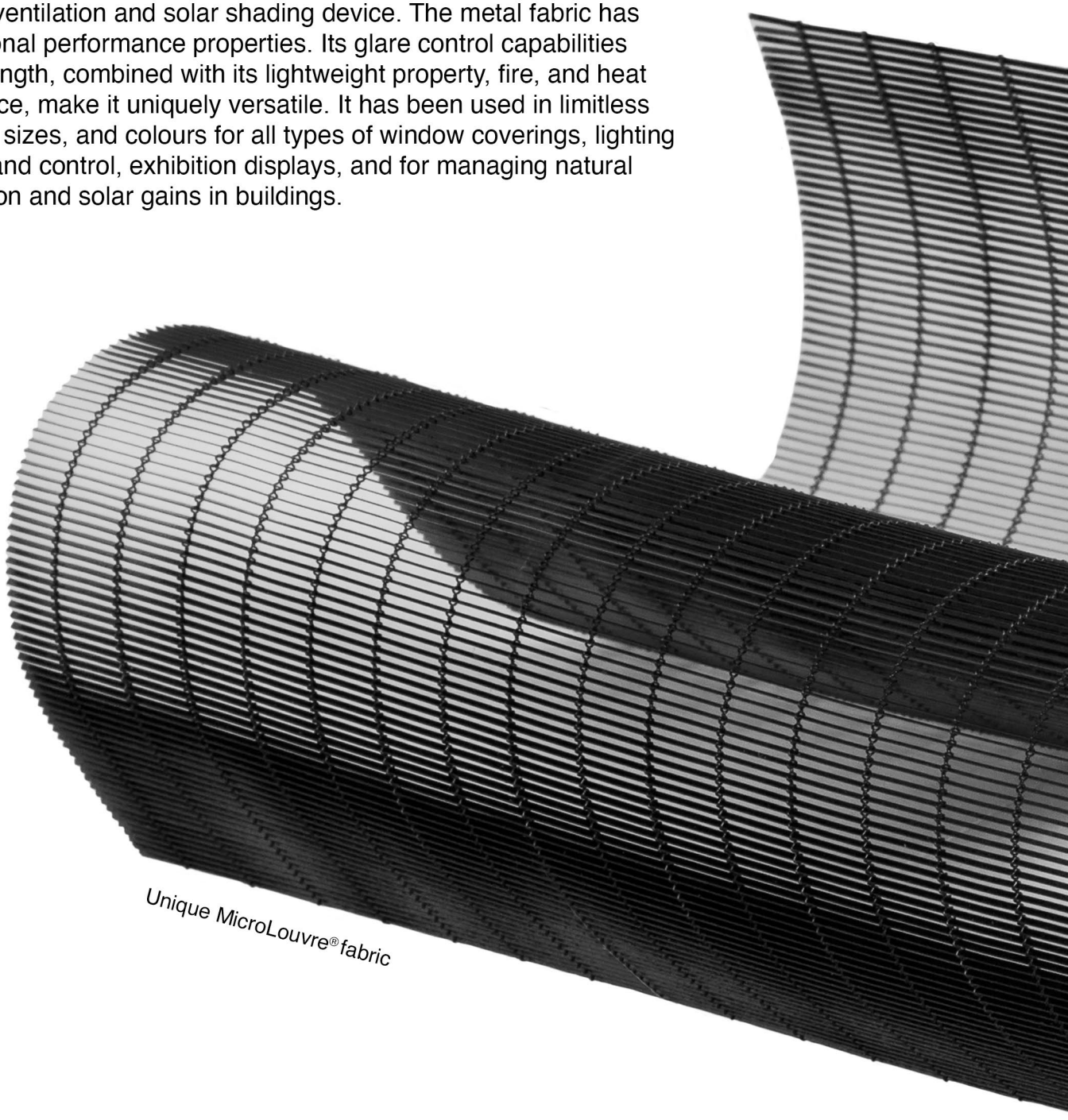
Smartlouvre Technology Ltd. Validates the Performance of a MicroLouvre® Screen for Low Energy Building Design With SimScale's Cloud-Based Platform.

