New Hub for Wine Studies

Washington State University welcomes Ste. Michelle Wine Estates Wine Science Center

By Ben Roush and Rustin Hall

The Wine Science Center is located adjacent to a trial vineyard planted in 2014. Trial plantings will complement the university's growing viticulture program.

Imagine a facility where the best equipment and high-tech laboratories are dedicated to the study of enology and viticulture in Washington state. Imagine that facility is dedicated to researching unique regional grape-growing and winemaking challenges and opportunities as well as teaching students the best practices in winemaking to prepare them for careers in the Washington wine industry. That was the vision of the Wine Science Center Development Authority, a collaboration between the city of Richland, Wash., Washington State University (WSU) and industry stakeholders. In 2015, that vision was realized in the new Ste. Michelle Wine Estates WSU Wine Science Center (WSC) at WSU Tri-Cities in Richland.

Public-private partnership

The WSC was funded by an innovative public-private partnership. Public funding came from the state of Washington and a grant from the U.S. Economic Development Association. Land adjacent to the WSU Tri-Cities campus was donated by the Port of Benton. Recognizing the importance of research and a quality education focused on Washington wines, the Wine Science Center Development Authority, a coalition of wine industry professionals, oversaw the planning and construction of the Wine Science Center.

Much of the equipment was provided through private donations from Cypress Semiconductors, Spokane Industries, Scott Laboratories, WECOtek and Mid-Columbia Forklift. The total facility construction cost was $15 million, with an additional $8 million in equipment. The total project cost was $23 million.

The facility totals 39,000 square feet that includes a 9,600-square-foot fermentation floor with 192 individually temperature controlled 200-liter (L) fermentors, a cold room for cooling grapes, two additional temperature-controlled fermentation rooms, a winery laboratory, and equipment and wine storage rooms; 13,000 square feet of teaching and lab space; a 500-square-foot wine library and an innovative 1,050-square-foot sensory lab.

Architectural design

ALSC Architects completed the design of the WSC based on various research, teaching and industry needs and includes pedestrian and vehicular traffic patterns for the public and campus sides of the facility. The floor plan reflects these patterns with a public entrance that serves as a focal point and forms a portal between the campus and the adjacent technology and research park. This entrance opens into a 1,700-square-foot lobby.

Providing sweeping views of the entire campus and of the fermentation floor below, the lobby can host wine-related events of up to 120 people and has direct access to an outdoor terrace. The main feature in the lobby is a wine library with more than 3,000 bottles of wine presenting the diversity and quality of Washington wines.

The architectural inspiration for the design aesthetic of the lobby was an exploded wine barrel motif, with the wine library representing the vessel containing the results of the process: some of the finest wine in the world, including wines produced at WSU.

The floor plan includes two separate entrances for research staff, leading directly to office spaces and research labs. There is a campus/student entrance on the campus side of the facility, allowing circulation in and out of the building without disruption of events in the lobby. Two vertical circulation cores enable groups to tour the multi-level facility in an efficient loop without disrupting activities in the building. The design supports ease of maintenance of mechanical equipment with elevator access to the mechanical penthouse.

Efficient, sustainable design

WSU is targeting LEED Silver certification for the facility, which includes many sustainable features. The design team looked at the primary sources of energy and water use in labs and wineries and designed systems to efficiently meet these functions.

In a typical lab, the primary energy user is the ventilation system to heat and supply replacement outside air for the exhaust. FSi consulting engineers implemented a heat-re-

