HVAC CFD Consulting Services

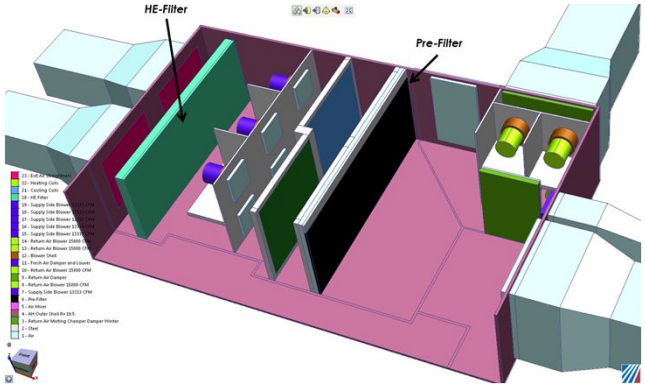
At Predictive Engineering, we developed our expertise in computational fluid dynamics (CFD) consulting with years of CFD project work in medical, aerospace, marine, HVAC, civil (e.g., gas turbine power plants) and automotive. Our work has been extensively benchmarked by experiments and in-service testing, giving us the necessary validation experience for world-class CFD service to our clients.

Our portfolio of case studies provides hard evidence of our many successful CFD consulting projects. These consulting endeavors include space-based communications equipment, hydroelectric spillways and HVAC air handling systems, to name just a few. We feel that our broad experience brings a fresh perspective to our clients' CFD challenges. This experience provides a cross-pollination between industries that have shared physics but different structures.

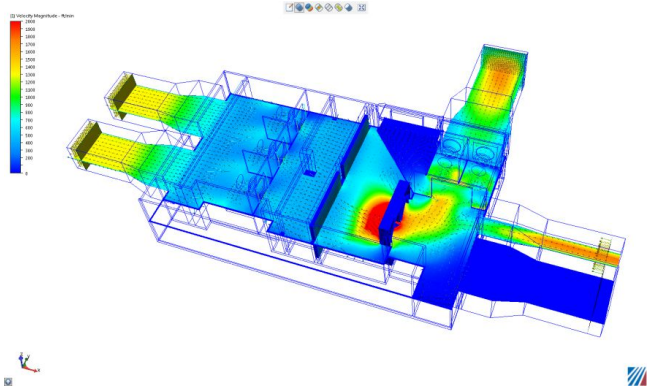
The following slides show a sample of CFD projects that are related to HVAC and building services. These projects span the range of applications from focused air handling unit performance to large factory floors. In many of these applications the end goals were to ensure an even mixing of air streams to meet criteria for uniform temperature distributions. The possible loading conditions for these type of analyses include varying flow streams, internal heat generation, internal vapor generation, and external heat from ambient and solar conditions.

CFD Analysis of Roof-Top Mounted Hospital Air Handler

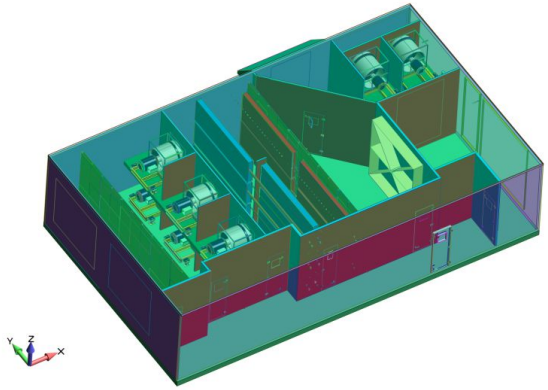
Geometry Definition



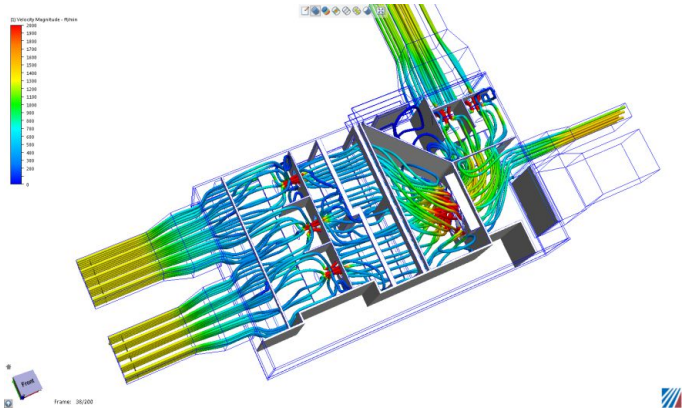
CFD Flow Results Showing Mixing of Outside and Return Air



