Flow Simulation in the Glass Industry

The glass factory building concept must be considered as an important influence on the overall efficiency of a plant, discusses Daniel Schippan*. CFD is one approach to achieve optimal glass factory planning.

Tomorrow's production has to meet high standards.

Efficiency and a safe future are as important for plant operation as cost savings and error reductions during the planning phase.

Special care is taken to guarantee the highest quality standards in production and products, not only in newly designed glass plants, but also in existing factories which are subject to a continuous process of optimisation.

CFD simulations are a new approach in holistic planning and glass factory optimisation to achieve these objectives.

What is CFD?

CFD stands for Computational Fluid Dynamics and is a mathematical calculation and visualisation of fluid dynamics. With the help of this technology it is possible to analyse currents of any kind and to recognise their behaviour and influence. Similar to a virtual wind tunnel, as used in the automotive industry, for example, CFD simulation can also be used to analyse and optimise a glass factory in its entirety or in specific sub-areas.

CFD in the glass industry

The application of fluid movements and its numerical calculations in the glass industry have also been a fundamental component for research, development and improvement of various processing operations. Individual operations such as the glass melting furnace process, or various cooling methods of the IS machine moulds, have already been developed using CFD technology.

However, the application of CFD to the overall process has thus far received little attention. This process offers a variety of optimisation options throughout the entire plant. Cm.project.ing is a market leader in the field of international planning and optimisation of glass factories. It has enhanced its planning methods through the use of CFD to further emphasise the holistic approach to the glass process.

Because of this, cm.project.ing is able to generate substantial added value in the form of increased efficiency and quality while simultaneously reducing costs for the glass industry. The focus of the CFD simulations is on the entire production process including the supply media.

Impact on production

Building designs of glass factories are often based solely on experience, estimates and the resulting space requirements for plant components and machinery. Little attention is paid to the planning of the production building, instead it is seen merely as a shell, only necessary for plant components. Unfortunately, the impact of the building design on the entire production process is recognised too late. Building openings are too small, placed in the wrong locations or are not even accessible. The consequences of such miscalculations include insufficient supply of air for compressors or draw air from other parts of the building, which in turn leads to undesirable circulation throughout the building.

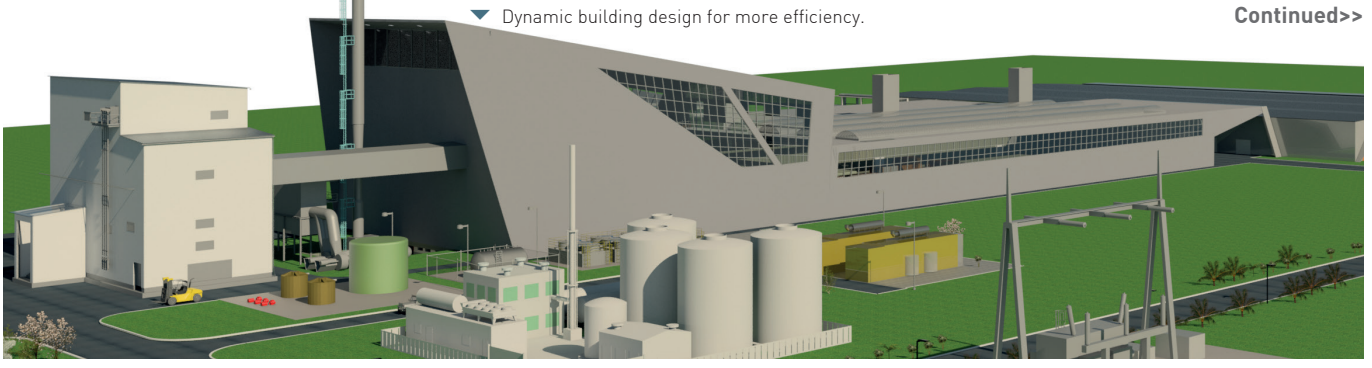
CFD visualisation helps with the optimal dimensioning of air supply openings as well as the positioning of machines within the building.

Outdoor climate conditions and their impact on the production process are also simulated by means of CFD, so that a consistently high level of plant efficiency can be guaranteed on hot summer days and cold winter days.

Impact on product quality

The highest quality and low rejection of the final product are the goals of every glass factory operator. To achieve and further optimise these standards, the influence of flows on the final product can be analysed with the aid of CFD simulation. It is often the things you cannot see that have a large impact on the bottom line.

