A New Spin on Appliances

A leading manufacturer reduces time in the development of innovative ovens, washing machines and other appliances through engineering simulation.

V-ZUG self-cleaning oven

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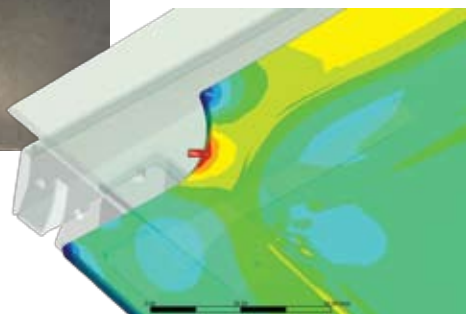
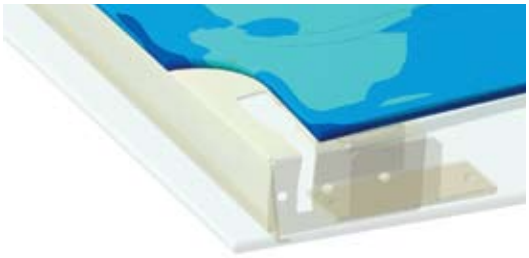
Leading household appliance manufacturer in Switzerland V-ZUG AG has a reputation for regularly developing and launching "world firsts" and building innovation into its products, such as a kitchen range extraction hood that is not only beautiful but provides excellent ventilation. These products reflect the company's philosophy of building to suit the most demanding customer expectations. Committed to environmental efficiency, V-ZUG was named the "most trusted brand on environmental issues in Switzerland" as a result of a recent *Reader's Digest* study.

As a purveyor of precision Swiss engineering, V-ZUG began using finite element analysis in 1996 to determine whether appliance components could withstand loading, to evaluate sealing performance, to avoid resonances at operating frequencies and more. V-ZUG's original finite element code was a powerful tool, but one had to have a considerable amount of specialized knowledge and training to navigate and leverage its full value. After an extensive search for simulation software to better meet its evolving needs, V-ZUG found that structural mechanics software from ANSYS supported by CADFEM, the local ANSYS channel partner, best met their requirements. These requisites included integration with the CATIA® V5 CAD system, ease-of-use for designers, and simulation power needed by analytical specialists. (See sidebar for more details.)

Glass on a prototype oven door broke due to high thermal loads.



Highest thermal stresses were seen in the corner of the oven door where the glass cracked.

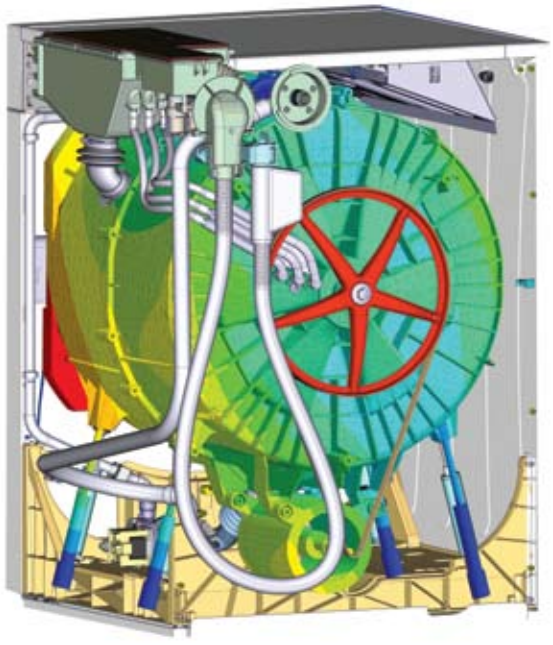


The oven door cracking problem was solved by switching to a different glass material.

One V-ZUG application that used software from ANSYS involved an oven with a steel door that incorporated a glass window glued to the frame. Originally, when the oven was operated at high temperatures (such as 500 degrees C for pyrolytical self-cleaning), the glass broke due to the thermal loads. To simulate the problem, the engineer imported the door geometry from CATIA into the ANSYS Workbench platform and simulated the thermal loading using the ANSYS DesignSpace tool. The simulation results matched the results seen in the prototype, with the highest stresses occurring in the corner where the crack started. The V-ZUG engineer then simulated the performance of a variety of glass materials in ANSYS DesignSpace to identify a material that would handle the thermal loads.

