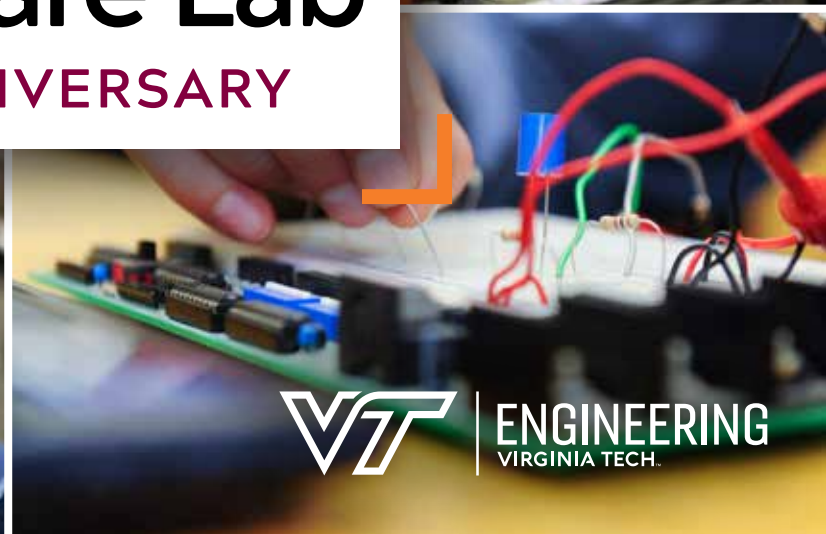


Joseph F. Ware Jr. Advanced Engineering

The Ware Lab

20TH ANNIVERSARY



ENGINEERING
VIRGINIA TECH.

Joseph F. Ware Jr.

Born and raised in Blacksburg, Virginia, Joseph F. Ware Jr. attended and graduated Virginia Tech with a degree in Mechanical / Aeronautical Engineering in 1937. He moved on to Cal Tech where he obtained his Masters Degree in the same area of study, and later joined Lockheed Martin as the Department Manager of Engineering Flight Test on the world's fastest and highest flying airplanes along side engineering legend Kelly Johnson.



“You can understand anything, and if you can understand it, you can fix it.”

– Joseph F. Ware Jr.



Ware was a family man and enjoyed flying his plane. He loved animals, teaching, economics, politics, and his country. He was a patriot and served in the Civil Air Patrol and the Coast Guard Auxiliary.

Ware and his wife Jenna co-founded the Ware Lab in 1998 to support undergraduate student design projects. Since his passing in 2012, his wife Jenna continues to support projects in the design laboratory and carrying on the generous legacy of the Ware name at Virginia Tech.

Joe Ware and College of Engineering Dean Emeritus Bill Stephenson (left) and walking around the opening of the Ware Lab (right).

Ware Lab

Joseph Ware recognized a need for a facility dedicated solely to undergraduate student projects at Virginia Tech, so he generously funded the conversion of the military laundry building to suit the needs of the design project teams. By 1998 the first teams moved into the lab and the facility and the number of teams has continued to grow ever since, housing an overflowing 11 teams in 2018.

The Ware Lab provides a unique learning environment for students from various majors across the university with more than 450 students, some receiving academic credit and others serving as volunteers. Participants may become involved as early as their freshman year, taking success from the classroom, to becoming members of an award-winning team,



all the while learning skills transferable to the workplace. The Ware Lab is not limited to just engineering-focused majors, all majors can find their fit. As the Virginia Tech's curriculum continues to integrate collaboration between different colleges, students from every major can find their place and participate with any team within the lab.

The lab is equipped with a 10,000 square foot project center complete with numerous work bays, a welding shop, a machine shop, and a computer design lab. Despite all the features incorporated into what Ware Lab is today, there is a need to expand space and utilities so that more students can participate. Donations are accepted and appreciated on behalf of the Virginia Tech Foundation.



Leadership



Bev Watford, Director

Watford is the associate dean for academic affairs and director of the Center for the Enhancement of Engineering Diversity, both in the College of Engineering. For over 25 years, Watford has worked to enrich the engineering profession through increasing diversity, focusing on under-represented students to achieve their educational and professional goals. Watford holds a bachelor's degree in mining engineering and a master's and Ph.D. in industrial engineering, all from Virginia Tech. **Email: deuce@vt.edu**



Dewey Spangler, Manager

Spangler is the full-time manager of the lab. He works with student teams, develops corporate sponsorships, and coordinates visits to the lab for prospective students and educational groups to promote engineering as a profession. He holds a bachelor's degree and a master's in civil engineering and a master's in mechanical engineering, all from Virginia Tech. **Email: spangler@vt.edu**



Phil Ratcliff, Assistant Manager

Ratcliff is responsible for the daily operation of the machine and welding labs, performing safety training, and assisting students engaged in project fabrication. For over 18 years, Ratcliff served as instructor-of-record for ISE 2214 - Manufacturing Processes Lab, in the department of industrial and systems engineering. He holds an applied science degree in machining technology from New River Community College. **Email: pratclif@vt.edu**

Klages Machine Shop

Arthur C. Klages, a 1942 industrial engineering graduate, donated tools and equipment needed to furnish the Ware Lab machine shop.

