AIDED DESIGN AND CADD: COMPUTER DRAFTING

With new developments in hardware and software, contractors can now install a complete CADD system—including the computer—at prices far less than just a few years ago.

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The traditional viewpoint teaches that nothing significant is achieved without hardship. In the case of Computer-Aided Design (CAD), the standard lime is that CAD is an expensive investment of time and money. CAD belongs, ‘They’ say, on $15,000-$30,000 minicomputers called workstations, running CAD programs (software) costing $3,000-$10,000, and it takes months of study and practice to become productive. In recent years, as microcomputers have become more powerful, CAD software has migrated to them, but the cost in time and money remained high.

It is small wonder, then, that many wall and ceiling contractors have been slow to embrace CAD (or CADD, the second ‘D’ is for drafting). But conventional thinking is usually a step or two behind, and the the case of CADD, way behind. With an investment of as little as $2,500 a basic, yet complete CAD system can be purchased that fulfills the drafting and design needs of most independent contractors. For those willing to spend more, the price of a new sedan can purchase a computer system equal in performance to the expensive workstations of two years ago.

As the name implies, CADD is for both design and drafting. Design being the “fashioning or creating of a plan,” while drafting is the “finalization of the details of the plan.” With this in mind, the most common reason...
for turning to CADD has been that of increasing drafting productivity. Many CADD system vendors quote average productivity increases on the order of 3 to 1, higher for certain activities.

As a design tool, CADD can be compared to its counterpart in financial management, the electronic spreadsheet. People are finding that the electronic medium allows one to easily and rapidly change variables and make different combinations on a “what if?” basis, without the tedious erasing and rewriting—or redrawing, in CADD. This is especially useful for a contractor who must submit shop drawings on a short schedule.

If you have considered purchasing a CADD system in the past, but stopped when you found out the cost, then it’s time to take another look. But the rules of business still hold true—any expense must provide benefits equal to or greater than its cost. The value of CADD lies in its day-to-day advantages over manual drafting and design methods, not in the bragging rights about the size of one’s CPU or plotter. To understand the value of CADD, take a look at the basic concepts of CADD.

**Concept No. 1: A drawing is a group of precisely defined objects. Once defined, they can be used and changed in many ways.**

In simple terms, people use a CADD system to draw objects. No mystery there, but what becomes of these objects holds the key. A CADD system takes a line (or an arc, a rectangle, etc.) drawn on the screen and gives it a precise mathematical definition. Its width, length, and coordinate position are calculated and entered into a list in memory. A complete CADD drawing is (to a computer) a long list of simple geometric objects, precisely defined.

Editing an object—changing the length of a line, for instance—has the computer finding the object’s description in the list, then altering its description.

A two-dimensional CADD system stores drawings in plain view. A three-dimensional CADD system stores objects in three-dimensional form, and can produce multiple views directly. The operator creates multiple views in the single plane, just as in manual drafting.

CADD systems typically use one of two methods to represent and manipulate points in the database. The first is integer-based arithmetic, and the second is floating-point arithmetic. Some of the differences are worth noting. Integer-based systems tend to have smaller drawing worlds than do floating point systems. On large CADD systems, typically hosted on mainframe computers or minicomputers, integer-based arithmetic provides a speed advantage with no great sacrifice in the size of the drawing world. Microcomputer systems, which cannot represent such large integers, typically use floating-point arithmetic, since the integer-based method would limit the drawing world’s size and impose many program limits.

Any item in CADD data list, or any group of items, may be easily changed.
Did the specs on plywood change from 3/8” to 1/2”? It’s simple to change just the plywood sheets in your drawings, instead of having to redraw everything, then print new working drawings as needed based on the updated information.

Good CADD programs allow for the use of components, pre-drawn items that can be used over and over again. The wall section in Figure 1 has 23 components, used a total of 42 times. The architect who drew the wall uses these components over and over again in his work, saving hundreds of hours of drafting time. Most experienced CADD users plan their work in building-block fashion, as illustrated in Figure 2, where simple objects are combined to form complex drawings.

Some CADD software companies, like Generic Software of Redmond, Washington, publish component libraries relevant to a variety of disciplines using CADD. Each library contains from 50 to over 200 symbols, drawn to professional standards, and sold for pennies per symbol. Each symbol can be used repeatedly, and copies of the symbols can be modified. The user can also add symbols to the library. Figure 3 shows a close-up of one portion of the wall section in Figure 1. The bricks, the sill plate and the wood stool are all predrawn components placed into the drawing.

Many independent agencies also produce symbol libraries for the major CADD products. The complete line of Anderson™ Size windows, for example, is published in Generic CADD’s format by Creative CADD Concepts, Longmont, Colorado, one of several independent publishers of CADD symbol libraries.

Concept No. 2: CADD drawings are created with real-world units, not scale units.

