Improving Office Comfort

Building designers avoid temperature variations with thermal and air flow analysis.

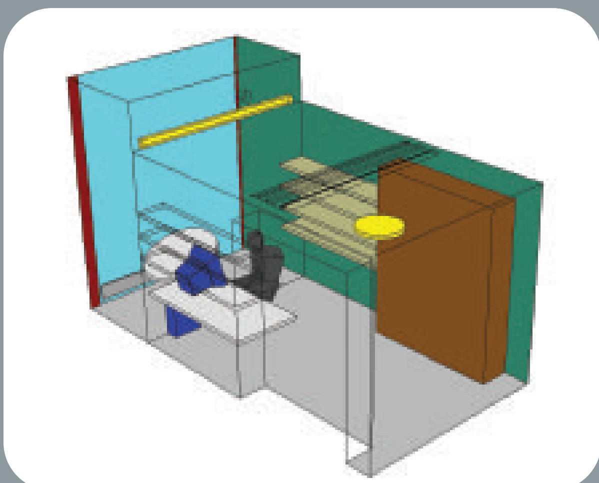
By Tuomas Laine, Manager of Research and Development, and Sami Lestinen, CFD Specialist, Olof Granlund Oy

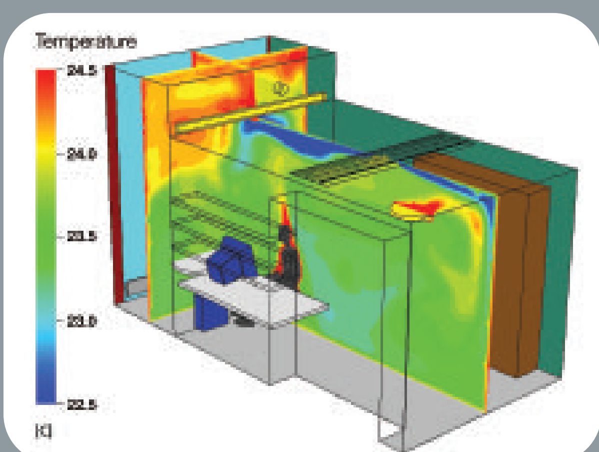
Have you ever worked in an office where you roasted in the summer and froze in the winter? The designers of a new office building in Helsinki, Finland, avoided this problem with CFD analysis performed by Olof Granlund Oy, the largest building services design and consulting firm in the country.

In addition to a large atrium, the new building design called for a large surface area of windows and skylights. In the past, an energy analysis program would have been used to simulate the building, estimate energy bills and predict average temperatures for particular spaces, hoping that there was not too much temperature variation. Even if the average temperature were adequate, occupants of some areas might face uncomfortably high or low temperatures, air flow, humidity or thermal radiation. The risk faced by the building owner would be that, after the building was finished, occupants would report major heating and cooling problems. A lengthy and expensive trial-and-error process would then need to be conducted to remedy the situation.

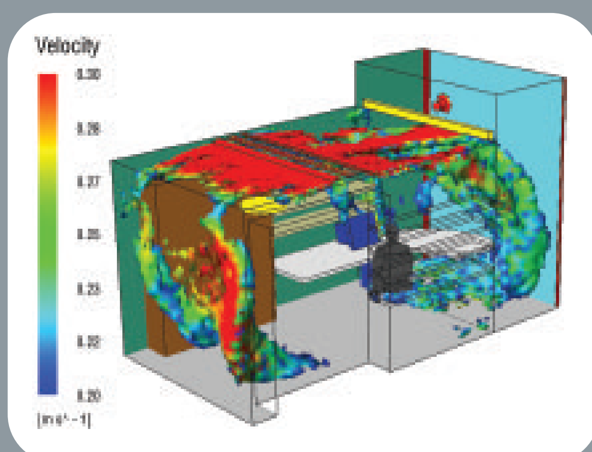
To avoid this kind of headache, the building owner asked Olof Granlund Oy to use advanced tools such as CFD to analyze temperatures and air flow throughout the building. The CFX-5 product was used because experience indicates that it can quickly and

An office was modeled to help determine thermal comfort based on temperature and air velocity.





Temperature



Velocity

Photorealistic visualization of the glazed lobby

easily model the complex geometries found in most large building projects, can account for a wide variety of physics and can accurately predict comfort factors such as PMV and PPD.

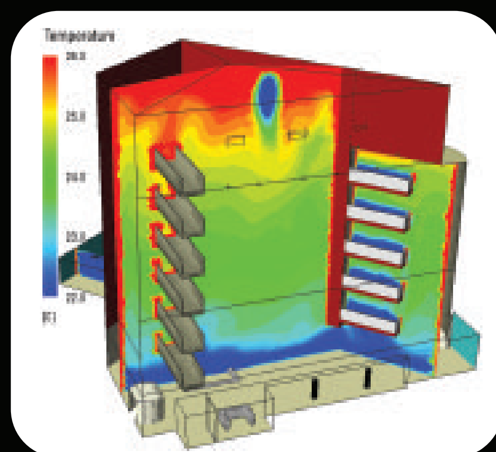
A model was created by importing the existing 3-D building geometry model in IFC format into the CFX-5 product, and then a mesh was generated. One of the challenges in modeling indoor thermal conditions is the need to account for small-scale supply air diffusers, while at the same time accommodating large open areas of the atrium. For this reason, the mesh density was set at a higher value in areas with large gradients, such as areas near air supply devices and heat sources. This made it possible to provide high levels of accuracy in critical areas while keeping the model to a manageable size.

RIUSKA, a program developed by Olof Granlund, was used to determine surface temperatures and heat gains. CFD Blockmaster from Halton Group, which simulates diffuser performance, was used to provide air terminal boundary conditions.

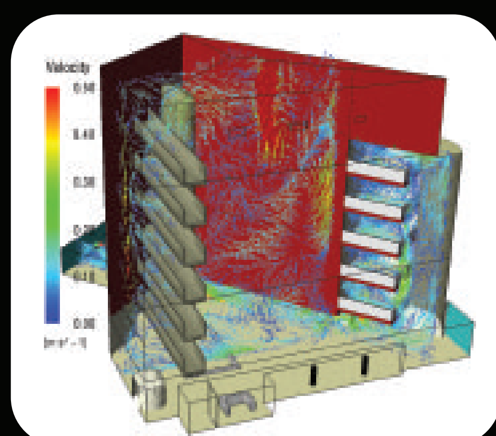
Results of the CFX-5 analysis showed that air velocities were too high for comfort in a number of occupied spaces. In addition, temperatures in certain areas of the atrium would be uncomfortably high during the summer due to thermal loading through the skylights. The airflow problem and the heat distribution in the atrium were addressed by evaluating a number of different diffuser configurations. A diffuser design was found that reduced airflow to comfortable levels while improving thermal distribution to the point that the temperature remained within an acceptable range in all occupied areas of the atrium under summer conditions. A variety of different window heating systems were also modeled to find the solution with both comfortable conditions and economically optimized system construction.

The CFX product supplements energy-analysis software by providing far more detailed results so that temperatures and air velocities can be predicted at any point in a building. The CFX-5 product made it possible to meet the challenge of providing results at a high level of accuracy in time to impact the building design. ■

Because large areas of glass in the new building affect comfort, the atrium was modeled for temperature and air velocity.



Temperature.



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