CHAM Limited

Pioneering CFD Software for Education & Industry

CHAM Case Study – Data Centre Simulation

for Thomson Reuters, UK

As part of a continuing collaboration with Thomson Reuters, a CFD model of a data centre was built by CHAM's Consultancy Team to analyze the cooling effectiveness of a proposed installation of high density computer cabinets. Different cooling strategies were investigated, with the objective of near-uniform operational temperatures across all cabinets.

The data centre employed a typical hot and cold aisle ventilation strategy. Chilled air was supplied into the under-floor space via several CRAC (Computer Room Air Conditioning) units on each side of the room, feeding the cold aisles through perforated floor tiles. This ventilation air is heated as it cools the electronics in each cabinet, and then collects in hot aisles before returning to CRAC units, completing the cycle. Under-floor dampers are employed to regulate the flow through the perforated tiles. Redundancy of the CRAC units was taken into account, which meant less than 90% of the total cooling capacity was modelled.

In the simulation shown, the heat loading of the server blades was averaged across each cabinet, with flow rates through the cabinets defined by the cooling fans. A specified amount of heat was extracted from the air as it passed through the CRAC units. Intake and exhausts for supply air were modelled, and a higher intake flow compared to extraction rate provided a positive pressure within the room to minimise dust and warmer air from outside entering. The positive pressure was maintained, and the mass flow within the domain balanced using high resistance leakage paths through exit doorways. Major flow obstructions, such as cable trays under the suspended floor, power rails, lighting, beams and soundproofing near the ceiling were all modelled. Also, additional sources of heat were included, such as due to fluorescent lights and external gains through walls, floors and ceilings.

The use of parameterised Q1 input files provided an efficient means of setting up multiple arrays of objects within the data centre. The final calculation mesh consisted of just over 10 million grid points. This provided sufficient refinement to resolve the geometry adequately and to capture the flow detail within the data centre.

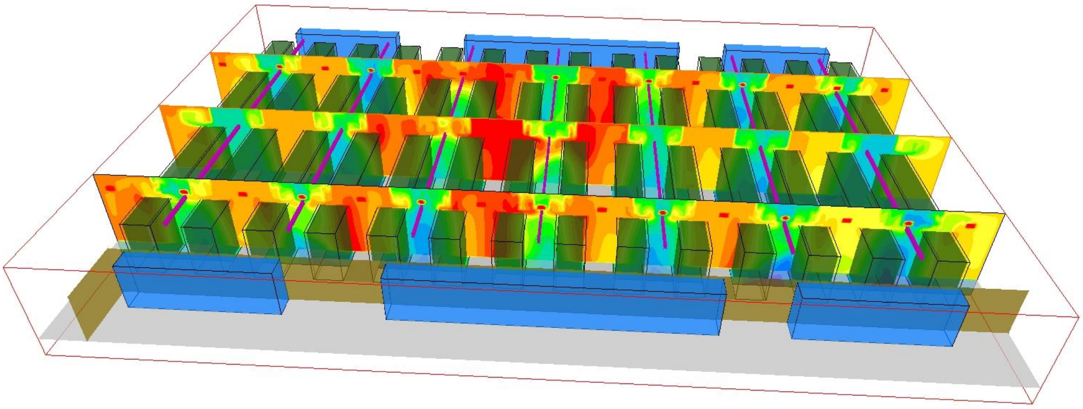

Figure 1 Temperature contours through computer cabinets (green) – under-floor and near-ceiling flow obstructions omitted

Steady-state simulations were performed for different cooling configurations. The average temperature of the hot return air and the chilled delivery air from each of the CRAC units was analysed to establish the system balance across the room. Any undesirable recirculation regions were identified; this is where warm air leaving the cabinets could get drawn back into a cabinet, before it has been re-chilled through the CRAC units. The use of cold aisle containment doors reduced the amount of recirculation. The presence of a technical corridor at one end of the room lead to some asymmetry in the predicted flow field, and had to be taken into account when optimising the cooling configuration.

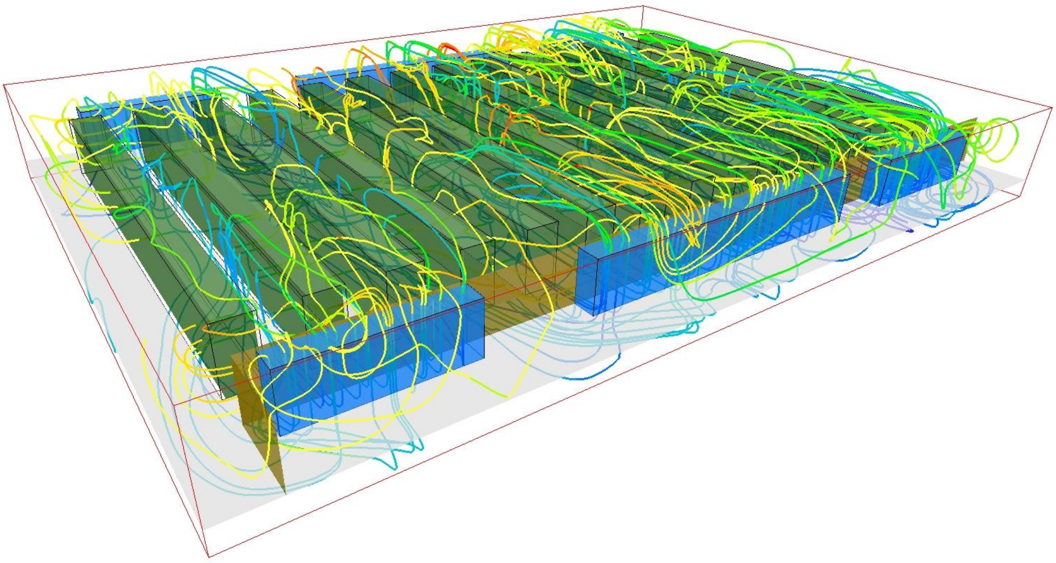

Figure 2 Streamlines through cabinets and return paths to CRAC units (blue)

CHAM Ltd, Bakery House, 40 High Street, Wimbledon Village, London SW19 5AU, UK
Tel: +44 (0)20 8947 7651 Fax: +44 (0)20 8879 3497 Email: phoenics@cham.co.uk
Web: http://www.cham.co.uk