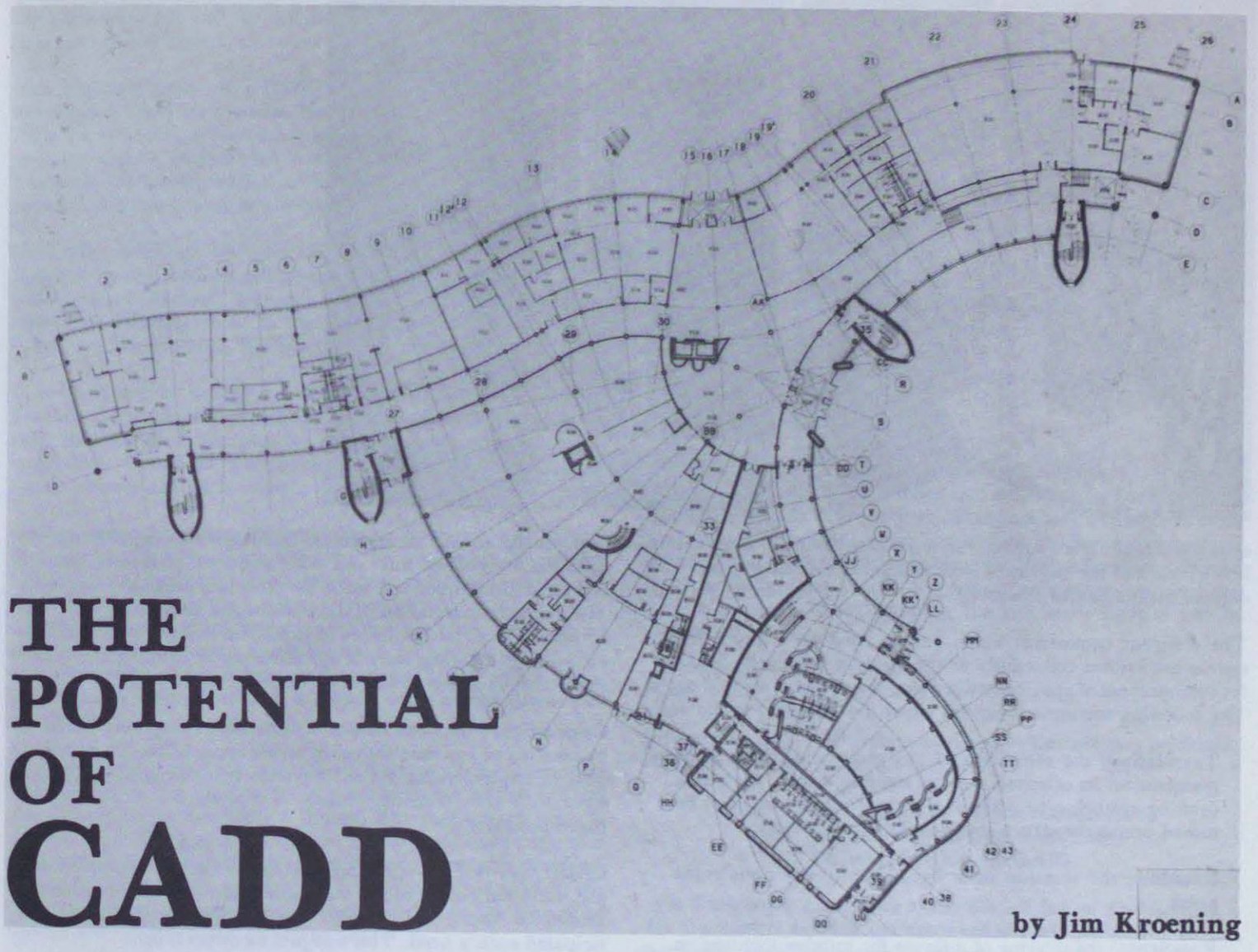
Main floor plan of St. Albert Place, St. Albert, Alberta, drawn using a CADD system by the office of Douglas Cardinal.



THE POTENTIAL OF CADD

by Jim Kroening

CADD is an acronym for Computer Aided Design and Drafting, a new method of producing drawings which may have a significant impact on operating procedures in the design professions.

One of the first Canadian architects to venture into CADD is Douglas Cardinal, of Edmonton. The accompanying drawings and photographs show some of his work. I am indebted to Jim Zulkoskey, of Cardinal's office, for the time he spent with me demonstrating their system and explaining its impact on their work.

We will begin with a discussion of the basic concepts underlying computer graphics, to underline some of the differences between production on a CADD system and traditional drafting. A brief review of some principles of geometry will help describe how computers produce graphic images.

