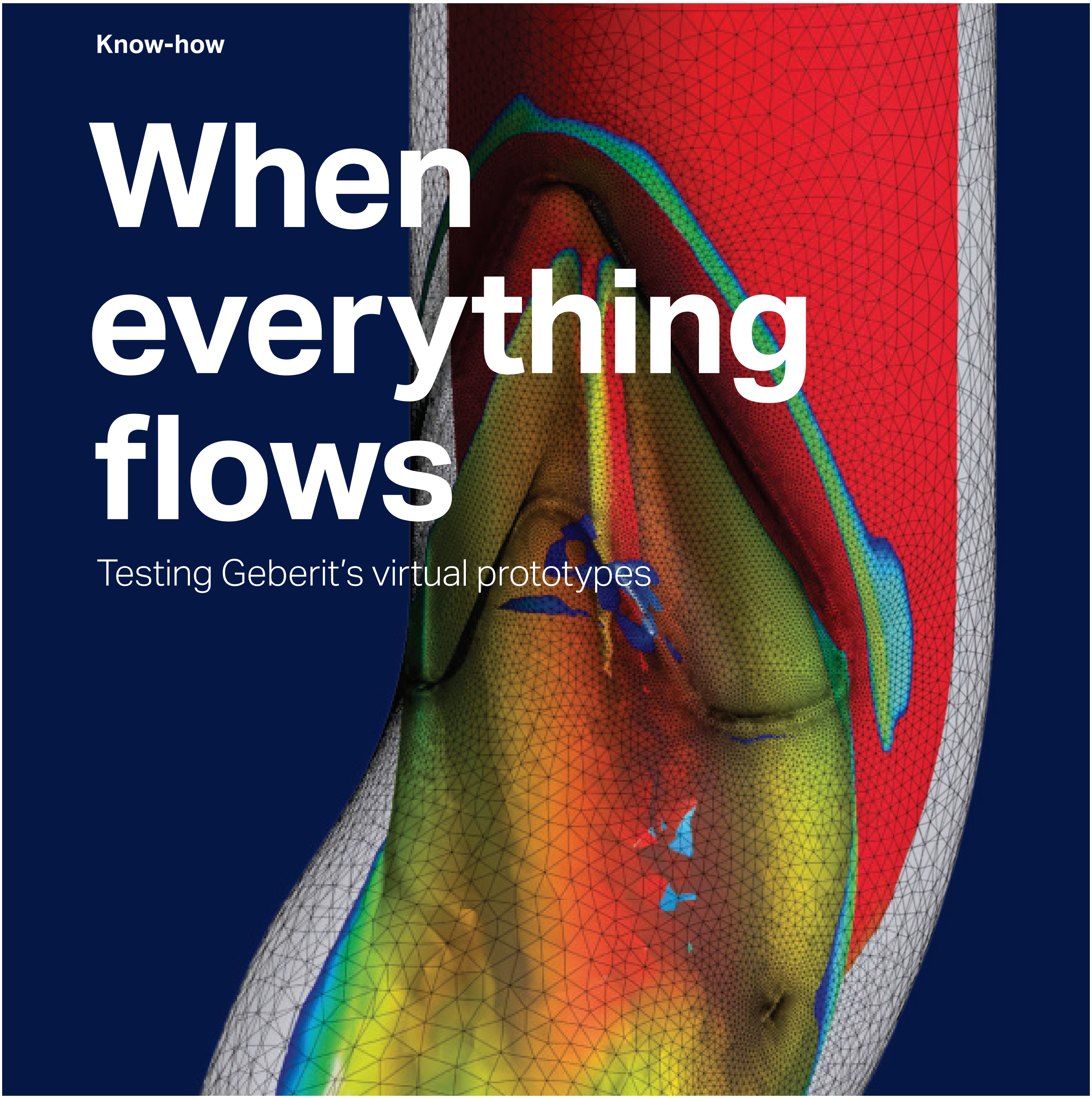
When everything flows

Testing Geberit's virtual prototypes



Waste and drainage systems from Geberit are noted for their excellent flow behavior. This is down to the great work carried out by the flow specialists and their computers. Before real prototypes are manufactured and tested, the flow specialists optimize virtual products using special simulation programs until the correct performance data is achieved.

← Art or science? Computer simulation of the flow conditions in a section of the enhanced Geberit Sovent fitting.

↑ This graphic visualization of the Sovent fitting is based on the data from the computer simulation.

In terms of aerodynamics, computer simulations are an essential part of Formula 1. Using computational fluid dynamics (CFD), racing car specialists calculate and simulate the airflow characteristics of their lean, mean racing machines. During product development at Geberit too, the flow behavior of individual components is simulated by high-performance computer workstations. In both cases, virtual grid models are designed for this purpose. Only when these models have been comprehensively tested and optimized are prototypes built and tested – in Formula 1 in a wind tunnel and at Geberit in the waste water tower in Jona.