Introducing the MicroLouvre® to Building Simulation

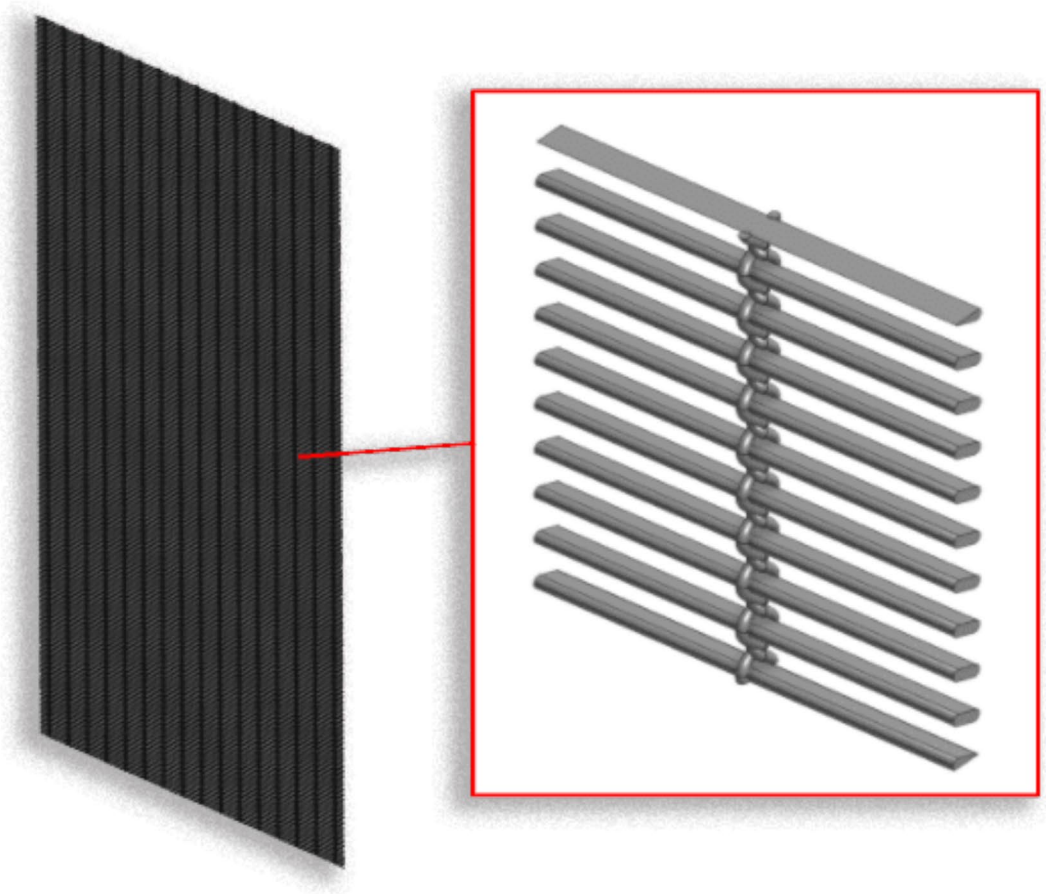
MicroLouvre®is a woven fabric /mesh of paper-thin bronze louvres used to enhance the performance of any glazing or building facade. It is commonly fixed as screens to external windows and acts as a natural ventilation and solar shading device. The metal fabric has exceptional performance properties. Its glare control capabilities and strength, combined with its lightweight property, fire, and heat resistance, make it uniquely versatile. It has been used in limitless shapes, sizes, and colours for all types of window coverings, lighting design and control, exhibition displays, and for managing natural ventilation and solar gains in buildings.