Glass is susceptible to thermal impacts after the moulding process. Stresses and associated quality defects are the result of hot glass coming into direct contact with unwanted cold air currents. These undesirable airflows occur in a glass factory mainly due to the difference in temperature between the hot production



▼ Dynamic building design for more efficiency.

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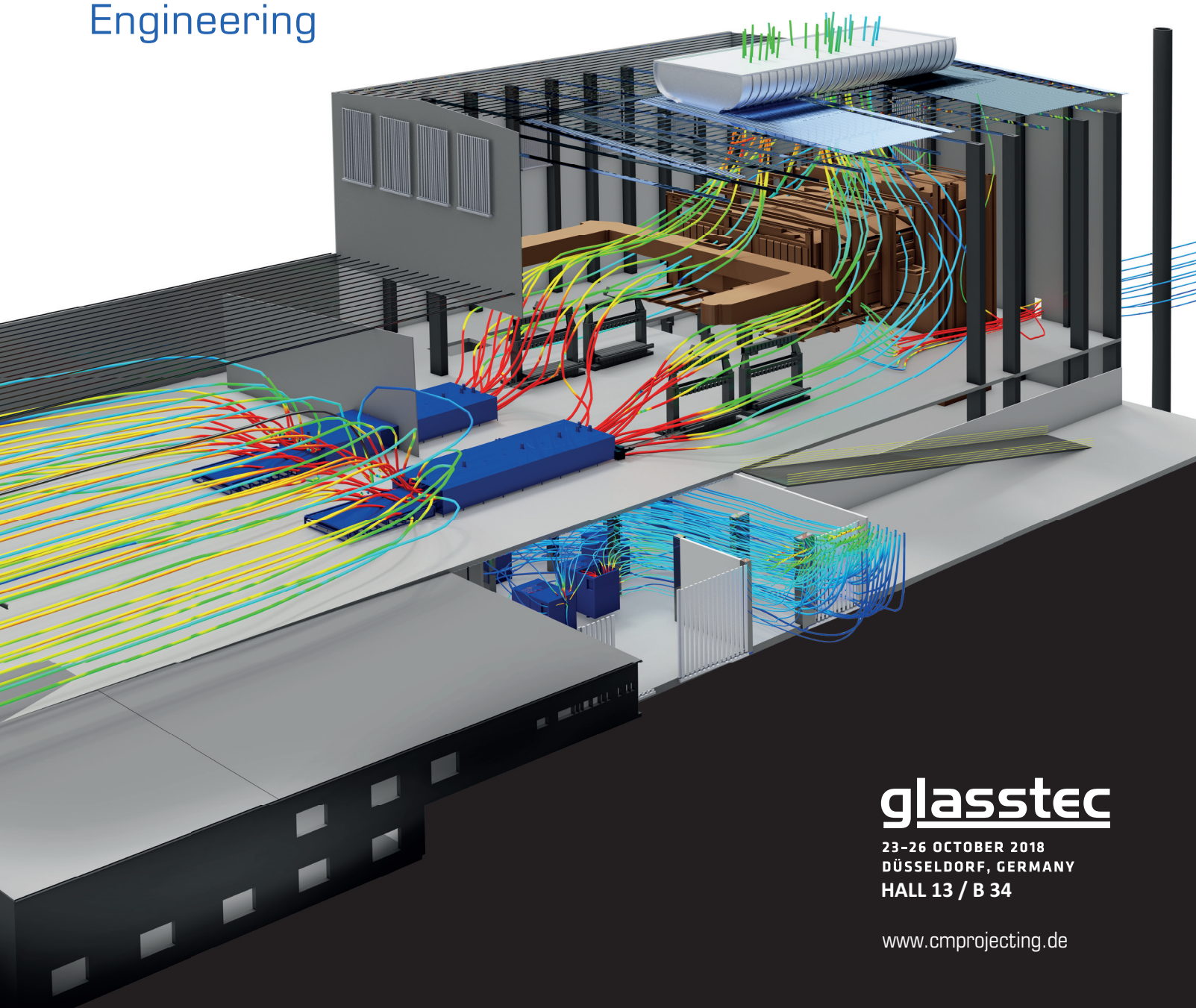