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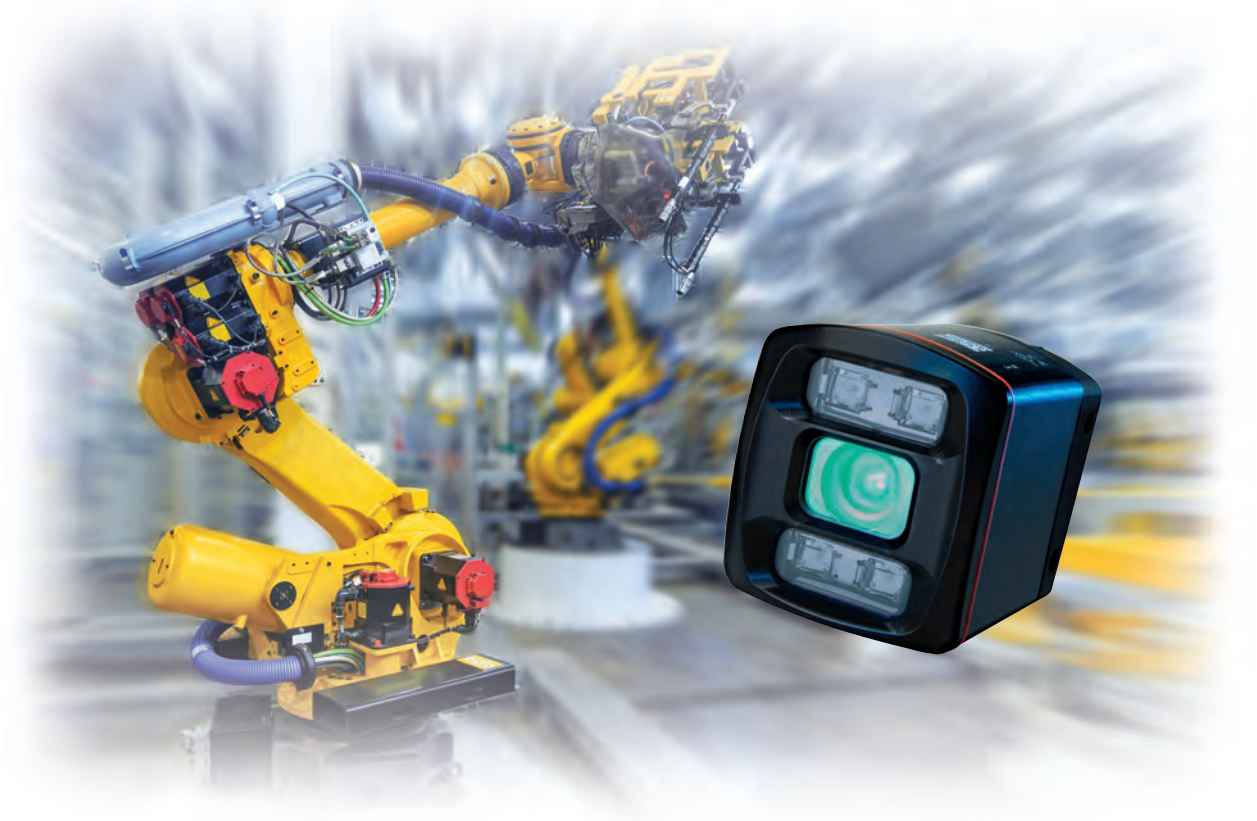

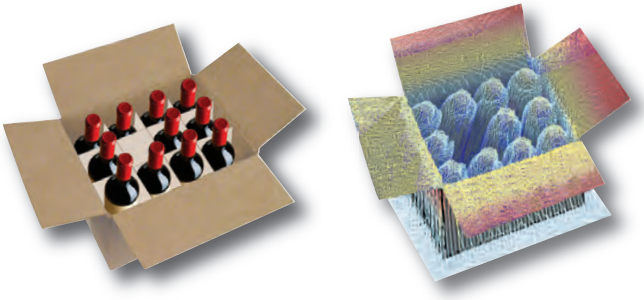

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covery ventilation unit to allow for energy recapture from lab exhaust.

Winery wash down accounts for a significant portion of both the water and energy used in a typical winery. The WSC uses high-efficiency condensing gas water heaters with 95% thermal efficiency to reduce energy use. Winery wash-down nozzles have a special low-flow, high-pressure design to cut water use in the winery by 50%—from about 7 gallons per minute (gpm) to about 3 gpm, which reduces the required heating energy by 60%. There is a higher pressure output to provide a wash-down effect similar to full-flow nozzles. These low-flow nozzles reduce total building energy use by 1%.

All winery wastewater is treated prior to entering the city sewer. The wastewater system is designed to be easily converted to a system allowing reuse of water, as funds become available.

The building insulation and windows exceed the code minimum, and the lighting systems are significantly more efficient than the code requires. In all, the building is 28% more energy efficient than a similar building built to code minimums. The envelope is constructed using a metal frame building with R-30 roof insulation above deck, 6-inch metal-stud walls with varying R-10 to R-19 cavity insulation and R-10 continuous insulation. The windows are high performing with a U-0.27 assembly U-factor, a 0.28 solar heat gain coefficient and 54% visible light transmittance.

The lighting system uses high-efficiency fixtures, occupancy sensors and day lighting to reduce the lighting power consumption by 28% below code allowable. Exterior light fixtures are similar with a reduction of 47% power usage over a baseline building following LEED standards.

All water entering the facility is dechlorinated—including wash-down water, the chilled and process heating water that provides temperature control of the fermentation vessels, all fermentation areas and wine storage areas. To supply this water, the WSC has a dechlorination system that can process more than 100 gallons of water per hour.