CFD Model Idealization



Flow Tracing to Verify Flow Uniformity

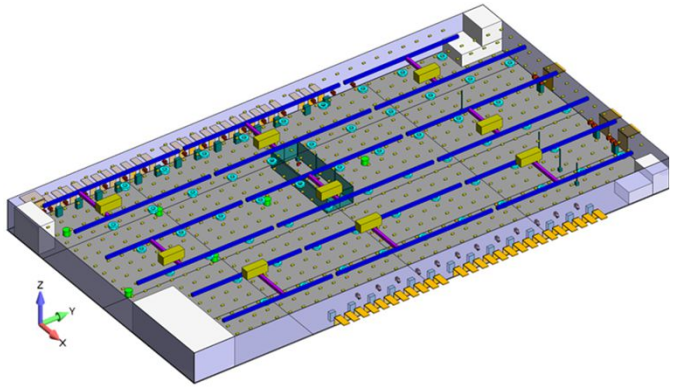


Our client was required to verify the air dynamics within their modular roof-top air handing unit (AHU) for a new medical facility. The CFD model contained blowers, multiple louvers, heating and cooling coils and a state-of-the-art HEPA filter. Stringent flow and temperature requirements were shown to be met based on our CFD engineering services and the unit is in service today.

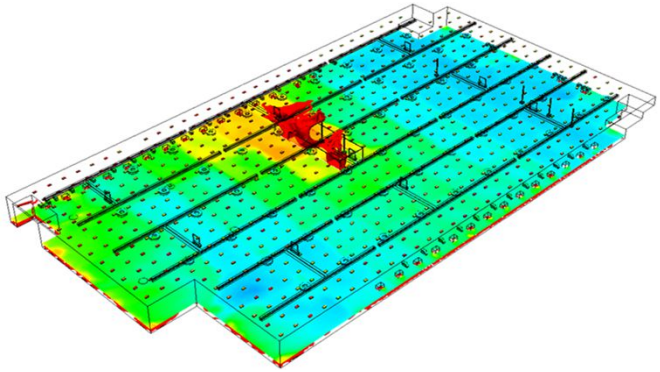
HVAC Analysis of Large Manufacturing Facility with Engine Test Center (Exhaust Control)

Agricultural Manufacturing Facility

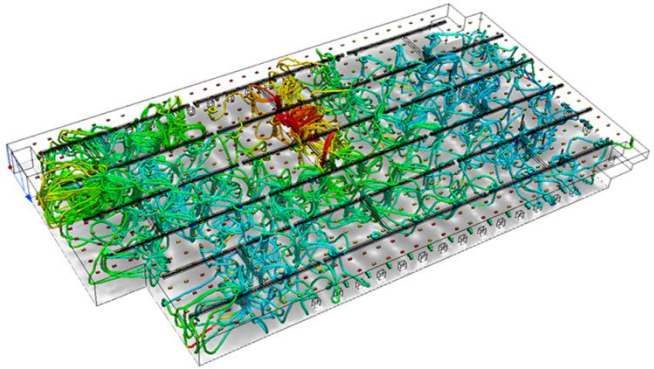
CFD Setup with Engine Test Center (Exhaust Control) at Center of Floor