Unique MicroLouvre®fabric

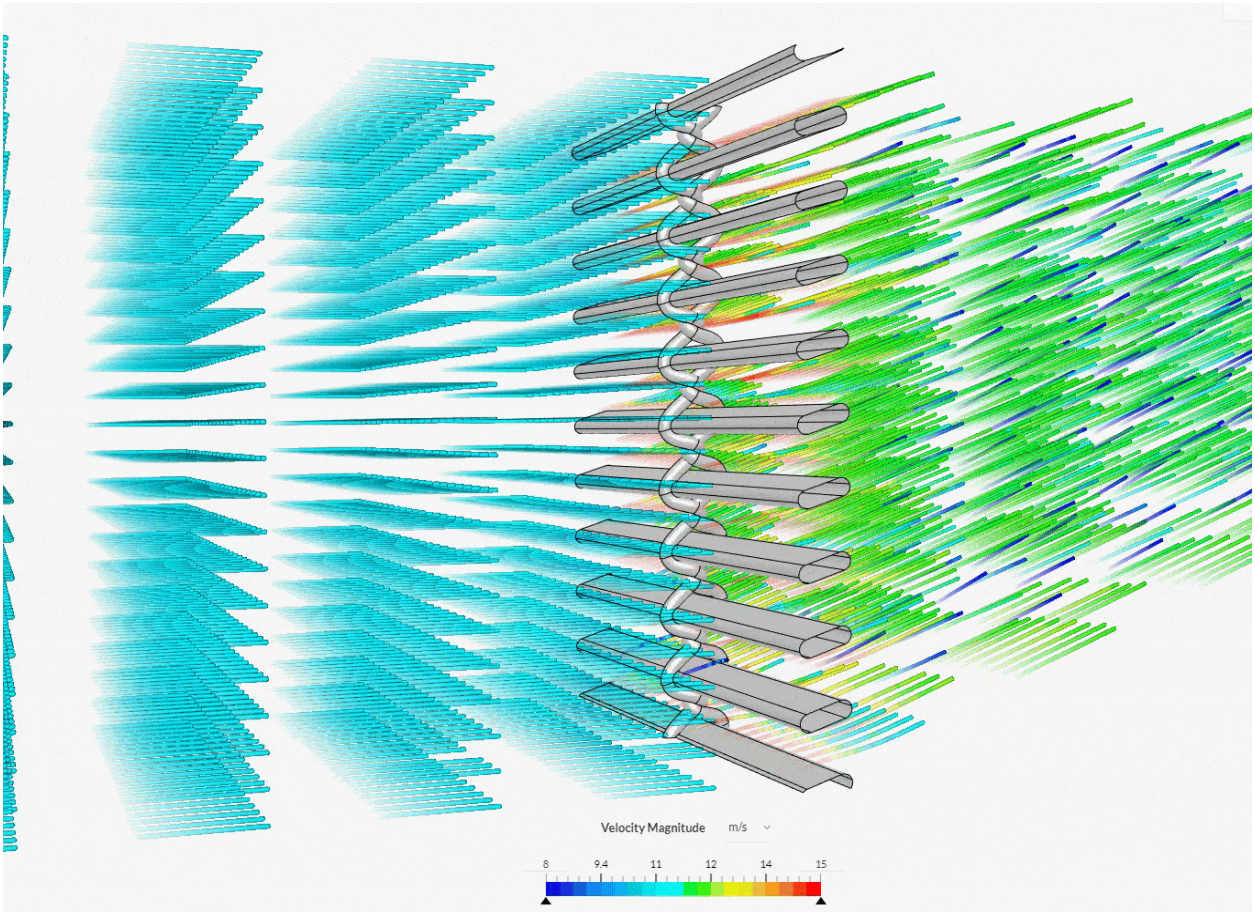
There is no other product like MicroLouvre® fabric. It is totally unique with a wider combination of thermal, environmental, and comfort performance characteristics. Due to the many variables which underpin the overall performance of MicroLouvre® Screens, it is necessary to be able to correctly replicate its performance in building modelling and simulation studies.

Building simulation is used widely in the construction industry to design, specify, and approve in accordance with building regulation standards. Building simulation tools are used by architects, engineers, and sustainability consultants to optimize the energy and environmental performance of a building design, and in turn use this as evidence to pass through the planning and approvals process. Only then can a new building or refurbishment/refit go ahead.



A 3D model of MicroLouvre® imported into SimScale's cloud-based platform.

Previously, the building simulation community was not aware of how to model the multiple performance characteristics of MicroLouvre®Screen. This meant that it was difficult to incorporate MicroLouvre®Screens into building designs as well as include it within standard specifications. Extensive testing at Fraunhofer ISE and LBNL California was commissioned to verify its performance for certain aspects like solar shading and thermal performance. These data sets, which proved the high performance of MicroLouvre® were then made available, but not in a form needed for building design.

