Pure competence in air.

SCHAKO

CFD SIMULATIONS

Computational Fluid Dynamics

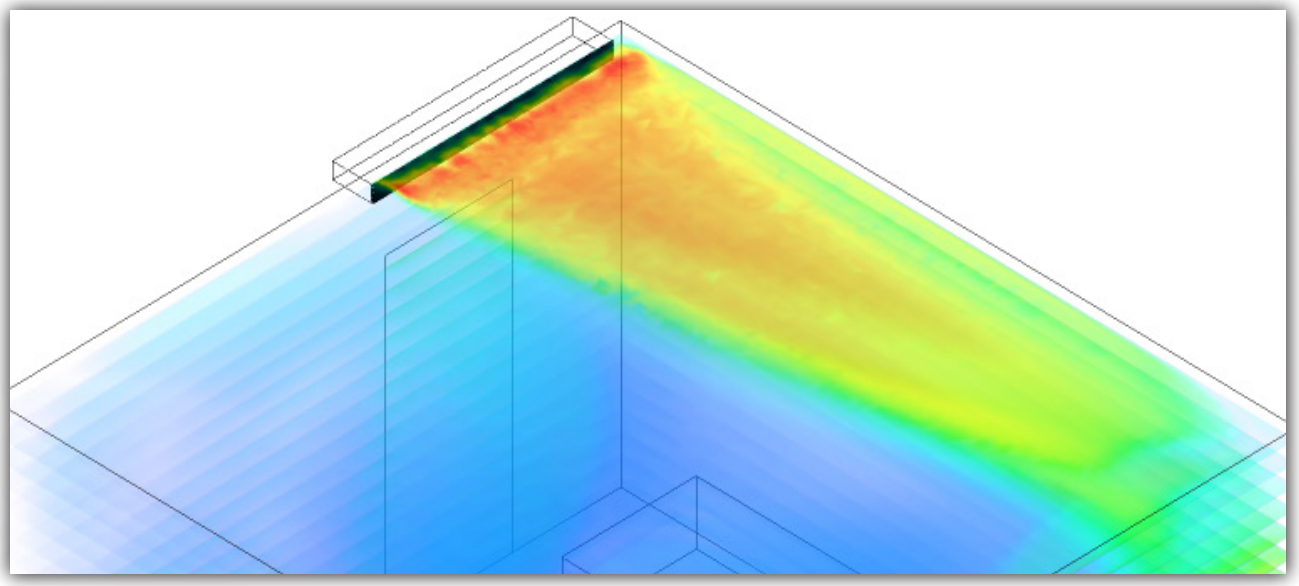
Computational Fluid Dynamics (CFD) simulations, a computer-based numerical approach, play a major role in understanding and optimising the performance of Heating, Ventilation, and Air Conditioning (HVAC) systems within diverse environments and operating conditions.

CFD simulations, in essence, involve the application of numerical methods to analyse the behaviour of fluid flow, heat transfer, and other related phenomena.