Virtual engineering

Geberit's simulation computers are located in the "Basic Sanitary Technology" department, which analyzes the flow patterns as well as the pressure and the velocity distribution of the water. The head of this department is Abdullah Öngören. "Building and testing prototypes is both complex and expensive as a new prototype has to be built for each new series of tests. Even with complex components, our computer-based simulations make it possible for us to virtually calculate and optimize the flow behavior before the first prototype is manufactured. This saves both time and money," explains Öngören, extolling the virtues of virtual engineering.

This can be illustrated in greater detail using the Geberit Sovent fitting as an example. This fitting is used in high-rises to connect the discharge pipes from the individual floor to the main discharge stack. As part of the product optimization process, the aim was to increase the product's discharge rate. The key question centered around the flow rate, both in terms of the limits of what can be achieved and the technical aspects required for its implementation. An everyday trick helped Öngören's team find the solution to the problem: If you hold a bottle filled with water with the opening facing downwards and rotate it slowly, a column of air can form. This air column ensures pressure compensation, which significantly accelerates the water's discharge rate.

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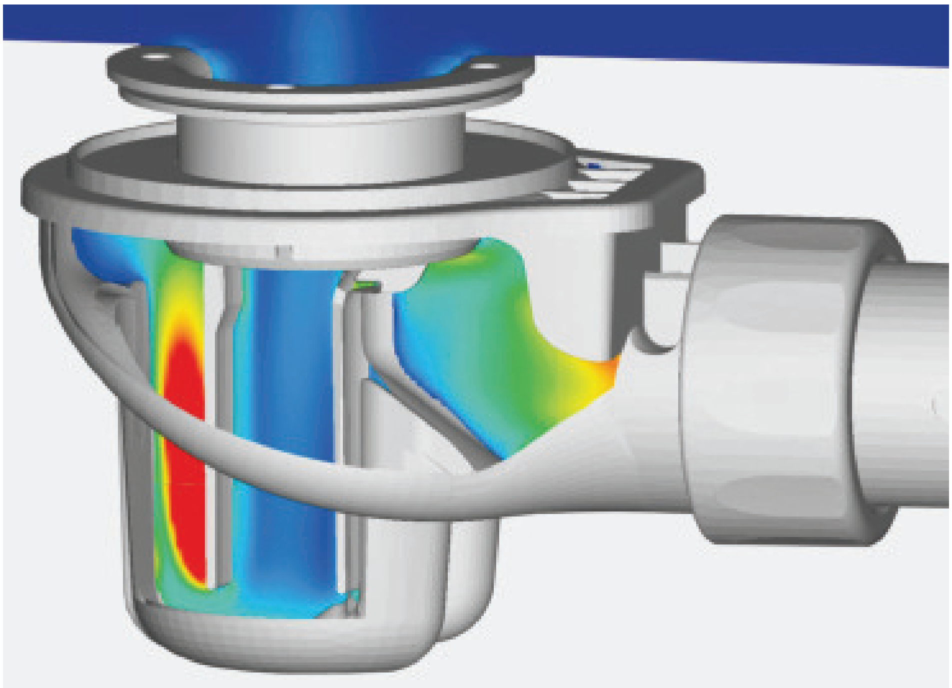

← Virtual flow test of an extra-flat trap for shower drains.

Major improvement in performance

Inspired by this physical phenomenon, the team developed an asymmetrical kink in the upper section of the fitting. This causes the water to rotate, creating a continuous column of air in the center that enables the water to drain away at a faster rate. In this way, the flow specialists were able to increase the discharge rate of the Sovent fitting by 40 percent.

"With product optimizations, we start off by creating a list of the issues at hand where we jot down our ideas and possible approaches to solving the problems before opting for one of the proposed strategies. Thanks to our many years of experience, we have a good idea of what is technically feasible," explains Öngören, outlining the procedure. The flow behavior of a virtual prototype is then tested using the simulation program. "The water flows on the computer screen just as it would in real life. Based on the images from the simulation, we were quickly able to decide what still needed to be optimized on the Sovent fitting," explains the mechanical engineer.

24-meter-high testing tower

After the computer simulation, the Sovent fitting was tested in the 24-meter-high waste water tower. "Our testing tower is the same height as an eight-story building. As the Sovent fitting is part of a drainage system for high-rises, it was important to carry out tests at this height. This enabled us to obtain conclusive results on the impact that Sovent's increase in capacity has on the entire piping system," explains Öngören. Sensors were mounted at the key sections of the prototype in order to test the function and the improvement in performance across the entire system.

Simulated optimization

However, elaborate system tests in the waste water tower are by no means required for all product developments. In many cases, computer-based simulations alone suffice, such as with the extra-flat trap for the Geberit shower drain. "Here we first of all analyzed which type of trap would be the best match for the shower drain and then simulated the potential improvements on the computer," explains Öngören.

The goal was for the water to drain away as quickly as possible. At the same time, the trap needed to be as compact and small as possible and feature a self-cleaning function. The trap was then tested in the computer simulation until the desired results were achieved and all the requirements were met. "It was not necessary to build a prototype for flow tests on this occasion. We were able to rely entirely on our computer calculations," explains Öngören, modestly forgetting to mention that his computers can ultimately only carry out the clever commands input by the real brains of the corporation. ←