Equipment in the machine shop includes:

- Three milling machines
- Three lathes
- Band saw
- Plate
- English wheel
- Various grinding and cutting machines

The welding shop is equipped with:

- Gas metal arc welding
- Gas tungsten arc welding
- Plasma cutter
- Sand blaster

Students that work in both facilities have the opportunity to receive training on a wide variety of machines providing a firm understanding of manufacturing, fabrication, and construction methodologies.



CAD / CFD / FEA Lab

Inside the Ware Lab there is a 24/7 design lab available to the student teams to work collaboratively in designing their engineering projects.

This lab is heavily utilized by team members using computer aided design (CAD), finite element analysis (FEA), and computational fluid dynamics (CFD). The facilities also have areas that can accommodate team discussions and group work.

As a result of generous corporate contributions to the lab, teams work on software that allows for optimization of competition vehicles, structures, and components.

The Formula SAE team performs full CFD analysis for each competition to ensure optimal wing angle-of-attack and vehicle down force.



AISC Steel Bridge

Each year the Virginia Tech Steel Bridge team takes on the challenge of building a scaled-size bridge made entirely from structural steel. The American Institute of Steel Construction specifies design rules for the competition bridges, as well as other parameters.

The required capacities of the bridges can reach as high as 2,500 lbs at various locations along the bridge. The bridges are based on bridge strength, stiffness, economics, aesthetics, and construction speed.

The steel bridge team competes annually and regularly scores in the top positions, earning them competitive spots in the national event held in various locations around the U.S.

Faculty Advisor

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ASCE Concrete Canoe

The Concrete Canoe program has been a part of Virginia Tech since the 1970's and involves construction of a full-size, functional canoe using a lighter-than-water concrete mix. The Concrete Canoe Team is club-based, meaning completion of the canoe is on-going while completing all course requirements in their respective majors.

Concrete Canoe competes each year in regional events sponsored by the American Society of Civil Engineers all around Virginia, and the national events held in various parts of the U.S. The competition has male and female-specific endurance races and sprints.

Faculty Advisor

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The first-generation canoe from the Concrete Canoe Team of 1998 is on display in the Ware Lab's front entrance. It rests on the original Virginia Tech table made specifically for this canoe's shape.





2013



2015



2017

STUDENT TEAM

Astrobotics

Virginia Tech Astrobotics is a senior design team for aerospace, mechanical, industrial systems and mining engineering students. Undergraduate volunteers from computer science, computer engineering, and electrical engineering, that have a passion for robotics and space exploration, also work on the Astrobotics team.

The Virginia Tech Astrobotics team will be competing in NASA's Robotic Mining Competition for its ninth consecutive year. The program challenges university students to design and build an autonomous robot to mine the surface of Mars. Fifty teams travel to Kennedy Space Center to compete in the week-long competition where they are judged on their robot's performance on a simulated Martian surface and performing various autonomous

routines. NASA created this competition to encourage research in the infant field of in-situ resource utilization. Astronauts in the not-too distant future can extract ice and necessary elements from Martian regolith, a critical part of successful deep-space exploration.

Aerospace Faculty Advisor

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Baja SAE

Virginia Tech Baja SAE students are tasked to design and build an off-road vehicle that will survive the severe punishment of rough terrain. Being a part of Baja SAE allows students the opportunity to test what they have learned in the classroom in an open and collaborative environment. The objective of the team is to experience the full production cycle of designing, building, promoting, and racing a vehicle capable of performing on all terrains.

Every year, the team builds a new vehicle from the ground up in order to continuously seek marginal gains and meet the needs of a changing regulatory structure. At each SAE event, teams compete against one another to have their design chosen for manufacture by a fictitious firm.

Faculty Advisor

John Ferris

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“I can truly say I use skills every day that I learned and developed as a captain of the VT Baja team ... My time in the Ware Lab and with the Baja team gave me the tools I needed to be recognized, earn credibility, and feel confident in my role.” – Jaime Dorfman, VT Baja SAE Co-Captain Spring 2014, Product Integrity Engineer, The Walt Disney Company



BOLT

The Virginia Tech Battery Operated Land Transport (BOLT) team has a reputation and history of top innovation by building an all-electric racing motorcycle. By challenging the standards of performance, BOLT expects to increase the visibility of clean emissions motorsports while proving the viability of the technology itself. Since BOLT's inception, three models have been built and proven themselves as competitors.