BENEFITS

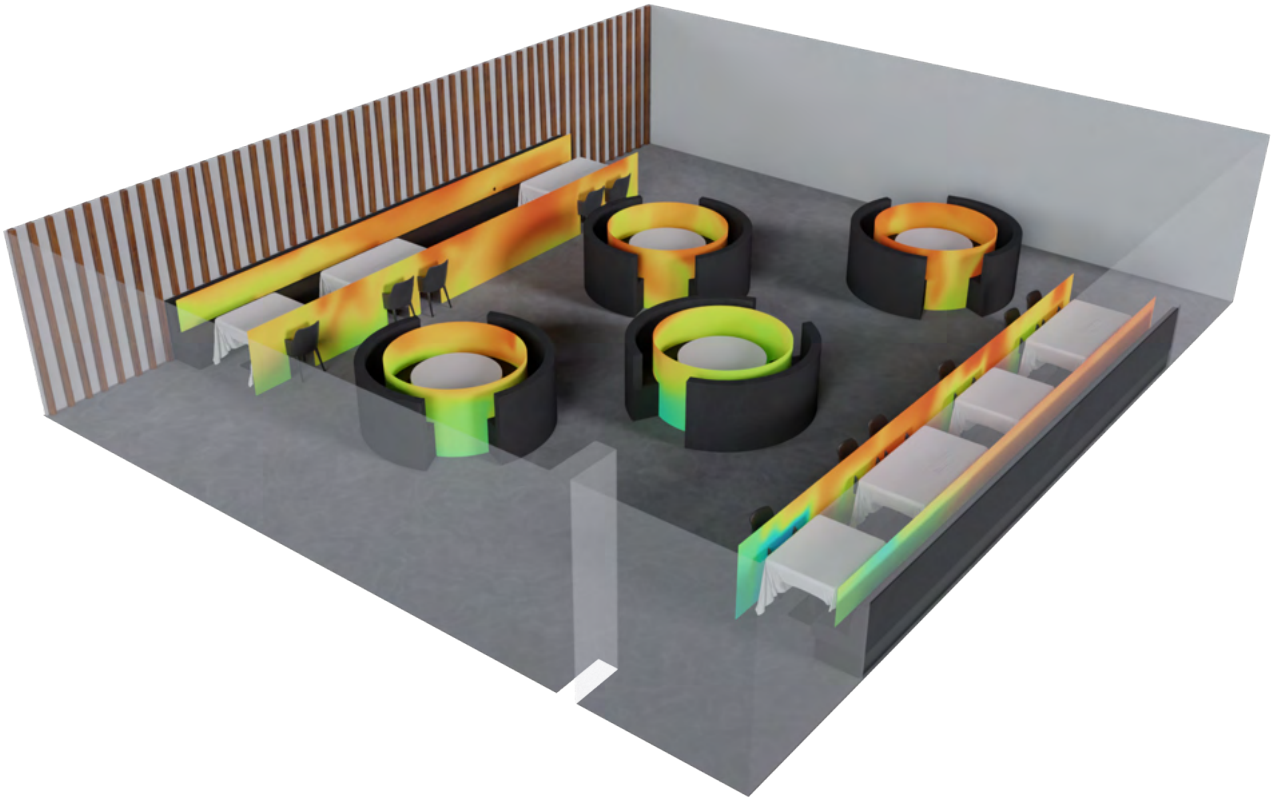
When specifically applied to HVAC systems, these simulations provide valuable benefits to all stakeholders involved in a project:

- **Ensure** that your design will work as planned with a high degree of confidence.
- **Optimise** the system without increasing laboratory infrastructure and prototyping costs.
- **Analyse** spaces with complex phenomena where tests cannot be conducted.
- **Minimise** the operation costs of the installation while improving comfort.
- **Receive** fully tailored support and advice from a dedicated team of CFD experts.
- **Facilitate** early-phase design decisions.
- **Gain** knowledge about complex air diffusion phenomena.



CFD simulations have a wide range of applications when used in HVAC:

- **Comfort:** Simulations can analyse the comfort of occupants. By evaluating variables such as velocity, temperature, or relative humidity, CFD simulations offer a comprehensive analysis. This includes a focused examination of various ventilation techniques, including mixed ventilation, displacement ventilation, and exposed installations. CFD proves instrumental in comparing and understanding the differences in velocity and temperature among these systems. This insight allows engineers to optimise system design effectively, enhancing the overall comfort index.