In geometry, two essential concepts are those of the point and the line. A point is a dimensionless location, and a line is two points connected (a distance, or an edge, with no width). Computer grahics involve the manipulation of these two concepts and their representation on a video screen or, ultimately, on mylar or paper.

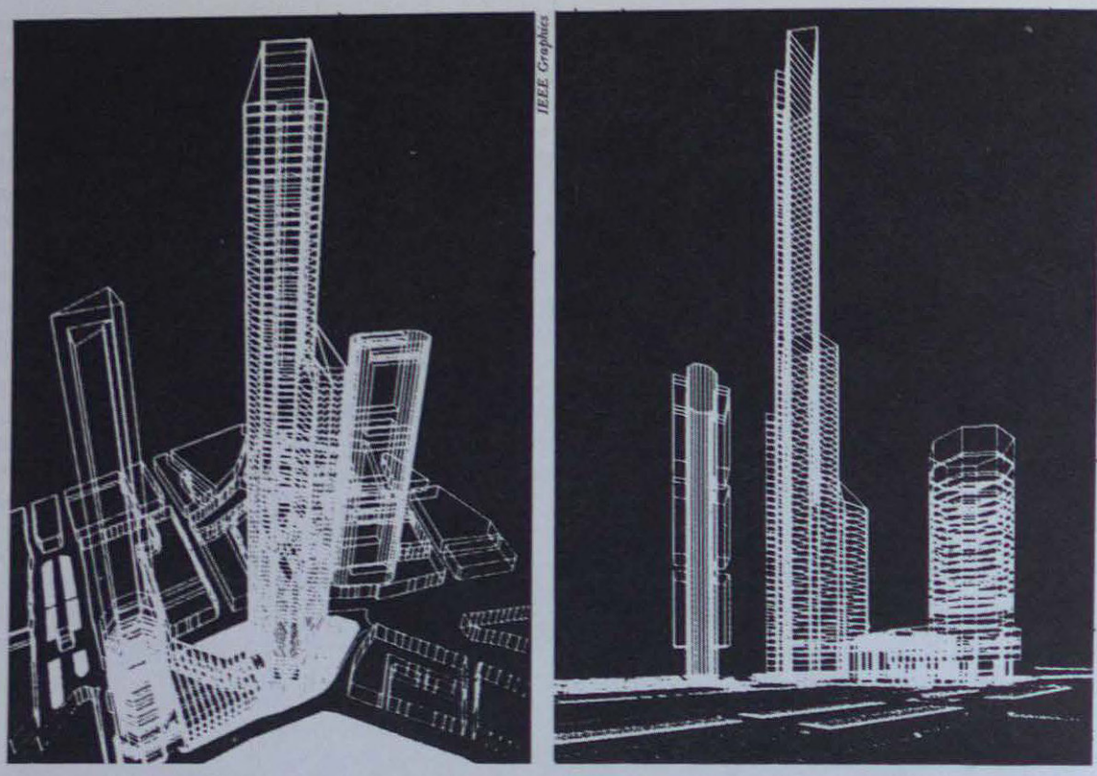
At the computer terminal, the user moves a point on the screen, represented by a flashing 'X'. This is called the cursor, and any command punched into the terminal keyboard will be undertaken on this point. One moves the cursor by various means; by punching some keys which direct it upwards, downwords, to the left or to the right, or by touching the screen or a desk-top tablet with an electrostatic pen. A given command will register the cursor's location as the beginning of a line. Another may define the center of a circle. Or a command could be given to move the cursor to the nearest grid line (which would set a dimensionless point directly on a line without width, something which cannot be accomplished by hand). Still another command would set the cursor at a specified distance from a line or point.

It becomes apparent that the computer is dealing with geometric concepts, interpreting graphic information as coordinates; number-crunching. The computer records distances between points, distances between parallel lines, angles between lines, adding and subtracting. This is consistent with our intuitive notion of a computer; a computer computes, it doesn't draw. It acts as an aid to design and drafting.

Drawing with CADD

The distinction here is that, as a sentence is a verbal idea, a drawing is a visual idea. As a typewriter does not write, a computer does not draw. This is important, as computers are presently being ascribed with all sorts of intelligence. The computer is essentially a

Layout: Jeff Telgarsky



Computer generated graphics allow perspective views of designs from several points, from aerial views to street-level approaches.

dumb machine. It is a sophisticated advance on the T-square, but it is a tool, and the quality of work produced with a computer will depend on the skill of the user.

