

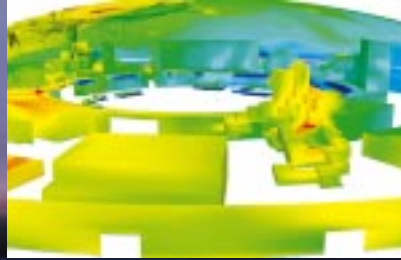
Buro Happold is a multi-disciplinary international engineering consultancy providing design advice to the construction industry. Current projects include the Greenwich Millennium Dome, the British Museum Great Court project and the Lowry Centre in Manchester. The company's commitment to leading-edge CFD is emphasized through its continued investment in both staff and technology.

For the Millennium Dome, Buro Happold undertook, in collaboration with AEA Technology, CFD analyses to optimize the design of the ventilation systems. The dual objectives were to provide a comfortable environment throughout the year and, in the unlikely event of a fire, to ensure that the smoke extraction enables safe escape.

In line with current trends, natural extraction is used wherever possible. However, numerically the resulting flows are notoriously unstable and Buro Happold chose CFX because of its rapid

convergence in these situations.

Using CFX, the optimum ventilation configurations for the Dome were designed and demonstrated. Comfort was assessed using the Relative Warmth Index, which takes account of an individual's metabolic rate and clothing, incident radiation and the local air temperature, humidity and velocity.



Simulation of ventilation in the Dome, showing flows induced by lighting.

In fire conditions, dilution of the smoke as it rises reduces its buoyancy, making it more susceptible to influence by environmental flows. To ensure that it would not then be transported

downwards onto the escape routes, engineers modelled its movement over a 30-minute period with the ventilation system switched to emergency (maximum smoke-clearance) mode. The results confirmed that the public areas remained clear of smoke and that safe evacuation was possible.

"CFD analysis is becoming an essential part of engineering design," commented Buro Happold managing partner, Padraic Kelly, "and CFX will play a leading role in ensuring that Buro Happold continues to provide the best service to our customers."



Simulation of a postulated fire in the Dome, showing smoke spread along the roof.

Energy efficient office design

by Stewart Miles, The Building Research Establishment Ltd (BRE), Watford, UK



As part of the drive to reduce global emissions of CO₂, attention has turned to the design of more energy efficient buildings. Commercial buildings in particular consume significant amounts of energy, with 25% typically accounted for by air conditioning. Natural ventilation is one solution, where the thermal properties of the building and unforced flow of fresh air could potentially provide the cooling requirement during summer.

To ensure the successful cooling of such buildings, the design must account for factors including the air flow, the

building's thermal response and any heat sources present (people, lighting and equipment). These complexities have drawn designers to physical and computational modelling to predict the internal environment and the occupants' thermal comfort satisfaction.

BRE has more than 20 years experience in CFD modelling and is now using CFX-5, where unstructured meshing provides the power and flexibility needed to analyze innovative building designs. It is currently being used to study the new Environmental Building at BRE, constructed as an exemplar naturally-ventilated office. Summer ventilation is driven by wind effects and buoyancy generated by the internal heat loads and by thermal stacks. The CFX-5 model considers the first floor office and the stacks, with surface heat fluxes prescribed for the people, computers and the glass panels on the front of the stacks. External

air is drawn in through high level windows on one side of the office and discharged into the stacks on the opposite side. The results show that the internal temperature is nearly everywhere at or below ambient, which is the desired condition.



Inside the BRE Environmental Building.

Surface temperatures in the office.