In 2013 the first generation BOLT Mk. I went undefeated in-class and won the North American Championship after placing 3rd internationally. In 2014 BOLT Mk. II competed in the American Historic Racing Motorcycle Association (AHRMA) eMotoRacing New Jersey circuit, placing first in the all-electric category. In 2015, BOLT Mk. II also competed in the AHMRA eMotoRacing Daytona circuit.

BOLT also recently finished manufacturing their newest motorcycle, BOLT Mk. III, which placed second in its first race at the New Jersey Motorsports Park in June 2017. Mk. III is targeted to compete in multiple AHMRA racing circuits while the team begins designs for BOLT Mk. IV.

Faculty Advisor

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Faculty Advisor

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2012



2015



2017

Design Build Fly

Design Build Fly is an undergraduate design team that design, builds, and flies remote controlled planes at an international competition hosted by the American Institute for Aeronautics and Astronautics (AIAA), Cessna, and Raytheon. The Design Build Fly team goes through all aspects of design and manufacturing including CAD, CFD analysis, composite layups, and wind tunnel testing. The 2017-18 AIAA competition called for an aircraft that can store a passenger and payload while having replaceable components. Design Build Fly chose a low span and low weight, flying-wing aircraft that will achieve the maximum score according to the provided scoring equations.

Design Build Fly is primarily led by eight seniors with about 30 underclassmen in various majors who assist with design and manufacturing. The team leads pass-down knowledge to subsequent years to ensure successful continuation.

Faculty Advisor

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2012



2015



2018

Formula SAE

The mission of the Virginia Tech Formula SAE Team is to conceive, design, and fabricate a high performance formula-style race car with easy maintenance and high reliability that would appeal to the nonprofessional weekend autocross racer. The team has been competing for nearly 30 years and frequently places in the top ten at the Formula SAE international competitions.

Typically, more than 120 vehicles from other colleges and universities around the world participate. In the last two years the Formula SAE team has integrated a second all-electric vehicle into their program in addition to their traditional combustion engine. In 2017, the team finished 5th overall in the Formula SAE Lincoln event with the combustion car, and the electric vehicle finished 7th overall.

Faculty Advisors

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Human Powered Submarine



1993

Human Powered Submarine is an undergraduate team that competes in the biennial International Submarine Races (ISR). In order to do so, the team must design, build, and race a fully-flooded human-powered submarine, which is judged on criteria such as speed and innovation. The International Submarine Races require the development of efficient solutions to marine engineering challenges and provides a valuable learning experience for undergraduate engineering students at Virginia Tech.



1999

Human Powered Submarine started work on its first submarine, Phantom 1, in 1991. In 2018, nine submarines and 27 years later, the team continues to thrive. Phantom 8, the current submarine, aimed to incorporate autonomous controls



2018

and variable-pitch, contra-rotating propellers. After facing challenges with this submarine at ISR 14, the team is focusing on revamping Phantom 8, extensively testing all its systems, and preparing it to excel at ISR 15.

Faculty Advisor

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Hybrid Electrical Vehicle Team

Hybrid Electric Vehicle Team (HEVT) competes in the Advanced Vehicle Technology Competition series (AVTCs) that challenges students to re-engineer a production vehicle to reduce its environmental impact while maintaining safety, performance, and consumer acceptability. HEVT competed in EcoCAR 3, the last AVTC, in which teams had four years to re-engineer a Chevrolet

Camaro with a renewed focus on cost and innovation. The team finished in fourth place.

Virginia Tech students continue to be involved in AVTCs because of their strong belief in the mission, which is to offer an unparalleled hands-on, real-world experience to educate the next generation of automotive engineers.

Faculty Advisors

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Aero SAE

The Virginia Tech Aero SAE Design team is comprised of senior aerospace engineering students tasked with constructing a gas-powered, remote controlled, scaled aircraft to achieve competitive objectives.

Aero SAE Design exposes students to system integration with the focus on data acquisition and aircraft performance for a complex, multi-faceted mission.

Every year Aero SAE Design participates in the SAE Design Series competition (advanced class). These events provide students with real-world design challenges and expose participants to the nuances of conceptual design, manufacturing, system integration / testing, and proof-of-concept.

Faculty Advisor

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2013



2016

SailBOT

Since 2013, Virginia Tech SailBOT has been a team with the goal of designing, building, testing and racing a two-meter long, fully autonomous sailboat each summer. The SailBOT International Robotic Sailing Competition involves a series of weighted events including: fleet racing, obstacle course navigation, station keeping, distance racing and object tracking, all performed autonomously.

Project completion is done via sub-teams that include: Naval architecture, mechanical, computer and electrical, and sail and mast, which work and communicate to produce a single autonomous boat in time for competition. Planned design aspects include a carbon fiber hull design, hydrodynamic keel and rudder design,

and a set of aerodynamically designed sails for use in a variety of wind conditions.

