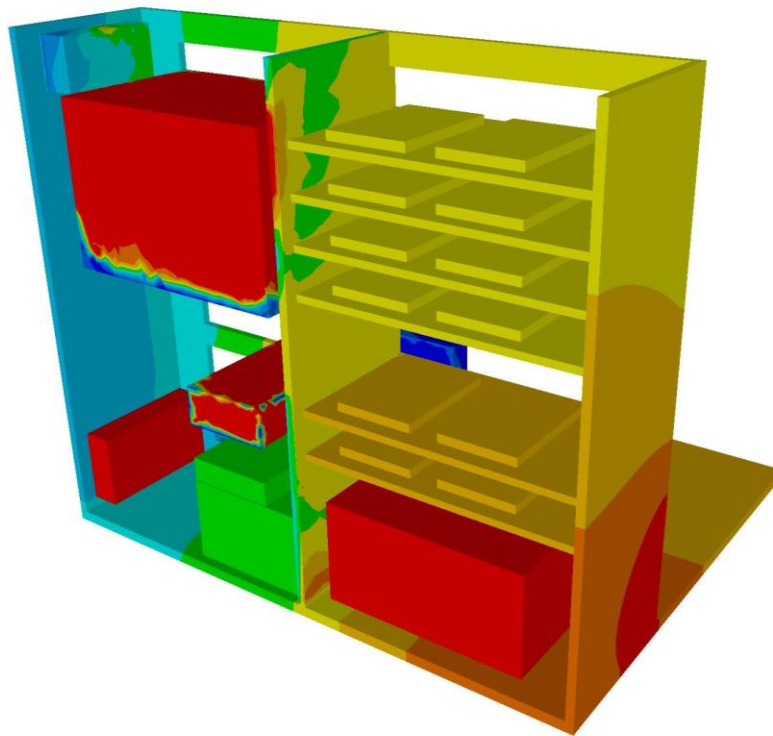


Thermal Conditioning Oven for Biological Samples

Analysis Type:

CFD, Thermal, Natural Convection, Air Flow, Fan Modeling, Conjugate Heat Transfer



Caption: Thermal optimization of biological conditioning oven by CFD simulation



Project Overview

Due to tight temperature requirements, a CFD study was done on an enclosure that is used for the automatic handling and thermal conditioning of biological samples. The key driver for this work was the client requirement to have the biological sample trays be within a two degree temperature range during processing.

Modeling Details

Figure 1 shows the starting point for the CFD simulation. The CAD geometry was de-featured and simplified for the model. The air flow within the oven was driven by natural convection and two large fans at the bottom of the case. One of the key requests from the client was to minimize the use of fans and to maintain a laminar flow through the cabinet. Our prior CFD consulting work allows us to leverage past “lessons learned” and to quickly develop optimized air flows.

Summary

CFD Results from this study were used to optimize the vent locations and provide the final design layout. Subsequent thermal tests by the client showed that the enclosure met the two degree temperature specification with margin.