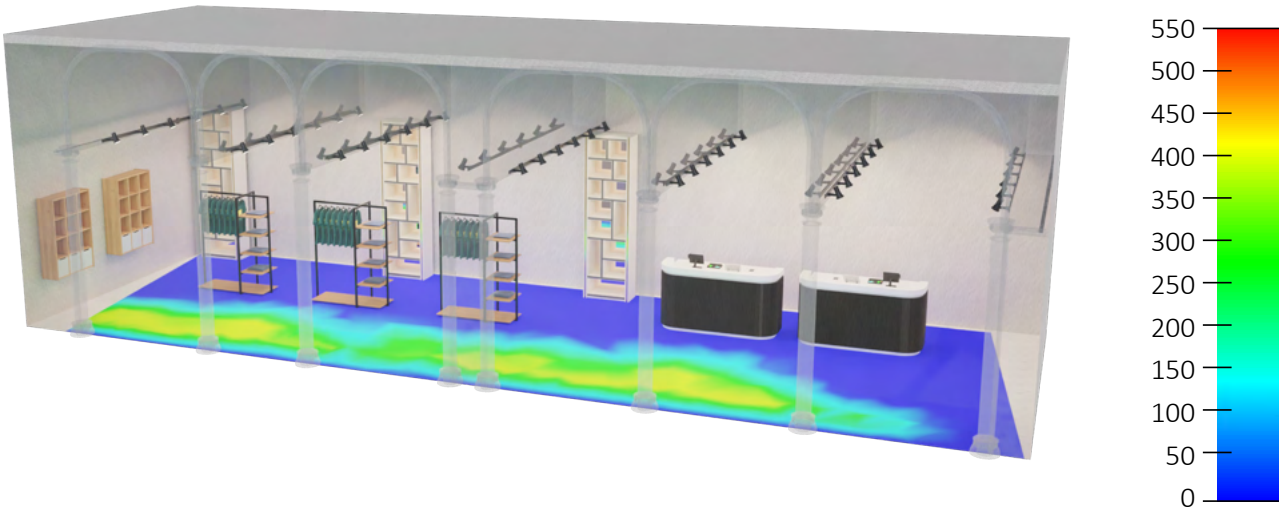


In this project, thermal comfort was analysed in a restaurant. Temperatures contours were evaluated at people seats.

- **Air Quality:** CFD allows the study of indoor air quality in buildings. In these studies, the air quality is a critical variable, useful for identifying zones with insufficient air renewal and calculating ventilation efficiency. Simulations can also be used to evaluate the distribution of contaminants, pathogens, or CO_2. Notably, CFD proves useful in analysing systems with induction units, where primary air induces secondary air for treatment, helping in optimising ventilation and ultimately contributing to enhancing people's health.

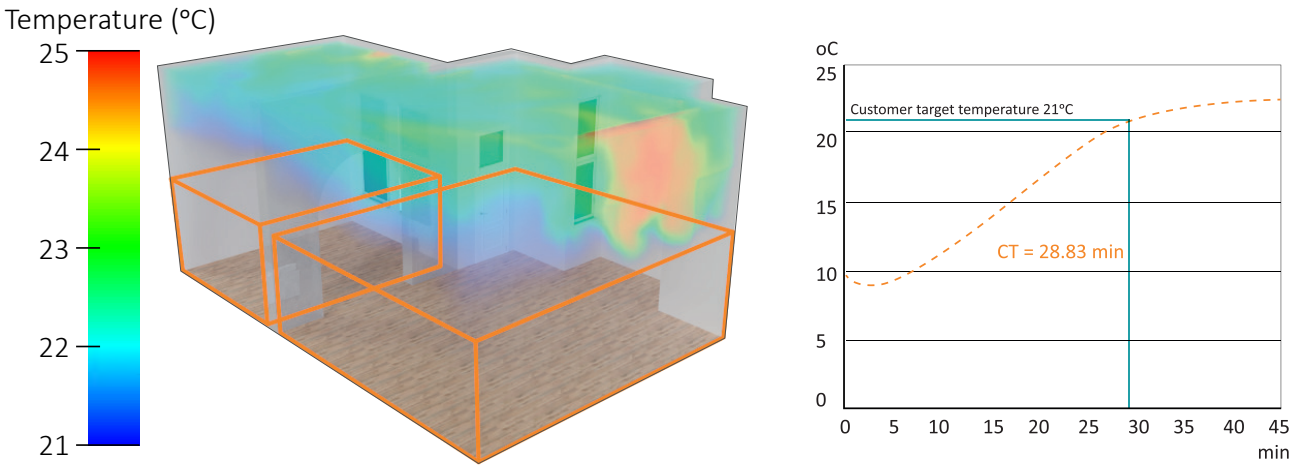
COVID infection probability was studied in an office for this project, using displacement ventilation. Contours show how the risk of infection is higher above the infected person.