CFD Thermal Results with Thermal Plume Around Engine Test Center

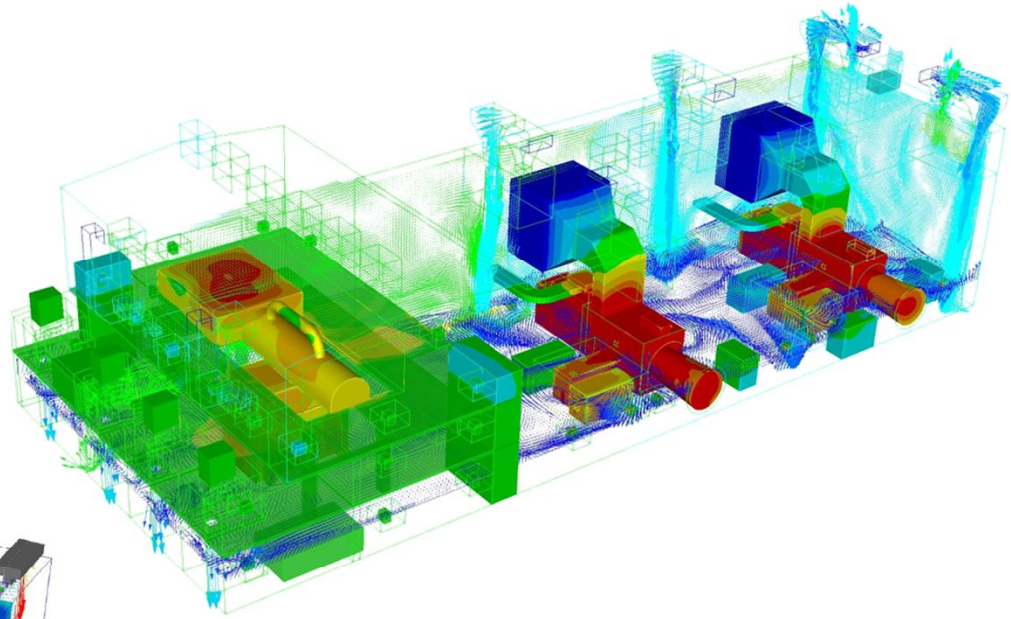


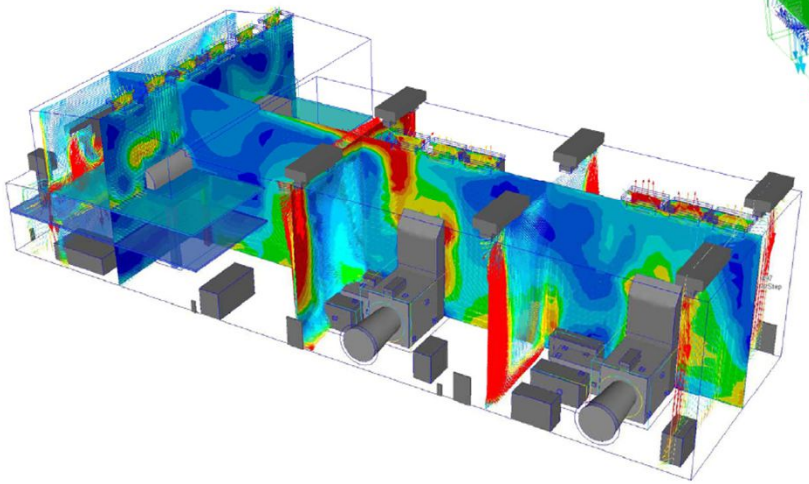
Air Flow and Smoke Tracing During Summer Operation



The objective of this analysis was to verify the HVAC design of a large manufacturing facility with 300,000 square ft. The facility provided a complex thermal problem with many localized temperature extremes. Additionally, the facility experienced extreme winter and summer conditions that would test the limits of the HVAC design. The results of this analysis provided the client temperature, air velocity, and flow path throughout the facility This analysis demonstrated that the HVAC design would be adequate in even the most severe conditions and modification to the design was unnecessary.

HVAC Analysis of Gas Turbine Power Plant



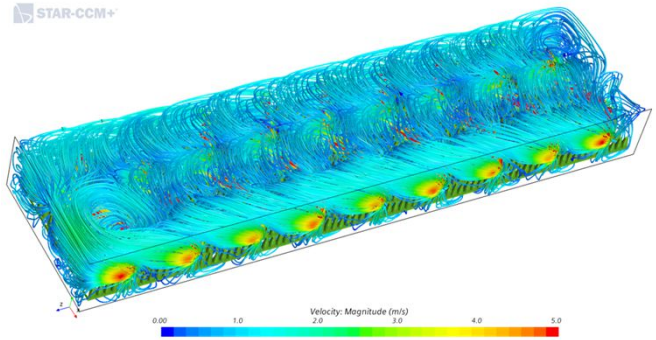


Computational fluid dynamics study on dual, gas turbine co-generation power plant building. The building had strict external noise requirements and thus required that the building remained sealed through out the year. As such, the building was air conditioned via large air movers at the rear and on the roof. CFD studies allowed the efficient sizing of the air conditioners and provided accurate predictions of temperature profiles within the building. Another power plant building was also similarly modeled.