The different commands which can be used on a given CADD system are known collectively as the system's 'software'. Software for various types of applications is being developed at a rapid pace. The following are some functions which are presently available:

Translation: the relocation of any geometric figure while maintaining its orientation. Any existing figure, such as a drafting symbol, a title block, a bathtub or a room, may be moved across the screen to a new location.

Rotation: the rotation of a figure about any preselected point.

Repetition: the copying of a figure for another location on the drawing.

Scaling: selecting two points, one is given the distance between.

Layering: building drawings, as in overlay drafting. After setting down a rough floor layout, drawings of furnishings, structural members, electrical service, etc. may be overlaid. Any combination of layered drawings may be called up for plotting.

Zoom: to change the scale of the image. Zoom produces an infinite and continuous range of drawing scales, allowing many levels of information on the same drawing. A speck on the floor plan may be, on closer examination, a fully detailed window jamb.

3-D modelling: to give a 3-D image of an object from a chosen vantage point. The image may be a see-through line drawing, or it may represent opaque surfaces. One aspect of 3-D viewing, called 'vector refresh', presents the viewer a series of images by changing the vantage point, as in animation. One can represent a walk-through or a flight around the design.

CADD systems offer many other functions, such as area calculations of any figure, or the flipping or reversing of a figure (with notes automatically re-oriented). Drawings may be built up with different weights of line and with hundred of colors. Material representation functions, such as cross-hatching, are available. Automatic manipulation of dimensions and imperial/metric conversion reduces the incidence of mathematical errors. In addition to layering, drawings may be split into parts, allowing many users simultaneous access to the same drawing.

Once a figure has been drawn, it is on file ('in memory'), and my be recalled at any time for use in a new application. An important part of implementing a CADD system is building this library of figures, be they drafting symbols or representations of manufactured products.

CADD software is improving as architects become involved in its use. Cardinal's office found that their system went down when they attempted their first erasure; the programmers had not anticipated such a need. This was just three years ago.

As CADD applications become more common and software more sophisticated, various opporunities present themselves. The computer industry now has standards set which will allow information transfer between any two computers. Manufacturers, such as Steelcase Canada, have begun to prepare computer files of product information. One can easily foresee the day when Sweet's Catalogue is delivered and updated over the telephone.

CADD and Architectural Practice

The discussion abouve has been concentrated on CADD in the professional's office. The implementation of CADD systems may also affect traditional relationships between architect and client, consultant, and contractor.

CADD makes architectural services more marketable by suggesting a progressive practice and by introducing innovations useful to the client. A CADD system allows architect and client to sit at a terminal and make rapid and significant changes to contract documents. Changes late in the production process, together with a shortened development period, may cut the cost of a project considerably.

CADD improves the coordination of consutants' contributions. CADD systems connected by telephone allow rapid communication, and layering techniques bring out locational problems.

Cardinal's office is presently considering installing a terminal on site for the contractor's use. As a user, the contractor can access the information required. For example, dimensioning is traditionally a game of second-guessing construction methods. With CADD, precise dimensions are implicit in the storage of information, and the contractor can call up any dimensions required. Shop drawings, put on the system, allow substitution decisions on site.

The implementation of a CADD system allows the professional more control over his practice. He may supervise drafting directly from his terminal, interrupting work only as required. Cardinal uses his system to establish precise layouts of his curvaceous buildings. These schematics will not need to be reinterpretted by his staff, his consultants or the contractor.

Generally speaking, the use of CADD removes some of the drudgery in the work and discourages errors. In addition, it improves project control, increases productivity, and allows more significant changes later in the project. one might think that CADD was heaven-sent. But what are the drawbacks?

If you will not be sitting at a CADD terminal soon, it may be because of the expense of these systems. Six-figure prices are the rule. And the more one pays for a CADD system, the greater its capabilities. Computer systems are defined by two parameters; the system's power and its memory.

System power determines how quickly an operation can be performed; how rapidly commands can be processed. If you are familiar with hand-held calculators, you may know that some functions, such as finding a square root, involve a bit of a lag. CADD functions are quite elaborate, and the more terminals in use, the more computing power required. In particular, the shift to 3-D imaging is a big step in computational ability and in price, and, as most production work is in 2-D, most offices choose 2-D systems.

The quantity of system memory determines how much information can be store on file. It is perfectly possible to record every brick, every shingle that goes into a design. But memory capacity is another expensive aspect of a system, and to bring costs down to a reasonable level, it is necessary to carefully circumscribe the information that is essential. Archival information may be stored off the system on magnetic tapes, but current work and the library of figures and symbols must be accessible.

Video terminals are also expensive components in a CADD system. Some firms have reluctantly adopted shift work to reduce the initial investment.

