Taking the Built Environment to New Heights

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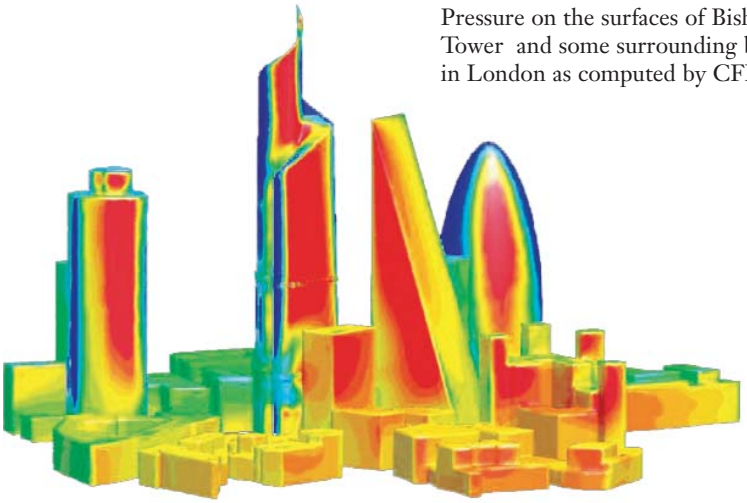
The ground floor entrance of London's Swiss Re Building

The design and construction of high-rise buildings in the centers of modern cities has become more complicated in recent years. City planners, property developers and architects have to take into account many new environmental constraints imposed by legislators, but they also have the benefit of newly available construction materials with unique strengths and properties. These changes have allowed architects to create imaginative designs not possible twenty years ago. Engineering consultants in the field have had to adapt dramatically to this ever-changing landscape.

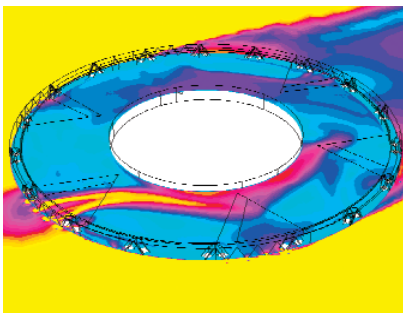
Hilson Moran, a leading European engineering consultancy firm based in London, is one such company, providing a comprehensive range of built environment services. Hilson Moran's simulation group applies state-of-the-art computer modeling techniques to the design of buildings and is one of the industry leaders in using scientific analysis to ascertain a building's performance.

In the late 1990s, London's mayor, Ken Livingstone introduced an Energy Strategy for the city. He demanded that all property developers design buildings that conform to the standards of the Greater London Authority Energy Committee in terms of a building's energy efficiency and "carbon footprint". The new standards were driven by the fact that approximately 50% of the UK's carbon emissions are currently due to the heating, cooling and servicing of buildings. Any new proposed development for London therefore needs to demonstrate efficient energy performance and reduced carbon emissions arising from the operation of the building. Similar standards exist in Germany and are being developed in France.



Pressure on the surfaces of Bishopsgate Tower and some surrounding buildings in London as computed by CFD

To achieve these environmental and sustainable goals, Consulting engineers at Hilson Moran use modern computer-aided engineering (CAE) tools like CAD and CFD, along with software for lighting, crowd modeling and visualization. Engineers are now heavily involved early in the planning process to ensure that the designs conform to regulations. They help guide and define the feasibility of architectural ideas. The CFD work is used for many purposes. For example, environmental models are used to generate "weather forecasts" inside



A CAD model of several floors in the Swiss Re building (left) and a CFD simulation showing airflow on one floor with windows open on the windward and leeward sides (right)

the building. The power to model "what if?" scenarios at the design stage for new buildings is also in great demand.

The simulation group at Hilson Moran was formed in 1998 and now consists of seventeen people. The added value the team has brought to large building projects over the years is significant. Their impressive portfolio of iconic high-rise buildings includes the Swiss Re building in London's Financial District with its unusual gherkin shape. The structure has become a tourist attraction, and two Hollywood movies have already featured it as a backdrop. It was designed with leading-edge sustainability as well as mechanical, electrical and public health standards in mind. The group used FLUENT to verify the building's fluid and thermal designs both inside and out. The models included simulations of many features, such as chilled floors, the cooling dome, solar heating, and pedestrian and office worker comfort.

With the power and speed of today's computer hardware, CAE tools have cut the time from the first architectural concept to the occupation of the finished building by as much as 30% in the last ten years. New meshing and solution techniques have also added to this decrease.

The future of our built environment promises more unique shapes than the straight lines and planar walls of the past. As the next generation of high-rise buildings is planned, it is likely that fuel cells, solar cells, and wind turbines will be incorporated into the designs. CFD and CAE will play a major role in this effort, with larger and more complex simulations being demanded of architectural engineers, or "archiengineers."

Indeed, if engineers want to make a difference in the world today, one area where they can have a big impact is in the environmental design of modern buildings using CAE tools. This new breed of professionals will combine a flair for architectural concepts and designs, as well as applied engineering know-how. The real dividends that these engineers and CAE will deliver to the building industry of the future are better buildings constructed more quickly and at less cost than ever before, in compliance with increasingly stringent environmental standards and optimum human comfort. ■

The Bishopsgate Tower in London