SEABOTIX, INC.

Designing breakthrough remote-controlled submersible vehicles with SolidWorks software

SeaBotix avoided the time and expense of repetitive tooling modifications by fully validating the LBV design with SolidWorks Simulation design analysis software.

SeaBotix, Inc., designed, manufactured, and introduced the first lightweight, low-cost, full-production, submersible Remotely Operated Vehicle (ROV). The company's Little Benthic Vehicle (LBV) represents a breakthrough in ROV design: the first underwater ROV that's light enough and affordable enough to appeal to a much larger market. Donald Rodocker, SeaBotix president and founder, is no stranger to underwater firsts, having participated in the US Navy's world-record–setting 1,010-foot open saturation dive.

Having worked on and under the ocean for most of his life, Rodocker knew his company would need modern 3D design tools to take his concept of a production model submersible ROV to a wider market. Because of the delays and tooling modifications he experienced with 2D CAD systems, Rodocker insisted on using modern 3D design tools to develop the LBV.

After evaluating the SolidWorks®, Pro/ENGINEER®, and Solid Edge® 3D design software systems for the LBV project, SeaBotix selected SolidWorks CAD software for its ease of use, ability to model organic shapes and surfaces, SolidWorks eDrawings® communication capabilities, and seamless integration with SolidWorks Simulation analysis software.

Plumbing new depths in ROV design

After developing the initial concept for the LBV in SolidWorks software, Rodocker handed off the project to Jeff Krause, an industrial design consultant, who completed the initial mechanical design. Rodocker estimates that SolidWorks software reduced the LBV design cycle by 50 percent: from the two years he spent on a previous ROV project to just under 12 months.

Results:

- Reduced design cycle by 50 percent
- Minimized tooling modification costs
- Communicated design information among several locations
- Introduced first full-production, lightweight submersible ROV

SOLIDWORKS

According to Krause, using SolidWorks software enabled him to combine both the mechanical and aesthetic requirements for the unit. "The challenge on this project was to package a sophisticated system within a compact, muscular styling theme," he notes. "The system had to function in a small, attractive package. SolidWorks software helped in every aspect of the development process, and PhotoWorks™ renderings aided us in visualizing and refining the design in terms of its shape and packaging."

"This was the first major project that I completed in SolidWorks software," Krause adds. "After using this software, I would never go back to anything else."

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Jeff Krause
Industrial Design Consultant

Validating pressure vessels with SolidWorks Simulation

By using integrated SolidWorks Simulation analysis capabilities, Rodocker says SeaBotix was also able to save money on tooling modifications, because the design was fully validated before the development of a production prototype. Stephanie Griffin, a project engineer with Watershot, Inc., a leading manufacturer of underwater camera housings, consulted on the analysis portion of the LBV project.

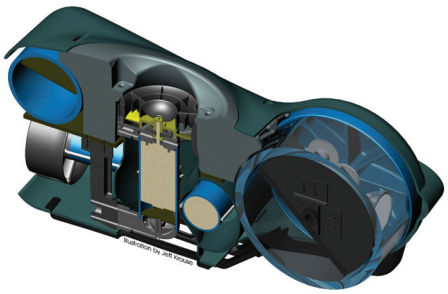
Griffin says she conducted static stress and displacement analyses on all six pressure vessel assemblies for the LBV—four for the custom-designed thrusters, one for the video camera housing, and one for the power supply housing where the umbilical attaches. She also performed thermal analyses on the pressure vessel that houses the video camera and control electronics.

"We had to make sure that the pressure chambers—some made of injection-molded plastic and others of 6061-T6 marine grade aluminum—could withstand the 2,190 psi of pressure that exists at 1,500 meters," Griffin says. "Our biggest challenge was addressing the temperature changes related to immersing the unit in frigid seawater after sitting on a boat deck in the hot sun. The camera has a glass element with a thermal coefficient that differs from aluminum. Using SolidWorks Simulation thermal analysis capabilities, we were able to come up with a functional design, which involved placing titanium washers between the glass and aluminum end caps."

Saving time and money with integration and SolidWorks eDrawings

For Rodocker, the key to developing the LBV quickly and cost-effectively was the flexibility afforded by combining SolidWorks 3D CAD software with eDrawings communication capabilities. Rodocker, Krause, and Griffin worked in different locations, and the manufacturing tooling vendor was based overseas. Via email, Griffin validated the SolidWorks software models created by Krause, and then made design suggestions using SolidWorks software and eDrawings files.

"Because the simulation software was integrated with SolidWorks design software, we were able to iterate using email and evolve the design to a state of reliability," Griffin says. "To confer with Don Rodocker on design changes, we performed more than 100 design iterations, and also used eDrawings files. We are using the same successful process to complete the 3,000-meter and 6,000-meter versions of the LBV."



SeaBotix used integrated SolidWorks design and analysis and eDrawings communications software to develop the first lightweight, low-cost, submersible ROV for depths of up to 1,500 meters.

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