- **Thermal Loads:** In buildings with large glazing, solar rays can impact internal temperature distribution, affecting occupants' thermal comfort. CFD simulations enable the comprehensive evaluation of elements such as glass coatings, curtains, etc., to mitigate radiation and achieve the final optimisation of the entire system.



For this study, the effect of solar radiation was evaluated. Glazing on the facade of the ground floor of a shopping centre allowed solar radiation to heat the occupied zone, raising the temperature.

- **Optimisation:** Simulations can be used not only to study steady state conditions, but also in transient scenarios. This enables the analysis of the temporal evolution of different variables and provides a valuable tool for optimising Building Management Systems (BMS) controls. For instance, it can determine the optimal lead time for starting the cooling/heating system to achieve the setpoint temperature. Another practical application involves assessing the required operational time for a system to effectively reduce pathogen concentration to a specified level.



For this hotel room, a transient simulation was performed. The target was to identify the necessary time to reach comfort temperature.

- **Troubleshooting:** In instances where a malfunction in an implemented HVAC system is causing discomfort, noise, or other issues, and the cause is uncertain, CFD analysis can swiftly identify the problem and propose solutions. This application is particularly valuable for enhancing the performance of previously installed systems.

Two supply systems were compared in this museum gallery. Velocities near the main paintings had to be as lowest as possible. CFD allowed to decide the best option.

SPACES WHERE **CFD CAN BE APPLIED**

CULTURAL BUILDINGS

Auditoriums, theatres, cinemas, concert halls, and similar buildings must guarantee people's comfort in large spaces, a challenging aspect in HVAC design. Simulations predict whether the proposed system will achieve the required level of comfort.

RETAIL SPACES

Retail stores and shopping malls require control over indoor comfort to create inviting environments where people want to spend time. CFD simulations play a crucial role in understanding air flow patterns, humidity, and temperature stratification in these spaces.

TRANSPORTATION FACILITIES

This category includes airports, large train, or bus stations, where the challenges involve handling large crowds, varying outdoor conditions, and different comfort targets in various areas. Simulations prove beneficial in analysing these complex aspects that are challenging to address with usual methods.