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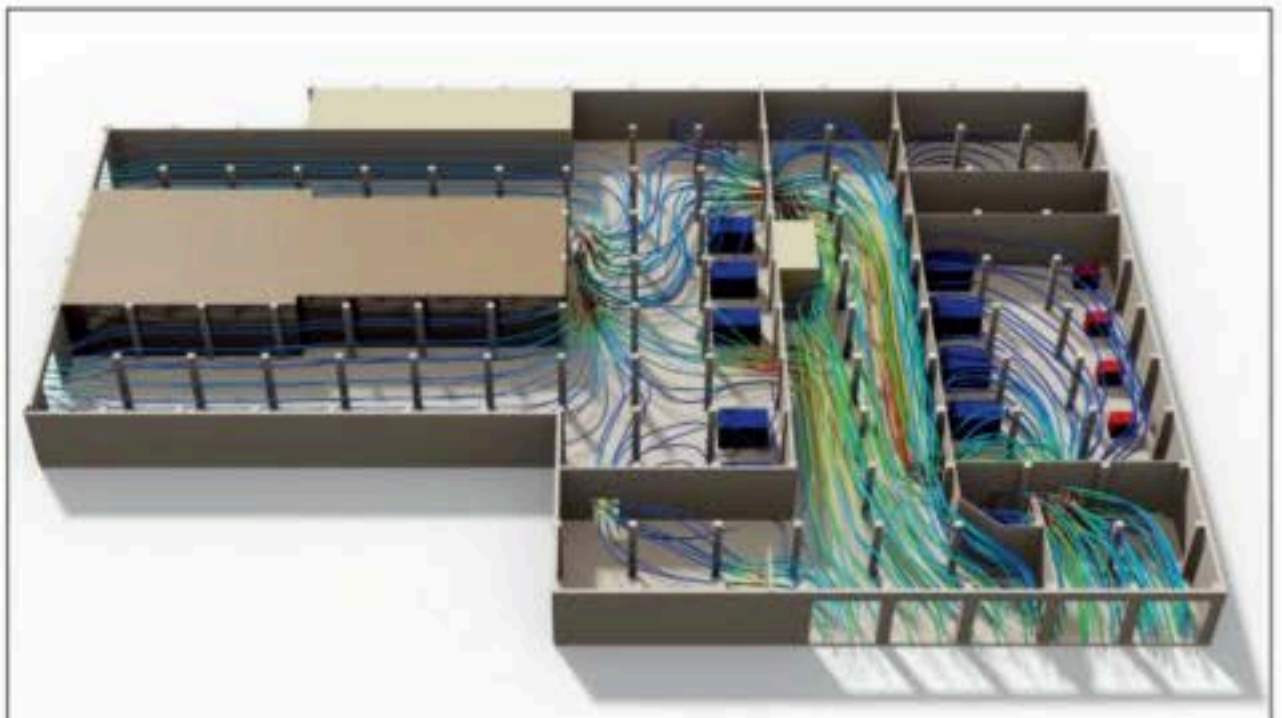
area, around the furnace and the cooler inspection area at the other end of the production hall. This thermal drift creates a noticeable draft in the production building, which can negatively affect product quality. Structurally, such flows in the building can be numerically calculated, displayed and then reduced or even avoided by subsequent changes in the layout or structural measures.

In contrast to experience and extensive subsequent changes to the construction, the advantage of CFD lies in the fact that different design scenarios can be simulated in advance, during planning, to achieve the optimal outcome. Potential thermal and fluidic problems in the later work are avoided. Existing factories can also experience advantages by utilising CFD analysis and adjustments.



▲ Air flow simulation inside a production building.

Holistic approach

The dominant view that the production process and the structure of the building that houses it as mutually exclusive, carries the risk that factors influencing unwanted flows and thermal effects in the plant will not be anticipated and will later cause problems in daily production.

Cm.project.ing therefore sees the detailed integration of the production building as well as an optimised layout design as an integral part of the overall production process ensuring the way to a highly efficient glass factory.

The building concept must be considered as an important influence on the overall efficiency of a factory.

New approaches in building design, ventilation systems and heat generation combined with the use of CFD simulations create a benefit for operators of glass factories in terms of increased efficiency and cost reduction. ■

*CEO, cm.project.ing, Julich, Germany
www.cmprojecting.de