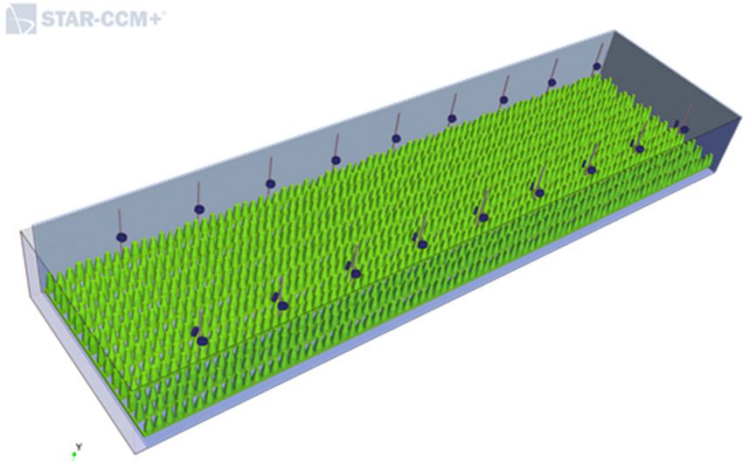
Growing Better Buds: CFD Analysis of Grow Facility

300,000 sqft Cannabis Grow Facility

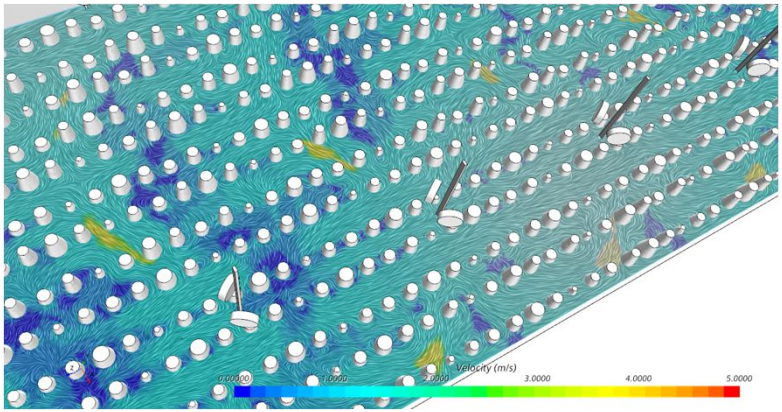
CFD Streamlines thru Plant Foliage (porous blocks)



CFD Idealization of 1/8th Section with 20 Fans and 1,568 Plants



Velocity Vectors at Plant Mid-Level for Humidity Control

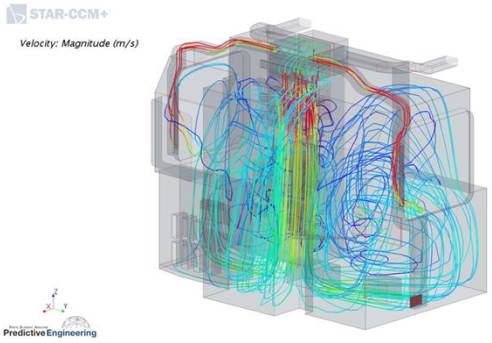


This CFD consulting project was our first of many subsequent grow room CFD analyses. Working closely with a major supplier of grow room equipment and grow products, we have optimized flow patterns, humidity levels and temperature gradients in several large grow facilities across North America. We are currently implementing a parametrized CFD strategy that will automatically mesh and optimized the fan configurations for a given room size and plant density-maturity.