The vendors of CADD systems claim that improved productivity will justify the investment. Cardinal's office has found that their productivity, measured as office cash flow per employee, has doubled. But an important part of their decision to use CADD was the unusual geometry of their buildings. Any analysis of the financial advantages of CADD production must consider the nature of the firm's work. It might be useful to begin with a time-share arrangement, whereby time is rented on a central computer and only terminals need be installed in the office.

Conclusion

A shift to CADD production must be done with conviction, and with allowance for potential difficulties in implementation. Although learning to use the software is not difficult (Cardinal's office finds that it takes two weeks for a new staff member to become proficient), building a library of figures and sysmbols is a significant investment of staff time, and a hitch in the system can stop all production.

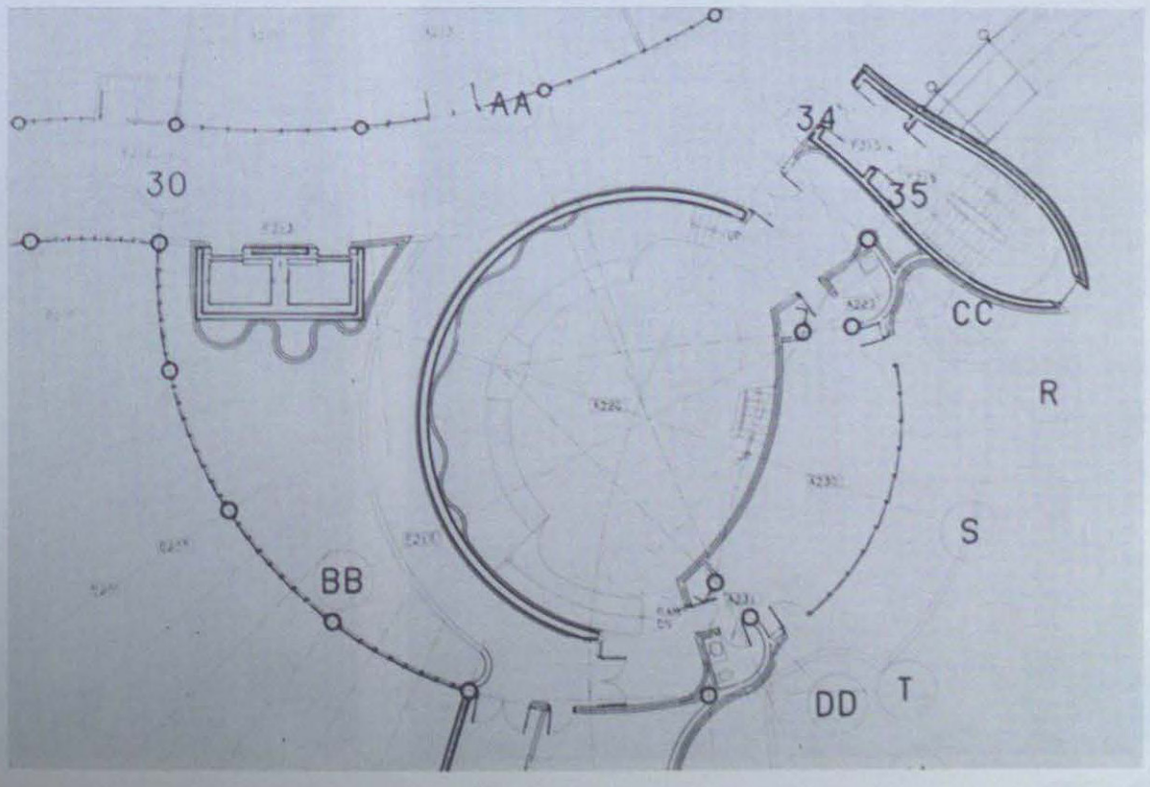
This brief look at CADD has been written in the hopes of demystifying this intrusion of technology into architectural practice. Most significantly, CADD can free the architect and technologist from some repetitive tasks and may improve the quality of architectural services. As one begins to appreciate the design freedom achieved by Douglas Cardinal on a CADD system, a computer begins to appear a natural tool for fulfilling the architect's rightful role in society.

Note

Information on CADD systems available in Canada may be obtained, free of charge, from:

The National Computer Graphics Association,
961 Eglinton Avenue East, Suite 200,
Toronto, Ontario, M4G 4B5

Jim Kroening is a graduate of the McGill School Architecture. He is presently working in Edmonton and completing an MBA, part-time, at the University of Alberta.



Detail of computer-drawn floor plan showing the high degree of complexity and detail available through the CADD system.