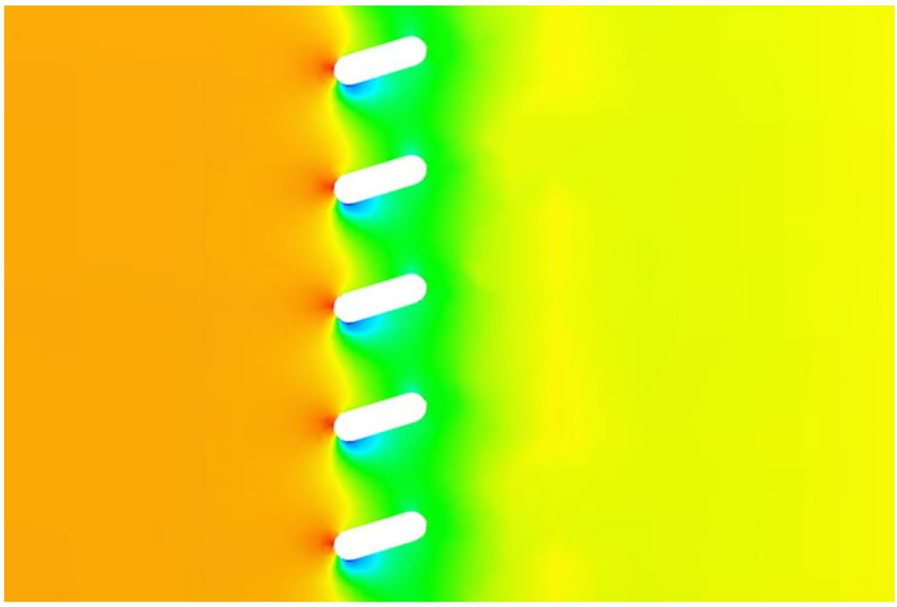


How Smartlouvre solved it with Simscale

The three steps that led to our success

The project with SimScale was completed in several stages:

- Firstly, SimScale conducted a thorough review of all MicroLouvre® existing test and certification reports in order to ascertain its actual performance characteristics.
- Secondly, SimScale used their expertise in CFD and building aerodynamics to evaluate the pressure-flow characteristics of MicroLouvre® to determine an appropriate discharge coefficient (Cd). The Cd value is a key property used in almost all building simulation tools to model the airflow in/out of building openings. Previously, this value did not exist for MicroLouvre®;SimScale simulated the device in their digital wind tunnel set up at various wind speeds and angles. The result is a Cd value of 0.39, which can be inputted directly into any thermal modelling software such as IES, TaS, and DesignBuilder for simulating the airflow through a MicroLouvre® Screen.



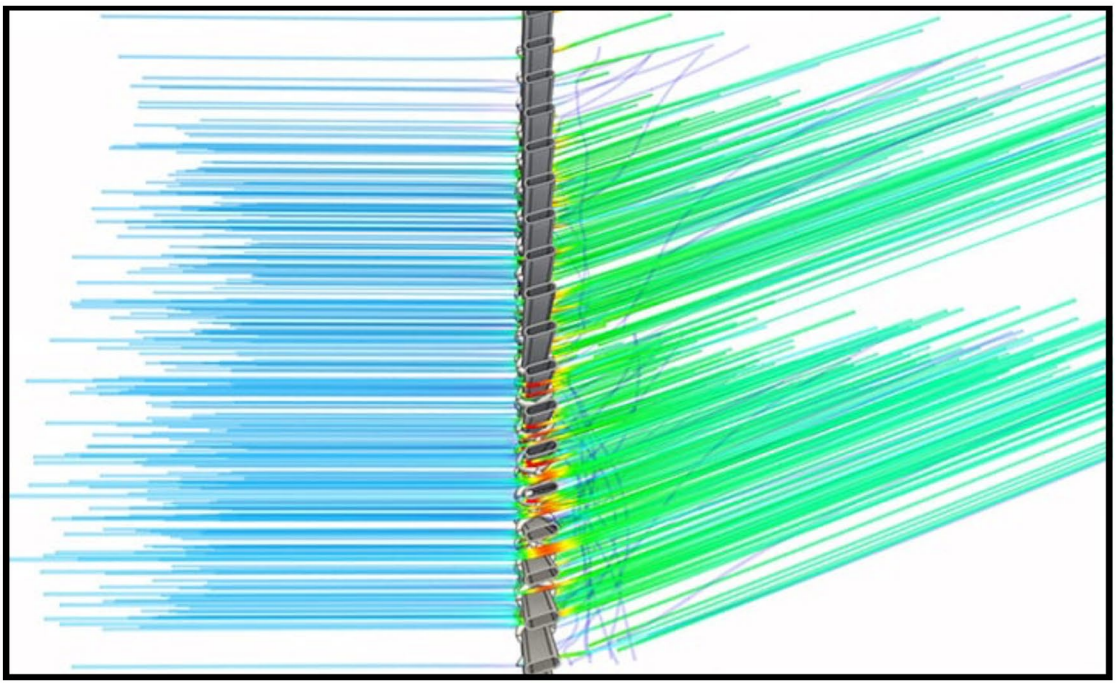
Evaluating the pressure field around a MicroLouvre® Screen using SimScale.

