FIGURE 14-7
Frank Gehry's Bilbao Guggenheim Museum.

the complex curved surfaces that have come to characterize Gehry's work. Design development is then based on the three-dimensional models, and takes place largely in a CAD environment. Physical models are repeatedly "built back" from the digital models, through rapid-prototyping, to provide a check that the visual and spatial qualities are developing appropriately and to provide compelling presentation materials. Eventually, the developed CAD model serves as the basis for a CAD/CAM fabrication and erection process.

This type of multimedia process opens up design territory that had hitherto been imaginable, but inaccessible as a practical matter. The complex curved

FIGURE 14-8
Frank Gehry, curved glass interior of the Conde-Nast cafeteria, New York.

forms of the Conde-Nast interior would have been extremely difficult to represent using conventional drafting and physical modeling techniques, for example. Even more important, it would have been impossible to build on an acceptable budget and schedule. But CAD/CAM techniques allowed the efficient production of the complex, nonrepeating curved glass shapes. This and similar projects illustrate that designers are now finding ways to break free from machine-age assumptions about mass production, repetition of parts, and economies of scale, and are beginning to explore the exciting new potentials of digitally enabled mass customization.

MEASUREMENT, ANALYSIS, AND SIMULATION

In addition to supporting

In addition to supporting rapid-prototyping and CAD/CAM, three-dimensional digital models facilitate the use of measurement, analysis, and simulation software. This software extracts the input data needed from the CAD model, processes them, then displays the required results for consideration by designers, consultants, and clients.

Visual simulation software is the most familiar tool of this type in interior design. In essence, this software computes the spatial and spectral distribution across the surfaces of an interior that is illuminated in a specified way, then displays the result as a shaded perspective image. The amount of computation required to produce an accurate result is immense, but that is rarely much of a problem today. When properly set up and calibrated, advanced rendering algorithms (in particular, radiosity and raytracing) can now produce scientifically accurate, photorealistic results (Figure 14-9).

The most advanced acoustic simulation software is equally impressive. In one of its forms, this software accepts a three-dimensional CAD model of an interior (such as a concert hall) as input, and asks the user which seat she would like to occupy. It also requires input of a musical performance recorded in an acoustically "dead" chamber—that is, with no sound reflections and reverberations. It then calculates the auditorium's acoustic effects, and replays the performance exactly as it would sound at the specified seat.

Interior airflow is another area in which computer simulation has made impressive advances. Techniques of computational fluid dynamics now allow