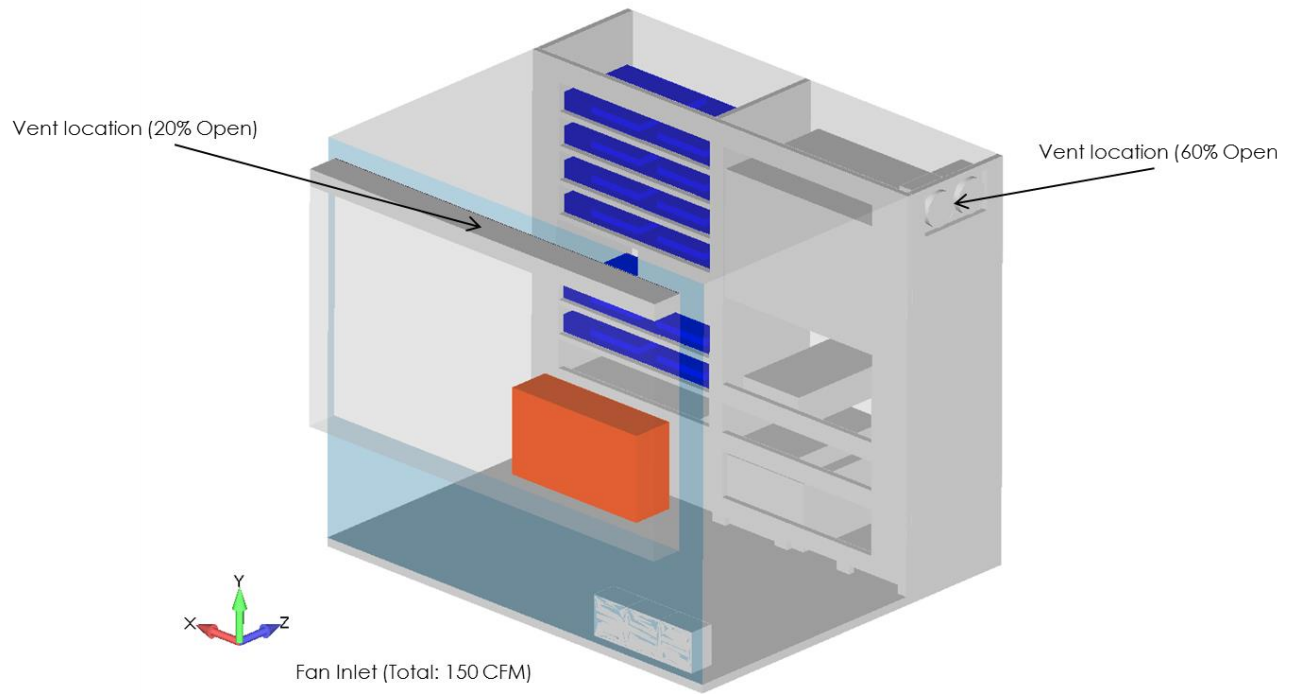


Figure 1: Starting geometry for CFD analysis showing inlets and fan location

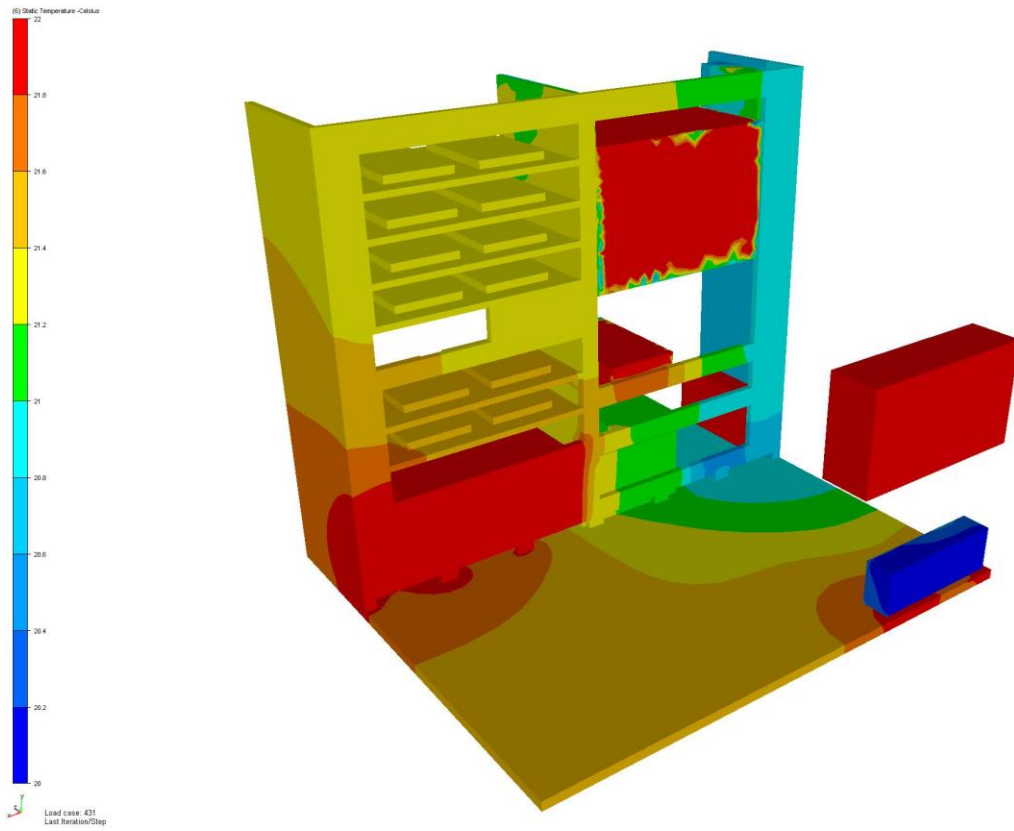


Figure 2: Thermal profile within the conditioning oven. Conjugate heat transfer between the fluid and metal components ensured good thermal coupling.