- The final stage was using the solar shading test data to devise a quick method for building simulation consultants to be able to mimic actual performance, in a few easy steps. With SimScale's support, we then produced together an easy-to-use guide that explains to building simulation users how to set up and model a MicroLouvre® Screen.

The results and next steps

Our continued collaboration

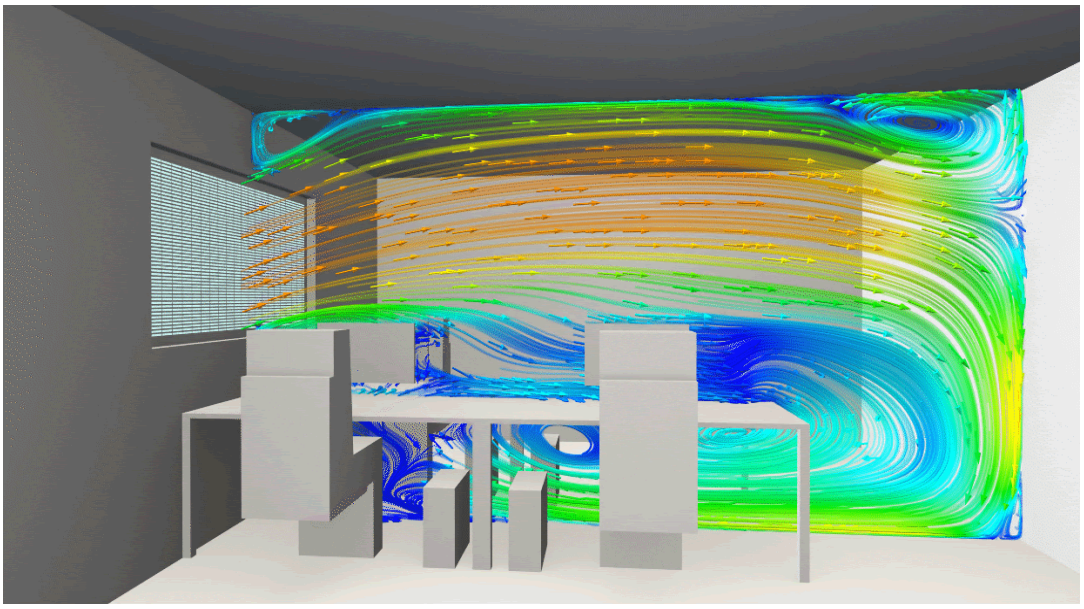
The results from SimScale illustrated the high performance characteristics of a MicroLouvre® Screen. Its aerodynamic behavior could be visualized, and SimScale was able to assess the pressure-flow characteristics at various wind speeds, flow rates, and wind directions. This insight is useful for understanding the current performance of MicroLouvre®, but also allowing a parametric design analysis to further enhance its overall performance by altering louvre angle, thickness and material.



Streamlines of airflow going through the screen system.

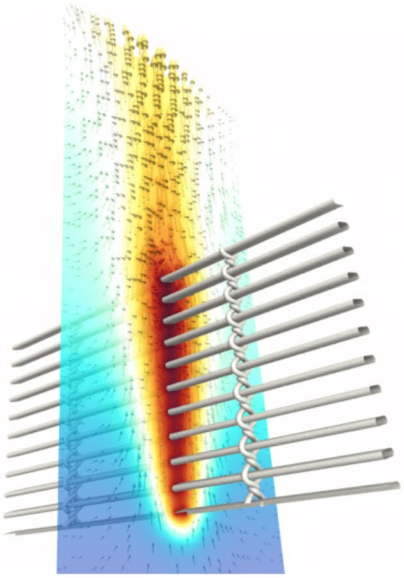
SimScale also showed how the air would enter a room, as the louvre angle was pitched at 17° thereby altering the flow of air. This attenuation is dependent on wind speed and local conditions, and serves to improve the efficacy of the air mixing in the room.

