry throughout the track
- Up to 2.75km of range

A2C Module

- Converts digital and electrical signals into a CAN signal
- Modules allow for global CAN communication
- Can be configured for speeds up to 1Mbps providing a wide range

CONCRETE CANOE

2024-2025

ABOUT THE TEAM

Concrete Canoe at Virginia Tech is a student-led engineering design team dedicated to designing and constructing a canoe made entirely of concrete. Each year, the team competes at an ASCE regional competition, where they are evaluated in multiple categories, including paddling races, technical proposal, oral presentation, and final prototype. In 2024, the team also had the privilege of advancing to the ASCE National Concrete Canoe Competition in San Luis Obispo, California, where they represented Virginia Tech on the national stage.

LOOKING AHEAD: WHAT'S NEXT?

Looking ahead, the team aims to enhance canoe stability by lowering rocker profile and increasing freeboard. Efforts are also underway to develop a complex and compelling theme to elevate the canoe's design and overall project presentation. The Virginia Tech Concrete Canoe Team continues to recruit passionate new members and looks forward to another year of innovation, teamwork, and competitive success.

CONCRETE CANOE
AT VIRGINIA TECH

COMPETITION RESULTS

Regional Competition

1st Place Overall

- 1st in Final Prototype
- 1st in Oral Presentation
- 1st in Technical Proposal
- 1st Paddling Races

National Competition

2nd Place Overall

- 1st in Final Prototype
- 3rd in Oral Presentation
- 4th in Technical Proposal
- 2nd in Paddling Races

LEADING SOLUTIONS FOR A BETTER FUTURE

concretecanoe@vt.edu

Design Build Fly at Virginia Tech

Subteams

Aerodynamics
- Designs wing configuration
- Analyze and sets aircraft parameters

Stability & Control
- Designs aircraft tail and control systems
- Determines flight characteristics

Electronics & Propulsion
- Designs propulsion systems
- Optimizes propulsion configuration for varying performance

Systems
- Designs fuselage
- Designs and implements all mission-specific aircraft components

Structures
- Contributes to aircraft model design
- Analyzes structural integrity of spar and boom and their materials
- Manages and leads composite usage

CAD
- Contributes to aircraft model design
- Analyzes structural integrity of the wing and its materials

Manufacturing
- Constructs and maintains aircraft
- Consults with design team to ensure manufacturability

2024 competition team

Welcome to DBF! Our team works together throughout the schoolyear to design, build, and test a fixed-wing RC aircraft in preparation for competition in April. We are open to **any and all** interested students.

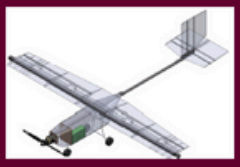
Visit the Ware Lab informational page to find links to the proper EHS training to get Ware Lab certified!

2025 plane, "Hokie Autonomous Transport" 7th worldwide

COMPOSITE ENVISIONS
ELECTRA.AERO
LOCKHEED MARTIN
SCORPION
SEC

2024 Plane ***4th Place***

2023 Plane
4th Place



VT COLLEGE OF ENGINEERING
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Formula SAE

At Virginia Tech Motorsports Formula SAE, we design, build, and race both IC (internal combustion) and EV (electric vehicle) race cars. During the 2025 season, the team continued to push boundaries with a strong focus on improving vehicle reliability, design, and overall performance.

Throughout the 2025 season, VT Motorsports demonstrated strong performance across both static and dynamic events, placing 15th out of 120 universities overall, with standout finishes in design and endurance.

The season concluded at the 2025 Michelin Shootout in South Carolina. Despite challenging conditions, the team earned 1st place in acceleration and 6th place overall. While the results did not fully meet expectations, the competition provided valuable insights heading into the 2026 season.

As we prepare for 2026, the team remains committed to applying these lessons to continue building strong, competitive IC and EV vehicles.

vtmotorsports.org
@vtmotorsports

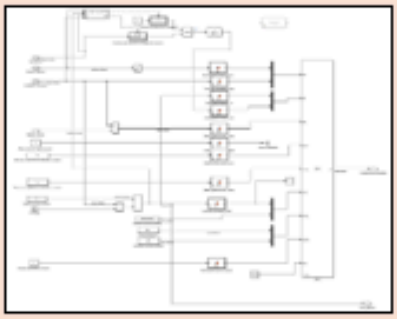
VT MOTORSPORTS FORMULA SAE

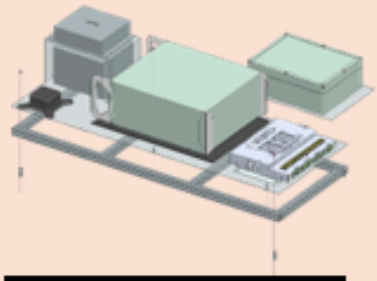
Hybrid Electric Vehicle Team (HEVT) at Virginia Tech