Another V-ZUG application for engineering simulation is in a washing machine. Product developers increased the capacity of the machine from 5 kilograms to 8 kilograms of dry clothes. This change made it necessary to develop a vibration absorbing system; otherwise, the 8-kilogram spinning system, when going through the spin cycle with an unbalanced load, would take up too much space in the housing. The engineer simulated the new design using ANSYS Mechanical software. With the company's previous software, a rotating force vector was used to model an unbalanced force. Using ANSYS Mechanical tools, the V-ZUG engineer modeled the four suspension struts using bushing joints, implemented the drum as a rotor, and added rotordynamics with Coriolis effects to the model. He performed complex modal analysis to ensure that the resonant frequencies would not be excited. The next step will be to simulate the washer using a time-transient dynamic analysis.

The four-noded tetrahedron element, introduced in ANSYS 12.0, was used to analyze a V-ZUG washing machine's rubber bellow, which connects the oscillating tub with the housing. The engineering analyst saved a considerable amount of time by automatically meshing this complicated geometry. He then performed a quasistatic nonlinear hyperelastic material analysis with nine load steps. The first step stretches the bellow over a tub and housing as the closing motion of the front door seals the tub. The next eight steps move the tub along the oscillating position and deform the rubber bellow. The simulation results matched the test results very well. Consequently, V-ZUG was able to evaluate a large number of different design alternatives in a relatively short period of time. In the end, engineers made significant improvements in the bellow that eliminated the presence of water at the end of the wash cycle.



Complete FEA system for the washing machine

The rubber bellow was completely meshed with four-noded tetrahedron elements, which saved considerable time.

Dynamic analysis of the spinning system was critical to ensure that the resonant frequencies would not be excited.

V-ZUG has been very pleased with the decision to move to ANSYS structural mechanics software. The engineering analysts can do simulations in half the time required in the past. Design engineers, who once were limited by the complexity of the previous finite element analysis software, can now perform simulations on their own. The ability to perform more simulations faster means that the company can now evaluate many more design alternatives and iterate to a better solution than was possible in the past. The ability to quickly design innovative products is a very cost-effective strategy for V-ZUG. ■

Finding Flexible Simulation Software to Meet Complex Requirements

The finite element code originally adopted by V-ZUG was a powerful tool, but it required a considerable amount of specialized knowledge and training to navigate and leverage its full value. Recognizing the benefits of engineering simulation, V-ZUG management wanted to extend use of simulation into the design engineering team. Using 20 selection criteria, including seamless integration with the CATIA V5 CAD system, the team evaluated leading analysis tools. They needed a platform that was intuitive enough for use by design engineers yet powerful enough to meet the more demanding requirements of analysts; at the same time, the solution needed to provide for easy collaboration between the two groups. Other key requirements were that the software be available in the German language with exemplary technical support in Switzerland.

After extensive review, V-ZUG chose structural mechanics software from ANSYS supported by CADFEM, the local ANSYS channel partner. The bidirectional interface of the software provides seamless transfer of design information. ANSYS software is provided in German, making it much easier for design engineers to use the programs. ANSYS Mechanical and ANSYS DesignSpace licenses service CAD seats in three development departments: one for water-containing appliances such as dishwashers and washing machines, one for other appliances such as ovens and steamers, and the last for design of production tooling.

Moving to software from ANSYS has improved analysis productivity and provides designers with the ability to perform their own analyses. The ANSYS Workbench graphical user interface is much easier to understand than V-ZUG's original software. It is now more efficient to import the CAD geometry and set all the connections, mesh inputs and boundary conditions directly on the geometry. The result is a substantial reduction in pre-processing time, which helps engineers run simulations much more quickly — leaving them more time to run multiple design candidates to home in on the ideal design. The interface of ANSYS DesignSpace software is similar to V-ZUG's CAD software, and since the designers are familiar with it, they are able to navigate through the software and perform their own analyses without any difficulties. For more complex simulations, engineers can add boundary conditions or nonlinear functionality to models created in ANSYS DesignSpace and run them directly in ANSYS Mechanical software without importing data or switching interfaces.