A drawing unit is the CADD system’s basic measure of distance. In most CADD systems we can select feet or inches, either separately or in combination, and whether in decimal or fractional notation. Many systems offer metric measurement, i.e., meters, centimeters, millimeters and kilometers. Some offer polar coordinates and arc values. Drawing units can be assigned throughout the drawing. The assignment of a unit’s meaning varies with the field or discipline in which the CADD system is used. Architects usually work in feet and inches, in which case the drawing unit would be inches. Electronic circuit board designers usually work in mils—thousandths of an inch. Most CADD systems will accommodate both.
printed or plotted on a sheet of media that scale becomes an important issue. The value of that scale is of no more significance to the CADD operator than is the distance a drafter stands from the drawing board. There is no need to place a scale or ruler on the screen to measure distances and coordinates. Instead, the CADD system displays the coordinates of the drawing cursor in the coordinate area of the screen. Or, it can be set to display the distance from the last point entered to the drawing cursor, as X and Y distances, or as a polar distance and angle. Finding the coordinates of a point requires only placing the drawing cursor on the desired point and reading the coordinate display. Being able to work in real-world units as opposed to scale is one significant advantage a CADD system has over manual drawing.

Concept No. 3: There are many ways of drawing with CADD that have little, if any, manual equivalent.

To those who have spent years drafting manually, moving to CADD
CADD offers benefits in drawing technique, flexibility in use of a drawing’s parts, and provides a new competitive edge in a crowded marketplace.

can be a bit of a shock. Consider these typical CADD features, and compare them to their manual equivalent, if one exists:

• **Auto-dimensioning** lets you identify an object, then the CADD program calculates its length (width, degrees, etc.) and prints the dimensions on the screen, complete with arrows and end points.

• **Smart trim** draws in details like bevels, and trims off extra lines at intersections.

• **Snap capability** takes two components that have been drawn separately and butts them together. Grid snap keeps the drawing cursor accurately locked in place on grid coordinates.

• **Rubber-banding** of arcs and circles let you adjust the radius on the screen by moving the cursor back and forth. The changes are dynamically displayed on the screen.

• **Hatches and fills** will automatically place a pattern or a solid color inside a boundary.

• **Takeoffs for estimating** order quantities. Objects are measured and counted in CADD, then the data is passed by the program to a special Estimating program. One example of this is Generic Estimator, which will be available Spring 1988 from Generic Software.

• **Keyboard entry of X-Y coordinates** is an alternative to drawing with an input device (mouse, light pen or digitizer).

• **Multiple layers** allows for drawing overlapping plans.

• **Zooms** allow a close-up view of very tiny segments of the drawing, i.e., one square inch of a wall can fill the computer screen. Zooms can be saved as separate drawings and printed, increasing the utility of one drawing.

• **Macro or batch commands** allow the user to combine or string together various commands in sequence. This, in effect, allows the user to automate many repetitive or common sequences of commands used in creating drawings.

The CADD drawing screen is the computer equivalent of the drafting board. To reflect the various ways CADD can be used, it must display...
several types of information for efficient operation (Figure 3). Some of the information is graphic, some is text. Most CADD screen displays are divided into windows. The most prominent area is the drawing window. This area is used to display the drawing. At the bottom of the screen, below the horizontal border line, is the prompt display. The CADD system uses this area to prompt the operator for the next command and for the data required to execute the current command. At the top of the screen is the coordinate display. Here the system displays numeric coordinate values indicating the location of the drawing cursor in the drawing world. Finally, usually at the right side of the screen is the menu display. A list of commands is given, any one of which can be selected by “pointing” and “picking”. Some systems, and all programs on the Apple Macintosh computer, make the commands available on “pulldown” menus. Only the category is visible until selected, then all options are displayed.

Although this display may seem complex at first, it soon becomes second nature to zoom, pan and change coordinates display formats to suit the task at hand—almost as if the CADD system’s display and keyboard were the control panel of a ship in an alternate, electronic universe.

When taken one at a time, each of these three CADD concepts offers new possibilities. But put them all together in a day-to-day working environment, and the productivity gains that can be achieved are significant:

**Quick turnaround for changes in specifications** — no more sending drawings to an architect or draftsman to change one detail;

**Enhanced professional image** — like it or not, a computerized firm is seen as being more modern, more productive;

**Exchange of data with subcontractors using CADD** — drawings can be shared with other individuals and firms on a project, increasing productivity on a joint project;

**Key competitive edge** — when Mrs. Jones wants her cupboards in Early American instead of Modern, and you’ve already drawn Early American telling her you’ll have the new plans in a day instead of a week will keep her business.

In short, CADD offers benefits in drawing technique, flexibility in use of a drawing’s parts, and provides a new competitive edge in a crowded marketplace. And with the affordability of the new generation of CADD, the benefits quickly pay for themselves.

“CADD: An Introduction to Computer Aided Design and Drafting” is a pamphlet published by Generic Software Press, a unit of Generic Software, Inc. The pamphlet explains CADD in greater detail, including a detailed breakdown of hardware and software costs. For a free copy, call 1-800-228-3601 or write Generic Software Press, 8763 148th Avenue N.E., Redmond, WA 98052.