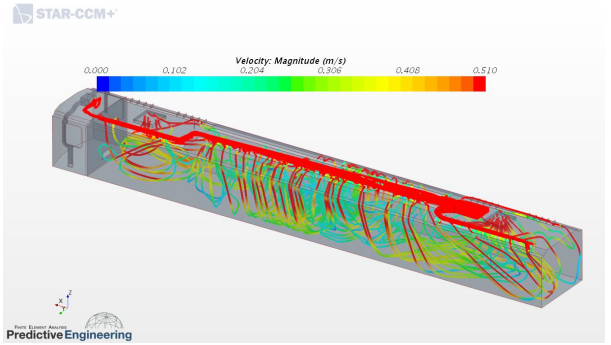
HVAC CFD Analysis of Lightrail Transit Car

Lightrail Transit Car

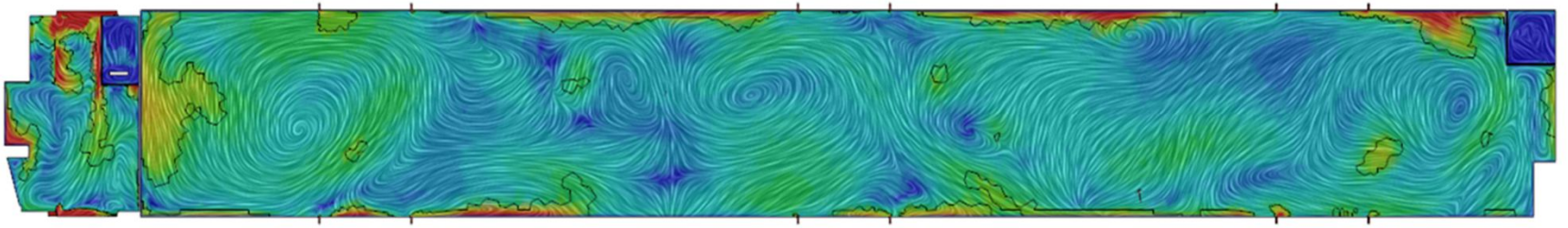
Thermal-Flow Analysis of Conductor's Cab



CFD Streamlines within Transit Car Body



Flow Velocity Modeling within Transit Car Body

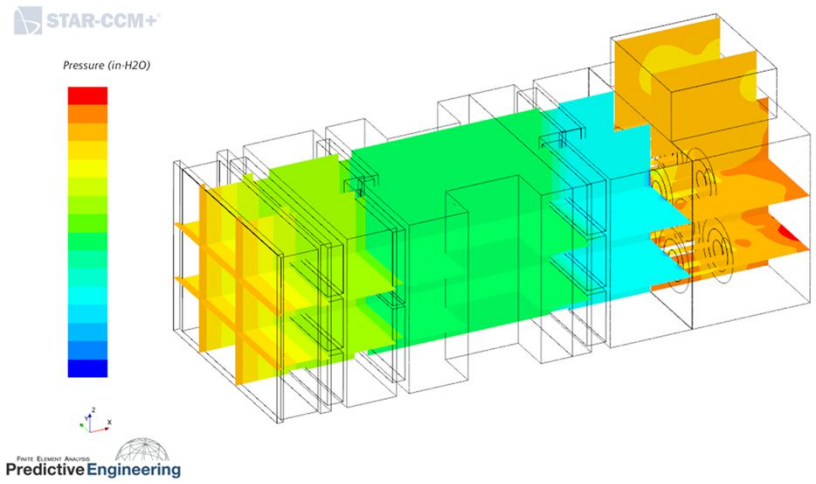


Evaluation of thermal and flow uniformity analysis for a subway car was performed to ensure the design met end customer specifications. The thermal loads included sensible and latent heat generation from full passenger load, electronic loads from three different cabinets within the vehicle, exterior radiation loads, and flow leakage out of the door gaps. Predictive's CFD consultants provided design input ensure that uniform flow could be achieved from the main overhead plenum, as well as even flow distribution in the front driver cab. Experimental measurements aligned well with our CFD results.

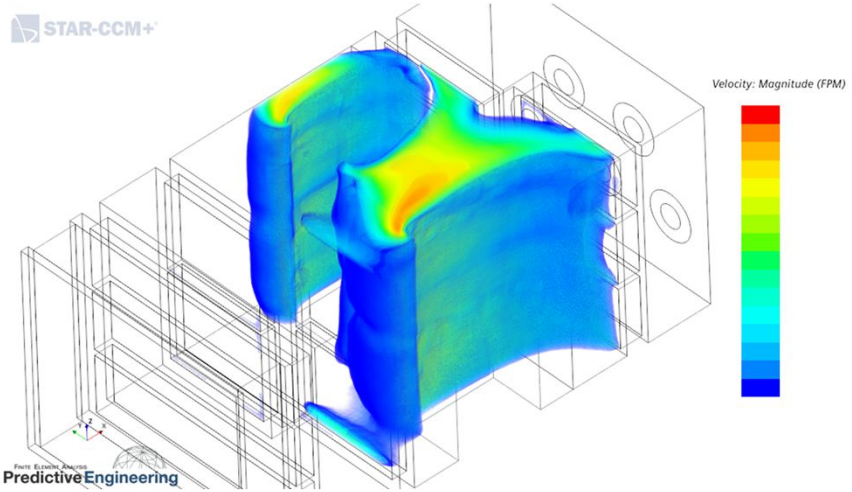
CFD Analysis of Roof Mounted Air Handling Units