The geometry of a MicroLouvre® Screen is complex and very fine. The louvres themselves are only 1.2 mm wide, meaning a 3D model accurately representing the build of the system is a very large file. This becomes prohibitive if engineers try to physically model MicroLouvre® in CFD, as the meshing and computational requirements become restrictive. SimScale used the Darcy-Forchheimer model to determine appropriate coefficients and unit vectors to be able to model the complex flow behavior of MicroLouvre® using a porous media simplification. The comparison between physically modelling MicroLouvre® and using the porous media simplification is almost a 100% match.



Natural ventilation air flow entering a room using a simplified Darcy-Forchheimer model in porous media setup.

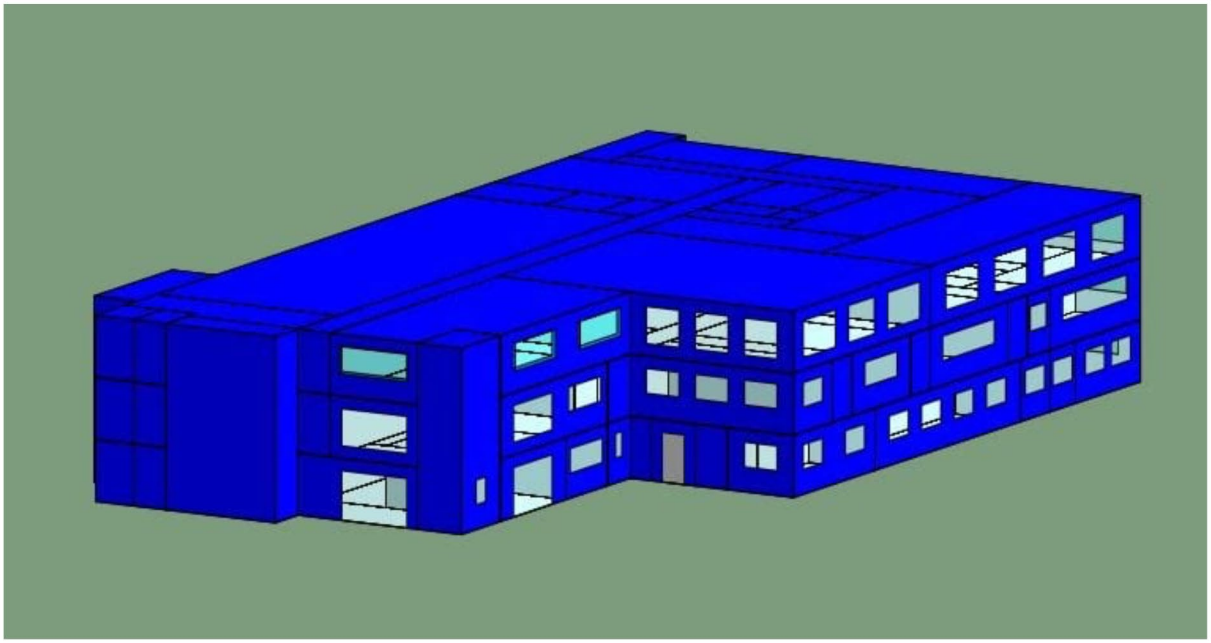
Due to the fact that MicroLouvre® is a metal fabric made of 90% copper alloy, its thermal conductivity is high. In still or low wind speed conditions a 'chimney effect' can be observed where the metal fabric is much warmer (due to incident solar radiation) than the surrounding air, causing air to rise like a column above a MicroLouvre® Screen. In certain double-skinned facade systems, this might be a useful property. This observation was also useful to determine a minimum MicroLouvre® Screen-Window distance to minimize any unwanted heat gains into a space.



The 'chimney effect' observed on a still day with incident solar gain warming the metal MicroLouvre® fabric

SimScale conducted some scenario analyses in various types of buildings to assess the installed impact of MicroLouvre® on thermal comfort and energy efficiency. For a three-story healthcare building with typical internal gains, a London climate and thermal performance meeting minimum Part L (Conservation of Fuel and Power 2013) regulations, the following was observed:

- Up to 90% drop in room solar gains with MicroLouvre® Screens installed.
- Up to 50% reduction in cooling load in Summer months with MicroLouvre® Screens installed.
- Exceeding minimum ventilation requirements when used for natural ventilation.



MicroLouvre® Screens installed (modelled) on a top floor room on a multi-story building.

We now have two methods to model MicroLouvre® Screens in building simulation models for solar shading and the relevant data to represent its performance in natural ventilation models. We are now confident that the construction industry can integrate the unique MicroLouvre® system in their building designs and refit plans.