The process chilled and heating water systems use innovative ultrasonic water treatment to prevent microbial growth. The process chilled water is supplied at 40° F, which eliminates the need to add glycol for freeze protection. Eliminating glycol in the system reduces costs and possible slipping hazards on the fermentation floor. Heating process water is supplied at 90° F from a high-efficiency hot water heater. Both the heated and chilled water systems use an open loop setup with overflow tanks placed in the mechanical loft at the high point of the system to prevent microbial growth.

Cypress Semiconductor donated tank controllers that include wireless networked functionality, variable-speed pumpover pumps, Brix sensors, temperature sensors and valve controllers.

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Research and collaboration

The WSC cutting-edge research facility was designed in partnership with the Teaching and Research Winery at the Robert Mondavi Institute for Wine and Food Science at the University of California, Davis. WSU is collaborating with UC Davis and other national and international research centers to understand the impacts of site, grapegrowing and winery practices on wine quality, to provide the Washington wine industry the knowledge base to address regional challenges and opportunities.

Recognizing the value of the research and education the WSC will provide, leading industry suppliers and manufacturers donated much of the equipment used in the facility.

Spokane Industries' Metal Products Division built and donated 192 200-liter fermentation tanks to the WSC. These tanks will accept and hold sensors and electronics built and donated by Cypress Semiconductor Corp. Cypress Semiconductors also donated advanced controls to the University of California, Davis.

The tanks, which are fully jacketed for precise temperature control, were constructed with #4 polished finish stainless steel. All interior welds and surfaces were ground and polished to facilitate ease of cleaning. The lids of the tanks incorporate an inflatable seal, which allows the tanks to seal out air no matter what the volume of product is in the tanks. Each lid incorporates a 4-inch Tri-clover fitting to facilitate the mounting of the electronics and sensors to the tank.

The Cypress Semiconductor fermentor controls include wireless networking so that each tank is continually tracked regardless of its location, Brix-sensing using an innovative pressure transducer setup and automatic and variable pumpover controls. The tanks are configured for precise control and data collection. The system provides temperature control, with temperature taken at two depths in each tank and on the jacket of each tank. The readings from these systems are tracked and recorded, allowing researchers to evaluate the finished wines in the context of these variables.

WECOtek Sorting and Automation Solutions donated a state-of-the-art optical wine grape sorter worth $71,500 to the new WSC. Researchers and students at the WSC will use the sorter to evaluate the merits of mechanized grape sorting compared to more conventional sorting by hand. The optical wine grape sorter will also be used at collaborating wineries in Washington to evaluate industry applications.

The 192 fermentation tanks on the main fermentation floor allow for the processing of small lots for experiments. The vessels are on casters, and the piping is configured to allow extreme flexibility for fermentor locations.

The spaces surrounding the main fermentation floor provide optimal and controllable conditions for wine research. The conditioned fruit-storage room can cool down fruit temperatures overnight to 40° F. Two temperature-controlled rooms can cool wine fermentation vessels or barrels to 25° F for cold stabilization and heat them to 75° F for malolactic fermentation.

Support spaces include offices, restrooms, an analytical lab, chemical and equipment storage, mechanical spaces and space reserved for future distillation apparatus on the fermentation work floor. The winery has more than 250 feet of trench drains for easy drainage. The trenches drain to a treatment sump prior to being released to the city sewer system.

Carbon dioxide-removal systems are integrated with makeup air provided by an air handler to fully heat and cool the fermentation workspace, while providing safe conditions for occupants. The systems include monitoring and alarm to evacuate the space if CO_2 levels exceed the OSHA eight-hour exposure limit (5,000 ppm). The system is variable to modulate as CO_2 levels go up and down. Temperature-controlled rooms for wine stabilization

LABORATORY DESIGN

The Ste. Michelle Wine Estates WSU Science Center at Washington State University offers research laboratories for grape and wine research and classrooms for students and industry members supported by laboratories outfitted for chemistry, microbiology, plant physiology and uncovering the characteristics of finished wines.

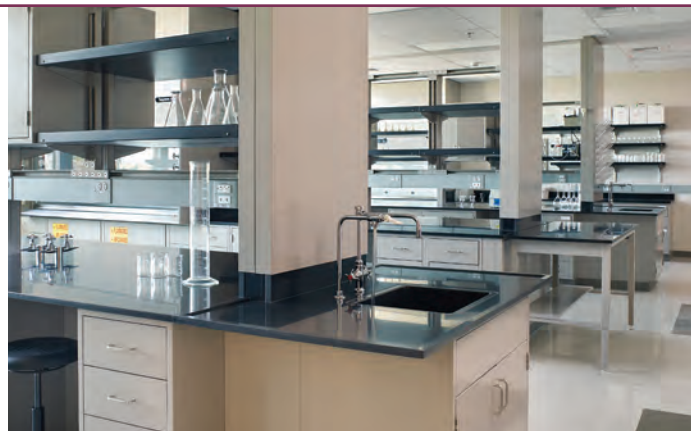
The facility's sensory lab provides a controlled environment for evaluating the taste, aroma and chemical composition of wines. There are two principal areas: a tasting room with five individual tasting booths complete with different lighting spectrums for evaluation, and a set up and clean up area. The sensory area has a sophisticated ventilation system with an activated carbon filtration and air pressurization to control odors that would be distracting in sensory evaluation. The lab has a specialty glass washer with a three-minute wash cycle and storage for more than 1,000 glasses.