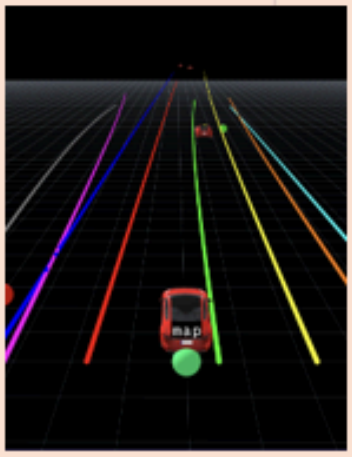
HEVT Competes in the EcoCAR EV Challenge, the most recent Advanced Vehicle Technology Competition (AVTC) sponsored by The U.S. Department of Energy, MathWorks, and General Motors. HEVT has been competing in AVTC's since 1992 and has a rich history of high performing teams. In the EcoCAR EV Challenge, 15 schools making up 13 teams compete to redesign the electric powertrain, propulsion systems, and autonomous features of a 2023 Cadilliac Lyriq to meet energy efficiency goals.

5

HEVT currently consists of 75 members over 6 different sub-teams. In the final year of our competition, the team is looking forward to collecting miles on public roads, calibrating our vehicle towards a production level vehicle! For more information contact us at hevt@vt.edu!







HUMAN POWERED SUBMARINE AT VIRGINIA TECH®

Fig. 1. The team poses with a newly completed EXLIENNI before a quarry test (April 2025).

International Submarine Races

We compete in the International Submarine Races (ISR) hosted by the Foundation for Underwater Research and Education (FURE). The event is held biennially at the Naval Surface Warfare Center in Bethesda, MD. The challenge of designing, building, and racing a human-powered submarine is intended to spark interest in ocean and marine engineering fields and to provide educational opportunities for science and engineering students in all fields around the world. Submarines are judged according to top speed, innovation, presentation of design and decisions, and overall performance, with the whole team are judged on spirit, efficiency, and final design report. As the name would suggest, the race is host to many foreign teams, with competitors from the United States, Canada, Poland, the U.K, Taiwan, and more.

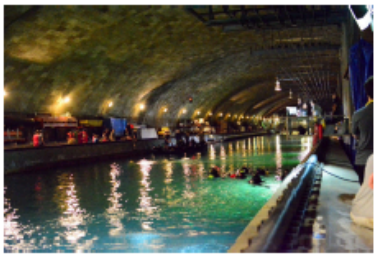


Fig. 2. Submarines race one at a time in the tow tank at Carderock Naval Surface Warfare Center. The tank is 5/8-mile long and flooded with water from the Potomac River. Spectators watch from the sidelines where there is a live video feed of the underwater race.

Please check out our website or find us on instagram @vthps.

If you have the time, come downstairs to the submarine bay during a Ware Lab tour, or feel free to email us at hps@vt.edu with questions.

www.hps.aoe.vt.edu

Mission

Human Powered Submarine at Virginia Tech is an undergraduate design-build team that designs, builds, and tests a fully flooded human-powered submersible vehicle to race in the International Submarine Races. The team aims to foster meaningful experiences for young engineers, especially ones in which they can develop an intuition for real-world engineering. Team members also learn valuable soft skills while promoting STEM to the university and community through outreach.

Design

Our team is currently working on the design our new submarine which will be raced at the 19th International Submarine Races in June 2027. Human Powered Submarine has four subteams: hydrodynamics, controls, structures, and electronics. Hydrodynamics designs and manufactures the hull and propellor based on flow simulations; they also create windows, a hydroscoop, and hatches for the submarine. Controls creates a manual control system and an electronic control system as well as design the dead-man switch. Structures manufactures the pilot rig, sternplate, pedal mount, drivetrain, tailcone, and hatches. The electronics subteam is creating a navigation system for the electronic controls and ensures the submarine has functioning safety lights. This year's senior design project involves designing and building a half-scale test submarine with an automatic ballasting system.