This CFD project evaluated air flow through four different configurations of roof top air handling units. The air handling units were built around existing columns and ducts which created regions of high flow velocities. The improved configuration of these units aimed to alleviated excess humidity issues that the current designed suffered under due to excess velocities hitting the cooling coils. Our analysis showed that under worst case conditions the clients design would meet maximum operational limits.

Pressure Drop Through Air Handling Unit



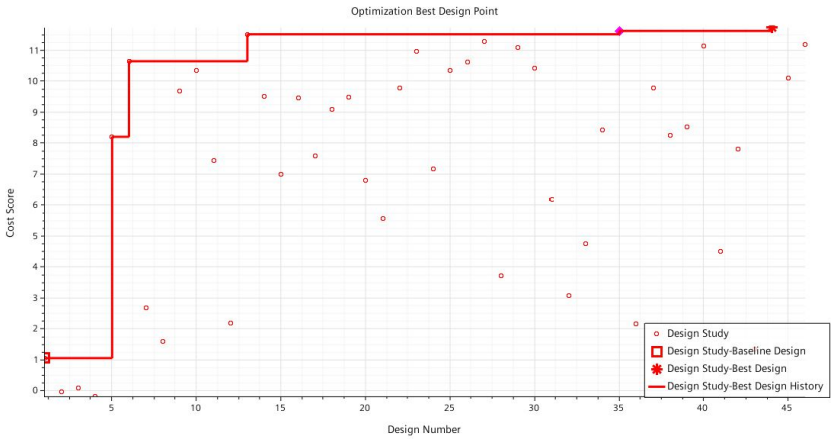
Peak Velocity Magnitudes Through Narrow Region



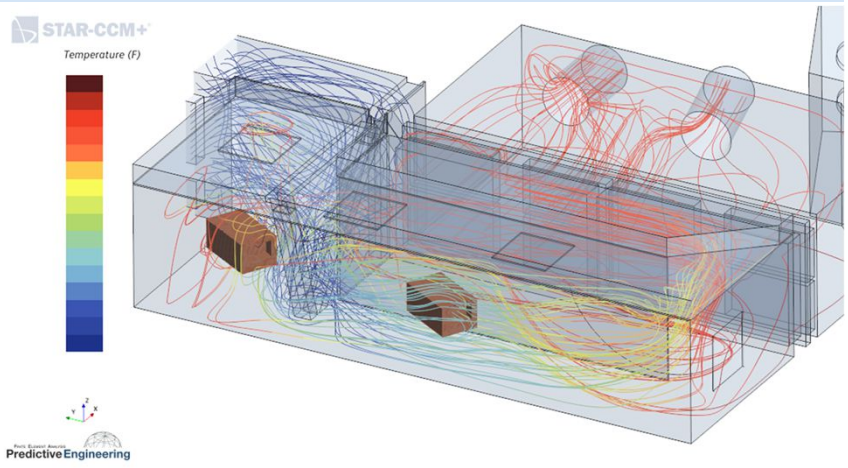
Optimization of Air Mixing in Office Tower Fan Room

Thermal optimization CFD analysis was performed for fan room designs in a new multistory office tower. The supply air from these rooms is made up of approximately 30% outside air mixed with return air. For very cold winter days this can result in a temperature difference of 48°C . Design optimization tools within STAR-CCM+ were used to automate the simulation to determine the appropriate placement for heaters and damper settings to provide the best air mixing between cold and return air.

Optimization History for Design Exploration



Streamline Mixing of Cold and Warm Airflows



Air Mass Below Temperature Limit