RESIDENTIAL BUILDINGS

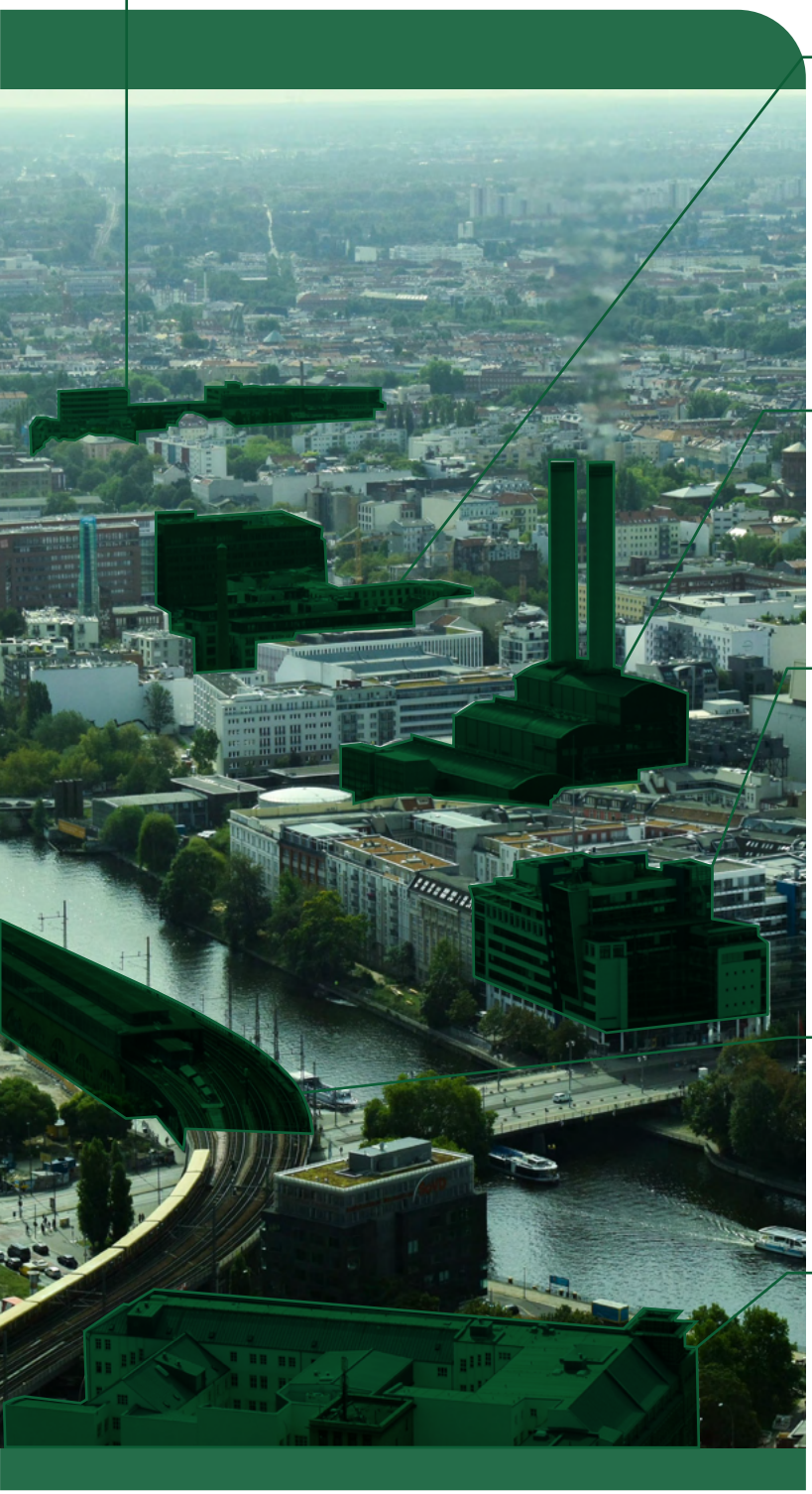
CFD is suitable for designing residential areas such as apartments and houses. These studies focus on reducing heat transfer through walls, floors, and windows to enhance comfort and energy efficiency in the building. This type of study provides knowledge that can be applied in further projects.

HOTEL INDUSTRY

Similar to restaurants, the hospitality sector relies heavily on the comfort level of its spaces. Simulations serve as valuable tools to achieve this goal, ensuring optimal temperature conditions in hotel guest rooms. Hotels are another clear example where one simulation can be reused for multiple rooms.

MEDICAL FACILITIES

Air quality in healthcare spaces is crucial. Hospitals and medical centres leverage CFD simulations to enhance air distribution, remove contaminants and pathogens, and ensure the comfort of patients and medical professionals in areas like patient rooms, waiting rooms, operating theatres, etc.



OFFICES

Large office spaces, cubicles, or individual workstations can be effectively assessed through simulation. Studying air circulation velocity, temperature profiles, and CO_2 concentration is critical to ensure a comfortable environment. In rooms that tend to be similar across all projects, simulations provide valuable knowledge that can be an advantage in the future.

INDUSTRIAL BUILDINGS

Comfort in industrial settings is crucial for worker well-being and productivity. Simulations enable the optimisation of velocity and temperature distribution in different buildings, such as warehouses or manufacturing plants.

RESTAURANTS

When choosing a restaurant, people seek not only a good meal but also a comfortable environment. CFD simulations contribute to designing these spaces for optimal comfort, minimising potential discomforts caused by inadequate flow patterns or undesired temperature differences. Simulations are extremely profitable for restaurant chains, where the same study can be reused all the time.

SINGULAR BUILDINGS

Simulations provide the solution for singular projects with critical requirements as hospitals, data centres, or museums that require conservation conditions.

EDUCATIONAL FACILITIES

Schools, universities, and other educational buildings are places where people spend a significant part of their lives. CFD simulations can help to achieve the optimum air distribution and air quality that is so important in reaching the required levels of concentration.

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