The laboratory has been designed to include three large growth chambers for the study of vines at different temperatures, irrigation and lighting conditions. Temperatures in these rooms can vary from -20° F to 122° F, with the irrigation and lighting set to simulate various growing regions around the world. An overhead door opens to the exterior for transporting large, potted vines.

A separate instrumentation lab was constructed to accommodate the various connections to specialty compressed gases such as nitrogen, argon, hydrogen and others. Specific exhaust connections (snorkels) were designed for analytical instruments requiring the exhaust of odors or heat. Many of these services were routed overhead to provide future flexibility.

Laboratories are notorious for being tough on finished surfaces. Durable, chemical-resistant finishes were chosen for the labs, including those on plumbing fixtures. Greater protection is given to the work surfaces, as they receive the greatest use and are most subject to chemical spills. For this reason epoxy resin, which resists damage from heat and most chemical spills, was chosen for all of the work surfaces in the lab spaces. Metal cabinetry—with a chemical-resistant baked enamel finish—was chosen for use in all of the labs because of its longevity, durability and because it has no effect on the properties of wine or the winemaking process.

While wood cabinetry may provide more flexibility for configurations, the porous quality of wood has the potential to contaminate wine



Lab stations include wine chemistry-specific layouts, reverse osmosis water on tap, as well as de-chlorinated and softened water.

BENJAMIN BENSCHNEIDER PHOTOGRAPHY

production and studies. Wood cabinetry was not used in any of the lab or wine-production areas but was installed in office spaces.

Laboratory equipment is primarily divided into two or three categories: large equipment, which requires building services such as sterilizers, glass washers and fume hoods; and small equipment such as analytical instruments, refrigerators, laminar flow hoods, etc. Tertiary equipment generally includes small scales, balances and scopes.

As the lab designer, we assisted in the selection of major laboratory equipment (sterilizers, glassware washers, hoods, etc.), suggesting a number of manufacturers and suppliers. The specific needs for electrical power, pure water and compressed air for this equipment was closely coordinated with other design team members and the contractor for installation.

Mark Osborn of Mark Osborn Laboratory Consultancy is a licensed architect and works exclusively in laboratory design. Some of his previous work has been for Haviland and Fidelitas wineries. He lives and works on Bainbridge Island, Wash.

and malolactic fermentation also include CO_2 exhaust, monitoring and alarm.

Unique lab spaces

All lab outfitting was done by Lab Consultancy, including design for growth chambers with controllable temperature, humidity and light. These chambers can be set to replicate specific climate conditions such as heat and cold events, light and irrigation, enabling researchers to learn how plants can adapt to various environments and how these environments affect grape ripening and wine quality. See the "Laboratory Design" sidebar for more information.

Source of pride for the Washington wine industry

Washington's wine industry is one of the fastest growing sectors in the state's economy, and the WSC is the next step in the industry's evolution. As Washington continues to gain recognition as a premium wine-producing region, the WSC will move the industry forward in its production of high-quality, regionally distinct wines.

Thomas Henick-Kling, Ph.D., director of the Viticulture & Enology Program and professor of enology, describes the new WSC as a source of pride, growth and development for the industry and the region. "Our program develops the educated workforce, research and innovation," explains Henick-Kling, "to further advance the Washington wine industry.

"We are giving viticulture and enology students first-hand exposure in laboratories, vineyards and wineries, working with the variables that make great wine. In the new WSC, they will work with advanced research equipment and focus on regional grapes and wines. They will bring this knowledge with them to the industry. The new WSC and its graduates will push the boundaries of wine science and advance winemaking in Washington to produce wines of consistent, distinct high quality."

Ben Roush, PE, LEED AP BD+C, is an associate at FSi Consulting Engineers. He loves wine, the science of winemaking and winery systems. He has worked with more than 15 wineries, providing studies, facility upgrades and design for small boutique wineries, large-capacity wineries up to 36,000 tons, teaching facilities and everything in between.

Rustin Hall graduated from Washington State University with degrees in architecture and construction management. With a resume that includes more than 25 higher education projects, Hall led the ALSC team in applying the consistent message of "rough to refined" to every facet of the Wine Science Center's design.