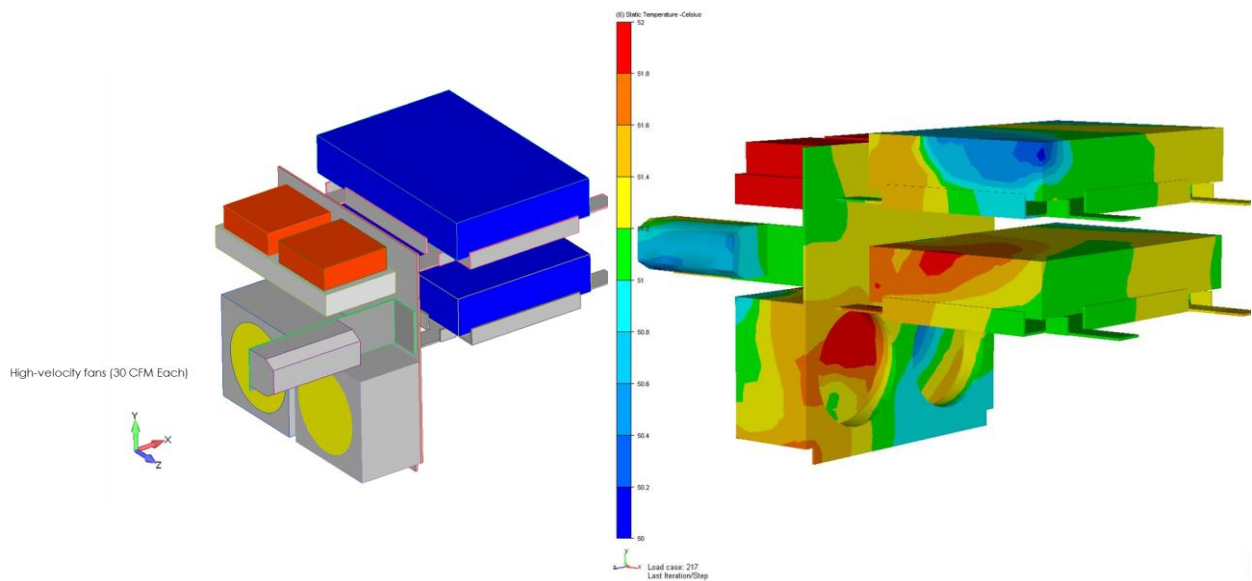


Figure 3: Within the enclosure was a small thermal sub-system to control specialized heating of two biological sample trays.

The CFD predictions on this sub-component were especially important to the client due to the high-value of the biological samples within this sub-section of the chamber. It was also especially good to see that these CFD results were validated by subsequent experimental work by the end-user.

Keywords:

Thermal Analysis, Computational Fluid Dynamics, CFD Simulation, fluid flow, optimization of air flow, natural convection, conjugate heat transfer, thermal analysis of oven, CFD Consulting, CFD fan modeling, fan curves, CFD Services

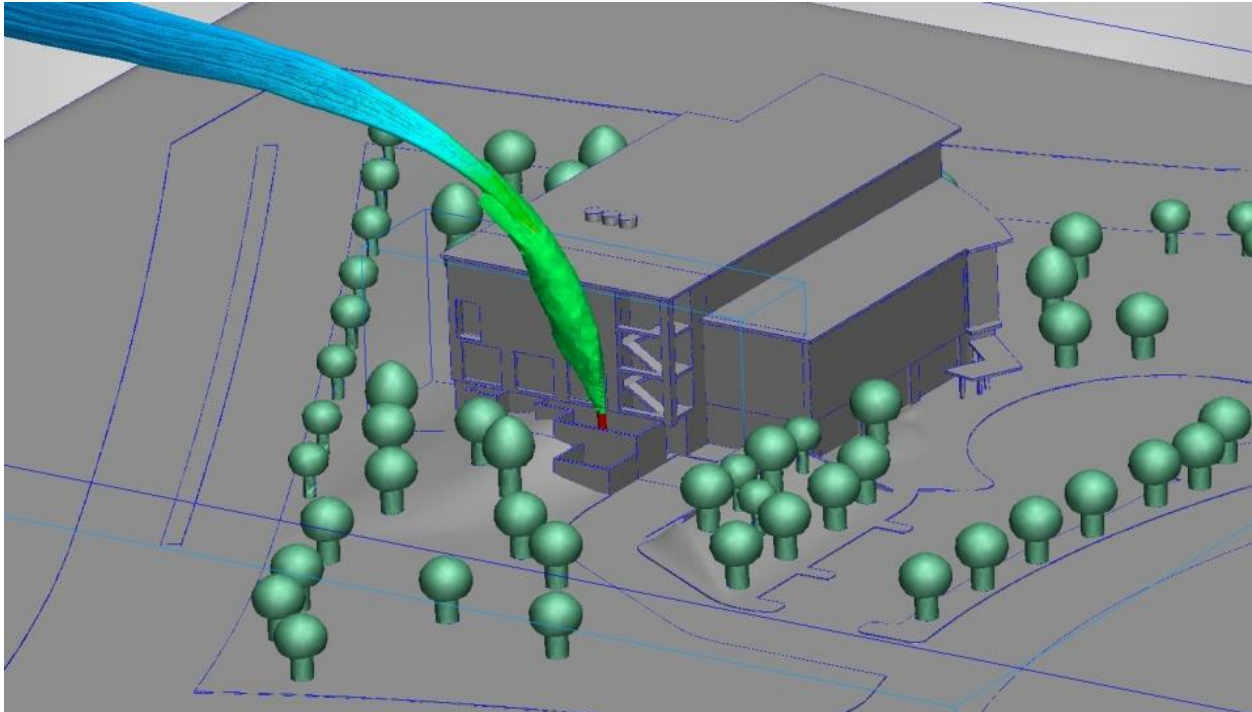


Figure 5: Particle tracing showing that the diesel exhaust will not infiltrate into the HVAC system even with a strong wind pushing the exhaust towards the inlet.

Contact



Predictive Engineering

2505 SE 11th, Suite 310
Portland Oregon 97202-1063

503-206-5571 (phone)

866-215-1220 (fax)

www.PredictiveEngineering.com