All aspects of design and construction must take into account the vessel's overall weight. As for full scale racing-yachts, it is necessary to eliminate unnecessary weight to maximize vessel speed. Stability and compatibility between vessel construction and autonomous systems are also major design criteria.

Faculty Advisor

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Ware Lab Outreach



Each year over 2,000 visitors from corporations, universities, and K-12 groups come to tour the Ware Lab to see Virginia Tech students at work.



An elementary school visitor takes a test ride on the Battery Operated Land Transport (BOLT) vehicle during the Science Festival.

Ware Lab Corporate and Organizational Sponsorship



Without the generous support of corporate, organizational, and private sponsors, Ware Lab teams would not have the resources available to design and fabricate the award-winning projects they do, or have exposure to this amazing real-world experience. Contributions in the form of money, materials, equipment, and software allow the Ware Lab groups to produce state-of-the art competition vehicles, structures, and components. Our corporate and organizational sponsorships are an integral part in the existence and success of the Ware Lab program and we'd like to thank the growing list of sponsors listed on the right:

- A123
- Aerospace Systems
- Associated Power
- Autodesk
- Baker Hughes
- Black & Decker
- Club Car
- Ford
- General Motors
- Goodyear
- Honeywell
- Leidos
- Lockheed Martin
- MPT
- Nucor OG Racing
- Parker
- PCB
- Proctor & Gamble Company
- Siemens
- Sign Systems Inc.
- Somic America, Inc.
- The MathWorks
- U.S. Department of Energy
- United Technologies Corporation
- UTC Aerospace Systems
- Virginia Tech Student Engineers' Council
- Westinghouse

Ware Lab Private Sponsorship

Private sponsorships are essential in assisting the Ware Lab cover operational expenses and allowing teams to receive yearly stipends that funnel straight into each team's individual processes. These funds help teams recruit new team members and purchase necessary equipment and services to complete their projects.



Private contributors that have created permanent endowments, providing projects with a continuous source of seed money are:

- John and Elizabeth Donehower
- Dale and Deborah Hamilton
- Marvin and Susan Johnson
- Arthur Klages
- Joseph F Ware, Jr
- Virginia Tech Student Engineers' Council

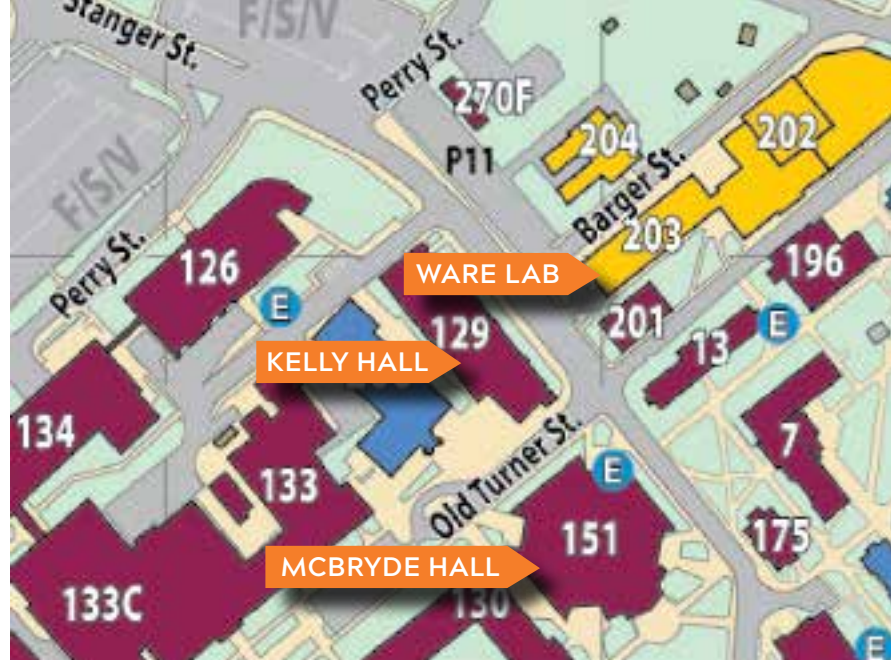
To become a part of the Ware Lab legacy: www.givingto.vt.edu

Visit the Ware Lab

The Ware Lab is located diagonally across from McBryde Hall and directly across from Kelly Hall on the engineering quad of the Virginia Tech campus.

For more information on the Ware Lab's location on Virginia Tech's main campus: www.maps.vt.edu

For important parking information: www.parking.vt.edu



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For inquiries regarding non-discrimination policies, contact the Office of Equity and Access at 540-231-2010 or Virginia Tech, North End Center, Suite 2300 (0318), 300 Turner St. NW, Blacksburg, VA 24061

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