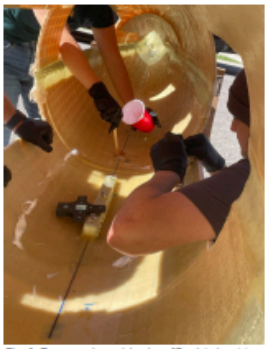


Fig. 3. Team members gluing in a 3D printed part to prepare EXLIENNI's control surfaces for a pool testing (Spring 2024).

Diver Support and Safety

Safety is important to consider, and this shows in the design. Competition requirements dictate that there must be sufficient air for 1.5 times that required for a standard run, a secondary air supply, a dead-man switch that triggers a buoy, and both internal and external hatch releases. A significant amount of time is spent each design cycle determining how to improve reliability of these systems, because when it comes to safety, "good enough" is never enough.

Team Breakdown

Two years ago, Human Powered Submarine completed its first year as an interdisciplinary senior design team; however, all academic levels and undergraduate majors have always been welcome, even those not in the college of engineering. As shown in Fig. 4, the team currently consists of members majoring in ten different engineering fields. Of our 64 current members, 23% are female, and 30% are freshman.

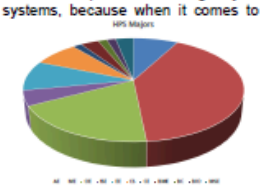


Fig. 4. Membership by Major as of November 2025

Commendations

HPS would like to extend a special thanks to Dr. Robert Stone, Dewey Spangler, Phillip Ratcliff, our sponsors, alumni, members, and their families, whose support and guidance make our project possible.

Fig. 5. EXLIENNI raced at ISR 18 in 2025 and placed second overall, with VT divers winning the smooth operator award for their performance underwater.

Our Sponsors

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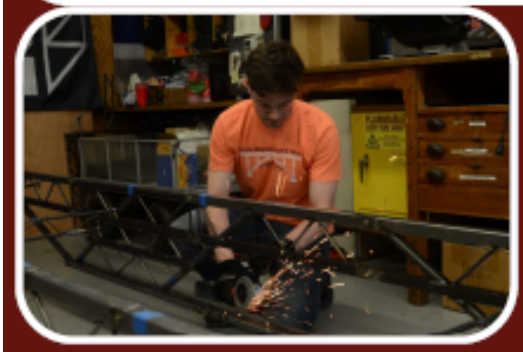
Steel Bridge Design Team
at Virginia Tech

VTSBT

COMPETITION OVERVIEW

The Student Steel Bridge Competition is a design-build contest organized by AISC and ASCE. Each year, these organizations change the rules so there is a new and unique challenge, requiring a redesigned bridge each year.



DESIGN, STRUCTURAL ANALYSIS, & FABRICATION

In order to analyze the structure and design, SAP2000, SolidWorks and AutoCAD are used. Several bridge designs are modeled using these softwares during the design process.

SAP2000 offers an accurate representation of the force interactions, reaction components, deflection, and force transfers between members for each of the load conditions that would occur during competition. Looking at specific members during the structural analysis phase, different steel dimensions were inputted to ensure the most effective dimensions were selected for the final design.

The final design for 2024-2025 was a 2D Vierendeel girder for its structural efficiency and constructability. A Vierendeel panel's ability to resist moments allows it to act as a rigid frame and avoids truss members over the impassable island. This placement reduces hard-to-reach members while maintaining the bridge's stiffness. The girder and bottom chord connections were chosen for easy bolt alignment and natural bearing strength in compression. Their location and orientation were planned for optimal tool access and swift construction.

During fabrication, a few minor constructability changes were made to the design and connections were improved. The fabrication stage was planned out and scheduled, allowing for enough timing for load testing, making adjustments, construction practice, and preparation for competition.

SCORING CRITERIA

- Structural Efficiency
- Construction speed
- Stiffness
- Lightness
- Cost Estimation
- Construction Economy
- Aesthetics

2024-2025 RESULTS

- **Virginia's Conference**
  - 1st Overall
- **National Finals**
  - 3rd Overall
  - 2nd in Structural Efficiency
  - 1st in Aesthetics

Special thanks to our team faculty advisor Dr. Matthew Eatherton, ASCE faculty advisor Dr. Paolo Scardina, and lab managers Dewey Spangler and Phillip Ratcliff for their continued support.

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