

Object-Oriented CAD

Two architects demonstrate how object-oriented CAD, the technology dujour, will change the way design work is done.

by **B. J. Novitski**

As computer software develops, its ability to support the way architects work and think constantly improves. While early CAD systems simply drew a line between two numerically defined points, the latest versions work with objects that embody specific architectural information. The term object, in this context, actually comes from computer-science jargon.

In an object-based system, a wall, for example, is more than two parallel lines on the computer screen. Instead, the graphic correlates with a database of characteristics, such as height, thickness, materials, finish, sound-transmission class, and fire rating.

Autodesk's new Architectural Desktop Release 2 incorporates within the software the long-awaited Industry Foundation Classes (IFCs), standardized computer definitions of objects and their behaviors. IFCs were developed by the International Alliance for Interoperability (IAI), an organization dedicated to developing software standards to facilitate compatibility between programs.

James J. Balding, AIA, and Larry Rocha, assoc. AIA, the chief information officer of the Newport Beach, Calif., office of Wimberly Allison Tong & Goo (WAT&G), are experimenting with Architectural Desktop to determine whether to use the program throughout the firm. WAT&G specializes in hotels, resorts, and theme parks and has been innovative in adopting information technologies. The firm has a long-standing relationship with, and an investment in Autodesk products, training, and customization. Here's what the architects have found:

The wonders of objects

"The first breakthrough you have when working with object-oriented software," Balding says, "is when you suddenly realize that you're no longer just drafting but building a model. This is exciting: a revolutionary mindset."

Rocha adds: "While there is a lot of focus on the 3-D graphical representation of objects, the biggest advantage of objects is in the nongraphic data that is attached to them."

Rocha is referring to the architect's ability, with Architectural Desktop, to input and modify an object's attributes with specialized on-screen dialogue boxes. A door, for example, is characterized by its material makeup and its association with a wall. If the architect places the door in the middle of a room, the program automatically snaps it to the nearest wall. If the wall is moved or deleted, the door will move or disappear with it. If the door's specifications place it six inches from a corner, it retains that offset even if the adjoining wall is moved.

"Eventually manufacturers will provide objects with complete specifications, including costs, attached to them," Rocha says. "We'll be able to extract this information with a simple search." He believes this development will not only automate material takeoffs and door and window schedules, but also will ensure their consistency because they come from the same database as the drawings.

Intelligent objects are wonderful in theory, but they can also be difficult to create because of their complex behavior. "A wall is not really a single object but a system of objects," Rocha says. "At WAT&G, we're studying the idea that there may be several levels of intelligent entities. These include basic components such as screws or nails; objects that are combinations of components, such as a knob or a hinge; assemblies that are collections of objects that exhibit complex behaviors and attributes, such as a wall or roof; and building systems, such as a structural or mechanical system." Viewed from this perspective, the complexity of defining objects and their behaviors is even more apparent.

New on the menu

In addition to the normal AutoCAD pull-down menus, Architectural Desktop has three new menus: Concept, Design, and Documentation, which contain tools for each phase of design. For example, the Concept menu lists functions that support the creation of massing models. By saving different massing combinations, the designer can compare and contrast a variety of schemes. "We find ourselves using this to communicate ideas to each other and to clients and consultants," says Balding. "These models clarify the three-dimensional space, proportions, design intent, and project scope."

WAT&G architects have been particularly impressed with the conceptual space-planning tools, also on the Concept menu. A designer can develop preliminary schemes conforming to specific area requirements without interrupting the design process to recalculate areas. With the digital equivalent of bubble-diagram manipulation, the architect can specify a space's floor area with one plan dimension; the computer will calculate the other dimension and provide a rectangle of the proper size, which can be moved in relation to other area rectangles.

The Design menu's customized objects provide the tools for producing and placing in the model walls, doors, windows, roofs, stairs, and other design elements. This menu is expected to get the most exercise at WAT&G.

The Documentation menu helps the architect annotate 2-D representations of the model. Some of the symbols are more intelligent than their AutoCAD equivalents. For example, each door tag is associated with a particular door, so when the door height changes, the tag updates automatically without manual editing. This feature not only speeds production drawing, but also ensures accuracy.

Customizing the software

Out of the box, Architectural Desktop includes many generic objects, which most firms will want to customize to conform to their own standards and practices. WAT&G has already begun to build wall types, doors, and fixtures that they will test in designs. Customizing objects does not require special programming, but simple editing of values in the associated dialogue boxes. In the process of specifying a wall object, for instance, the thickness of each layer of material within the wall is defined in terms of its distance from a baseline, such as the face of a stud.

Typically, a firm would establish a set of styles to correspond to the wall types likely for a given project. This painstaking process should be conducted by an experienced architect familiar with the firm's construction standards. After the various styles are established, however, it will be far easier for the rest of the staff to apply the styles without worrying about technical details. An object from the menu will automatically contain the necessary data. This will not guarantee error-free design, however, because it's always possible that an inexperienced designer will pick an inappropriate wall type.

Productivity suffers when CAD forces designers to become too specific about materials too early in the design process. "To resolve this, all walls are initially specified as five, six, or eight inches thick," Balding says. "Then, when all the walls have been laid out to an acceptable level, the designer can go back and assign them a more specifically defined style, such as a six-inch stud with two layers of gypsum board on each side. The wall in the underlying database is then appropriately updated. The change is instantaneously reflected in each displayed view. The same can be done for doors, windows, and most other objects." Later, when dimensions are applied, they refer to the revised configuration.

Using the Design menu, architects can also project elevations, sections, and perspectives. These alternate views do not contain the level of detail normally associated with design development and construction drawings but can serve as templates on which to add more detail. For example, a wall in a section might initially show only a few vertical lines representing the stud and layers of gypsum board, but symbols for headers and insulation would have to be added with conventional computer-aided-drafting techniques.

Although these 2-D additions are not part of the intelligent 3-D model, they remain visible in the section drawing. An anchor to move such graphic elements with the associated model components when there are design modifications would be an improvement.

In the distant future, every detail of a building will be modeled as an intelligent object. Until then, design and production drawings will necessarily be hybrids of projections from the model with ordinary drafted elements. This means that automated material takeoffs will operate only on the true objects, and architects will need to manually change the drafted elements when the associated objects are moved or modified.

Tapping the knowledge base

DesignCenter, the centralized symbol repository in AutoCAD 2000, is structured as a nested hierarchy of folders. This folder structure is an index to firm-specific object libraries. By opening these folders in Architectural Desktop, designers find thumbnail, wire-frame versions of 3-D objects. These miniatures can be rotated in real time and dragged into the working model. Eventually, DesignCenter will provide the means for architects to archive object-based product information transmitted via the Internet.

Manipulating forms and objects within Architectural Desktop is intuitive and easy to learn for those used to AutoCAD; the interfaces for both are similar, Balding says. Familiar point-and-click and drag-and-drop techniques enable designers to do graphic editing. Nongraphic editing requires selecting data windows from a menu and typing in appropriate data fields.

Both Balding and Rocha look forward to the day when a single model embodies all of the information, graphic and nongraphic, about a building. The promise of the IAI has been that such a model would become a receptacle for design input from all disciplines, throughout every phase of a building's life cycle.

There are still major hurdles to overcome before this becomes a reality, however. According to Balding, architects need greater computing speed and power, reliable operating systems, better Internet-based file management, and more of the building defined in terms of IFCs. Architectural Desktop Release 2, he says, is a step in the right direction.