Project Description

MIT and Tsinghua were asked by the Design Department of Beijing Vanke Co. Ltd. to develop the site plan and architectural design for a residential development in the area of the former Asian Games site in Beijing (Figure 1). Throughout the process, architects and engineers worked together to design a site plan and building designs that would promote comfortable outdoor and indoor environments.

A number of designs and studies were carried out for this project. The first task was to perform an analysis of the developer's existing designs (Figures 2 and 3). After the initial analysis, the MIT team developed low-rise development options as alternatives to the originally proposed design. The new schemes consisted of various buildings comprising a low-rise high-density development. Because the developer already secured a government permit for the original high-rise master plan, a scheme that sought to redesign the four high-rise towers was developed in greater detail. Throughout the design process, technical studies were carried out for the various design iterations. These studies analyzed building features and specification upgrades, as well as natural ventilation and shading performance.
CLIMATE RESEARCH AND ENERGY STUDIES

The project began with a basic consideration of Beijing's climate data and existing site conditions. At 40° latitude, the climate in Beijing requires heating for a better part of the year. Refer to the comfort zone table in chapter 7, Figure 4 for further information. The demand for cooling is also high, and will increase as the standard of living rises.

A study was performed to see what technologies would help to reduce heating and cooling energy needs in a Beijing building by a target of 30 to 50 percent. A simple steady-state model of a "shoebox"-style unit was developed using monthly average temperatures and solar heat gain factors. The base case consisted of uninsulated concrete walls with gypsum board interior (U=1.73 W/m²K), 3.2-millimeter-thick single-glazed windows (U=7.24 W/m²K), no shading, and infiltration rates of 1.5 and 2 air changes per hour (ACH) in summer and winter, respectively.

The model was generated in Microsoft Excel and served as a simple tool for analyzing trade-offs in technical specifications of various features, including types of walls (encompassing insulation), window area and window type, infiltration rate, and window shading coefficients. This tool was interactive, and engineers and architects were able to make changes to the model to analyze individual and combined upgrades.

Two generic unit designs were considered in the analysis. Both had exposed southern façades. One had an exposed eastern façade, and the other had an exposed western façade. Major findings were as follows:

- decreasing infiltration alone reduced energy consumption by about 20 to 35 percent;

Figure 1 The former Asian Games site — Beijing Star Garden, the project site, is shown circled (north is to the top)

Figure 2 Vanke’s original design for Beijing Star Garden master plan (north is to the upper right)

Figure 3 Vanke’s original design for the four high-rise towers at the northeast area of the site (north is to the top)